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ESSAYS ON MACROECONOMIC INTERACTIONS OF SECTORAL BALANCE SHEETS

BY
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Essays on macroeconomic interactions of sectoral balance sheets

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Supervisor: Professor Finn Olesen

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The Department of Business and Management

Aalborg University

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Article 3: Sectoral balance analysis: Short run deviations from long run patterns

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Declaration

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I hereby solemnly declare that my submitted thesis with the title:

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has not been subject to any previous assessment.

Declaration of Compliance with Good Scientific Practice

By signing this declaration, I confirm that the PhD thesis submitted by me was done, to the best of my belief, in accordance with good scientific practice (according to the ministerial guidelines http://ufm.dk/publikationer/2014/the-danish-code-of-conduct-for-research-integrity).

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Abstract (English version)

This thesis investigates the interaction between the sector balance sheets in Denmark, as they are crucial for understanding the impact and transmission of economic shocks and policies for the economy. This is particularly important in the context of rapid financial balance sheet expansion that preceded the Global Financial Crisis (GFC). The thesis thus addresses four key objectives: The first is to identify what the primary source of change in sector balance sheets is; the second is to empirically identify the connections and dependencies (interactions) between the three primary sectors - the private sector (PRI), the government sector (GOV) and the foreign sector (ROW); the third is to explore the implications of these interactions, and extends this analysis to include a disaggregated PRI - split into the household sector (HH), the non-financial corporate sector (NFC) and the financial corporate sector (FC); and, the fourth is to assimilate these interactions into a single macroeconomic framework - in order to examine the transmission of economic shocks or policy measures throughout the economy - and to use this framework to investigate the causes and implications of the unprecedented expansion of private debt relative to disposable income of Danish HH. The thesis addresses these issues within the Post Keynesian economic paradigm and the Babylonian mode of thinking, where path dependency and a pluralist approach to method and methodology are encouraged. This is accomplished in the form of five independent, but progressive and related articles which use several methods:

The first article, *Money at first principles: A social value theory of money*, is a theoretical investigation of how money creation is linked to debt, and explains how this is connected to institutional level balance sheets. The article argues that the source of change in the structure of the balance sheet of an economic agent is an imbalance between the level of money available from income, and the level required for expenditures. Any shortfall is satisfied through the demand for credit in exchange for debt. These budget constraints can be aggregated to find sector level net funding requirements. Money is defined according to four base concepts, the monetary unit, the monetary token, the monetary space and social value. These base concepts are then used to argue that the demand for debt of all sectors plays an important role in the flow of funds, and in the relative balance sheet positions of all sectors. It is further argued that government should play an active role in debt accumulation, and so opens the discussion on sector interdependence.

The second article, *Sectoral balance analysis: Evidence from Scandinavia*, uses the Sector Balance Analysis (SBA) approach to analyse long historical datasets. The methods include a descriptive analysis of the trends in sector net lending (NL), long-run correlation statistics between the sectors, and a range of lagged correlation estimates relative to the output gap in order to examine the extent to which each sector pro- or counter-cyclically net lends relative to economic expansion. The article investigates the interaction between sector level net lending requirements for Denmark, Norway and Sweden between 1950 and 2017, and argues that there is reason to doubt generalised theories about sector level interactions. In particular, the Ricardian Equivalence (REH) predicts a negative correlation between PRI and GOV. The analysis also reveals this negative correlation, but, contrary to REH, the correlation is explained by the automatic stabilising mechanisms in the three Nordic countries, rather than by the behaviour of rational agents. The Twin Deficits Hypotheses (TDH) predicts positive correlation between GOV and ROW, and a similar result is observed in the analysis for Norway. This, however, is the result of international oil revenue flowing to GOV. Furthermore, the article contends, with the aid of historical record, that the present positive trade balances of each country can best be explained by the history of investment and development in each.

The third article, *Sectoral balance analysis: Short run deviations from long run patterns*, uses a rolling correlation window to test the stability of the long-run relationships between sector net lending positions identified in article two. On the basis of the rolling correlations, it is argued that long run patterns observed at the sector level do persist for extended periods of time, but that these relationships change significantly over time. The results also illustrate that these deviations can be explained by specific economic incidents, which cause at least one sector (most often PRI) to change behaviour for a certain period of time. In addition to evaluating the persistence of relationships, the analysis provides a simple way to identify structural breaks in the behaviour of individual sectors. The main conclusion of the article is that long-run correlation patterns between PRI, GOV and ROW, break down at different points and for varying lengths of time.

The fourth article, *Sektorbalancer i Danmark efter krisen*, extends the SBA approach by disaggregating PRI into HH, NFC and FC in order to evaluate the logic of the Danish austerity policies introduced after the GFC. It suggests that the consolidation of debt by FC and NFC was largely offset by flows from ROW, and that the improvement in GOV NL was driven by a boost to demand from HH borrowing (counter-cyclical net lending). The article focuses on the automatic stabilising functions built into the Danish welfare state, and provides the argument that while GOV is the one sector where decision making can (in theory) be centralised, it is also the sector that is designed to be most passive to the changes in the other sectors (particularly PRI). It is asserted that a government deficit should be expected in periods of recession, and that it would thus be illogical to introduce contractionary fiscal policy that would further reduce national income - since the recovery of the GOV budget relies on a reversal of PRI net savings behaviour.

The fifth article, *Flexible rate mortgage loans: An SFC model of the impact of mortgage credit innovations on Danish balance sheet stability*, is the main analysis of the thesis, and presents a hybrid of the empirical investigations of the SBA approach, and theoretically driven behavioural structures. With the use of the System of National Accounts (SNA), the paper implements a fully empirical stock flow consistent (SFC) model of the Danish economy, estimated on data for the period 1995 to 2016. Taking a narrower focus, to address the Household sector (HH), it addresses the main changes in the composition of the HH sector balance sheet. The primary aim is to test the sensitivity of household responses to an unanticipated increase in interest rates, or a fall in property prices. The model is based on Byrialsen & Raza (2019), with the central modification to include a split in household debt between fixed- and flexible-interest rate borrowing. This focus is largely due to a shift in the composition of HH debt that occurred following innovations in products and legislation between 1996 and 2007. Within the setting of the macroeconomic model, it is argued that household responses to economic shocks have become more sensitive as a result of the innovations in the mortgage financing sector. The effects throughout the transmission channels are amplified as a result of the migration of mortgage borrowing from fixed- to flexible-interest rate products, with amplified general effects to key economic indicators. The article thus recommends policy actions that promote the migration from flexible- to fixed-interest rate products as far as possible, in order to minimise macroeconomic instability in the event of a negative shock.

Supplementary to the SFC model presented in article five, the thesis outlines three potential modifications for future research. These modifications include, firstly, the integration of household refinancing; secondly, the integration of credit risk, defaults and loan to value ratios; and finally, the circular integration of household and pension fund balance sheets.

In relation to the primary objectives of the thesis, it is concluded that, the primary source of change in sector balance sheets is the creation of debt, and that the balance sheets of the institutional sectors are directly dependent on one another. Consequently the behaviour of one sector should not be analysed independently of the other sectors. It is thus argued that the dependent nature of sector flows and balance sheets restricts the plausible outcomes of economic policies. In relation to the expansion of household debt in Denmark, it is argued that the primary causes are a combination of financial innovations and the liberalisation of the Danish mortgage finance system. The implication of which, is that HH balance sheets have become more sensitive to potential economic shocks - and as a result, so has the Danish economy.

Abstract (Danish version)

Denne afhandling undersøger interaktionen mellem sektorbalancer i Danmark, da disse er af afgørende betydning for at forstå effekterne og transmissionen af såkaldte økonomiske “shocks” og politikker for en økonomi. Dette er især vigtigt i konteksten af den hurtige udvidelse af finansielle sektorbalancer forud for den finansielle krise. Afhandlingen adresserer dermed fire overordnede formål: Det første er at identificere primære kilder til forandringer i sektorbalancer; Den anden er empirisk at identificere sammenhænge og afhængigheder mellem de tre primære sektorer – den private sektor (PRI), den offentlige sektor (GOV) og den udenlandske sektor (ROW); Det tredje formål er at udforske implikationer af disse interaktioner, og udvider analysen med en opdeling af PRI i tre sektorer – husholdningssektoren (HH), den ikke-finansielle virksomhedssektor (NFC) og den finansielle virksomhedssektor (FC); Endeligt er det fjerde formål at integrere interaktionerne i et samlet makroøkonomisk framework – med formålet at undersøge transmissionen af økonomiske shocks eller politiske ændringer igennem økonomien – og at bruge frameworket til at undersøge årsager til og implikationer af den hidtil usete udvidelse af ratioen mellem den private gæld og disponibel indkomst i den danske husholdningssektor (HH). Afhandlingen adresserer disse anliggender med afsæt i det Post-Keynesianske økonomiske paradigme og den Babylonske tankegang, hvori stiafhængighed og en pluralistisk tilgang til metode og metodologi tilskyndes. Dette opnås gennem fem uafhængige, men beslægtede og opbyggende artikler.

Den første artikel, *Money at first principles: A social value theory of money*, er en teoretisk udforskning af, hvordan pengedannelse er forbundet til gæld, og forklarer, hvordan dette er forbundet til regnskabsbalancer på institutionelt niveau. Artiklen argumenterer for, at kilden til forandring i en økonomisk agents balancestruktur, er en ubalance mellem niveauet af disponible penge fra indkomst og niveauet for påkrævede udgifter. Ethvert underskud dækkes gennem efterspørgslen af kredit i bytte for gæld. Disse budgetbegrænsninger kan aggregeres til netto finansieringsbehov på sektorniveau. Penge defineres ud fra fire grundlæggende principper; den monetære enhed, det monetære symbol, det monetære rum og social værdi. Disse grundprincipper anvendes til at argumentere for, at efterspørgslen efter gæld i alle sektorer spiller en vigtig rolle i forhold til pengestrømme og i forhold til de relative sektorbalancepositioner i alle sektorer. Endvidere argumenteres der for, at staten bør spille en aktiv rolle i forhold til gældsakkumulering, og åbner derved diskussionen om sektorers indbyrdes afhængighed.

Afhandlingens anden artikel, *Sectoral balance analysis: Evidence from Scandinavia*, anvender Sector Balance Analysis (SBA) som fremgangsmåde til at analysere langvarige historiske datasæt. Metoden inkluderer en deskriptiv analyse af tendenser i sektorers nettoudlån (NL), langsigtede korrelationsstatistikker mellem sektorer, samt en række af laggede korrelationsestimater relativt til output-gabet, for at estimere timingen, hvormed hver sektor netto-udlåner relativt til økonomisk ekspansion. Artiklen undersøger interaktionen mellem nettoudlånskrav på sektorniveau for Danmark, Norge og Sverige i perioden 1950-2017 og der argumenteres for, at der er grund til at betvivle anvendelighed af generaliserede teorier om sektorinteraktioner. I særdeleshed prædikterer Ricardiansk Ækvivalens Hypotesen (REH) en negativ korrelation mellem PRI og GOV. Analysen påviser denne negative korrelation, men viser at korrelationen er forklaret af automatiske stabiliserende mekanismer i de tre nordiske lande og ikke, som beskrevet af REH, af adfærden hos rationelle agenter. Twin Deficit Hypotesen (TDH) prædikterer positive korrelationer mellem GOV og ROW, hvilket findes at være tilfældet i Norge. Dette er til gengæld drevet af indkomstflow til GOV fra indtægter fra internationalt oliesalg. Endvidere viser artiklen, med brug af historisk data, at nuværende positive handelsbalancer mellem hvert land, bedst kan forklares af historiske investeringer og udviklinger i hvert land.

Den tredje artikel, *Sectoral balance analysis: Short run deviations from long run patterns*, bruger rullende korrelations vinduer til at teste stabiliteten af langsigtsrelationer mellem sektorers netto udlånspositioner identificeret i den anden artikel. På baggrund af de rullende korrelationer argumenteres der for, at langsigtsrelationerne observeret på sektoralt niveau empirisk kan identificeres i lange perioder, men at relationerne ændrer sig signifikant over tid. Resultatet illustrerer også, at de store afvigelser kan forklares ud fra specifikke økonomiske hændelser, som medfører at mindst én sektor (oftest PRI) ændrer adfærd i en periode. Udover at evaluere vedholdenhed i relationer, viser analysen en simpel måde at identificere strukturelle brud i de individuelle sektorers adfærd. Hovedkonklusionen i artiklen er, at langsigtskorrelationer mellem PRI, GOV og ROW bryder ned på bestemte tidspunkter, og derfor varierer over tid.

Den fjerde artikel, *Sektorbalancer i Danmark Efter Krisen*, udvider SBA tilgangen ved at disaggregere PRI i HH, NFC og FC med det formål at evaluere logikken af danske recessionspolitikker introduceret efter den finansielle krise. Den foreslår at konsolideringen af FC og NFC gæld blev udlignet af flows fra ROW, og en forbedring af GOV netto udlån var drevet af stigning i efterspørgslen efter husholdningslån (anti-cyklisk i forhold til netto lån). Artiklen fokuserer på automatiske stabiliserende funktioner bygget ind i den danske velfærdsstat og foreslår, at mens GOV er en sektor, hvor beslutningstagning (teoretisk) kan centraliseres, er det også sektoren, der er designet til at være mest passiv i forhold til ændringer i andre sektorer (særligt PRI). Der fremsættes, at statsligt underskud kan forventes i perioder med recession, og at det vil være ulogisk at introducere kontraktiv finanspolitik der kan reducere national indkomst – eftersom GOV budgettet afhænger af en vending i PRIs netto låneadfærd.

Den femte artikle, *Flexible rate mortgage loans: An SFC model of the impact of mortgage credit innovations on Danish balance sheet stability,* er hovedanalysen i artiklen, og præsenterer en hybrid af de empiriske undersøgelser af SBA tilgangen, og teoretisk drevne adfærdsstrukturer. Med brug af SNA (System og National Accounts) introducerer artiklen en empirisk stock flow konsistent (SFC) model af den danske økonomi, baseret på data for perioden 1995-2016. Med fokus på husholdningssektoren adresserer den hovedændringer i kompositionen af husholdningssektorens balance. Det primære fokus er test af husholdningernes følsomhed over for uventede ændringer i renter, eller fald i huspriser. Modellen er baseret på Byrialsen og Raza (2019), med modifikationer som splitter husholdningsgæld i fast- og variabelt forrentede lån. Dette fokus skyldes ændringer i husholdningers gæld som følge af innovationer i finansielle produkter og lovgrundlag i perioden 1996 og 2007. Ud fra den makroøkonomiske model, argumenteres der for at husholdninger reagerer på økonomiske shocks ved at være mere følsomme, som følge af de finansielle innovationer. Effekterne styrkes som resultat af migration af husholdningslån fra fast- og fleksibelt forrentede produkter, med forstærkede generelle effekter på økonomiske nøgleindikatorer. Artiklen foreslår politisk handling, der kan understøtte migration fra fleksibelt til fast-forrentede produkter så vidt muligt, med det formål at minimere makroøkonomisk ustabilitet i tilfælde af negative shocks.

Supplerende til SFC modellen i kapitel fem, præsenterer afhandlingen tre potentielle modifikationer som kan undersøges i fremtidig forskning. Disse

modifikationer inkluderer først en integration af husholdningers refinansieringsmuligheder, derefter integration af kreditrisiko, misligholdelse af lån og lån til værdi-ratioer, og endeligt den cirkulære integration af husholdninger og pensionsfondes finansielle balancer.

I relation til afhandlingens overordnede formål, konkluderes det, at den primære kilde til ændringer i sektorers finansielle balancer er dannelsen af gæld, og at balancerne for institutionelle sektorer er direkte afhængige af hinanden. Som følge heraf bør adfærden i en sektor ikke analyseres uafhængigt fra andre sektorer. Der argumenteres for, at den afhængige karakter af sektorbevægelserne og balancerne begrænses af plausible økonomiske politikker. I relation til udvidelsen af husholdningers gæld i Danmark, argumenteres der for, at den primære årsag er en kombination af finansielle innovationer og liberaliseringen af det danske lånesystem for husholdningslån. Implikationen er, at husholdningssektorens finansielle balance er blevet sensitivt over for potentielle økonomiske shocks, og som resultat heraf, er den danske økonomi også blevet det.

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Contents

Introduction

Robert Ayreton Bailey Smith

Supervisor: Professor Finn Olesen

The Department of Business and Management

Aalborg University

Introductory remarks

This dissertation consists of an introductory section, including a literature review and methodological contextualisation, four self-contained but progressive articles, an abbreviated future research agenda and a conclusion. Each of the four articles can be read independently, and due to the similarity of topics they do contain some overlap.

The main aim of the thesis is to investigate the dynamic interaction of sector balance sheets. The five main institutional sectors are the household sector (HH), the non-financial corporate sector (NFC), the financial corporate sector (FC), and these first three sectors are collectively called the private sector (PRI). The fourth is the government sector (GOV) and the fifth and final is foreign sector (or, rest of the world, ROW). To assist with the flow between the otherwise independent articles, a brief inter-leading paragraph is included between them.

Context

This work began in November of 2016, in the middle of a turbulent decade, and is nearing completion in the first months of 2020, shortly after the tenth anniversary of the global financial crisis (GFC). It could be argued that the GFC began in earnest with the collapse of Lehman Brothers on 15th September 2008. By 2014, the OECD (Ollivaud & Turner, 2014) estimated that among all OECD countries the median potential output loss was roughly 2.75%. For the Czech Republic, Estonia, Greece, Hungary, Iceland, Ireland and Slovenia the estimated loss was more than 10% (Ollivaud & Turner, 2014). Eleven years after the crash, the USA, with Donald Trump as president, appears to be on a modestly positive growth path, and China's growth appears to have slowed marginally. After recent tariff battles in an ongoing trade war, there is uncertainty regarding future trade relations between the United States and China, as well as the potential (and actual) spillover effects for other countries (Bhattarai, Chatterjee, & Park, 2019; Li, He, & Lin, 2018). Far-right and far-left political movements have emerged as serious political contenders, and there have been a wave of protests and anti-austerity movements in France, Belgium, Portugal, Italy, Ireland and Greece (Fominaya, 2017). The United Kingdom has just exited from the European Union under the stewardship of Boris Johnson, and will now go through the arduous two-year process of disentangling itself and building a new international profile outside of the European Economic Area (EEA) (McGrattan & Waddle, 2020). The unconventional monetary policies of quantitative easing (QE), and the ECB's bond-purchase program are still in force, as Euro-zone economic growth has remained low. As noted by European Commission's Directorate-General for Economic and Financial Affairs (2020), "elevated policy uncertainty as well as geopolitical and social tensions continue to weigh on global growth prospects." It is perhaps needless to say that the global financial crisis (GFC) had, and continues to have, dramatic impacts, not only on the financial but also on the real economic circumstances of virtually every country around the world.

The aim of this work is to examine the macroeconomic interactions of sector level balance sheets for the Danish economy and, thereby, to contribute to the understanding of the developments that led to the GFC, and the implications of the decisions of economic agents during this time for macroeconomic stability. Much like many other developed nations, Denmark went through a process of financial liberalisation in the late 1990s. Adjustable rate mortgages were introduced in 1996 (Skinhøj, Gottschalck, Kunde, & Isaksen, 2019), and as noted by Laustsen (2009), a range of credit market innovations occurred between then and 2007. These are discussed in more detail in the article containing the empirical model in Article 5, but the general effect was to reduce the cost of borrowing and to make credit more readily accessible to borrowers. These changes also had significant impacts on the behaviour of PRI.

The developments in the sectoral financial assets and liabilities can be observed in the total aggregate financial balance sheet (FBS) for Denmark. Between 1995 and 2017, the size of the total FBS of Danish institutional sectors effectively doubled in relative size, from around 7.5 times GDP to just over 14 times GDP[1.1]. As can be seen in Figure 1.1[1.2], the relative size of financial stocks grew

[1.1] Data sourced from Eurostat, and the author's own calculations. A similar plot for each of the institutional sectors can be found in the appendix in Section 10. The general patterns for each sector reflect a similar degree of financial expansion. The one exception might be GOV, which reduced its financial footprint considerably between 2000 and 2006.

[1.2] The asset classes indicated follow the ESA 2010 (Statistical Office of the European Communities., 2013) classifications and are abbreviated in the chart for brevity. F1. Monetary gold and special drawing rights (SDRs) are excluded from the HH analysis as the total value is negligible and is only held by FC. The full names of categories are as follows: Monetary gold and special drawing rights (F1), Currency and deposits (F2), Debt securities (F3), Loans (F4), Equity and investment fund shares (F5), Insurance, pensions and standardized guarantee schemes (F6), Financial derivatives and employees stock options (F7) and Other accounts (F8) rapidly prior to the Dot-Com crash in 2001, stabilised briefly before accelerating between 2000 and 2007 leading up to the GFC, and then fell in 2008. Total assets and liabilities recovered through 2011 and since 2016 has remained almost constant. This is a substantial change in the relative scale of the financial sector in Denmark. It also constitutes a significant change in the overall balance sheet structures of each of the underlying sectors. To understand the role that each sector played in this, and the causal mechanisms were that drove the expansion, it is necessary to examine more disaggregated data.

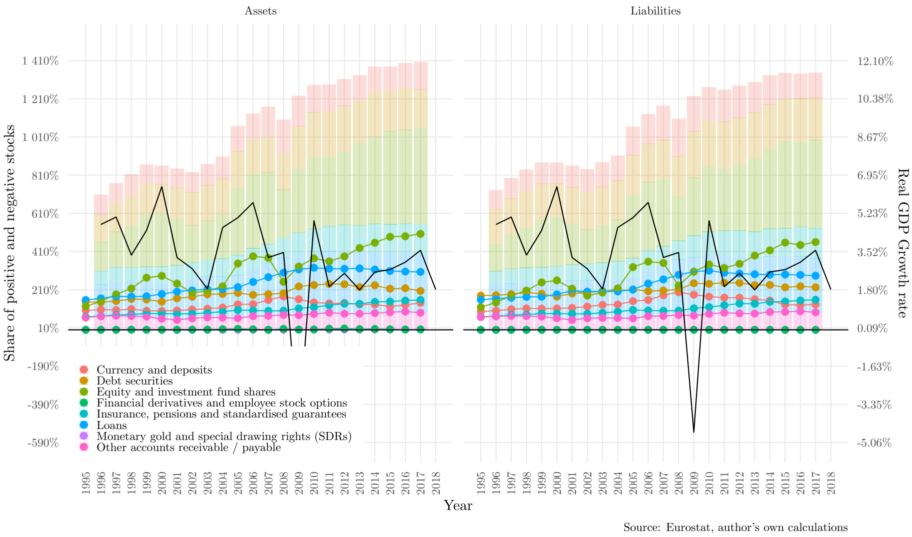
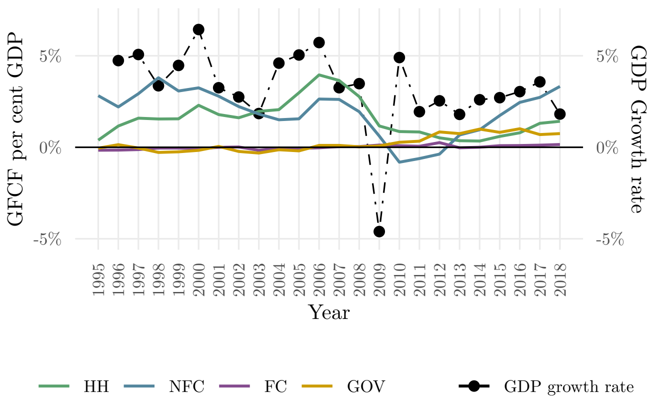


Figure 1.1: Financial Assets and Liabilities: Denmark

Each stage of rapid expansion (between 1995 and 2000, and again between 2001 and 2007) appears to be associated with a surge in the real GDP growth rate (as illustrated by the dotted line against the right-hand axis). The constant increase in the outstanding volume of FBSs, however is measured *relative* to total incomes in Figure 1.1. This implies that the growth in income has not kept pace with growth in the FBS. The non-consolidated data in the plot could possibly be halved, since the assets of one party will necessarily be the liabilities of another, but the relative scale would still double from roughly three times GDP in 1995 to around six times GDP in 2017. The growth in FBSs appears not to have had any discernible impact on another key macroeconomic indicator, gross fixed capital formation (GFCF), or investment.

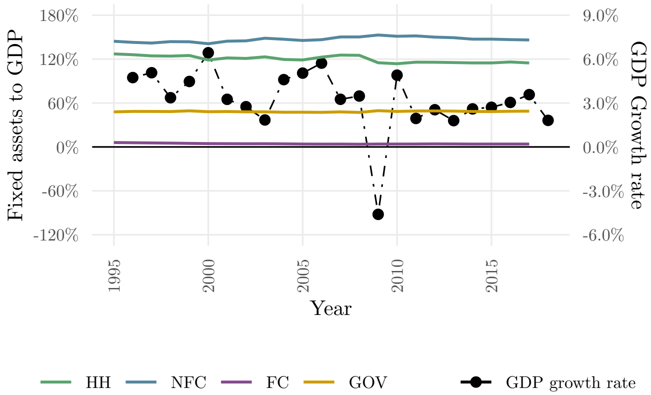


Source: Statistics Denmark, author's own calculation

Figure 1.2: Total economy: Gross fixed capital formation less depreciation

After the deduction of depreciation (or consumption of fixed capital) from investment, as shown in Figure 1.2, the actual additions to capital stocks per sector were less than five per cent of GDP per annum[1.3]. The effect of this is captured in Figure 1.3, which shows that fixed capital stocks (also measured as a proportion of GDP) have remained relatively unaffected. Figure 1.3 illustrates that the levels of fixed capital stock relative to GDP have been almost perfectly static. The dotted line in the chart illustrates real GDP growth through the period, as measured on the right-hand axis. The sharp decline in 2009, coinciding with the global financial crisis (GFC), can be seen to have some impact on HH, as the prices of property fell. It would appear, from these illustrations, that there were no lasting effects on the physical stock of capital relative to the aggregate level of income. It should also be noted, that this measure includes physical property, such as HH dwellings and corporate property, where price inflation should have helped assets keep pace with financial market changes. On the surface it would appear that, generally speaking, the changes to the real economy did not reflect the changes that occurred on the financial side.

[1.3] This is not an ideal measure, since investment is a major component of GDP, but it does give a clue as to the relative importance of fixed capital investment, and the contribution towards total national income.



Source: Statistics Denmark, author's own calculation

Figure 1.3: Total economy: Fixed assets

The rise in prominence and influence of the financial markets has received both strong support and strong critique. Before the financial crisis, it was common for authors to promote the deregulation of capital markets in favour of the expansion of financial services, and the deepening of financial markets (Darrat, 1999; Nazmi, 2005). These results supported the financial liberalisation thesis, as did many others, and helped to drive policies of privatisation and deregulation, such as those of the Washington Consensus[1.4]. As Isenberg (2006) identified, financial liberalisation and the promotion of competition between financial services provided strong impetus for financial innovation, largely in the name of improved efficiencies, reduced costs and greater flexibility.

Others, such as Arestis & Demetriades (1997), were not convinced, and pointed to painful failures of financial liberalisation and deregulation in Latin America and the fallibility of *post hoc* theoretical revisions regarding the sequencing (between real and financial markets) and necessary pre-conditions (pre-financial-reform of the real sector) for success. Isenberg (2006) agreed that the progressive

[1.4] These policies were prescribed by the World Bank and International Monetary Fund (IMF) to developed and developing economies alike. As noted in Williamson (1993), the prescription for economic success included *Fiscal Discipline*, *Public Expenditure reprioritisation*, and *Tax Reform*. Financial Liberalization should be implemented where "the ultimate objective is market-determined interest rates. . . ", and *Exchange Rate controls* should be used to promote exports. *Trade Liberalisation* and the use of tariffs rather than quantitative restrictions. Promotion of *Foreign Direct Investment*. *Privatization* of all state enterprises, and *deregulation* and the removal of impediments to new entrants and competition. Finally, *Property Rights* should be secured.

rounds of deregulation fostered competition and innovation, and mergers and acquisition allowed large conglomerate banking enterprises to provide comprehensive financial services (or what Davies, Richardson, Katinaite, & Manning (2010) called the universal bank), but that the interconnectedness and interdependence of the underlying components of these institutions introduced contagion risks between markets. One common theme to financial crisis is that the participants in the period of euphoria seldom see the crisis coming, or if they do expect a crisis, they behave as though they will be able to avoid the crisis if it were to arrive. Some participants take risks that they are not equipped or prepared for, and it is only in the crisis that they they become aware of their position or realise that it is not possible to offload the risks that they accumulated prior. In relation to contingent risk in reinsurance "retrocessionaires", Buffet (2001, p. 10) remarked, "After all, you only find out who is swimming naked when the tide goes out." It is sometimes easier said than done to know if you "have a bathing suit on", and Davies et al. (2010) supported the argument that deregulation and unchecked financial development contributed to the GFC - primarily because the many important contingencies and dependencies were concealed in the presence of rapid innovation, just as the resources available to regulation were depleted. They also noted that the internal dependencies large conglomerate financial "universal banks" were often difficult or impossible to penetrate as an external observer.

More recently, Lavoie (2012) related the growth in prominence of financial markets to broad acceptance of the principles of neoliberalism, and, amongst others, the focus of central banks on inflation, the impacts of globalisation and a shift in focus from a stakeholder corporate policy to a shareholder corporate policy. He related these issues to "financialisation"[1.5], and argued that contrary to the favourable orthodox view of financial markets as places of complete information, that they were in fact quite the opposite, and were characterised by fraud and misinformation. He emphasised the need for more realistic views of financial markets.

Several prominent theories (re)emerged to explain the the apparent increase in macroeconomic fragility and the "financialisation" of the economy. Caverzasi

[1.5] As Sawyer (2013) explained, it is a rather ill defined term. As a field of study we can follow Sawyer (2013) and accept Epstein (2005)'s definition of the concept as "the increasing role of financial motives, financial markets, financial actors and financial institutions in the operation of the domestic and international economies."

& Godin (2015a) identified the theory of Capital Market Inflation (CMI) by Toporowski & Gicquel (1999), wherein equity price increases trigger portfolio demand in response to capital gains in the secondary market. This theory can also be connected to the re-emergence the Minskian (1970, 1992) financial instability hypothesis (FIH), which details the tendency of capitalist systems towards periods of euphoria. As he (Minsky, 1978, p. 92) later noted, at some point economic interventions prevent "fragile financial relations from leading to debt deflations and deep depressions". He explained that these periods of "euphoria" involve excessive risk-taking, inadequate or insufficient regulation. Caverzasi & Godin (2015a), and Girón & Chapoy (2012) argue that this is precisely what preceded the GFC in the USA, with rapid and unchecked expansion of sub-prime lending to borrowers with questionable credit-worthiness. The interaction between HH and FC resulted in the rapid expansion of debt on the balance sheets of HH. The difference this time, they noted, was that the initial lenders recognised the risks, repackaged the risky loan assets in order to offload the risks. FC in the USA, thus restructured the risky assets on their balance sheets and used investment markets to shift the assets to the balance sheets of other members of FC, HH and NFC. Unfortunately, this spread the risk beyond the borders of the USA, and well beyond the banking sector. When the USA government failed to provide a guarantee on Lehman Brothers, and they filed for bankruptcy, markets reacted globally. German, UK and US money market bid-to-ask spreads rose to triple, four times and five and a half times in less than one month respectively (Nationalbank, 2009, p. 28), liquidity collapsed and bid-to-ask spreads tripled in the widely used credit default swap market. Property and mortgage debt markets were some of the hardest hit. Denmark was no exception, with property prices falling by roughly 20% from the peak in 2006 to the trough in 2011. This forced regulators to change the capital assessment criteria on covered bond portfolios for major Danish credit institutions, as covered mortgage bond capital rules were affected by changes in the loan to value ratios of the underlying bonds (Danmarks Nationalbank, 2016, p. 35).

Whether or not these developments have been or are problematic is a complex question to answer, and it is important to establish where strong connections might exist. We can take the net financial wealth position for each sector as a point of departure, as in Figure 1.4. From the perspective of net financial assets (i.e. assets less liabilities), relative to GDP, the solvency of each sector is unremarkable. With the exceptions possibly of HH with assets of approx. 174% of GDP, and RoW, with liabilities of 52% of Danish GDP at the end of 2017. From this figure, FC and HH appear to be strongly (inversely) related up until the crisis, and then diverge.

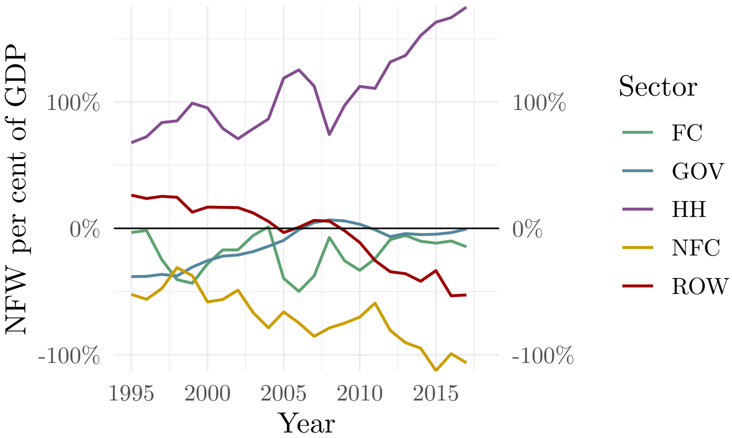


Figure 1.4: National net financial wealth

Net positions are somewhat misleading for several reasons. Firstly, net positions conceal the case where assets and liabilities expand simultaneously - i.e. gross changes in balance sheet magnitude. Secondly, it is not possible to observe changes in composition that occur within the asset and liability categories. As a result, the interactions between sectors are somewhat obscured. Plotting the progression of balance sheet composition reveals similarities across the sectors and provides an initial indication of how the sectors might be related. It reveals that the bulk of changes in the HH balance sheet asset position, and a significant portion of the positive net asset position reflected in Figure 1.4, are the result of a rapid rise in the portion of financial assets held in equities and pension assets. On the surface this seems good, a simple excess in accumulation of assets over liabilities. A more detailed examination of the underlying changes in each[1.6], however, reveals that the bulk of changes in the value of both the equity and pension assets of HH came in the form of price changes (or revaluations). From a net balance point of view, in Figure 1.4, NFC appears to be in significant

[1.6] As can be found in the appendix in Section 10.3.2

deficit, but outstanding equity liabilities are marked-to-market[1.7], and by far the greatest proportion of the downward trend is simply a mirror of the rising equity prices observed for HH[1.8]. This simple analysis illustrates a possible relationship between the level of HH assets, the level of NFC liabilities and capital gains on NFC equity. To contrast this, the increase of liabilities for HH was driven by the active acquisition of greater quantities of debt - most of which is mortgage debt. If equity prices were to fall, this relationship may prove to be risky for HH.

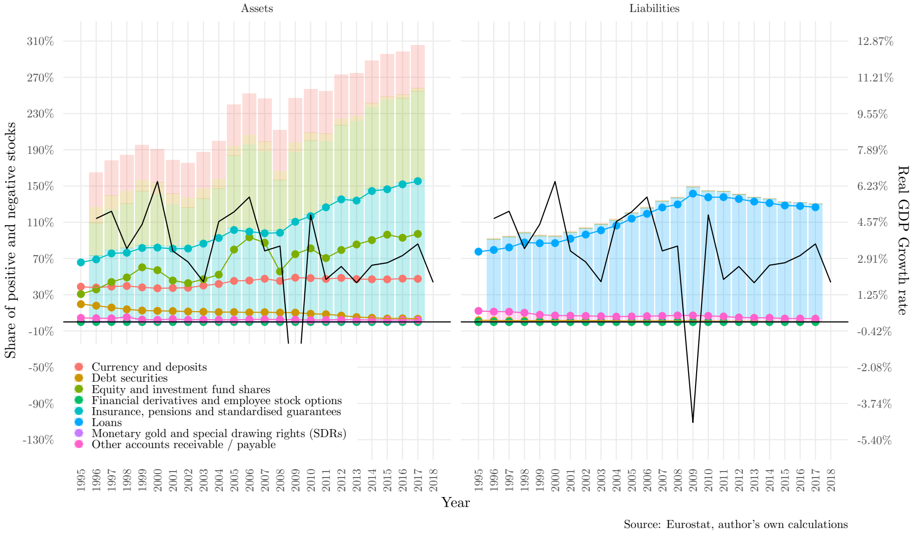


Figure 1.5: HH: Financial Assets and Liabilities

The Danish HH is of interest for another reason. Even before the crisis broke, Denmark was recognised as having the highest level of HH debt to disposable in come in the world (Girouard, Kennedy, & André, 2006). This can again be seen through the lens of the sector balance sheet. HH financial assets, as shown in Figure 1.5, as a proportion of GDP, doubled from around 155% to just over 300% of GDP. Liabilities, rose from just under 75% of GDP to a peak of around 150% of GDP in 2009 (just over 300% of HH disposable income). Financial deregulation, relaxation of borrowing criteria and product innovation have been

[1.7] For accounting purposes, assets are valued at the current market value, rather than at par value or initial sale value.

[1.8] Additional evidence of revaluation and transactions components in the change of stocks for each sector can be seen in the appendix, in Section 10.4. The data presented is collected from Eurostat, and includes the author's own calculations.

suggested as the leading causes of this trend (Scanlon, Lunde, & Whitehead, 2008). Paradoxically, in spite of the highest global level of debt to disposable income, the Danish central bank (Danmarks Nationalbank, 2016) and the IMF (Sheehy, 2014) report that there are no serious threats to financial stability. This, it is argued, is because of a peculiar set of institutional arrangements that insulate HH from negative shocks. At the height of the GFC, Skinhøj et al. (2019, p. 6) illustrated that the number of forced sales only rose to around 500 from around 150 per month, and the arrears ratio on mortgage payments rose to around 0.5% from an average of around 0.25%[1.9]. Although large in terms of percentage change, according to an OECD study (André, 2016), they are substantially lower than those for the other countries, such as the UK[1.10], USA, Ireland or Spain.

A significant concern in the context of the Danish economy is that although Denmark maintains a sovereign currency, the Danish Krone is pegged to the Euro. In order to maintain the currency peg, and to avoid currency speculation, the Danish Nationalbank is thus compelled to keep Danish interest rates in line with those set by the European Central Bank. The consequence of which is that Danish interest rates are to a large extent, outside of the control of Danish authorities. The interest rates faced by HH therefore followed European interest rates to the lowest ever recorded levels during the crisis, which may explain the modest impact described by Skinhøj et al. (2019). If interest rates increase, however, so will the rates faced by Danish borrowers. The impact of the cumulative decisions of sector participants leading up to the crisis, for the macro economy, depends the transmission of economic shocks or policy measures throughout the economy. As noted above, these transmissions are determined by the web of connections between sectors.

Objectives

To achieve an adequate understanding of how the sector level balance sheets are connected, it is necessary to unpack these interactions progressively. To do so, the thesis thus addresses four key objectives: The first is to identify what the primary source of change in sector balance sheets is; the second is to empirically

[1.9] The proportion of total mortgage payments at least 105 days overdue.

[1.10] The UK (peaked at around 2%), US (peaks per product category were: sub-prime-adjustable products over 6%; prime adjustable over 3%; sub-prime-fixed 3%; prime fixed just under 1%), Ireland (rose to over 12% by 2014) or Spain (peaked at over 5%)

identify the connections and dependencies (interactions) between the three primary sectors (PRI, GOV and ROW); the third is to explore the implications of these interactions, and extends this analysis to include a disaggregated PRI (split into HH, NFC and FC); and, the fourth is to assimilate these interactions into a single macroeconomic framework - in order to examine the transmission of economic shocks or policy measures throughout the economy - and to use this framework to investigate the causes and implications of the expansion of PRI debt relative to disposable income of Danish HH.

Research agenda

In order to located the research in the literature, the *Literature Review* covers the core literature for the thesis. It describes the Post Keynesian link between debt and money creation, and highlights the importance of the system of national accounts and recent developments in financial account record-keeping. It links the creation of money and debt to the net financing requirements of a sector, and introduces Sector Balance Analysis (SBA) as a tool for both historical analysis and identification of structural breaks. It provides an introduction to stock-flow consistency and stock-flow consistent models, and an outline of the most prominent Danish macroeconomic models. Finally, it locates the research in the economic methodology literature, and discusses some theory of science and methodological considerations. An additional basic outline of the structures of SFC models is provided for readers who are not familiar with the framework. An appendix, *Appendix: Balance sheet descriptive analysis*, is a preliminary investigation into the underlying stock and flow characteristics of the five institutional sectors of Denmark, and for the most part is used to inform the analysis contained in the articles.

The first objective of this thesis is to identify the primary source of change in sector balance sheets. The first article, in Article 1, is titled *Money at first principles: A social value theory of money*, and takes the first step, and investigates how money creation is linked to debt. It further explores what the moral and ethical implications are of a redefinition of money creation (as an endogenous extension of credit), and questions the current role of money in our understanding of economic growth and development. Finally, it helps to answer the question of how money creation is linked to aggregate sector positions. In particular, how government (GOV) budget decisions are connected to private debt. The description of budget limitations can be applied at an aggregate level to understand the accumulation of claims and counter-claims between sectors.

In terms of the second objective, and due to the closed accounting system, it is relevant that the net position of each sector is suspended in balance with all other sectors, and that the possibilities faced by each sector are shaped by the collective positions of all other sectors. This condition provides crucial information regarding the possible outcomes of economic policy under different conditions. Beyond the flow of funds data available, it also means that the relative sizes of flows and stocks of each sector can be compared in order to identify likely interactions. In the wake of the GFC, several countries in Europe have endured an extended period of low interest rates and centrally imposed austerity measures. One of the primary motivations for these measures is the idea that the external balance in each country cannot be positively affected by GOV debt driven spending. There has been a strong focus on the benefits of balanced GOV budgets at a European level, and this has translated into policy in the form of EU imposed limitations of GOV indebtedness and fiscal deficits. Part of the motivation for these policies is that the interactions between sectors have been framed as long-run norms and generalisable theories. This leads into the second analysis.

The second article, *Sectoral balance analysis: Evidence from Scandinavia*, addresses the second objective, to establish empirical evidence of interactions. The Sector Balance Analysis (SBA) approach is used to analyse long historical datasets, in order to explore the extent to which the government (GOV), private (PRI) and foreign (ROW) sectors are connected at an aggregate level. The methods include a descriptive analysis of the trends in sector net lending (NL), long-run correlation statistics between the sectors, and a range of lagged correlation estimates relative to the output gap in order to examine the extent to which each sector pro- or counter-cyclically net lends relative to economic expansion. The article investigates the interaction between sector level net lending requirements for Denmark, Norway and Sweden between 1950 and 2017. It considers whether, or to what extent, each sector is in control of their net lending positions, and finally it addresses the question of how generalisable the findings for each of the Scandinavian economies really are, and whether generalised theories should be used to justify general economic policy. It is also the first time SBA is applied to longer historical datasets for the purpose of historical analysis.

The third article, in Article 3, is titled *Sectoral balance analysis: Short run deviations from long run patterns.* As the title suggests, the paper explores the stability of the long-run relationships between sector net lending positions identified in Article two. Where Article 2 explores the extent to which a cross-country comparison is valid, this article uses a rolling correlation window to evaluate the extent to which the long-run patterns for each country persist over time. The implication being that if they are not stable, then policy prescriptions should be adjusted accordingly. In addition to evaluating the persistence of relationships, the analysis provides a simple way to identify structural breaks in the behaviour of individual sectors. It is thus predominantly focused on the second objective. The SBA approach, applied to the three primary sectors (GOV, PRI and ROW), thus provides a strong foundation for understanding the aggregate level dependencies between sectors, and some of the risks related to property income flows.

The third objective, to explore the implications of these interactions, is addressed in the fourth article, *Sektorbalancer i Danmark efter krisen*, and extends this analysis to include a disaggregated PRI, and builds on the SBAs from Articles 2 and 3 for policy analysis. This separation also permits a more complex description of the flows between the sectors, and takes the analysis a step closer to understanding HH accumulations in a macroeconomic context. The article focusses on the Danish austerity policies introduced after the GFC. Particularly, the interactions related to the Danish welfare state, and the role of government in response to periods of economic recession or crisis.

The fifth and final article, *Flexible rate mortgage loans: An SFC model of the impact of mortgage credit innovations on Danish balance sheet stability*, is the main contribution of the thesis, and presents a hybrid of the empirical investigations of the SBA approach, and theoretically driven behavioural structures. With the use of the System of National Accounts (SNA), the paper implements a fully empirical stock flow consistent (SFC) model of the Danish economy, estimated on data for the period 1995 to 2016. It thus addresses the fourth objective, and uses the model to investigate the innovations to the mortgage financing industry in Denmark leading up to the GFC. It will also address the two key risk factors identified above: an increase in interest rates; and, a possible property market response.

Finally, three additional modifications are identified as *Future research perspectives*, and the final section, *Conclusion*, provides a brief overview of the main findings in the context of the research objectives.

Literature review

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2.1 Introductory remarks

The purpose of this review is to cover the core literature in each of the key areas of this thesis, namely the social value theory of money, systems of national accounts, sector balance analysis, stock-flow consistent (SFC) models and Danish macroeconomic models. The literature has been reviewed by a combination of traditional methods and structured searches of the academic literature.

The content of the review follows a simple progression; firstly, money is defined and linked to the creation of debt. This link is based on economic theory from the Post Keynesian economic paradigm, which differs in some fundamental ways from what is largely considered to be mainstream economic theory. These differences stem from a difference in the philosophical and methodological foundations of each. Of the two broader paradigms, the Post Keynesian paradigm provides a closer representation of reality when we consider descriptions of money.

The Post Keynesian link between debt and money creation is the cornerstone of financial balance sheet expansion, and the attention to the rigidities of accounting and banking systems make the paradigm perfectly suited to analysing data stored in the form of national accounts. Recent developments in the system of national accounts have made it possible to analyse the interaction between the financial side of the economy and the real side within a closed accounting system. At an national level, this is achieved by aggregating the economy up to the main institutional sectors.

The most advanced form of analysis within the Post Keynesian paradigm, Stock-Flow Consistent (SFC) models, incorporates Post Keynesian theoretical behaviours into medium to large systems of simultaneous equations. One of the main authors in the SFC tradition, Wynne Godley (1999a), also promoted another form of analysis, sectoral balance analysis (SBA). SBA can be used to inform the modeller of some of the main interactions between the institutional sectors. Much like the money creation and debt link for the private individual, sectors as a whole have incomes and expenditures and accumulate debts and assets. SBA allows an SFC modeller to build an understanding of the net financing requirements of each of the sectors over time. This knowledge is invaluable in the complex task of building a large empirical structural model of an economy. It is also instructive for policy limitations, depending on the pre-existing economic conditions.

The final part of the literature review is a slight divergence into the fundamental structure of SFC models, as the basic structural characteristics of SFC models are not included in Article 5, which presents the empirical SFC model.

The review below is an attempt to cover the core literature behind this chain of logic, and these main topics also represent the tools and analyses presented in the articles that follow.

2.2 Money and social importance

The literature on money is extensive, as a result it is necessary to be selective in terms of the literature included in this section. This inclusion is to support the work in Article 1, and first presents something of a controversy regarding the connection between debt and money creation.

Most will agree that money is of central importance in an economy. Broadly speaking, the definition of money has been dominated by what has come to be known as the mainstream view. This is particularly the case for the definition of the role that the banking sector plays in the creation of money. Money is most commonly defined by its functions as a means of payment, store of value or unit of account (Acemoglu, Laibson, & List, 2015, p. 621; Blanchard, Amighini, & Giavazzi, 2013, p. 67; Frank, Bernanke, & Kaufman, 2007, p. 648; Mishkin & Eakins, 2016, pp. G-11). The creation of money is then typically described by the money multiplier[2.11], where a deposit is made in a bank, which can then lend a portion of that deposit, dependent on the level of the fractional reserve requirements set by the central bank.

In recent decades, an alternative economic paradigm, the Post Keynesian (PK) paradigm, has emerged that challenges this description. According to PK authors, such as Moore (1983a) and Palley (2002), the money multiplier is based on outdated and outright incorrect monetarist theory, and promotes the idea that it is possible for a central authority of some kind to control the supply of money into an economy - an *exogenous money supply*[2.12]. In pedagogical representations this is captured by a vertical supply of money curve in the market for money. They further argue that this misguided description

[2.11] See for example Silber & Ritter (1983, p. 51), Kelly (1993, p. 309), Mishkin (2007, p. 374), Kidwell, Blackwell, Whidbee, & Peterson (2009, p. 52), Madura (2010, p. 103), Pilbeam (2010, p. 78).

[2.12] This is particularly relevant for Denmark, where monetary policy is limited to the maintenance of a fixed exchange rate to the Euro. (Spange & Toftdahl, 2014) of money creation has wide-reaching social and political implications, some of which are explored further in Article 1. The circuit theory of money (CTOM), which echoes the PK theory, developed simultaneously in France, the earliest publications of which were by Le Bourva (1959, 1962). As a form of validation of the concrete description of money creation provided by PK and CTOM authors, simple pedagogical explanations have also recently been provided by S&P's chief economist Sheard (2013), the Bank of England (McLeay, Radia, & Thomas, 2014) and the Bundesbank in Germany (Deutsche Bundesbank, 2017).

A central argument by PK authors was that the money multiplier description was out of line with reality. This was relatively easy to demonstrate[2.13], but the challenge that PKs wished to make was at a deeper level. Both CTOM and PK theory explained that money is created by banks in the process of lending. Although this is similar to the money multiplier, the one fundamental difference is that PK and CTOM authors believe that there is no initial amount of money that is floating around in the economy waiting to be deposited[2.14]. The trigger for growth in the money stock therefore cannot be the *supply* of a deposit, but must rather be the *demand* for new money - this demand is then accommodated by the central bank through the issue of central bank reserves (see, A P Faure, 2013). This was initially illustrated pedagogically, in direct contrast to the classical, monetarist and neo-classical (CMN) schools[2.15], as a horizontal money supply curve[2.16]. CTOM and PK therefore emphasise that the

[2.13] Moore (1983b) presented formal causality tests and micro-theoretic models of banking. The institutional arrangements of modern banking, and the present instruments of monetary and interest rate policy were covered by Arestis & Eichner (1988), Lavoie (1996), Lavoie (2006), and Dow (2006). The temporal ordering of lagged fractional reserve accounting was also covered by Godley & Cripps (1983) and Godley & Lavoie (2012), and number of additional studies have since emerged showing the disconnection between the level of the fractional reserve requirement and the level of money in circulation in an economy. In addition, qualitative descriptive explorations of bank and central bank processes were provided by Kock (1954), Le Bourva (1992) and Faure (2008), and these clearly show that the timing of bank loan issuances and the delayed settlement of bank-to-central-bank reserve requirements make it impossible (within modern banking institutional structures) that causality could run from reserve requirements backwards to the level of broad money in circulation.

[2.14] Further history of the development of money and banking systems is available in Smith (2014).

[2.15] The strongest objections raised were against monetarists, and the money multiplier explanation should perhaps not be used as device to coerce a broad array of economists into the objectionable category of "orthodoxy". It was not only the money multiplier in of itself that was the target of the initial PK critique, but the application of monetarist policies, based on a modified versions of the quantity theory of money (Kaldor, 1970).

[2.16] This was disputed amongst Post Keynesian authors but resolve as a difference in focus, rather than in fundamental beliefs about the money creation process. Those who believed that all demand for credit could be and generally was accommodated by the central bank productive process in the economy is triggered by this initial demand. Money, then, is considered to be *endogenously* determined by the participants of the economy - and so cannot be exogenous.

For PKs, this endogeneity was reflective of a broader truth - if the volume of money was a direct reflection of the volume of production in the economy, it was impossible that money could be a simple lubricant in the economic system. This idea, that money was a neutral element for long term growth prospects, was, and still is, a central component of CMN theories, and one of the foundations of the theory of a long-run general equilibrium. To accept the endogeneity of money creation (and thus to reject the neutrality of money) was, to PKs (Moore, 1983b), to reject the notion of general equilibrium. The relevance of long term averages was questioned in the light of structural and technological changes, and the growing belief if the market mechanism as a self-managing, self-correcting force was rejected. The endogeneity of money was thus a cornerstone of much broader theoretical critiques.

For the present discussion, and the sections to follow, these assertions have some important implications. Firstly, as will be discussed in Article 1, the composition of debt is very important, as the purpose for which it is borrowed will have implications for how the economy develops in the future.

Secondly, when the expansion of the stock of money is tied to the expansion of debt, as Faure (2013; 2014) has described in great detail, the provision of a loan by a bank results in the expansion of the balance sheets of both the borrower and the lender. The borrower experiences an increase in deposit assets (money) and a simultaneous increase in a debt liability (the loan contract). The lender experiences the inverse, the deposits are a liability for the bank, and the loan is an asset. This is as true for a sector as a whole as it is for an individual. It also means when someone borrows from a commercial bank, by virtue of dual entry accounting, it results in the expansion of both the borrower and lender's

were dubbed horizontalists (such as, Moore, 1983b), and those that argued that the central bank would impose some kind of limits (thus adjusting the shape of the supply curve to be somewhat upward sloping) were called structuralists (see, Goodhart (1989), Palley (1991), Palley (1996)). As note by Dow (2006, p. 37), the main emphasis of earlier authors was that a vertical money supply curve was illogical, and the primary aim was to contradict the monetarist view, and that the structuralist view simply introduced additional considerations. Lavoie (2006, p. 19) also identified several reasons why the suggested structural constraints might not be relevant over very short time-frames - allowing the supply of money curve to take a variety of forms, depending on the length of time considered.

balance sheet[2.17]. For example, if the private sector borrowed from the financial corporate sector, then both the private sector and financial corporate sector balance sheets would increase in size by the same amount as the loan. This can then be observed at an aggregate level in the balance sheet data for each of the institutional sectors. As a result, developments in the scale of financial balance sheets is a reflection of credit extension, and developments in the composition of financial balances sheets reveal a great deal about how the initial credit was utilised, and the interaction between the borrowing and lending sectors. Balance sheet analysis in general thus provides a window into the distributional and developmental effects of credit creation. The appendix to the thesis provides such a simple balance sheet analysis for Denmark. Although it does not answer any specific question, it provides useful information about the progression of the financial balance sheets of each sector.

Thirdly, the future levels of macroeconomic indicators are not pre-determined by any long-run forces, but are the result of active intervention by various economic participants. The economy then is not on any long run trajectory, but is the cumulative result of continuous active intervention - it is therefore path-dependent. Davidson (2003) described this feature as non-ergodic, and Dow (2010) described it as non-deterministic. This feature makes the long term nature of the economy very difficult to predict. As noted by Dow (2010, p. 4):

> “If the system’s internal structure is evolving in a non-deterministic manner, and the influences to which it is subject in the future are not known (or all knowable) in advance, then the scope for using frequency distributions to quantify a probabilistic or stochastic expectation is lacking.”

As she discussed, this does not close the possibility for ordinal probabilistic outcomes. In other words, it is still possible to estimate with some degree of probability whether one event is more likely to occur than another. The argument is rather that longer term predictability is problematic - as is reflected in the relatively short-term focus in the empirical model in Article 5.

The process of economic activity in a credit based economy, or as Keynes (J. Keynes, 1933) described, a monetary production economy, can be captured in

[2.17] Both the deposit and loan components must simultaneously be recorded against both the borrower and lender, resulting in four simultaneous additions. See A P Faure (2013) for a pedagogical explanation.

comprehensive macroeconomic stock-flow consistent (SFC) accounting models. SFC models are the most advanced form of analysis in the PK paradigm, and incorporate PK theoretical behaviours into medium to large systems of simultaneous equations. The recent protagonists for the use of these models were Wynne Godley and Marc Lavoie, who provided what could be seen as a quantitative synthesis of many Post-Keynesian theoretical perspectives (Wynne Godley, 1999b; Godley & Lavoie, 2001, 2005, 2012). Together with the growing availability of financial market data, these models took cognisance of the inclusion of a detailed financial side to the economy, particularly the mechanical flow of money.

As noted in the brief introduction above, Wynne Godley (1999a) promoted the use of Sectoral Balance Analysis (SBA) as a tool explore the interactions between sectors. In particular he explored the impact of sustained patterns of surplus or deficit funding requirements between the sectors. SBA respects the legalities and rigidities of accounting practices, much like the SFC tradition, but focuses primarily on the net lending or net borrowing requirements of each sector. Much like the money creation and debt link for the private individual, sectors as a whole have incomes and expenditures and accumulate debts and assets. As financial assets or debts grow, they also generate proportional income or expenditure flows - or property income.

Wynne Godley (1999a) used SBA to identify unsustainable patterns in the US economy. Later, Godley (2000) also used SBA to predict many of the difficulties faced by the US economy as a result of the excessive accumulation of debt by households. More recently, there have been relatively few examples of SBA used for economic analysis, and none that use SBA for historical event analysis. The only examples to be found through structured searches of the literature were Barbosa-Filho, Rada, Taylor, & Zamparelli (2006), Barbosa-Filho, Arnim, Taylor, & Zamparelli (2008) and Glötzl & Rezai (2018). The focus of these analyses are primarily to test the validity of two main theoretical positions; Richardian equivalence, which refers to the intertemporal smoothing of household consumption; and the twin deficits hypothesis, which, in it's simplest form, predicts that deficits in the public sector will result in greater foreign deficits for the country in question.

Article 2 below contributes to the SBA literature with an application to historical analysis, where SBA is used to reinterpret historical economic events from the perspective of sector financing requirements. It also contains an historical review of the development of sectoral accounts in the three Scandinavian economies of Denmark Norway and Sweden. Article 3 extends the use of SBA further, as a tool for the identification of structural breaks in historical data. The use of rolling windows, applied to the correlation of net lending and borrowing positions between the broader sectors, allows the analyst to identify changes in the general pattern of sector interactions. This identification strategy identifies most major changes in expenditure and income patters for each of the sectors.

In general, SBA, especially when applied together with a balance sheet analysis, allows an SFC model builder to develop a detailed understanding of the net financing requirements, and the drivers thereof, for each of the sectors over time. These analyses, however, would not be possible without accurate and reliable data. The collection of this data, and the history of the development of these datasets is of great relevance for the future prospects of both SBA and SFC modelling.

2.3 System of National Accounts, SBA and social accounting

This section reflects briefly on the importance of the development of the System of National Accounts (SNA) for economic analysis. The structure of national accounts and the statistical work required to produce a systematic, dual entry accounting, stock, flow and stock-flow consistent national framework are prerequisites for empirical SBA and SFC modelling.

As noted in the section above, the balance sheets of each economic unit, or collectively of each sector, allow us to observe and map interesting and useful behaviours in an economy. We can observe the changes in aggregate balance sheet because of the availability of aggregated national accounts statistics. Fortunately in modern times these are organised in the systematic dual entry accounting format of internationally standardised systems of national accounts (SNA). While several scholars in several countries around the world had attempted to measure the national income and product in various ways, it was Morris A. Copeland that was responsible for the development of the first flow-of-funds accounts for the USA between 1944 and 1952 - initially covering the period 1936 to 1942. Early works are also attributed to James Meade and Richard Stone of

England, who, together with Copeland, contributed greatly to the establishment of the 1953 United Nations System of National Accounts (SNA53)[2.18].

The first report linked to the United Nations, and which emphasised the need for standardised accounts was published in 1947 by the United Nations Statistical Commission (UNSC), by a committee of experts. The project was a continuation of work that was started as the result of recommendations made at an international conference in 1928[2.19] - work that was unfortunately later interrupted by the Second World War. This was followed in 1953 by the first set of 6 accounts and 12 tables. Revisions followed in 1960, 1964, 1968[2.20], 1993[2.21] and 2008.

Although a more complete description of the developments is provided in Article 2 below, it is relevant here to mention that some efforts were simultaneously under way in Scandinavia. In Denmark, the earliest records of estimates of national income are from the late 1800s and early 1900s[2.22], but as noted by Abildgren (2008), the development of separate accounts for the institutional sectors occurred fairly late. Abildgren (2008) also noted that the first complete set of annual flow-of-funds accounts for the institutional sectors of Denmark were only produced in 2001 by Statistics Denmark (DST), covering from the end of 1994[2.23]. The first quarterly statistics were only produced from 2004 by Danmarks Nationalbank[2.24]. Where Denmark has lagged behind in publication of quarterly financial statistics, the country has excelled in the establishment of

[2.18] Historic versions of the SNA can be found at https://unstats.un.org/unsd/nationalaccount/hsna.asp .

[2.19] As noted in the preface of Stone (1947), the work began in response to "Recommendations V(I) of the Final Act of the International Conference relating to Economic Statistics, Geneva. 14 December 1928."

[2.20] At this point the SNA were extended to include balance sheets and input-output tables. In addition, there was increased focus on constant prices.

[2.21] The 1993 version provided a more complete synergy with international accounting systems.

[2.22] Christensen, Hjerppe, Krantz, & Nilsson (1995) provides a fairly detailed historical account of the development of national accounts in Denmark.

[2.23] Abildgren (2008) has more recently constructed a variety of annual financial stock statistics from 1875 to 2005, the general nature of which appear to be very robust when checked against more comprehensive recent DST data. Abildgren (2012) has consequently constructed non-seasonally adjusted quarterly flow data for the period 1948 to 2010, using largely the same indicator variables as Statistics Denmark for the decomposition of annual statistics to quarterly. Where indicators were available he used the Proportional Denton Least Square Method, and where not, he used the mechanical least-squares method - both of which were the recommended methods of the IMF manual on quarterly national accounts.

[2.24] As noted by Abildgren (2008), both the quarterly and annual sets were produced in accordance with the European System of National Accounts (1995), ESA95, which was the European version of the United Nations system of national accounts, SNA93. The latter being the first to fully detail the inclusion of financial accounts.

micro-data collection and storage. Enormous efforts of DST, universities and public administration have produced data at the level of the individual and firm for all members of the population, and all firms. The data covers a range of tax, income, health, employment and education categories and is now some of the most detailed, complete and accessible[2.25] in the world. These micro-data are used for a detailed understanding of the composition of household mortgage debt in Denmark in Article 5 below. As noted above, Article 2 includes a review of these developments in Scandinavian countries, and will therefore not be discussed further here.

As useful and powerful as the SNA have become, there is an important caveat to how broadly the information contained therein should be applied. The history of the recording of national accounts statistics differs between regions, with the initial focus being on a measurement of national income, or national product. The measurement and definitions of concepts, however, can rarely be reconciled perfectly. Copeland (1935) recognised from an early stage that there are significant limitations in the construction of data driven definitions. As he explained in the excerpts below, such an approach makes definitions much clearer, even if they do not capture the full scope of a more morally acceptable definition.

> "When we define our basic economic concepts in terms of the methods of measuring them statistically, their meaning is clarified and made more precise. The concepts also become less neat and we may be compelled to recognize certain ambiguities, to reckon with two definite meanings instead of one vaguer one." (Copeland, 1935, p. 377)

> "The ethical significance of the concepts of national wealth and national income has been emphasized. To be sure they are ethical in a somewhat narrow sense - they conceive our society and its organic and inorganic environment in collectivist terms as a system, a system serving exclusively human wants, and serving only those human wants the means of satisfying which can be measured in dollars." (Copeland, 1935, p. 381)

The importance of excluding intermediate consumption and the problems of

[2.25] Accessibility is contingent on many criteria, but provided the researcher is willing to live up to those criteria, the process by which to access the data is quick and simple.

double counting were one such ambiguity. His argument was that by starting with measurement, the contents of a measured concept might be clearer than if one started with a concept for which measurement was not possible. This had and continues to have very serious implications for the content of these measurements, and the inferences that can be drawn from them. National accounts by definition only include records of economic activity where a transaction has taken place. As a result, many valuable social and household activities are excluded from the general reckoning of GDP.

He also made clear that while the ethical composition of concepts (or their definitions) was important, this should not prevent or detract from the value of using measurements in order to come to some very valuable insights about the economy. The risk of such an approach is that the practitioner, that makes use of the data to draw insights, might lose touch with the statistician that compiles the data from a variety of sources. His conclusion (Copeland, 1935, p. 386) was not unclear about the potential to link such measurements to more ethical and moral social considerations, noting that,

> "Development in this direction of social cost accounting should do much to bring about a closer articulation of the theory of value and distribution with statistical measurement."

It is these ethical and moral considerations that inspire much of Article 1, where an attempt is made to reconcile the definition of money with the concept of social value. More recent developments on alternative measures of economic performance have be presented by Stiglitz, Sen, & Fitoussi (2010), which has already stimulated several active measures of economic performance in terms of social progress - rather than purely monetary criteria.

The advances in data collection and the statistical recording infrastructure have been profoundly influenced by advances in technology over the past fifty years. Computing and data storage technology has today made it possible to collect vast quantities of data in exceptional detail. Whereas in Copeland's time, the collection of statistical material could quite literally be measured in physical volumes. Although discussion of the ethical considerations have been extensive, many of these discussions took place in the time before statistical or data-driven alternatives were possible. It is important that the moral and ethical considerations are again brought to the forefront. As mention, this is in part what is attempted in Article 1.

The simultaneous construction of financial and real accounts, which developed in earnest after the 1993 revision of the SNA, allows for cross-verification of the net funding requirement of each sector. By this it is meant that changes in the financial assets of each sector can be cross-verified against transactions that take place in the real side of the economy. As noted above, SBA involves the assessment of institutional sector flows and stock accounts, but it pays particular attention to the accounting identities that require all sector flows (and associated financial stocks) to net sum to zero. This ability to cross reference the real and financial flows allows us to draw connections between the cumulative actions of the participants in each sector (for example, a fall in the general propensity to invest) and the ultimate financial and real position that the sector ends up in (possibly with lower overall demand, lower employment, but with positive net financial balances).

The importance of these relationships was recognised by Wynne Godley around 1974, as he noted in (W Godley & Lavoie, 2007, p. xxxvi), Godley & Cripps (1974) was the first account of their acknowledgement of the importance of the net lending identity (that should net sum to zero) for economic analysis. This was followed by several publications (Cripps & Godley, 1976, 1978) while working as the Cambridge Economic Policy Group (CEPG), culminating in the book Godley & Cripps (1983). Godley continued to develop models, and ultimately, via a number of correspondences, wrote what is now broadly used as the textbook for stock-flow consistent modelling in 2007, with the updated 2012 version, Godley & Lavoie (2012), published posthumously. Godley is recognised by several economists, such as Bezemer (2009) and Fiebiger (2013), as a key contributor to the emergence of sector balance analysis (or sector financial balance analysis), and thereafter SFC modelling.

The formal modelling work of Godley, in Godley & Lavoie (2012), is the basis of the final article in this thesis, Article 5, but unlike many modern models, the model was not an adaptation of a model from one of the chapters of the book. The model adheres to the SFC rules, but the accounting identities and the aggregation choices are based on the national accounts of Denmark, and the peculiar features of the balance sheets of each sector.

In order to provide some context to where the model fits into the existing literature, some of the more recent developments in SFC modelling are discussed below.

2.4 Post Keynesian Stock-flow consistent models

This section will be divided into two very brief sections. The first is a brief description of what is meant by stock-flow consistency, as these are the fundamental rules of the SFC model in Article 5. The second covers the SFC literature that has addressed the problem of expanding household debt, a short summary of the current macroeconomic models in used at major institutions in Denmark, and a brief history of SFC models for the Danish economy.

Dos Santos (2006), Caverzasi & Godin (2013), Caverzasi & Godin (2015b) and Nikiforos & Zezza (2017) provide surveys of the literature, each progressively covering the most recent publications. As noted by Nikiforos & Zezza (2017), "accounting consistency is just one side of the SFC approach, with a demand-led economy and an explicit treatment of the financial side being the other." The first step, however is to describe the accounting consistency.

2.4.1 Stock-flow consistency

Stock-flow consistency describes a set of models that observe strict accounting rules. Nikiforos & Zezza (2017) delineated this further, specifying that such models should be consistent across three dimensions, flow, stock, and stock-flow. Flow consistency is further sub-divided into horizontal (inter-sector) and vertical (intra-sector) consistency. The names come from the spreadsheet-like transactions flow matrix (TFM), as illustrated in Table 2.2, reproduced from Godley & Lavoie (2012, p. 7) in Section 2.6.2. The flows can be somewhat confusing at first, but are designed to connect the financial and real components of the economy.

Horizontal consistency requires that any inflow (income) to one sector must be identically matched by an outflow (expense) from another sector. Wages, for example would be an outflow for firms, and an inflow for households. Vertical consistency reflects an internal consistency between the real and financial aspects of each sector. Financial flows are considered in a lower part of the table, and must net out the real flows that occur in the TFM. These are calculated at the end of each observation period (I.e. after any consumption or investment decisions). While it may seem counter intuitive, at the end of a period, any positive balance remaining after expenditures must be recorded as a negative flow out of the recipient sector. For example, if households choose to hold deposits at the end of a given period, any positive balance for households after real flows will be marked as a negative flow in the deposits row, as cash must flow out for HH to acquire deposits. The sector that provides the financial or fixed asset in exchange for these outflows (for example if the financial sector provides deposit securities) must record a positive flow (or inflow)[2.26].

Stock consistency is treated similarly, and applies to all financial stocks. All financial assets must always be reflected by equivalent counterpart liabilities. Physical assets, such as fixed property are permitted to accumulate without counter-balancing liabilities. Taken again from Godley & Lavoie (2012), Table 2.1 (in Section 2.6.1) represents a highly simplified balance sheet for a closed economy. Stock-flow consistency requires that all flows are fully accounted for in the accumulation of stocks. Capital gains are treated separately in a revaluations matrix, but are also fully reflected in stock values. Price adjustments can be driven by changes inside the model, but do not in themselves represent transactions and so are recorded separately.

Stock-flow consistency is thus a means of delimitation, or a restrictive covenant for model construction, rather than a specific model type or method. The restriction requires that the model is formulated with at least some attention paid to the macro-implications of a modelling choice. In many ways this limits the modeller from introducing behaviours that are not consistent with reality. Or, as Nikiforos & Zezza (2017) described this, it imposes constraints that reduce the degrees of freedom available to the builder.

2.4.2 SFC models of household debt

Household debt has been a feature of SFC models since the 2007-08 global financial crisis (GFC). Lavoie (2008) was one of the first models to introduce household debt, but this was initially limited to consumer credit.

[2.26] For example, if the household sector allocates 100 euros of all income to deposits, the "Deposits" line (or row) will contain (€-100) in the household column, and plus (€+100) in the banking sector column. This reflects the transfer of purchasing power to the banks in order to "purchase" deposit securities. The same would be true for any transfer to the financial sector for financial assets, or the non-financial corporate sector for equities. The purchase of equities from the NFC would result in a negative flow for HH and a positive flow for NFC.

The sub-prime mortgage crisis in the USA, and similar links to mortgage borrowing in other countries, spurred the introduction of household debt to models. Due to the mortgage borrowing context, it was commonly linked to the introduction of a more defined property market. There are very few SFC models of real estate property and mortgage markets available in the literature. The main works include, Zezza (2008), Fontana & Godin (2013), Khalil (2011), Effah (2012), Beckta (2015) and Nikolaidi (2015).

To investigate wealth distribution effects, Zezza (2008) built a theoretical model to which he introduced both mortgage debt for capitalist households and firm debt for the non-financial corporate sector.

Zezza (2008) is a central model in the literature related to mortgage debt accumulation, and utilised the PK theory of mark-up pricing by firms to set up a property market, where households purchase houses from firms. House prices can then be determined in a supply and demand framework, where excessive build up of inventories, or low demand for houses can result in a fall in prices for new houses. A key feature in the model was a differentiation in the propensities to consume our of wealth for the two classes of households presented.

As a means to evaluate the effects of financialisation (the recent prominence of financial markets), Treeck (2009) developed a synthetic model where households are split between workers and rentiers, where rentiers borrow, but the model is intended to discuss financialisation, and so did not focus on mortgage borrowing.

Some time later, Khalil (2011) presented three models as part of a PhD dissertation, the first introduced mortgage borrowing by households, where households are also purchase houses - based largely on the structure of Zezza (2008). The second model excluded household debt, but modelled the interactions of two economies. The third model re-introduced household debt in the multi-country setting, where he captured interbank debt, and the effects of a credit crunch. As noted by Beckta (2015), it is the first model to introduce rental income as an opportunity cost. Like Khalil (2011), the model in Article 5 below includes depreciation of houses.

Effah (2012) introduced non-performing loans in a single model with a variety of simulations (or experiments).

Beckta (2015) expanded on this feature, based also on the Zezza (2008) mark-up pricing of houses by the NFC sector, he introduced cyclicality to the level of the mark-up. Households accumulate mortgage debts, and use the mortgages to purchase houses that are produced by the NFC sector. A key feature introduced by Beckta was a large number of conditional behaviours (operators) in the behavioural equations for each sector. He, like Khalil (2011), modelled the returns on houses as the real (net of potential rental income) returns of investment in houses. He, like Effah (2012), also introduced non-performing loans, together with capital adequacy ratios in the commercial banking sector. Unlike the empirical model in Article 5 below, his model also allowed interest rates to adjust according to a modified Taylor rule. Nikolaidi (2015) has since constructed a detailed theoretical model that is able to incorporate the securitisation of household debt. An aspect of the model that is potentially very useful for further developments of the present work is the inclusion of credit rationing, where desired loans are not necessarily satisfied by the financial sector. This is the model with the most advanced financial sector in the literature, and provides a guide to the inclusion of debt securitisation for future work.

Although each of these models provide useful tools for the integration of real-estate and debt markets into the SFC framework, they do not link the mortgage lending system to the complete set of national accounts data, nor do they address conditions in the Danish economy. The labour required for developing such a model is a limiting factor of fully empirical macroeconomic SFC models, which is a key motivating factor for the current work. SFC models are also only produced by a narrow portion of economic modellers, and thus the number of empirical SFC models to focus on the Danish system are limited.

The housing market in the model in Article 5 is driven by house prices, and the relative shift in house prices and construction costs. A major innovation to housing markets was introduced by Byrialsen & Raza (2019), where investment in houses is undertaken by households as a sector. The relative attractiveness of houses as an investment opportunity then determine the household demand for debt. The supply of debt, however, is not presently restricted.

The present work extends the analysis of household debt by incorporating one of the many innovations made to mortgage products over the last decade. Article 5 provides a detailed discussion of these innovations, and identifies the introduction of flexible-interest mortgage products (or adjustable rate mortgages, ARMs) as a major change in the Danish mortgage system. This additional layer of detail in the nature of debt has not yet been covered in the SFC literature that includes household debt. It is also the first to do so in a fully empirical model.

The section below provides a brief introduction to the most prominent macroeconomic models used in Denmark, and rounds this section off with the recent development of SFC models by the MaMTEP[2.27] research group in Aalborg.

2.4.3 Existing Danish macro-economic models

There are several macroeconomic models operated by official bodies in Denmark, although each provides somewhat different insights, and most are not directly accessible. If they are accessible it is generally with a substantial fee. Stephensen, Ejarque, Høegh, Kronborg, & Bonde (2017) provide a brief summary of the core characteristics of DREAM and ADAM, the two most prominent models outside of the Danish central bank (Danmarks Nationalbank). The ADAM (Annual Danish Aggregate Model) model is operated by Statistics Denmark, and is a highly detailed and effective structural econometric model, which, as described by Stephensen et al. (2017, p. 2), "is a large model and produces data output that serves as a data-repository for projections of macroeconomic variables including detailed government incomes and expenditures." It contains over 2500 equations, and is fully consistent with the system of national accounts.

In addition to these models, the Danish Economic Council also maintains the SMEC (Simulation Model of the Economic Council) macroeconomic model, which is used to supplement the semi-annual report of the council. Bocian, Nielsen, & Smidt (1999) provide a description of the model. The council also employs a variety of other models, including some computable general equilibrium (CGE) models.

The Danish national bank model, Mona (from, "Model" and "Nationalbank"), is a quarterly model of the Danish economy (Nationalbank, 2003). As noted by Nationalbank (2003, p. 13), it is a business-cycle model, and is "a synthesis between the pure short-term model where prices are never changed and the pure long-term model where volumes always balance because prices clear the market." The model is ultimately a long-run equilibrium model, and is well suited to estimating variations in quarterly monetary demand.

[2.27] The Macroeconomic Methodology, Theory and Economic Policy research group, at Aalborg University in Denmark.

The Danish research institute, DREAM (which stands for Danish Rational Economic Agents Model) developed several models, including the dynamic CGE model, dubbed DREAM, the SMILE model (Simulation Model for Individual Life-cycle Evaluation) as described in Hansen, Stephensen, & Kristensen (2013), which is a micro-data based projection model, and a static CGE model called REFORM. Several member of this group are also involved in the most recent development of the MAKRO model. This model is intended to be a combination of micro-simulation features, which inform an overlapping generations (OLG) long run component, and the structural econometric features of the ADAM model (Stephensen et al., 2017). MAKRO is still under development, but a key component of it is intended to be the life-cycle spending and savings patterns of each annual cohort in Denmark. SMILE has recently been use, based on micro-data, to forecast morbidity in Denmark (Bjerregaard & Hansen, 2019). This is likely to contribute to the MAKRO project in the long run.

A more recent model form to emerge is the stock-flow consistent (SFC) group of models, which will be discussed in more detail below. There are essentially three SFC models that have been developed for Denmark. The first was developed by Godley & Zezza (1989), and was closely followed by a second by Godley & Zezza (1992). After this, the tradition died out in Denmark, until it was revived more recently by Byrialsen (2016) and M R Byrialsen & Raza (2018).

Byrialsen (2016) was used to analyse household debt in Denmark, and was adaptation of the model presented in Chapter 12 of Godley & Lavoie (2012), which was rebuilt as a growth model for the Danish economy. It was also used to illustrate developments in key indicators in the Danish economy to discuss alternative scenarios with regards consumption parameters, as well as the potential impacts of austerity measures. M R Byrialsen & Raza (2018) later reconstructed the model in order to investigate the effects of changes in unemployment benefits for the Danish economy. In particular it illustrated the sensitivity of macroeconomic models of labour markets to changes in the participation rate.

Mikael Randrup Byrialsen and Hamid Raza, over a period of three years, then developed a fully empirical model of the Danish economy. The present author, together with Jesper Eriksen, prepared the code to source and organise much of the data used in the model, but only participated as an observer to the initial stages of the construction of the model. The latest published version of the model is Byrialsen & Raza (2019), and the model presented in Article 5 is based primarily on this model, although with a number of minor alterations, as explained in the appendix of Article 5, Section 7.10.

The choice to use and further develop a Post Keynesian SFC model is based on both practical and theoretical reasons. As mentioned above, the Post Keynesian paradigm was chosen partly due to the descriptive accuracy of the money creation process. This is, however, only part of the motivation. A greater motivation is the pragmatic approach to the development of knowledge in the paradigm. The section below provides some of the meta-methodological reasoning behind this belief.

2.5 Methodological approaches

This section briefly explores, in relation to PK and CMN schools of thought, the hierarchy of philosophy (paradigm), methodology, theory and method. PK theory of the money creation process has, as noted above, been shown to be more realistic than the CMN money-multiplier approach, and is therefore chosen as the framework for this thesis. To understand some of the implications of this choice, it is necessary to briefly explore the foundations of both the PK and the mainstream perspectives. This requires a short description of the methodological foundations of each.

The underlying philosophical grounding for the so called “mainstream” views on money and monetary management were explored by Dow (1985), Chick & Dow (2001) and Chick & Dow (2002). Chick (2003) also summarised a comparative, critical analysis of the methodological and philosophical foundations of New Neoclassical Synthesis (NNS) and Keynesian and PK schools of thought. In brief, the outcome was that the economy and social relations cannot be accounted for by atomistic theories of science, which the CMN are due to decomposition of the economy into atomic components - commonly described as being “micro-founded”. These foundational differences are discussed further below.

Dow (2001, p. 12) defined a paradigm as a “disciplinary matrix based on a particular world view and communicated by exemplars”, and where one’s perspective “determines the core beliefs about the nature of the subject matter and the questions asked, whereas the disciplinary matrix provides the theoretical and empirical tools used to answer these questions.” She (Dow, 1999, p. 21) also noted that there was a descending hierarchy of meta-methodology, these were philosophy, then methodology, and finally method. This tiered structure is the basis for the determination of reliability and validity of results in research. Once the over-arching structures are accepted, a theory can be constructed on the basis of the results of a method that is considered valid and reliable. This validity and reliability, she explained, are driven by mathematical formalism in the CMN schools.

The PK paradigm, she explained, is part of the *Babylonian mode of thinking*. This approach argues that in order to understand a problem in its entirety, one must approach it from multiple perspectives. A plurality of methods and methodologies are therefore recommended in order to get a more nuanced understanding of the problem at hand. Dow (1999, p. 22) identified that Lawson (1997) and Fleetwood (1999) had presented similar philosophical foundations under the name *critical realism*. The overlap was not considered problematic, as she (Dow, 1999, p. 22) explained that they both “emphasize the organic complexity of human agency and social reality, which prevents the identification of causal laws; rather, the emphasis is on studying the various causal forces at work in the system, and their evolution, in order to build up knowledge that is as reliable as possible, with a view to action.” To PKs and to critical realists, she argued, the aim should not be to provide axioms or universal truths, but to try to understand the immediate reality of the economy.

This perspective, Dow (1999) contrasted with the the CMN schools. She described the orthodox methodology as following the Cartesian/Euclidean mode of thought, and that it relied on deductive logic, applied “to a single set of axioms in order to arrive at universally applicable conclusions”. This critique was directed mostly at the New Neo-Classical Synthesis (NNS), and New-Keynesianism, whom she and Chick (2003) considered to place too much emphasis on long-term historical means, which form the basis for general equilibrium theory. Chick (2003, p. 321) summarised the differences succinctly in Figures 2.6 and 2.7 (Chick, 2003, p. 311) below.

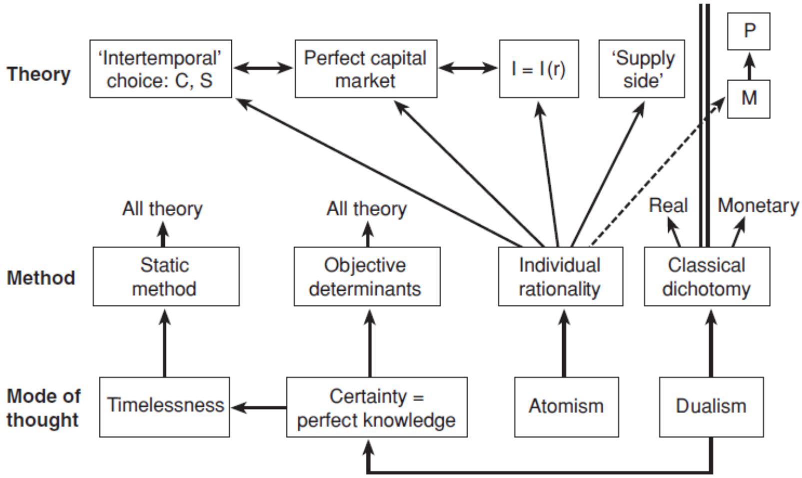

Figure 2.6: Mode of thinking: Cartesian/Euclidean (Chick, 2003, p. 321)

Figure 2.6 above illustrates the orthodox link between methodology and theory, where the economy is considered to be summative (or atomic), and the real and financial side considered separately. Leading up to the global financial crisis, many prominent institutions placed a lot of emphasis on various forms of dynamic static general equilibrium (DSGE) models.These are typically long-run models and involve a substantial amount of intertemporal smoothing. This smoothing is driven by optimisation behaviours that typically link to a long run target or rate, which PKs reject pre-emptively. Another key criticism of the DSGE approach was the neglect of the financial side of the economy. This is reflected in the schematic above, with monetary factors (to the right), considered separately from real (the classical dichotomy). Money and debt therefore do not play a major role.

Time is also considered quite differently in these depictions of the two paradigms. The orthodox framework above is a long-run system, and under the long run equilibrium condition, the neutrality of money implies that money (M) is considered only as a source of changes in prices (P). Individual rationality is the source of intertemporal optimisation, information is assumed to be perfect and thus, capital accumulation is efficient. In the long run it is only the core elements of the system that are preserved, and which guide the system, and thus, time or the sequence of time are of no significance.

Dow (2007) noted clearly that more recent developments in orthodox circles of economics have addressed the complications of reality, but that this has resulted in greater variety, or ‘pluralism’, of theory rather than of methodology. The second figure below, Figure 2.7 shows what Chick (2003, p. 311) calls organicism. This approach rejects the idea of any long run predictability or equilibrium, and replaces it with path dependency. Atomism is replaced by the theory that the sum of the many interactions between the underlying elements of the economy (the “organic” sum), is greater than the sum of its parts. Perfect information is rejected as an impossibility, and uncertainty regarded as the general case for all decision-making. Especially in the generation of expectations.

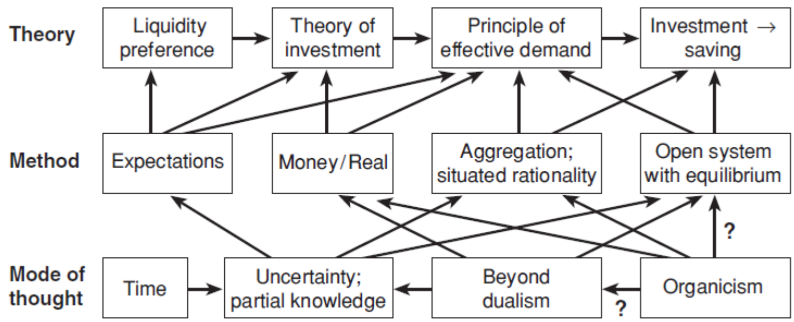

Figure 2.7: Mode of thinking: Babylonian (Chick, 2003, p. 311)

Those expectations drive all elements of aggregate demand, although each agent’s expectations are determined by their subjective perceptions of limited information. The theory of investment therefore relies on behaviour that is not rational in an objective or perfect-information sense. Since the all economic agents act under the general case of uncertainty, the is not knowable, and the future structure of the economy is equally obscured. Path dependency together with this uncertainty implies that the future is not pre-determined, stated otherwise, it is not a deterministic outcome. This proposition requires that the sequence of events in time should be taken seriously.

The model presented in Article 5 below is constructed accordingly. Participants do not have access to future information, and make decisions in the consecutive periods based on the most recent information available. In addition, the accumulation of stocks of assets or debts over time can result in significant structural changes to the economy - particularly with regards property income flows. The model is essentially constructed to be path dependent, and does not rely on any optimisation or mean reversion. All behaviours are estimated based on previous behaviours, but these are only used to inform possible events in the short term - as there are likely to be unforeseeable events in the long term that change the structure of the economy.

Dow (2010), in opposition to the use of purely mathematical, or historical statistical tools, argued that if "the system's internal structure is evolving in a non-deterministic manner, and the influences to which it is subject in the future are not known (or all knowable) in advance, then the scope for using frequency distributions to quantify a probabilistic or stochastic expectation is lacking. Keynes believed that this was particularly the case with social systems." Moore (1991, p. 128) further argued against the presumption of some form of long run mean reversion or equilibrium, that "in the real world there is no unique general equilibrium position toward which the economy is tending. Moreover, for a credit money (monetary production) economy, it is not analytically valid or heuristically useful to postulate one."

Since the sequence of events is considered important, so is the finance that is a pre-requisite for investment. Money, and access to money, are considered crucial in this framework. The creation of money is an important part of this process, and is described in greater detail below. Ultimately, however, in monetary terms, it is not possible for monetary savings to pre-date the creation of that money. Neither is it possible to have excess capital or resources prior to investment.

Logic therefore requires that demand for money pre-dates money creation, which subsequently pre-dates investment, then production, then revenues, then savings. It may be possible to re-invest out of retained earnings, but the causal flow cannot be initiated by savings. In short, investment leads to savings, and not the reverse. These features are again captured in the model in Article 5, where savings and net lending positions are passive to the ongoing activities of each sector. The model is also demand driven, in the sense that it is the demand for investment that determines the level of economic activity, and this in turn determines the level of wages and incomes in all sectors. The extent to which this results in positive or negative savings for each of the individual sectors is not clear in advance, since the ultimate level of savings depends on the actions taken by all sectors.

The model does not tend to any general equilibrium in the short or long term. Money and the creation of money are not neutral, since economic growth depends on an increase in demand, which is indirectly dependent on the demand by the private sector to invest. This in turn requires borrowing (that is, money creation) in order to be realised. Money is therefore a significant determinant of the future path of the economy. Further details on the behaviours of each of the sectors can be found in the appendix of Article 5, Section 7.10.

A final section to the literature review is provided below, and provides a basic introduction to the structure and components of SFC models.

2.6 A short introduction to SFC models

This final section of the literature review is intended to provide the reader with a concise introduction to SFC models. If the reader is familiar with SFC models, and the contents of Godley & Lavoie (2012), they can comfortably skip this section and continue to Article 1.

An SFC model is a simultaneous equation type model, based on national accounting balance sheets that solves over multiple iterations (ordinarily over 500). SFC models are typically aggregate macroeconomic models of an economy, and as the name suggests, they include the flows and stocks of that economy. In each period the interactions of the sectors generate flows back and forth between them. The net accumulation of the activity of the participants of each sector are calculated by offsetting the flows in each period. Net positive positions in each period are reflected in an accumulation of financial assets. Net negative positions in the accumulation of financial liabilities.

The model simultaneously accumulates and adjusts stock variables, which affect (through property incomes, such as rents or interest), and are affected by, the interaction between the institutional sectors. The following is a brief outline based on Godley & Lavoie (2012). Because of the accounting background of SFC models, it is convenient to represent the underlying components as matrices.

In construction of a model, the universe of possible assets and liabilities is one of the first decisions to be made. The number of sectors must be decided simultaneously, and the distribution of the assets can then be made between them. This distribution is illustrated in the generic balance sheet matrix (BSM), Table 2.1, below. Thereafter, the flows that will be modelled in the economy are identified. These include all flows of money between the broader sectors, and are typically modelled according to theoretical guidelines of the initiation of productive activity in the economy, a generic example of a matrix representation is in the transactions flow matrix (TFM), Table 2.2, below. The final matrix that must be constructed is the glue that binds the balance sheets to the flows. It is the representation of the expected allocation of financial wealth at the end of any given period - this also includes any capital gains or income earned on financial products. This matrix is represented in Table 2.3 below, and is called a full integration matrix.

These tables represent the core structures in the economy, but the behaviours and interactions between the sectors must be defined separately. The matrix representation provides a guide to how the accounting identities of the system should be constructed in order to ensure that all flows can be accounted for, just as they would be in reality.

2.6.1 Balance sheet matrix

The first matrix is set up for the balance sheets of sectors that will be included and essentially determines the level of aggregation for the economy, as well as the stock variables that will be featured in the model.

Table 2.1: Balance sheet matrix: BSM

Stocks	Households	Firms	Banks	Government	Σ
Financial stocks					
Loans		$-L$	$+L$		0
Cash	$+H_h$		$+H_b$	$-H$	0
Deposits	$-\Delta M$		$-M$		0
Bills	$+B_h$			$-B_h$	0
Equities	$+e \cdot p_e$	$-e_f \cdot p_e$	$-e_b \cdot p_e$		0
Tangible stocks					
Tangible capital	$+K_h$	$+K_f$			$+K$
Sum (net worth)	NW_h	NW_f	NW_b	NW_g	K

The example in Table 2.1 above, from Godley & Lavoie (2012, p. xx), includes five financial assets and a generic sum of all tangible capital. Where a stock is typically held as an asset it is preceded by a plus (+) sign, and liabilities by a minus (−). This is a very basic example of a closed economy balance sheet across four domestic sectors. As can be seen from the sum (Σ) column and sum (Σ) rows, horizontal consistency is maintained. The only component that does not net to zero in the final sums is tangible capital (K). If tangible capital was excluded from the assets of all sectors, the sum of all sectors' financial net wealth would necessarily be zero, as the creation of any financial asset is offset via accounting records by an entry into balance sheet of the counterpart owner. Every asset is thus a liability of someone else, and vice versa.

2.6.2 Transactions flow matrix (TFM)

The transactions flow matrix, as illustrated above in Table 2.2, then determines the flows between each sector in each period. A revaluation matrix is then constructed to adjust all assets and liabilities for capital gains or losses in each period - this will alter the nominal level of stocks of the applicable securities or assets for start of the next period. As is the case in reality, all transactions require quadruple entry accounting consistency in order to avoid any leakage in the model. Behavioural equations then define the manner in which flows and capital gains affect stocks, and the manner in which stock variables in turn affect flows.

Table 2.2: Transactions flow matrix: TFM

		Firms				
Flows	Households	Current	Capital	Banks	Government	Σ
Real flows						
Consumption	$-C$	$+C$				0
Investment		$+I$	$-I$			0
Govt Expenditures		$+G$			$-G$	0
Wages	$+WB$	$-WB$				0
Profits	$+FD_f$	$-F_f$	$+FU_f$			0
Taxes and transfers	$-T$				$+T$	0
Financial flows						
Change in loans			$+\Delta L_f$	$-\Delta L$		0
Change in cash	$-\Delta H_h$			$-\Delta H_b$	$+\Delta H$	0
Change in deposits	$-\Delta M$			$+\Delta M$		0
Change in bills	$-\Delta B_h$			$-\Delta B_b$	$+\Delta B$	0
Change in equities	$-\Delta e \cdot p_e$		$+\Delta e \cdot p_e$			0
Σ	0	0	0	0	0	

As mentioned above, these flows can be confusing to begin with. Here, a plus sign preceding an entry in the table indicates that funds flow into the sector, and a minus that funds flow out of the sector.

The confusion arises in the financial flows part of the table. This part of the table explains how each sector either funds its shortfall, or allocates its excess funds. Funds are considered in a rather abstract manner here in order to accurately portray the budget constraint of each sector in each period. For example, once the household sector has received all incomes (in this case WB and FD_f) and paid all expenses and taxes (in this case C and T), it is likely to have a residual. This residual must then be allocated amongst a variety of options.

The abstraction is that the remaining "funds" must flow out of the household sector as a result of some kind of asset allocation decision. If the household wishes to hold some of those "funds" in the form of bank deposits then this is recorded as a negative flow of funds ($-M$) for households and a positive flow ($+M$) for banks. In exchange, banks issue a liability against themselves (deposits) and receive the funds. Although in reality receipt of wages is likely to have been in the form of an electronic transfer into a bank account, and deposits would simply be a residual bank balance after any spending or alternative asset allocations.

The same abstraction applies to changes in all financial and physical assets. As a result, all flows are accounted for a the end of each period, and after all asset allocations, all sectors respect the strict budget constraint.

2.6.3 Transactions and revaluations matrix

As noted by Godley & Lavoie (2012, p. 44), the full integration of both changes from both transactions and revaluations can and possibly should be completed in a single table with the effects on net wealth recorded in a more complete fashion. As illustrated below in Table 2.3.

Table 2.3 above begins in the first row with the wealth of each sector from the previous period (NW). The signs on each of the entries which follow refer to changes in the nominal value of the assets to which each apply. For example, the change in loans (ΔL) us added to banks, this means that an increase in the number of loans in the economy will add to the level of loan assets held by banks. It will also add to the loan liabilities held by households or firms (represented by $-\Delta L$ for each). An increase in assets is thus reflected as plus

Table 2.3: Full integration matrix: Including revaluations

Effect on Assets (+) and Liabilities (-)	Households	Firms	Banks	Government	Central Bank	Σ
Changes arising from transactions						
Net worth, end of previous period	NW_{h-1}	NW_{f-1}	NW_{b-1}	NW_{g-1}	0	K
Change in loans	$-\Delta L_h$	$-\Delta L_f$	$+\Delta L$			0
Change in cash	$+\Delta H_h$		$+\Delta H_b$		$-\Delta H$	0
Change in deposits	$+\Delta M$		$-\Delta M$			0
Change in bills	$+\Delta B_h$		$+\Delta B_b$	$-\Delta B$	$+\Delta B_{cb}$	0
Change in equities	$+\Delta e_f \cdot p_{ef} + \Delta e_b \cdot p_{eb}$	$-\Delta e_f \cdot p_{ef}$	$-\Delta e_b \cdot p_{eb}$			0
Change in tangible capital	$+\Delta k_h \cdot p_k$	$+\Delta k_f \cdot p_k$				$+\Delta k \cdot p_k$
Changes arising from revaluations						
Capital gains in equities	$+\Delta p_{ef} \cdot e_{f-1} + \Delta p_{eb} \cdot e_{b-1}$	$-\Delta p_{ef} \cdot e_{f-1}$	$-\Delta p_{eb} \cdot e_{b-1}$			0
Capital gains in tangible capital	$+\Delta p_k \cdot k_{h-1}$	$+\Delta p_k \cdot k_{f-1}$				$+\Delta p_k \cdot (k_{h-1} + k_{f-1})$
Sum (net worth)	NW_h	NW_f	NW_b	NW_g		K

(+), and an increase in liabilities by a minus ($-$). The central bank is assumed to issue physical cash (or high powered money, H) as a liability, which is held by households and banks. Deposits (M) are issued by banks, and government is assumed to issue bills (B). The nominal value of new equities that are acquired by transactions are recorded as a change in equities, and here calculated by the change in quantity in prices (Δe), multiplied by the current price of equities (p_e). In the example above, both banks and firms are permitted to issue equities. Tangible capital, like equities, has a price(p_k) and a real quantity (k) component.

Since both equities and capital are subject to revaluation on the basis of price changes, it is important that we can account for capital gains in the model. This is captured in the lower portion of the table under *Changes arising from revaluations.*

In the case of equities, the total value of assets (or liabilities for the sector that holds other end of the security) is determined by the total volume of the stock held at the end of the previous period (e_{-1}) is multiplied by the change in prices (Δp_e). This provides an adjustment to the current level of assets and liabilities outstanding. The same is true for tangible capital in the example above, where Δp_k is multiplied by k_{-1} to calculate the capital adjustment.

The final line of the table reflects the sector level net wealth at the end of the period, after taking all transactions and revaluations into account.

2.6.4 Model construction

Pedagogical models can be constructed with as few as ten equations, and can be solved mathematically for descriptive purposes. Models that are more realistic require greater complexity, ranging from around 60 equations for relatively simple models to over 150 equations for models with multiple sectors or sub-sectors. Such models cannot be solved analytically due to the complexity of the network of simultaneous equations. Theoretical models can typically be solved through simulation and calibration, while empirical models typically include an element of estimation to a greater or lesser degree. The interactions between agents (or sectors) within the models depends on the specification of behavioural equations and thus parameters by which variables in the model interact.

Resolution of the model requires completeness, or as Godley & Lavoie (2012) call it, an adding up constraint. As they note, this ensures that even in the simplest formulation of the model "everything comes from somewhere and everything goes somewhere." The model thus requires a theoretical understanding of real world relationships at a functional level, on top of which data is fitted in an attempt to replicate the current state of the economy.

With regards the design of the model, the level of realism must be balanced with the usability of the results of the modelling process. Complex construction obscures interpretation, and the more components, and thus behavioural equations, that are included in the model, the more difficult it is to identify clear lines of causality.

3 Article 1: Money at first principles: A social value theory of money

Introductory remarks

This article addresses the first research objective and is a theoretical investigation of how money creation is linked to debt. This is necessary as a base concept, as there is a direct connection between the creation of debt and the expansion of assets and liabilities and financial balance sheets. As noted in the introduction, the article explores the moral and ethical implications of a redefinition of money creation as an endogenous extension of credit. It further questions the current role of money in our understanding of economic growth and development. This is the first step in understanding the interconnections between sector level balance sheets.

Money at first principles: A social value theory of money

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Abstract

The term 'money' is inadequate for a deep discussion of the fundamental nature of economic interactions. As a concept, money has been explored at length and yet there exists little consensus on the origins and fundamental nature of money. As a result, money is often presented non-specifically. This obfuscates the process of money creation, and therefore the accountability that should be associated with that process. It is proposed here that the concept should be decomposed into core components – these are, the monetary unit, monetary token, social value and the monetary space. These base concepts are then used to argue that the demand for debt of all sectors plays an important role in the flow of funds, and in the relative balance sheet positions of all sectors. It is further argued that government should play an active role in debt accumulation, and so opens the discussion on sector interdependence.[3.1]

3.1 Introduction

The question of what money is and where it comes has once again captured the interest of economists. Following the crisis of 2007-09, two prominent central banks, the Bank of England (McLeay et al., 2014) and the Bundesbank (Deutsche Bundesbank, 2017), have provided explanation of the lending driven, endogenous nature of the money creation process[3.2], calling into question the popular textbook definition of money creation through the money multiplier process. In addition, the recent growth in prominence of electronic crypto currencies, such as bitcoin and Etherium, has motivated many to question if they are in fact money (Baek & Elbeck, 2015; Bjerg, 2016), or more generally, what money is. The modern textbook definition of money (Acemoglu et al., 2015, p. 621; Blanchard et al., 2013, p. 67; Frank et al., 2007, p. 648; Mishkin & Eakins, 2016, pp. G-11) has not much changed in recent decades, and can typically be summarised into functional definitions (means of payment, store of value, unit of account), instrumental classifications (typically in the scope of monetary policy), and is almost always related to the tale of commodity medium

[3.1] This article benefited from comments from several colleagues and I would like to express my gratitude especially to Finn Olesen, Mogens Ove Madsen and Mikael Randrup Byrialsen. All errors remain entirely my own.

[3.2] The theoretical and empirical grounds for the assertions of the central banks was well documented by authors from the Post Keynesian (Chick, 1978; Lavoie, 2006; Moore, 1988), and the monetary circuit (Bossone, 2001; Graziani, 2003; Lavoie, 1992; Le Bourva, 1959) schools of thought.

of exchange evolution. The new forms of money, or private moneys, that have recently emerged are then typically discussed within the same discourse - a discourse which has obscured a large portion of accountability that should be attached to money, and the creation of money. It also obscures important interconnections between economic agents, and the sectors to which they belong.

The observable economic system is recorded through the practice of accounting, and all transactions are conducted according to money-based prices. Money and the monetary system are thus inseparable from the analysis of the economy. As noted by Christensen, Hansen, & Lilkær (1997), money is central to the functioning of a modern economy, as wages are paid in the form of money, sale of goods is in the form of money and profits are realized in the form of money. Value, and relative value, in the past, the present and the future, is almost always denominated in a money of some kind, as noted by Chick (1978) relative monetary prices (even in modern barter transactions) depend on the money prices of other resources. The money, or the value of money, provides a reference point for decision making to all economic agents[3.3]. Economic agents are thus bound to both money and monetary pricing as an integral aspect of thinking and planning. Questions regarding the nature of money are therefore fundamental to the study of economics, where the vast majority of data is denominated in one or another money (unit of currency, or price based on a unit of currency).

The failing, however is not in the appreciation of the uses or benefits of money, but in the taxonomy used to discuss monetary matters. The term ‘money’ is inadequate for a deep discussion of the fundamental nature of economic interactions. As a concept, money has been explored at length and yet there exists little consensus on the origins and fundamental nature of money. As a result, money is often presented non-specifically. This obfuscates the process of money creation, and therefore the accountability that should be associated with that process. It is proposed here that the concept should be decomposed into core components – these are, the monetary unit, monetary token, social value and the monetary space. These core components are entirely separable in theory, but in practice are necessarily interdependent. Critically important is that no single component alone can be called money, although functional

[3.3] As she (Chick, 1978, p. 46) explained, “In the determination of reserve price, the seller’s imputation of the value of his goods in *other* potential exchange situations than the one he is presently facing is an important factor, along with the articles’ use-value to himself.”

definitions of 'money' often discuss these as characteristics, and use the term 'money' to describe each separate component interchangeably. As noted by Chick (1978), depending on the application or question asked, the functional and instrumental definitions of money vary dramatically. The identification of the core nature, or origin of money has proven equally tricky, and theories of money have been discussed by economists for time immemorial in the absence of consensus. It is proposed here that the fundamental nature of the monetary token was identified and well described by Innes (1913) as the credit theory of money in 1913, but that this was only one component, and a satisfactory theory of the origins of money has only been developed more recently. The argument here is not that the components to be presented are new, but more that they are not adequately considered in the modern definition of money.

In connection with responsibility and direction of this validation in society is a powerful narrative of the efficiency of market mechanisms. Unfortunately, market failures are not uncommon, and two of the major market failures highlighted by Jaffe, Newell, & Stavins (2005) is the limitation of environmental pollution and the innovation and diffusion of technologies that could help to solve the problem. Some would argue that these market failures are the primary responsibility of public bodies and governments. The implication here is that money, and money creation are and should essential components of any discussion public finance and the provision of public goods. This is not presently the case, as noted by Rosen (2002), "the fundamental issues are not financial (that is, relating to money). Rather, the key problems relate to the use of real resources."

The most broadly accepted and distributed history of money is arguably that of Adam Smith, and later Paul Samuelson, as the evolution of commodity based money from truck and barter, on the basis of improved efficiency (reduction of transactions costs) and appropriateness for trade. Contrary to this, authors such as Ingham (1996, 2000, 2004), Wray (Goodhart, 1998; Tymoigne & Wray, 2013; Wray, 2004, 2015) and Bell (Bell, 1998, 2001; Fullwiler, Bell, & Wray, 2012) have argued that the simplicity of such an evolutionary view lacks credibility from a historical perspective. They present an alternative modern money theory of the origin that encompasses sociological preconditions, social relations and tangible manifestations of different forms of 'money', monetary systems, and hierarchical structures of monetary tokens. Their theory and findings suggest that institutions and social dynamics have been both necessary and instrumental in the development of the money-based economic systems to be found in most countries today, and consequently, that money could not have evolved independently as a simple lubricant for markets. As many readers will point out, the authors of "Modern Money Theory" have been heavily associated with the chartalist views of Knapp (1924), and the recent emergence of bitcoin and other cryptocurrencies and cyber currencies appear to contradict the theory, but this is largely due to a misreading of the MMT[3.4], and the inadequacy of the modern definition of money to account for the monetary space. As will be seen below, tracing the origins of 'money', as they have done, is very useful when attempting to identify the core components of the concept.

More to the point of this article, proposed here is a social value theory of money, where money is deconstructed into its fundamental components - the most important of which is the concept of social value. Using the terminology to be described shortly, the monetary unit is argued to have logically preceded the monetary token (or credit), and both require a monetary space within which they are made valid. The token represents a credit between participants within the monetary space, typically created against a debt to a third-party banking (or bank-like) institution. Social value is then validated through the use of monetary tokens in transactions (purchase and sale). All modern economic activity, as recorded through the practice of accounting, is thus dependent on the ongoing creation debts and credits, where the credits are then used for this purchase/sale based validation of value.

The primary aim here is to clarify the institutional nature of the monetary unit and the credit-based nature of the monetary token, and to emphasise the importance of acknowledging that the future is, as Keynes described, fundamentally uncertain, and thus non-deterministic (or, in Davidson (2003)'s taxonomy, non-ergodic). The credit based monetary system permits those with access to credit creation facilities to direct the generation of and maintenance of social value in society, and in so doing, to determine what aspects of society will be validated through exchange for monetary tokens. What this means is that those who are empowered to create money with debt are both responsible and

[3.4]In a response to critics Tymoigne & Wray (2013) explained that several of the major critiques have missed the pedagogical purpose of presenting the benefits of a sovereign currency and focused heavily on inflationary implication of policy application and technical details regarding modern institutional arrangements. Or as they wrote, "The critique of lack of descriptiveness misses the point." (Tymoigne & Wray, 2013, p. 13) accountable for doing so – for better or for worse. This makes credit markets fundamentally political in nature, and the decisions to regulate or not regulate, or how heavily to regulate credit markets are therefore political. Either actively through regulation or passively by omission. To fully explain these assertions, the core components of 'money' are presented in the next section. That is, socially contextual value (or social value), the monetary unit and the monetary token or credit, and the monetary space.

3.1.1 The structure of the remainder of this paper

The remainder of the paper includes a more detailed description of the core components of money in Section 3.2. This is followed by a brief explanation of the credit theory of money with some reference to the origins of money in Section 3.3. Section 3.3.1 explains the creation of monetary tokens within modern banking systems, provides additional historical and logical context and touches on some social-structural limitations in the development of monetary systems. Section 3.4 is a discussion of some implications of this alternative interpretation of money and Section 3.5 concludes.

3.2 Definitions of society, the monetary unit, monetary token, the monetary space and social value

First is the monetary unit[3.5], this is an intangible, abstract divisor (or *numeraire*). Similar to the principle presented by Orrell (2016), it allows us to understand abstract, intangible, subjective, socially contextual and immeasurable underlying 'value' in terms of specific numbers. Similar also, as noted by Innes (1914), to any unit of measurement such as metres for length or kilograms for weight, the monetary unit is simply a numerical denominator for value. It is what Orrell refers to as a quantum, and reflects an attempt to quantify and relativise value. As such, it is the source of relative pricing. Like any unit of measurement, it is most useful when perfectly stable. Importantly, there is no finite number of units of measurement. There is no fixed quantity of meters or grams; there may be a limited quantity of the medium ('value') that is to be measured, but

[3.5] A concept that Ingham (2004, p. 176), and as he noted, several other authors, including Keynes (1930), Enaudi (1936) and Bloch (1954), referred to as the "money of account". The shift in nomenclature here is in order to avoid the use of the term money. Wray (2001, pp. 7–9) argued, along similar lines to Keynes, that this is a concept to which a name is given, or a "title" in Keynes' words. This title can then be represented at par or at a variety of exchange rates by any token that is seen fit to serve the purpose.

the unit of measurement itself is essentially infinite. Also, as in the quantity theory of money, a certain quantity of value can be divided into any number of individual parts, the choice of which depends largely on simplicity of calculation and usage[3.6]. Monetary units are also perfectly homogeneous, in that each unit is exactly equal to any other unit and represents one monetary unit of value. The monetary unit is the equivalent of what other authors Keynes (1930) have described as money of account. Ingham (1996) noted Keynes (1930) in emphasising, "Money of Account, namely that which Debts and Prices and General Purchasing Power are expressed is the primary concept of Theory of Money."

The monetary token or credit[3.7], this is a countable item, which could be tangible (such as a coin or a note) or intangible (such as a deposit record, or an accounting record). These are items that are created in finite quantities, and can be held physically or on record. A monetary token may or may not be generally accepted, but for the purposes of a discussion of the modern capitalist banking system, it is important to note that each token, like each monetary unit, is perfectly homogeneous. Each token is also a non-specific transferable record of credit against the resources of society. They may be created by any private or public agent, provided that they are recognised and accepted as valid records of credit. In the creation of these credits there is a simultaneous creation of an equivalent debt. As noted by Rochon & Rossi (2013), they are essentially elements of a system of social memory for credits, against which, at some point, a debt was incurred[3.8].

While the monetary unit and monetary token are separable at a conceptual level, they are now in practice exceedingly integrated. In modern systems, one monetary token is typically equivalent to one monetary unit of value, although,

[3.6] It is pragmatic to choose a size that makes daily usage simple for transacting. The metric system has been adopted by most modern systems, with single digits applicable to the purchase of commonly purchased low value items. $1 divided into 100c with the cost of a loaf of bread in America currently just under $1. A notable exception was the British Pound, which previously divided into 20 shillings and 240 pence; it has subsequently been decimalised and since 1971 divides into 100 pence.

[3.7] In Chick (1978, p. 46) this is called a "money asset", Ingham (2004) used the term "means of payment", and Wray (2001, p. 8) referred to "money things".

[3.8] The emphasis here is that the token is a credit, and that the credit is *not* the same thing as the debt. The credit, if accepted provides access to resources, but the debt can be either explicit or implicit. This is because, in a given monetary space, all participants are willing to accept the token in exchange for assets, goods, services or settlement of debt. They are therefore part of the collective that will provide resources in exchange for the credits, implicitly settling the debt that the collective held as contra to the credit of the token holder.

as demonstrated by Innes (1913, p. 393), this has not always been the case[3.9].

The unit of measurement must be associated with a medium, and the token is created in order to represent a portion of that medium. To this end, a combination of Innes (1913, 1914), Ingham (1996, 2004), Wray (2001) and Rochon & Rossi (2013), may provide a transparent and historically accurate answer. The medium to which the monetary unit applies is an abstract quantum of value, which will be called social value. Social value is dependent on, to use Ingham (1996)'s terminology, social structural conditions. This is because the value of a good or service depends on the needs of the agent assessing the benefits of having the good or receiving the service, and is thus entirely subjective, and dependent on the environmental context in which it exists.

The monetary space is defined here as the collection of economic agents that recognise the monetary unit as a means of assessing value (i.e. relative pricing) and are willing (and able) to accept a monetary token in exchange for goods or services. This space may be defined by physical borders, social class, legislative limitations, direct institutional or interpersonal relations, or any other social construction. In most countries today, the monetary space, for generally accepted monetary tokens, is most broadly defined by the state border – as noted by Ingham (2004, p. 200) this was not the case 15$^{\text{th}}$ and 16$^{\text{th}}$ century Europe. What is most important is that within the monetary space, the credits that are created in favour of a borrower are accepted and trusted. society then comprises all those agents that live or participate in the ongoing activities of the monetary space. Included in the definition of society here are social constructs, institutions and infrastructure.

A monetary token is created to record a non-specific credit for a particular level of value that is acquired initially by the acknowledgement of a debt. Later (due to homogeneity), those tokens can be acquired by any member of society in exchange for the supply of an asset, a good or service of value. Over time these tokens have acquired a range of attributes, including transferability, homogeneity, general acceptance, divisibility, geographic boundaries and importantly,

[3.9] Commerce and trade continued unabated, both at a retail and in large scale for centuries in the absence of any money or monetary unit. In successive centuries, Innes (1913, p. 394) provided a number of examples to demonstrate the maintenance of commerce with a various combinations of credit recording systems and credit trading systems, as well as examples for most of the major European financial centres of the use of monetary tokens where prices in terms of the monetary unit and monetary token were not aligned.

denomination in a particular monetary unit. This means that the monetary token is indirectly subject to the same contextual dependency as the monetary unit and the concept of social value. If tokens are created for the purpose of purchase, the buyer does not provide alternative goods in exchange – as this would effectively be barter and there would be no need for tokens and thus no record of any outstanding debt. The point made here is that credits represented by monetary tokens are utilised to acquire something of value from society, and that their existence logically requires the existence of a debt[3.10].

The global society has become so acclimatised to the existence of monetary tokens, that it almost exclusively demands settlement of payment in them. Those with monetary tokens are in a position of surplus credits. Those who would like to sell goods or services in exchange for monetary tokens are in a position of resource surplus, but would first have to find a willing buyer in order to gain monetary credits (tokens) against society – one might say that they are implicitly dependent on those with surplus credits as a result of their willingness (and desire) to accept credits in payment for their goods and services. In terms of GDP, the value of a produced good or service is only validated for recording purposes upon sale in exchange for monetary tokens. Commerce is thus dependent on the source of creation, as well as the flow of tokens after the point of creation.

The monetary token is also a credit that will only be exchanged for valuable resources at some point in the immediate or extended future. The quantum of social value represented by a monetary token is therefore highly dependent on

[3.10] Again, bitcoins present a useful analogy. The scope of goods available for purchase using bitcoins depends on the scope of the society that are willing to accept them, and the value represented by a bitcoin token (the monetary unit) is subject to enormous volatility. Alternatively, bitcoins must be exchanged for an alternative monetary token that exists in another monetary space, for example bank deposits (the monetary token) denominated in Danish Krone (the monetary unit). Danish Krone bank deposits all clear through the Danish Banking system and are a good example of a relatively limited monetary space. The value of the monetary unit is pegged to the Euro, and maintained by the activities of Danmarks Nationalbank, which include the rapid creation and absorption of large quantities of tokens in order to iron out volatility in demand from the foreign sector, or for liquidity in the domestic sector. This makes it very a useful unit for forward looking decision making and planning. There are several features of each token that make them attractive or unattractive for different reasons. Bitcoins, for example, transcend national borders, avoid tax systems, are largely immune to counterfeiting and provide the holder with anonymity. They are also unregulated, have an essentially fixed quantity and are therefore susceptible to speculative attacks and thus far less useful for forward planning. The monetary space is geographically larger, but the bitcoin society is much smaller than for most national monetary units. An emphasis here is that the deconstructed definition of money presented here allows for a more complete discussion, and is free of the constraints of functional definitions.

the capacity of the agents within a given monetary space to be able to provide value in the future. As Rochon & Rossi (2013) explained, the true value of the credit is thus dependent not only on existing resources, but also the future product of society.

3.3 The credit theory of money

This section takes a step back, and elucidates why the monetary token should be referred to as a credit. It is also intended to probe the reader into a critical view of the popularised explanations of the source of money. Innes (1913, 1914) presented credit, or rather the credit relations of society, as the foundation of money, stating that "credit and credit alone is money" (Innes, 1913, p. 392). Innes (1913, p. 391) debunked several examples where the relative values of goods were thought to have been determined in relation to the value of some divisible commodity. In every case, while there may have been legal precedent for the enforcement of contracts on the basis of a particular commodity, he explained that a monetary unit for the assessment of value existed external to the commodity itself. In his description, the commodity used was merely a means of settlement rather than pricing.

He (Innes, 1913, p. 391) also presented a historical account of the progressive development of monetary tokens, in a partial attempt to redress what he saw as the inaccuracies of popularised commodity theories of money, particularly those that linked the fineness of metals in coins to the quantum of social value purchasing power that they embodied. The antithesis of Smith was largely based on archaeological findings that Smith would not have had access to, but Innes' principle argument was related more to the nature of money as a concept, and to monetary origins in principle. He assessed that,

> "Adam Smith's position depends on the truth of the proposition that, if the baker or the brewer wants meat from the butcher, but has (the latter being sufficiently supplied with bread and beer) nothing to offer in exchange, no exchange can be made between them." … "Assuming the baker and the brewer to be honest men, and honesty is no modern virtue, the butcher could take from them an acknowledgement that they had bought from him so much meat, and all we have to assume is that the community would recognise the obligation of the baker and the brewer to redeem these

> acknowledgements in bread or beer at the relative values current in the village market, whenever presented to them, and we at once have a good and sufficient currency. A sale, according to this theory, is not the exchange of a commodity for intermediate commodity called the"medium if exchange," but the exchange of a commodity for a credit."

Although Innes refers to honesty and social custom above, what he emphasises is that the acknowledgement provides the holder of the acknowledgement with access to the provider's goods at some point in the future. He (Innes, 1913, p. 378) argued that, "In both instances in which Adam Smith believes that he has discovered a tangible currency, he has, in fact, merely found – credit." In contrast to the commodity theory of money, he presented the foundations of trade in terms of the acknowledgement of indebtedness, which, as noted by Ingham (1996), requires a social context[3.11].

> "The value of a credit depends not on the existence of any gold or silver or other property behind it, but solely on the"solvency" of the debtor, and that depends solely on whether, when the debt comes due, he in his turn has sufficient credits on others to set off against his debts. If the debtor neither possesses nor can acquire such credits which can be offset against his debts, then the possession of those debts is of no value to the creditors who own them." (Innes, 1913, p. 378)

The importance of Innes' statement is that, as noted in the introduction, in any transaction for a good, where goods are not directly exchanged, it is an acknowledgement of debt and credit that balances the trade. The value of gold and silver coins was not held in the practical uses of the metals, but in the vast quantities of social resources that could be acquired by exchanging the coins with other members of society. Precious metals are a truly unfortunate element in the evolution of money, as they confuse the intrinsic value and usefulness of valuable metals with the fundamental value that society can provide in exchange for the credit that gold and silver coins represented[3.12]. That credit is then

[3.11] Although Ingham agreed with the principles of Innes discussion, he emphasised that in the absence of certain social constructs, the "honesty" referred to by Innes, or the recognition of the obligation by a community, could not exist – this is explored in greater detail later.

[3.12] Gold coins are a lot more valuable in a thriving society with an abundance of produced goods than they would be in a barren country in the midst of a famine. The reason for which represented in some way or form, either as a tangible token or in a record keeping system. Rather than considering "money" as the object of desire, Innes (1913), [pp. 392] presented the underlying source of the perceived value; credit.

> "A first class credit is the most valuable kind of property. Having no corporeal existence, it has no weight and takes no room. It can easily be transferred, often without any formality whatever. It is movable at will from place to place by simple order with nothing but the cost of letter of a telegram. It can be immediately used to supply any material want, and it can be guarded against destruction and theft at little expense. It is the most easily handled of all forms of property and is one of the most permanent. It lives with the debtor and shares his fortunes and when he dies, it passes to the heirs of his estate. As long as the estate exists, the obligation continues, and under favourable circumstances and in a healthy state of commerce there seems no reason why it should ever suffer deterioration. Credit is the purchasing power so often mentioned in economic works as being one of the principal attributes of money, and, as I shall try to show, credit and credit alone is money. Credit and not gold or silver is the one property which all men seek, the acquisition of which is the aim and object of all commerce."

The parallels with the functional definitions commonly presented for the money asset are immediately obvious (As noted by Chick (1978, p. 41), "durability, recognisability, portability, divisibility" and so on), as are the reasons why a generally accepted monetary token, that met the requirements for the above description of credit (no corporeal existence, no weight, takes up no room, etc., such as an electronic record in a bank account), might possess the much lauded property of liquidity while carrying relatively low levels of risk of loss.

This analogy can be extended to the aggregate case if one considers the creditor or lender to be society as a whole. Since credits created in the present are intended for settlement at some point in the future, the "estate" of the debtor can then be extended to the current and future assets and the current and future product created by or supported by all indebted participants of society. Since almost all recorded economic activity in modern society is validated by

is that the credit represented by the gold coin depends not on the properties gold, but on the product of society.

monetary payment, it follows that all measurable economic activity is implicitly validated through the repercussions of the act of borrowing at some point in the immediate or distant past. If a credit for social value could be conceived as a perfectly homogeneous credit of purchasing power, of all items for value for sale within a given monetary space, then any token created to represent that credit would inherit some of those characteristics. As Innes asserted, it is also irrelevant what the token is, as long as the intrinsic value thereof does not exceed the value of the purchasing power that the credit represents (in which case the tangible token would be of greater value that the credit).

As noted by Chick (1978, p. 41), money, or rather monetary tokens, rely on confidence, but in contrast to many assertions, it is not the quality of issuer of the tokens that determines the value that those tokens possess, but the capacity of those who are indebted (and the beneficiaries of their spending) to provide value when those tokens of credit are presented for settlement – in this case, all those willing to provide goods and services within the monetary space, or "society", both in the present and in the future. The trade of monetary tokens for goods or services is therefore a transfer of goods or services in exchange for a credit position against the current and future product of society (recalling that society is defined by those who participate in the monetary space).

It also follows that those institutions or agents empowered with the capacity to create such tokens are able to create perfectly homogeneous credits against society (a significant capability, and thus responsibility). Hypothetically, in exchange for such a credit, a debtor provides a promise to create sufficient value within society to be able to sell their products or services in the future, and in doing so accumulate sufficient credits to settle their original debt. This will be explored in greater detail below.

3.3.1 The creation of monetary units and tokens

As noted in the introduction, economic agents are bound to both monetary units and monetary tokens as an integral aspect of thinking and planning. How then are the monetary unit and monetary token maintained and created in modern economies? From the outset it is important to emphasise that modern tokens are only ever created in exchange for the creation of a debt. For all intents and purposes, since the establishment of the nation state, the homogenisation of monetary tokens and denomination thereof in a state nominated monetary unit, generally accepted monetary tokens have been created by banking institutions. To categorise broadly, tokens have been created on behalf of one of two groups, state (governmental) or private borrowers.

3.3.2 Private creation of monetary tokens

Innes (1914, p. 152) described the creation and usage of monetary credits in the private banking process as follows,

> "...in practice it is not necessary for a debtor to acquire credits on the same persons to whom he is debtor. We are all both buyers and sellers, so that we are all at the same time both debtors and creditors of each other, and by the wonderfully efficient machinery of the banks to which we sell our credits, and which thus become the clearing houses of commerce, the debts and credits of the whole community are centralized and set off against each other. In practice, therefore, any good credit will pay any debt. Again in theory we create a debt every time we buy and acquire a credit every time we sell, but in practice this theory is also modified, at least in advanced commercial communities. When we are successful in business, we accumulate credits on a banker and we can then buy without creating new debts, by merely transferring to our sellers a part of our accumulated credits."

To settle a debt, one could therefore simply instruct a transfer of credits from your own account of record to that of another, thus effecting payment. From a trade perspective, it also became custom that a purchase or sale transaction could be completed by the intermediated transfer of credits held at a third-party bank[3.13]. It is therefore important to understand how these credits are created. While many examples exist of credit-based banking systems in Europe prior

[3.13] When a debt to a bank is created, the borrower provides the bank with a contract of indebtedness, and in return the bank creates credits (deposits) which initially are provided to the borrower in a simultaneous debt and credit transaction. In effect, the bank has created tokens of credit against society. The initial borrower is formally indebted to the bank, but once the credits have been spent it is the duty of the borrower to try to re-acquire those same (or similar) credits from society through the sale of either goods or services. It is only in the process of spending that the borrower effectively becomes a debtor to society in general. The bank has simply served as a medium (and gatekeeper) in the process. This process has recently been validated by publications from the Bank of England, the Bundesbank (Deutsche Bundesbank, 2017; McLeay et al., 2014; Werner, 2014) and an extensive Post Keynesian monetary literature.

to the 1700s, the progression of the English monetary system prior to the establishment of the Bank of England in 1694 was particularly important, as it pre-empted the harmonisation of state and private debt and credit.

As noted by Ingham (2004, p. 193), in reference to Usher (1953 [1934]: 292) the practice of private bank lending for the creation of monetary tokens, and the acceptance of these counterparts of private bank records of debt as a means of payment occurred earlier, and was a critical step.

> "This creation of credit money by lending in the form of issued notes and bills, which exist independently of any particular level of incoming deposits, is the critical development that Schumpeter and others identified as the *differentia specifica* of capitalism. The issue of credit money in the form of notes and bills requires the depersonalisation of debt which enables the transferability of paper promises to pay that can then circulate as credit money outside of the network of any particular banks and its customers."

The establishment of public banks and central banks, the centralisation of clearing and settlement, and the homogenisation of all private bank created credits (notes, or "promises to pay"), and state endorsement thereof, then facilitated the acceptability of privately created and government created notes and deposit records as means of payment. The critical development, as noted by A P Faure (2013, p. 50), and Ingham (2004, p. 195) was the transformation of the role of banking institutions from physical deposit takers (of less sophisticated forms of monetary token) to creators of an accounting debt record in exchange for the creation of book keeping (intangible) monetary tokens. As explained by A P Faure (2013, pp. 50–59), the result of this was the creation of (transferable) bank records of deposit in exchange for private domestic loan extension, or loans to the non-bank private sector (NBPS). The banker owned the rights to the underlying items of value[3.14] through the debt contract, and the borrower or government could utilise the deposit records (monetary tokens) to transact. Ingham (2004, p. 214) thus noted that,

> "the capitalist monetary system's distinctiveness is that it contains a social mechanism by which privately contracted credit relations are routinely 'monetised' by the linkages between the state and

[3.14] More specifically, a quantum of value, expressed in terms of monetary tokens, representative of the value of the underlying contracts, goods or items.

> its creditors, the central bank, and the banking system. Capitalist 'credit money' was the result of the hybridisation of the private mercantile credit instruments ('near money' in today's lexicon) with the sovereign's coinage, or public credits. The essential element is the construction of myriad private credit relations into a hierarchy of payments headed by the central or public bank which enables lending to create new deposits of 'money' - that is the socially valid abstract value that constitutes the means of final payment."

An essential aspect of the capitalist system described above, is that the "monetisation" process requires homogenisation of credits into a single medium. As a result, an established and generally accepted monetary unit is also required. Essentially, the debt to banks of larger institutions (and later of individuals) were counterbalanced by depersonalised, homogeneous, divisible, and fully transferable credits against all items or services of value available for purchase within the specific sovereign monetary space. The importance of this cannot be overstated - it meant that all credits were equalised and that credit created by a private borrower, became equivalent to credit created by a business or government. The quality of each counterpart debt, however, continues to differ significantly. Monetary tokens created when an individual overspends on an overdraft facility have ever since carried the identical purchasing power capacity to monetary tokens created when a government deficit spends.

Post Keynesian literature provides a substantial pool of literature to explain the dynamics of private debt driven creation of monetary tokens. It is explained that in modern monetary systems, bank lending (commercial, retail, and central bank[3.15]) creates bank deposit records[3.16], and that these are by far the most prolific form of modern monetary tokens[3.17]. Members of the non-banking

[3.15] With notable exceptions in specific countries for certain types of lending. For example in Denmark, where mortgage lenders are required to fully absorb money from the non-banking private sector through the sale of debt securities in advance of the extension of the mortgage loan (Frankel, Gyntelberg, Kjeldsen, & Persson, 2004, p. 100). In principle, however, even though the aggregate level of money in circulation remains constant in such circumstances, money is still created in the lending leg of the process.

[3.16] It should be noted here, that monetary tokens in circulation in the domestic economy are affected by international trade and capital movements, particularly through the purchase and sale of foreign exchange. This affects the composition of ownership of domestic monetary tokens, and possibly the extent to which those monetary tokens are likely to circulate back to the original borrower.

[3.17] There are also institutions that classify as third-party asset transformation institutions that accumulate funds in order to re-lend them, for example building societies in South Africa. These institutions are excluded from the definition of banks, especially as they do not typically private sector then have the opportunity to convert those deposits (credits) into physical notes and coin provided by central banks.

In contrast to the money multiplier story of deposits creating loans, the so-called 'reverse causality', which runs from debt creation to money creation in modern economies has, amongst others, been demonstrated through: qualitative descriptive explorations of bank and central bank processes (A P Faure, 2013; Kock, 1954; Le Bourva, 1992), institutional mechanisms (Arestis & Eichner, 1988; Dow, 2006; Lavoie, 1996, 2006) and the temporal ordering of lagged fractional reserve accounting (Godley & Cripps (1983); W Godley & Lavoie (2007)); formal causality tests (Moore, 1983b); historical records of the development of money and the creation of money (A P Faure, 2013); micro-theoretic models of banking (Moore, 1983b, p. 541); the historical development of banking systems (Chick, 1993; A Pierre Faure, 2013); detailed pedagogical demonstrations of the balance sheet impacts of bank lending (Faure, 2014); and comprehensive stock flow accounting models of entire economies (Godley & Lavoie, 2012). Simple pedagogical explanations were also provided as early as 1983 by Moore, and in 1962 by Jacques Le Bourva, and more recently by McLeay et al. (2014) of the Bank of England, and Werner (2014) who is reported to have influenced members of the Bundesbank in Germany to publish a similar report (Deutsche Bundesbank, 2017).

In summary, the records of credit that appear in a borrower's bank account when a loan is extended do not come from another depositor's account. Those credits are new credits, homogeneous credits, that enable the holder to access the resources of all of society. They are created by a bank simultaneously with a loan agreement (of identical size) against a specific borrower. The borrower then typically transfers the ownership of those newly created credits to another person or organisation in exchange for something valuable. The borrower thus absorbs value from society (spending credits in exchange for valuable goods or services). The borrower is then in a predicament: they have a debt to a bank and an agreement as to how quickly that debt must be repaid. The debt agreement requires that they must return to the bank the same homogeneous credits as were created on their behalf. Since all bank-created monetary token credits are homogeneous, it does not matter who the initial borrower was. Only that the tokens can be acquired.

have access to central bank accommodation services in modern monetary systems.

If the borrower's initial spending generates additional value in the form of a product or service, then the borrower might be able to sell that product or service in order to acquire tokens of credit. Alternatively, if the borrower has a skill-set that is particularly valuable to society, they are likely to be able to acquire credits by providing (selling) their own labour. As Innes (1913, p. 393) noted "it is through selling, I repeat, and by selling alone - ... - that we acquire the credits by which we liberate ourselves from debt, and it is by his selling power that a prudent banker estimates his client's value as a debtor." The goal of course is to sell for more credits than were initially borrowed.

A numerical example is presented below as a thought experiment. In Figure 1 below, Jo borrows 100 credits from the bank. Instantaneously Jo has both a credit of 100, and a debt of 100 perfectly identical units (represented by the green and red solid bars respectively). In the second week Jo spends all of the credits on setting up a shop and buying stock (absorbing value from society). Each week Jo earns 20 credits in income, spends an additional 2 units in stock and wages, and pays back 15 units of debt (except in the last week when only 10 units of debt remained), and keeps the remaining 3 credits (of profit).

As can be seen it takes Jo 9 weeks to fully repay the loan. Jo has also accumulated 26 extra credits of profit. Jo was obviously able to provide greater value than was initially borrowed, as is demonstrated by society's willingness to transfer their credits to Jo in exchange for the good / service. There is, however, a problem. Only 100 credits were created, 100 units were repaid, and Jo still has 26 units! All of the units created for Jo have since been destroyed upon repayment of the debt, thus the units must have come from creation of credits on behalf of another party. More importantly, that party incurred a debt upon creation. This principle applies equally at an aggregate level. The credits earned represent value created by Jo that was validated through monetary transaction. Since monetary tokens can easily be re-spent, it is possible for one token to validate several units of value (linked to the velocity of money, and the Keynesian multiplier principle).

What remains true, however, is that monetary tokens are initially created in a finite quantity and, as noted by Bossone (2001), that quantity excludes interest[3.18]. It also means that at any credit held by a party that is not a

[3.18] Which means that all interest payments constitute an initial transfer of resources from society to the banking sector, and the payment of wages by the banking sector to households debtor to a bank represents a friction in the flow of credits back to the original borrower. “Savings” of money, therefore, do not finance lending, but quite the opposite. This is not a statement of macroeconomic causality, but of micro-causal necessity. This explanation emphasises the problematic nature of the demand for and retention of money for the monetary circuit[3.19].

constitutes a counterbalancing flow to interest payments and fees. Whether or not the banking sector extracts excessive rents is beyond the scope of discussion here. The focus is on the initial point of creation, as a finite quantity that excludes future costs of borrowing as per the interest defined in the loan contract.

[3.19] According to Bossone (2001), and in the opinion of the author, this was an important aspect of Keynes' general theory, but has subsequently been misinterpreted as an optimisation problem within the demand and supply framework of AS/LM. In addition, while Keynes represented the demand for money in terms of positive, intelligent intertemporal behaviour, it seems far more likely to the present author that money is retained by the vast majority of people for far less flattering reasons. In addition to transactions, precautionary and speculative demand one could add laziness, a lack of knowledge about alternatives and a general lack of interest in exploring alternative investment opportunities (ignorance and incompetence), fear of change and distrust of those offering alternatives, and a misguided understanding of the aggregate benefits of saving monetary tokens of credit. If deposits are not accumulated in the accounts of savers, the likelihood of them returning to the original borrowers is higher, and the full term of a debt contract potentially shorter; which extends the term for which interest rent can be extracted. This may or may not be understood by the banking sector, but the possibility certain makes one question the motives for selling long term deposit securities to deposit holders – at significant interest spread below the cost of borrowing.

3.3.3 Figure 1: Jo's loan, profits and savings

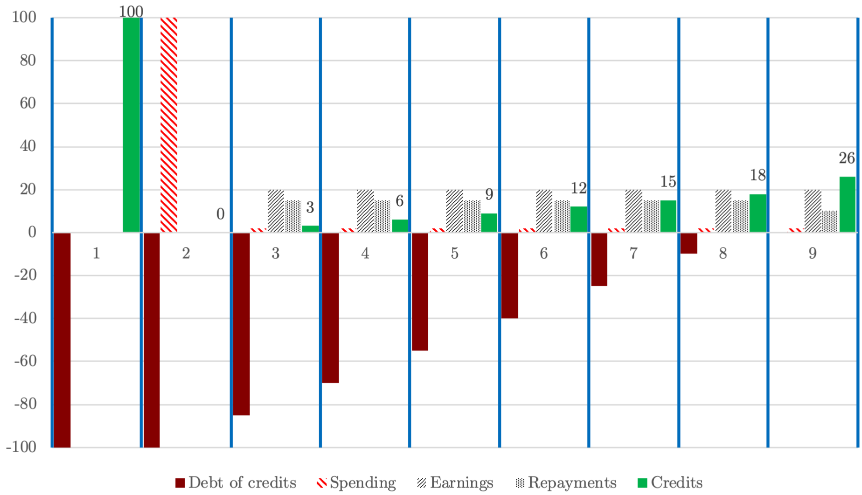

Figure 3.1: Jo's loan, profits and savings

3.3.4 Governmental creation of monetary tokens

Of all parties on behalf of which credits are created, government is by far the largest. The Post-Keynesian literature has focussed largely on the creation of monetary tokens by commercial banks on behalf of private individuals and firms, where the demand for a loan precedes the creation of monetary tokens, which then results in an increase in reserves held by banks in their settlement accounts. Government driven money creation, on the other hand, is somewhat neglected.

Wray (2001, 2010, 2015), Fullwiler et al. (2012) and Bell (2001) have filled this gap, and over the past two decades presented Modern Money Theory (MMT) as an collection of thoughts of similar authors (including Knapp, Keynes, Lerner, Minsky and Godley) that emphasises the role of the state - incorporating both the credit understanding of money and the social structural conditions within which monetary systems exist. As explained by Wray (2001), government debt and credit creation is essentially the same process as described above in the private case.

As he noted, governments spend by debiting their own bank account and crediting the account of the service or product provider. In the absence of any specific legal limitation, it is irrelevant whether the government account balance is positive or negative (that is, whether the government has previously accumulated credits through tax or borrowing or not). If the account balance is negative, each unit of credit that is transferred to a service or product provider is simultaneously created against an identical debt record on behalf of government. The service provider receives a credit, and the government records a debit in their accounts. The credit is transferred to the product / service provider just as it would be from a private person's overdraft facility on a checking account.

The one major distinction is in the capacity of the "state" to impose liabilities on the population. Where a private person must be able to sell in order to accumulate credits against their peers, a government can impose a tax liability[3.20].

The value added by government to society

Governments provide value less directly. In addition to the services that citizens might benefit from directly, governments have the capacity to develop the supporting conditions that might be required for the expansion of social value. This is typically through the employment of labour and resources for the development of physical and social infrastructure and institutions (such as education, roads, legal institutions, healthcare, electrical infrastructure etc.) from which positive externalities can emerge – such as reduced crime rates, self-governance, collectivism, artistic expression, etc. The benefits of a stable and well-functioning governmental system that could provide high quality multi-generational education, healthcare and financial security, would be difficult if not impossible to measure[3.21], but the scope of value for which a monetary

[3.20] The irony of income tax is that it is only those that are able / capable / willing to provide or generate additional social value that are made liable. Consumption tax through VAT as the exception. Alternatively, one could perceive tax of the high-income earner to be "giving back" part of the long-term benefits accrued from society.

[3.21] The benefits of government spending programs cannot be received equally by all social participants. Some will be in a better position to receive those benefits than others, and thus will move forward. Others will be less able, and thus fall behind. The ability of the state to tax within a social welfare system is thus perhaps far less perverse than a purely capitalist system, where those who benefit from accumulated social capital over multiple generations are most likely to move further ahead, and those who fall behind are likely to fall further behind.

token (credit for social value) could be exchanged, would very likely be broader than in a poorly governed society.

This also raises the important question of what aspects of society are of value in the long run, and what the goal of our enquiry into economics and macroeconomics is. Is something only of value if private individuals are willing to purchase it with their privately acquired monetary tokens? Is the study of ethics or morality, or history valueless if there are no buyers? It is difficult to believe that the necessary components of a sustainable society can be identified by the general population in the absence of knowledge accumulation and dissemination (learning and education). It is also difficult to believe that those that find themselves in positions of power will automatically behave in the interests of equality or fairness, as illustrated by Akerlof & Shiller (2015), the profit seeking or maximisation motive is often completely disconnected from social values. If we are interested in the sustainable well-being or welfare of all persons (or possibly other species), rather than a *laissez-faire* economy, it may be necessary to accept a degree of social engineering – which would require significant central decision-making and social control practices.

3.3.5 Limitations of a finite means of value validation

This process of money creation presents a conundrum, as society is implicitly dependent on debt creation. Why is this? Social value is only validated upon a purchase or sale. In a society where all purchases and sales take place in exchange for monetary tokens, one party must have monetary tokens before any transaction can take place. To explain this, the analogy of the 9 week loan above, can be extended to the economy as a whole. Value validation requires the transfer of monetary tokens (credits), for a given quantum of monetary tokens and a given rate of transfer, any additional validation this requires additional tokens. These tokens are not distributed, except possibly through helicopter money policies[3.22], but rather are created through one or another form of lending. In the private sector they are created on demand for any party that meets creditworthiness requirements. In the public sector they are created as growth in deficit spending (or indirect additional private borrowing, if the government cannot outright deficit spend, as in the USA).

[3.22]Referring here to policy driven instantaneous expansion of broad money through the credit of bank accounts, as explained by Bützer (2017).

The third and final method is through a positive change in the external balance of payments (BoP), in which case the debt sits with the counterpart trading country. The monetary accounting system in a sovereign monetary space is a closed system, in that at an aggregate level, the total quantum of debts created should balance with the total quantum of credits in existence. Growth in economic activity, as validated by aggregate purchases or sales (expenditure or income), in the absence of declining prices, consequently necessitates the expansion of either private, public or external sector debt. For example, if a government maintains a balanced budget, and there is a negative or balanced BoP, an expansion of the quantum of monetary tokens requires expansion of private sector debt.

3.4 Discussion

This section has two purposes, the first is to discuss some of the implications of a social value theory of money, and the second is to provide some insights into how the alternative definition of money presented above can be used to understand modern economies. First, we discuss economic possibilities and the achievement of optimal resource utilisation. Second, private sector access to credit creation facilities is discussed, together with some implications for wealth distribution. Thirdly, is a short note on the necessary wastage of resources. Forth, are some implications for fiscal policy, and fifth and finally is a note on the current role of central banks as implementers of monetary policy.

3.4.1 Economic possibilities and the validation of a future society

Validation of activity and assets

The capacity to immediately validate value within the economy through the creation of monetary tokens (either publicly or through the private sector) and subsequent purchase of goods or services presents an enormous opportunity. In the presence of idle or untapped resources, the creation of monetary tokens can stimulate the employment of labour or production of goods. As explained by the Post Keynesian and circuit theory of money schools of thought, the creation of monetary tokens can thus be seen as the initial trigger for the production process. J. Keynes (1933) first presented this theory as the monetary theory of production (MTP). This he later (Keynes, 1936) contrast to a the dichotomy of the Theory of Value and Distribution on one hand, and the Theory of Money on the other. A simple explanation of the theory is that the extension of monetary token debt permits the borrower (in the MTP a firm) to access the resources of society in order to produce something of greater value than the inputs. In contrast, if all resources, both human and otherwise, are already employed and functioning at their optimal maximum level of productivity (full employment), it is unlikely that additional stimulation would result in excess value creation for the future.

Balance, sustainability and contribution to social value

The composition of the debt, the quality of the borrowers, and the use of the credits are crucial factors to consider, and the sustainability of the creation of monetary tokens is a question of balance. In terms of social value, the borrowing (creation) of monetary tokens involves the promise of the borrower to provide at least as much value to society as is consumed when using the newly created monetary tokens. A general rule, however, is that if the credits are used purely to consume resources, and not used to generate additional value (at least equivalent value), society will experience a net loss, and the borrower will most likely be unable to recover the credits originated on their behalf. Innes (1913, 1914) assessed money to have always been a credit relationship but, in contrast to Innes (1913) and Rochon & Rossi (2013), credit (monetary tokens) and debt cannot be regarded as synonymous in modern economies. The major distinction is that the quality commercial bank debt is subjectively determined by the quality of the borrower, whereas the quality of a credit is non-specifically determined by society as a whole.

Survival of the most desired (and therefore demanded) goods and service providers

A powerful advantage for society is that a unified form of credits allows for intertemporal adjustment and connectivity, and facilitates natural selection of products and companies. Homogeneity of monetary credits across time, means that it is irrelevant for what purpose or when a credit was created when one is trying to acquire them. A credit from a baker, builder or government borrower are entirely indistinguishable. Therefore, the original debtor is also irrelevant when it comes to accumulation. Credits created in a current period, to produce an undesired good, are likely to be transferred to a producer of a good or service that is desired – and in theory, only the most desired products and services will prevail. Debts created for unsuccessful borrowers are written off as irrecoverable, and settled either against credits of the banking sector, or the government (society as tax payers). When banks receive tax payer bailouts, such as in 2009-10, it is to cover wasteful borrowing, and thus poor lending decisions.

Validation of socially desirable institutions

Balance can also be found in the preservation of certain social institutions that provide less direct benefits, or those that might prevent social deterioration. Philosophers may be needed to assess the ethical and moral implications of social actions, or sociologists, anthropologists and historians to help prevent the repetition of social ills – if there is no active private market for such cultural capital, there must be a central system that validates and sustains those aspects of society that would otherwise disappear. If individuals are relied upon to make prioritisation decisions (purchases) with their own resources, other more predictable needs might also be neglected, such as antenatal guidance, healthcare, parental guidance, access to public knowledge institutions, education systems, or poverty alleviation.

Just as the long-term benefits of a stable society are almost impossible to measure, the damage caused by cumulative degradation of portions of society over multiple generations is equally difficult to assess. The harmonisation of public and private sector credits allows cognisant governments to validate a wide array of such indirect forms of social value that can help to prevent social decay. Such decay can result in economic exclusion and political instability, as illustrated by Guy Standing in *The Precariat: The New Dangerous Class.*

3.4.2 Private sector access to credit creation facilities and wealth distribution effects

Private individual borrowers typically promise to achieve the balance between value consumption and value provision through the provision of labour (through employment) through the course of their lives. Firms and entrepreneurs promise to achieve this through the production of goods and services, through the acquisition of (employment of) labour and resources. In both cases the private sector is obliged to generate and sell value.

Socially beneficial outcomes, or the lack thereof

As Innes (1913, p. 393) so clearly identified: “it is by his selling power that a prudent banker estimates his client's value as a debtor". Selling, however, is not only a question of product quality, but also of the ability to manipulate human impulses, stimuli, desires and fears. A concept wonderfully illustrated by George Akerlof (2015), where the proverbial impulsive monkey on your shoulder drives a large part of personal resource allocation. There is absolutely no guarantee that the economic agent best at selling will provide the best outcomes for society, nor that the purchasing decisions of society will validate the most socially beneficial goods and services[3.23]. Regardless of whether the intention is good or not, the ability to sell, and thereby acquire homogeneous credits against society, is the primary determinant of economic successes in the private sector of a liberal capitalist economy. The corollary of which is access to resources to produce the goods or services that will be for sale, and to pay for marketing expertise. Such access is granted to borrowers that can demonstrate the above-mentioned success in selling – either in the form of a proven track-record, or in the form of ownership of assets of value (i.e. a strong balance sheet).

Capital gains, bubbles, and redistributions of wealth

Unfortunately, solvency of a private individual is therefore also linked to prices of assets, which are subject to demand – demand that can be satisfied by purchase with monetary tokens. Credits that are created for the purchase of such assets, based on expected capital value returns – which are in turn dependent on price appreciation – can quickly fuel a circular, self-fulfilling process of price escalation that is completely disconnected from underlying social value (a bubble).[3.24] In addition, the rapid expansion of monetary tokens

[3.23] Examples of successful selling that has detracted from social value include the worldwide sale of asset backed securities prior to the 2007, the abundance of Ponzi schemes, the exorbitant wealth of leaders of commercialised religious groups (such as Kenneth Copeland, Edir Macedo, Creflo Dollar etc.), countless internet and eBay fraud schemes, and the proliferation of fast food chains such as MacDonald's, and the enormity of the international narcotics industry.

[3.24] The most recent example is the 2008-2009 financial crisis, which was predicated on the extension of credit, (and thus money creation) which fuelled a process of financialisation. As noted by Lavoie (2012), "[f]inancialisation transformed a growth regime based on high real wages and high business investment into a regime based on high consumption spending and ever-rising household gross debt, justified by high prices in the stock and real estate market." Money creation was permitted on the self-fulfilling prophesy of improved household balance sheets (as asset prices rose), and the prospect of future financial capital gains (driven by price increases that were in tern driven by the extension of credit). As Buffet once said, it's only when the tide goes out that you discover who's been swimming naked. The information required to foresee the crisis, and who exactly was swimming without their bathing suits, was available in the disproportionate balance sheet accounting data of the various sectors of the US economy. The unwinding of the financial crisis has once again revealed the irresponsible nature of lenders, as well as the need to understand the aggregate effects of the process can result in a shift in the proportional distribution of credits for social value – in much the same way as a corporate rights issue can dilute proportional shareholding in a company, inflationary monetary expansion can redistribute a greater proportion of underlying social value to the beneficiaries of credit expansion.

In the presence of idle resources, access to credit can also permit the borrower to gain ownership and control of assets that generate substantial value in the future. Access to borrowing opportunities thus not only affect the type of project that will be supported and the proportional distribution of social value credits, but also the distribution of access to wealth generating resources – and thus very likely the distribution of income and wealth within society.

Value creation and validation without borrowing

Fortunately, due to homogeneity and the non-specificity of monetary token credits, it is also possible for resourceful economic agents, who do not have access to debt financing to create value in advance of acquiring monetary tokens. Provided that monetary tokens do not become idle (i.e. sit dormant in savings accounts), it remains possible for new forms value to be validated in the private sector, regardless of the borrowing source of creation. In the presence of any holding of monetary tokens as "savings", the potential for tokens to flow back to the original borrower is reduced.

Ultimately, however, and regardless of the degree of ingenuity of economic agents, selling is dependent on spending, and spending is dependent on the possession of credits, and the existence credits depends on debt creation. This puts those with access to debt creation at an economic advantage.

3.4.3 Necessary wastage in monetary economic systems

As explained above, it is not only the present, but the future assets and product of society that will determine the aggregate level of social value in a given monetary space. Since social value is subjective, and there is no way of knowing the future wants or needs of people, the measure of what will or will not be

of credit extension, together with a holistic understanding of the interactions between the balance sheets of various economic agents. As Bezemer (2009) concluded, looking forwards, within the current system of collateralised lending, "the balance sheets of firms, households and governments, and the regulations of the economics system on what sorts of balance sheets are being allowed, co-determine what forms new credit flows can take, how much there can be of it to different sectors, and consequently how the economy will evolve."

considered valuable cannot not be known entirely in the present. It may be possible to guess at some things, but they will never be known for certain. Technological innovation, changes in tastes and changes in social dynamics are just a few of the possible reasons why present expectations might turn out to be wrong. Since not all inventions will be successful and not all innovations useful, there must necessarily be some wastage of the resources of society progress is desired – a process that is linked to the inter-temporal connectivity mentioned above. This does not mean, however, that the selection of which ideas to support, or which borrowers should be eligible to receive a credit against society should be reckless.

3.4.4 Fiscal policy and forms of governmental debt

In a similar manner, society entrusts government to spend in a fashion that facilitates the generation of additional social value. As mentioned previously, governments are unique in that they are both able to create money through fiscal spending, and to impose liabilities through taxation[3.25]. In terms of government spending and debt, for a country with a sovereign currency there is essentially no limit to the extent of domestic deficit debt creation. One of the major concerns with government spending as a source of creation of monetary tokens is that it is possible that an excessive expansion in the quantity of monetary tokens held by the NBPS might have inflationary consequences.

In terms of social value, as governments spend, and create debt and monetary tokens, they essentially become indebted to society as a whole. If they are unable to develop the physical and intellectual resources of the country sufficiently, they may never be able to retrieve those monetary tokens through taxation. This may result in what proponents of the quantity theory of money would describe as an excess quantity of tokens chasing a limited quantity of valuable goods and services, and consequently inflationary processes. In order to manage the inflationary impact of government spending, as noted by Fullwiler et al. (2012, p. 6), governments and central banks have at least four debt instrument

[3.25]This is not withstanding specific legal limitations and institutional arrangements. For example in the US, government is only allowed to spend money if there is a positive balance in the governmental accounts. This very ironically means that the tokens must be created on behalf of a non-governmental party, and can later be borrowed by the US government through the sale of bonds. Thus creating a legislative necessity for private debt creation to fund future government spending expansions.

sale alternatives to choose from[3.26], none of which are a necessary means of financing. The fact that certain governments (such as the US government) are required to hold positive balances in their account before spending is a matter of legislative and political convention.

This also sheds some light on the debt crisis and subsequent economic stagnation in Europe since the 2008 financial crisis. Where resources lie idle, governments of economically depressed countries that do not have control of a sovereign monetary unit and token, are not able to create monetary tokens to facilitate or stimulate additional social value creation. This is not to suggest that governments of all countries should have access to a sovereign currency. The government of Zimbabwe between 2000 and 2008 utilised monetary tokens purely for the consumption of existing resources. Corruption and self-enrichment of political figureheads, and the simultaneous destruction of social and physical institutions resulted in the creation of an enormous quantity of monetary tokens against a rapidly declining quantum of social value[3.27]. The Zimbabwean dollar was abandoned shortly afterwards, and the US dollar was introduced initially through black-market usage, and later as the official trading currency.

The focus on balanced government budgets as an element of austerity measures, as implemented after the 2008-09 financial crisis, might be explained by fears of similar events occurring in European countries with a substantiated risk of systemic corruption.

[3.26] In addition to the issuance of long term debt instruments (bonds), they note that other options include matching the interest paid on reserve balances with the target rate, the issuance of short-term T-Bills, and lastly, simply setting the rates on a variety of short, medium and long term bills, and letting the private sector purchase as many as they wish to hold.

[3.27] A P Faure (2013, p. 11) provided examples of excessive government borrowing resulting in extremely large quantities of monetary tokens that were wasted by irresponsible governments. The consequence of which has typically included extreme levels of price inflation in terms of the monetary unit, the worst two examples of which were 41 900 000 000 000 000% per annum in Hungary in 1946, and 7 000 000 000 000 000 000 000% per annum in Zimbabwe in 2008. This does not mean that there is a predictable relationship between the nominal quantity of monetary tokens in circulation and prices under relatively stable conditions, although, it would be equally naïve to think that the defensive liquidity management practices of central banks do not affect the quantity of monetary tokens in circulation. It could be argued that the liquidity management operations of a central bank are essentially quantitative, but that they are ex post reactions to large scale changes in the quantity of monetary tokens demanded and in circulation.

3.4.5 The hamstrung role of central banks in modern economies

Since private agents and modern states both utilise banking services (central or commercial) to create monetary tokens, all modern monetary tokens are originated in the banking sector. One would thus expect that central banks would maintain a significant role in the direction of validation of economic value within modern societies. In contrast, many modern central banks are officially disconnected from both fiscal policy decisions and the lending decisions of private banks, and limited to the primary objective of the maintenance of price stability. The irony of this is that that the true value of the monetary unit is as much dependent on the developmental effects of fiscal spending as it is on the effective implementation of monetary policy. This is because the value of the underlying society is the product of multi-generational tangible, institutional and intellectual capacity development.

It is all of society that entrusts commercial bankers to conduct credit assessments of would-be borrowers, and it should be to all of society that bankers are accountable to for their lending decisions. It is hard to believe that the incentives and interests of a large profit oriented, and highly competitive private banking sector will be aligned with the interests of society in general. Over the course of history, private banks have repeatedly demonstrated innovation and ingenuity, and on the other hand, had a tendency towards greed and instability A P Faure (2013). At the very least, the central bank should be in a position to protect society from the ineptitude and greed of irresponsible bankers[3.28]. By and large, central banks limit their activities to the internal and external maintenance of the value of the monetary unit, with little or no attention given to the compositional distribution or access to the creation of monetary tokens.

Private banks and governments (through central banks and democratic decision or sovereign decree) alone have the capacity to create monetary tokens. They thus stand as the gatekeepers to access to borrowing of credits from society as a whole. They share the role of assessing the viability of projects and ideas, and the importance of investments into socially beneficial infrastructure

[3.28] Until recently, private debts to a bank were entirely non-transferable. Banks, however, have devised the means to package and remove debts from their own balance sheets – consequently obscuring responsibility for lending decisions. There should be great concern when the only institutions permitted to extend universal credits within a monetary space attempt to obfuscate accountability. The recent subprime lending crisis in the USA is a perfect example of the provision of massive sums of credit to borrowers that could never generate sufficient social value to settle the debt.

and institutions. Inadvertently, this means that they are also responsible for the assessment of the potential addition to social value that might occur if a particular good or service is validated through the expenditure of newly manufactured monetary tokens (credits).

Money is created in exchange for debt, which means that is is created because the demands of the borrower cannot be satisfied from the resources that they already have. The accumulation of debts by individuals can otherwise be defined as a net financing requirement. If the income of an individual is not sufficient to cover the cost of their demand, they are required to accumulate liabilities to finance their purchases. The relevance for economic analysis is related to the endogenous money theory, which argues that money is not neutral. The function that money serves as a unit of account, and the stability of the value of the unit of account, allow money to be used as tool for pricing. The valuable inputs to production can thus be priced in terms of money, and by convention or by law, the means of production can be remunerated with money. It is therefore argued that it is the ability of institutions to create money in exchange for a debt contract that is in-turn the basis of financial expansion.

Money creation and debt creation are the foundation for the development of a money-based society. These functions are also the catalysts for financial expansion and for the allocation and development of resources in an economy. Money, when defined as credit, or as a claim on the goods and resources of all others who are willing to accept money, becomes the foundation for a system of accumulation, or account. Money balances held as “savings” are considered to be a friction, and not to finance investment. Rather, they slow the return of tokens to the borrower. This is not a statement of macroeconomic causality, but of micro-causal necessity. Sector level savings cannot be allocated by any one member of the sector, and so any notion that the private sector as a whole is able to mobilise savings is to conflate savers with investors when they may be entirely different and separately motivated agents.

The credit based monetary system permits those with access to credit creation facilities to direct the generation of and maintenance of social value in society (through transaction), and in so doing, to determine what aspects of society will be “validated” and thus maintained in exchange for monetary tokens. This highlights the importance of the stock of resources that might be mobilised if further credit were created - in the absence of spare capacity, inflation is a risk.

Resources in this case are the skills and technical capacity of labour, physical inputs to production, intellectual property, and technological resources. With endogenous money creation for investment purposes, it is possible to expand the capital or possibly the labour stock (labour defined here as the special labour value of higher skilled workers, not purely in units of time), however, the development of labour skills and materialisation of benefits from the investment are expected to take many years, but proper investment in the capabilities of the population will create greater pools of resources for activation in the future. It is therefore concluded that money and money creation should be an integral part of the public finance and public choice debate.

To the extent that the economy grows over time, and that an increase in the quantity of money required for expansion to take place, there is a strong argument (particularly with regard to the terms of borrowing) that it would be a more optimal scenario for an appropriate portion of debts to be held by government rather than against private borrowers. This is not to suggest it would always be the case, but where government investment can be carried out responsibly and efficiently, it should at least be part of public debate. Much like the issues of equitable distribution of income, or optimal taxation, as noted by Rosen (2002, p. 14), these are normative questions that "cannot be answered without a statement of ethical goals." Unfortunately it is difficult to find common ground on these ethical goals, the present lack of political consensus on climate policy, environmental protection or the reduction of pollution as current examples.

Beyond the political and ethical differences, it is not only a question of Pareto efficiency, in terms of the of the current allocation resources. It is also the long-term implications for the availability of resources, that can be activated in the future with the use of new money. The neoclassical theory of crowding out of private investment, as discussed by Rosen (2002, p. 24) assumes that there are limited capital and labour resources, this fails to consider the possibility that the pool of possible resources can be enlarged by appropriate public investment. Furthermore, the credit nature of money and money creation is important as it affects the allocation of power over and accountability for the use of resources in society. It is thus argued that the present reliance on the capacity to demonstrate a profitable business concern, or the ownership of collateral (possession of wealth or assets as a prerequisite) are likely to exacerbate the ever growing problems of income and wealth inequality.

3.5 Concluding remarks

Chick (1978 PP. 37) recognised that "our concentration on money's role in exchange has limited our understanding of the operation of money economies. Money not only affects the efficiency with which we conduct trade, but also influences the rate of capital accumulation, the commodity composition of output, and relative prices." A major reason for this, is believed here to be a failure to appreciate the underlying nature of money. Any asset can be used in exchange, but only the monetary token exists as a homogeneous record of credit against the resources of all society. As noted earlier, Innes provided the vital connection between interpersonal credit, debtor productivity and general purchasing power. Ingham and Wray have since provided a historically sound theory and record of the origins of a monetary unit, with particular focus on the fundamental necessity and instrumental impact of centralised institutional developments and decisions. Rochon and Rossi then provided a clear description of the record keeping function of the banking sector. Post Keynesian literature provides a detailed understanding of how personalised debt contracts permit the creation of monetary credits in modern society and MMT explains the role of the state and the usage of government debt securities for the management of liquidity and interest rates.

It is accepted that the monetary unit most likely emerged as a result of the actions of a central authority, with emphasis on the role of a government like authority in the development. It is then from the credit relations between economic agents, within a specific socio-structural context, that monetary tokens emerge with socially dependent value. The interrelationships between specific social structural contexts and progressive banking and monetary development facilitated the emergence of credit based 'capitalist monetary tokens', specifically homogeneous, depersonalised representations of an abstract quantum of social value.

The monetary token is, as Ingham has argued, the representation of a social relation. That relation is a debt and credit relationship, and in modern economies, the debt is homogeneous in substance, but personalised, specific and dependent on the quality of the debtor. Credit, on the other hand, is homogeneous and depersonalised, while both the debt and the credit are harmonised by their denomination at par in the monetary unit. Borrowers provide a personalised debt agreement in exchange for general credit against society. Upon spending, those borrowers, while officially only indebted to a single entity (probably a bank), are in fact indebted to all participants in the monetary space, society. Society lends resources to the borrowers for their usage. They are required in the future to acquire identical, homogeneous credits from other members of society in order to settle their personalised debt, and can only do so by means of the sale of goods, services, assets, or labour – i.e. by the provision of value to society. What is emphasised is that the monetary token represents a socially accepted right to the resources of other members of a society within a particular monetary space.

This theory is presented with full acknowledgement of the benefits of competitive markets such as the contribution to specialisation and division of labour, elimination of monopolistic pricing, enhanced innovation and the diversification of product offerings. It cannot, however, be accepted that money – the monetary unit, token, or space – emerged from the cost minimising quest for efficiency of the market system. As Post-Keynesians might say, the progression and emergence of money was not a deterministic process. An accurate record of the historical origins of the components of modern monetary systems necessitates the acknowledgement of temporal ordering of events, social structures and institutions in the assessment of economic problems and the determination of our future societies.

Money can also not be regarded as a neutral lubricant. It must be considered as a contextually dependent asset, the value of which depends not only on the general ability of those within the monetary space to provide value, but also on the effective decision-making of those permitted to issue monetary tokens and manage the monetary system, and to coordinate public and private interests, hopefully towards the common goal of prosperity.

The origins and nature of money are relevant for more than just academic interest. Our beliefs regarding the nature of money directly affect the mechanisms chosen to manage the monetary system in a country, which can be also linked to different political ideologies or ulterior motives – leaving the direction of causality out of the discussion for now. The quantity, monetarist and neutrality theories of money can be linked to minimalist government and privatisation ideologies (possibly liberalism or neoliberalism), while the production and credit theories of money can be linked to big government and collectivistic ideologies such as the welfare state, socialism or social democracy.

Different explanations of money are also supportive of distinctly different economic paradigms. For example, neo-classical theory is compatible the former, while Keynesian and post-Keynesian theory is compatible with the latter. Depending on the current state of affairs, one might favour one or the other theory. In the pursuit of equality under a dictatorial monarchy, one might be fully supportive of neoliberalism, whereas in a country dominated by a powerful elite private class one might prefer a Keynesian-like approach. The purpose of this article is not to explore the theoretical associations of different theories of money, but to present money conceptually.

Some important considerations that have not been discussed here include: Implications for foreign exchange in terms of underlying social value of inputs and the volatility of relative monetary prices; the distortionary impacts of linking the monetary unit and monetary token, and the possibility for a valuation system that is disconnected from institutions that have the capacity to expand the quantum of credits; the possibility for a global monetary unit, or possibly a value reference system – possibly with an interest in mitigating the risk of exploitation of labour; and, alternative mechanisms for credit management within economies – particularly non-productive consumer credit.

4 Article 2: Sectoral balance analysis: Evidence from Scandinavia

Introductory remarks

Article 1 explores the sources of change in financial balance sheet, and argued that there were a number of ethical and moral implications for the creation of debt. It was further argued, that the accumulations in each sector are dependent on the decisions to borrow by the other sectors. Thus linking the source of change and potential connection between sectors at an aggregate level. The second article follows from this, and addresses the second objective, to establish empirical evidence of interactions between the sectoral balances. As noted in the introduction, the objective of the article is to investigate the interaction between sector level net lending requirements for Denmark, Norway and Sweden between 1950 and 2017. It considers whether, or to what extent, each sector is in control of their net lending positions. This is in order to gain an understanding for sector interdependencies. Finally it addresses the question of how generalisable the findings for each of the Scandinavian economies really are, and whether generalised theories should be used to justify general economic policy.

Sectoral balance analysis: Evidence from Scandinavia

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Abstract

This paper explores the sectoral balances for the private sector, the public sector and the foreign sector for Denmark, Norway and Sweden from a historical perspective. The use of the sectoral balance approach for Scandinavian countries is largely ignored in both the contemporary and historical economic literature. From a sectoral balance point of view, two important changes in the Danish economy from 1975-2016 are identified; the status of the current account and the Great Recession. Sweden (1950-2016) similarly exhibits two important changes; the opening of financial markets and the banking crisis. For Norway (1978-2016), two related events are behind a major change in the economy; the production of oil, with associated revenues for government, and the creation of the Norwegian Petroleum Fund and the associated property income flows. In combination with idiosyncratic historical events for each country, and supplementary observations of macroeconomic indicators, it is possible to paint a rich picture of the evolution of each country. All three exhibit strong automatic stabilisation mechanisms, as expected from welfare states. In addition, all three emerged from the late 1990s into strong current account positions. The internal structure of the domestic balances within the three countries, however, diverge significantly.

4.1 Introduction

The System of National Accounts (SNA) is the backbone of macroeconomic investigation[4.4], but the accounting structures embedded the SNA have been neglected by recent empirical research. According to Bergman (2015), "A rather common view is that academics and other economic analysts do not fully comprehend the whole potential of the SNA ... SNA is often not seen as the prevailing tool for economic analysis." As he emphasises, the information contained in the SNA can easily be reframed to provide alternative, highly insightful perspectives on the status of an economy. Both historically and in recent years, there has been much attention paid to inter-country imbalances, though it is important to recognise that an imbalance towards rest of the world is necessarily reflected in the interactions of the domestic sectors and thereby imbalances between the domestic sectors within a country. If, for example, domestic national savings exceed domestic national investment, the country is

[4.4] An early attempt at such social accounting frameworks can be traced back to François Quesnay when he published the two-sector circular flow model in his 1758 book *Tableau èconomique*.

by definition running a current account surplus. Therefore, an imbalance in the domestic sector balances is met by an equal imbalance towards rest of the world. Since the sum of the imbalances by definition is zero, not all sectors of an economy can be net savers or net borrowers at the same time. When one sector is in sectoral surplus at least one other sector must be in sectoral deficit.

Following the tradition of Keynes, Minsky, Godley and others, the approach of sectoral balances analysis has gained more interest and impact among economists. The main sectors analysed are the government sector (GOV) the private sector (PRI) and the rest of the world sector[4.5] (ROW). Krugman (2009) is one of the few attempts to use the sectoral balances approach (SBA) to explain what happened in the American economy from a historical point of view. He specifically draws attention to a major difference between the Great Recession and the Great Depression looking at the sectoral balances. SBA has also been used as a tool to discuss the sustainability and consequences of developments in specific sectors[4.6].

The purpose of this paper is to investigate whether the SBA can be used on historical data to identify and explain major shifts in the post-war Scandinavian economies.

The choice to use the Scandinavian countries, can be summarized by two main arguments: i) the long history of reporting reliable national accounting data. Data reaching back to 1950s for Sweden and 1970s for Denmark and Norway for the sectoral balances has more recently been made available. ii) the lack of Literature using SBA on Scandinavian economies. To a large degree, recent research involving the national accounts can be split between large quantitative empirical analyses, and in-depth historical accounts of the developments in given countries. Our approach tries to combine elements of both, where data regarding the interactions between sectors could provide a crucial overview of persistent trends and patterns over time.

The reasons for choosing the SBA are, as suggested above, manifold. First, due

[4.5] The balance for the ROW is viewed from the ROW perspective. A current account surplus for the domestic country (for example Denmark) is therefore a deficit for the ROW.

[4.6] In his 1999 analysis, Godley identified 7 unsustainable processes in the American economy and in the period from 1999 to 2006 he warned against a forthcoming crisis several times. He argued, that as soon as the deficit (and exploding debt) in the private sector abated, the American economy would go into a recession – unless the public sector (and the interaction with the rest of the world) changed its behaviour dramatically.

to the underlying accounting structure of the approach, it allows us to check the logic behind a specific argument. Let us assume we have a country with either a current account deficit or even a current account of zero. In this situation, an argument stating that both the private and the public sector should target deleveraging at the same time, can easily be proven to in illogical. Second, using a simple Keynesian theoretical foundation behind the SBA, an explanation of how different sectors react to a certain change in one other sector can be provided. Thirdly, long run patterns in net balances result in the accumulation of stocks, and the financial implications of these build-ups can be extreme, vis a vis the recent global financial crisis, and subsequent recession. Fourth, the sector balances are residuals of one another, and are thus interdependent, therefore the analysis of events in the absence of a systemic framework can be biased and misleading. Fifth, financing requirements for economic development are crucial for economic policy, and sector balances provide a poignant summary of the net financial position of each sector. Finally, the incorporation of financial balances allows for a much richer understanding of the evolution of the Scandinavian economies.

The key contributions of this paper can be summarized by three points. Firstly, to the best of our knowledge this is the first paper to use the SBA on historical data for the three Scandinavian countries. Secondly, we use the SBA with a retrospective investigative focus, as opposed to the more common prognostic purpose. Finally, for the period of 1995 and onwards we integrate a stock element (sectoral wealth) into our analysis, which helps us to highlight the importance of incorporating stock-flow-consistency in the analysis.

The paper is organised as follows: Section 4.2 provides a contracted historical review of various contributions regarding national accounts for the three Scandinavian countries, and notes some core accounting identities. Section 4.3 recognises some of the recent contributions to, and uses of, the SBA. Section 4.4 presents sectoral balances data for the three countries, and Section 4.5 presents the analysis, and Section 4.6 and Section 4.7 respectively provide an international comparative and discussion of the data presented. Finally, Section 4.8 concludes.

4.2 Sectoral Balances approach

This section offers first a brief introduction to the development of a system of national accounts seen from a historical point of view. Secondly, the principle of sectoral balances is derived from national account identities, presenting some important accounting relations.

4.2.1 Background

As stated in Ark (1995), the history on using national accounts concepts dates back many years[4.7]. However, works on national accounting would await the Keynesian Revolution before featuring significantly in macroeconomic works. With Keynes and the Keynesians, a need for using national accounting data developed. Especially the need to be able to forecast the economic performance of modern Western economies became important in particular, with the aim of trying to identify what trajectory performance they were likely to take in the near future. Would the economy be expected to perform rather poorly or was the economy rather heading towards a boom phase? With a Keynesian strategy on economic policy matters, the need of introducing fiscal and monetary changes was, in general, a major priority on the political agenda. However, in order to make effective policy decisions, macroeconomists and politicians alike needed a tool, and that tool was found in developing macroeconometric models. However, to be able to do this, one needed to have the necessary data on relevant macroeconomic variables at hand. This triggered work that resulted in further data collection and eventually in the development of national account systems, following the international guidelines given by the United Nations System of National Accounts (SNA).

Christensen et al. (1995) surveyed the Nordic National Accounts since the 1880s. In general, the focus of their article was on the development of the national accounts, focusing on the real side of the economy (covering for instance a discussion on the commodity-flow method, early input-output computation and the consequences of the Kuznets project). They dated the first attempts to calculate the national income back to the end of the 19th century for Denmark

[4.7] Ark (1995) presented an interesting discussion on both the purpose of doing historical national accounting in general and the problems one faces (e.g.problems with getting the right benchmark years, various weighting procedures, how to treat the service sector correctly and how to make useful cross-country comparisons). However interesting these aspects and problems may be, it is beyond the scope of the present article to explore these detailed aspects.

and Norway and to the beginning of the 20$^{\text{th}}$ century for Sweden, using an income statistical method based mainly on tax data. As pointed out by Christensen et al. (1995, p. 31), in general, these early estimates, in comparison to the more modern Historical National Accounts (HNA) studies of the Nordic countries, seem to underestimate the economic development of these countries[4.8].

In the 1920s and the 1930s, the commodity-flow method inspired the work in Sweden (a research team led by Erik Lindahl); in reality, a sort of basic input-output computation. The project was titled "Wages, Cost of Living and National Income in Sweden, 1860-1930". Originally, this work was initiated by Gösta Bagge, and beside the construction of historical national accounts, it was supplemented by series on wage data, cost of living indices and demographic data. As such, according to Christensen et al. (1995) this work was pioneering in an international context making "Sweden unique in the development of national income statistics"; op. cit. p. 33. Likewise, in the 1920s, Danish statisticians also began using output statistics rather than income statistics. With Viggo Kampmann (whom in the 1950s as a Social Democrat became Minister of Finance, and later, Prime Minister in Denmark), national accounting was put on the agenda as a main task for Statistics Denmark further developing the output-statistical method (constructing input-output tables, use of input-output techniques and calculating series not only in current prices but also in constant prices)[4.9].

However, they (Christensen et al., 1995, p. 35) did mention that Ragnar Frisch, already as early as the 1930s, emphasized the need to distinguish between real (goods and services) and financial aspects (claims and counterclaims). A work by Frisch that finally became completed in the 1940s with his "Eco-circ System"[4.10]. However, the line of work done by Lindahl and Kampmann seems to have been preferred in Norway as a project was started in this tradition on National Income in Norway for the period 1935-1943.

Despite the point made by Frisch on the need to focusing also on financial aspects,

[4.8] However, they mention that the calculations of the British statistician Mulhall, for the case of Denmark, "show levels of income in 1878, 1880, 1890 and 1895, which are very close to those in the latest historical series".

[4.9] As concluded by Christensen et al. (1995, p. 34), "the Danish series for the 1930s is a thorough work, containing series for gross as well as net domestic product, calculated both in factor and market prices and with many separate series for both consumption, investment, productions branches ect.".

[4.10] For more details on this system by Frisch see for instance Bjerve (1986).

work on national accounts in this period hardly addressed the financial side[4.11]. Later, the demand for financial data increased, leading to the development of the flow of funds accounts, which is now an integrated part of the SNA[4.12]. With the 1968-SNA standardization, the financial balance sheet was added to the national account system. It was, however, not before the implementation of SNA 93 guidelines that a fully specified system of financial accounts, including the revaluation account, were established. According to Abildgren (2008), Statistics Denmark integrated financial account stock and flow data in the SNA statistics from 2001. Series on financial data were provided at a later stage, which date back to 1995[4.13].

Abildgren (2012) constructed quarterly national accounts in current as well as in constant prices for Denmark covering the period 1948-71 to supplement existing quarterly data made available by Statistics Denmark and the central bank of Denmark (Danmarks Nationalbank) from 1971 and onwards. He also made a collection of 17 other important key quarterly macroeconomic indicators (including several key financial variables) from 1948 to present time. Using these data in a VAR analysis[4.14], Abildgren argues that the volatility of the real GDP component in the Danish business cycle has been substantially lower from the beginning of the 1980s compared to earlier decades up to the resent crisis[4.15]. He finds that "the unemployment rate tends to lag the business cycle

[4.11] The lack of information on the financial side of the economy was not only a concern for Frisch, but also a concern for Copeland in the US and Denitez in France. As expressed by Copeland (1949, p. 254), "When total purchases of our national product increase, where does the money come from to finance them? When purchases of our national product decline, what becomes of the money that is not spent?"

[4.12] This kind of standardization resulting in the first SNA from the United Nations in 1947 followed as a natural consequence of the requirements of the Marshall Plan and OEEC. As pointed out by Christensen et al. (1995), although the Nordic countries fully accepted the international guidelines, they somehow also tried to stick to their own long Nordic tradition. However, in the 1960s initiatives were taken in both Denmark, Norway and Sweden to extend the NA-systems. Furthermore, inspired by the Kuznets-project work on Historical National Accounts took on in these countries. As an example, in Norway, series were constructed back first to 1900, then to 1865 and later on in the 1970s back to 1835.

[4.13] A Danish case study of how to construct a set of historical financial account data is given in Abildgren (2008). In this study, Abildgren focuses only on stock data rather than flow data and only on major financial assets and liabilities.

[4.14] Using this kind of method, Abildgren (2012, p. 66) argues: "Since the dynamic interactions between the financial sector and the real economy are rich and complicated, a VAR approach seems particularly useful for studies of financial instability due to the few a priori restrictions imposed on such models".

[4.15] Moreover, this is not only a Danish phenomenon. With Abildgren (2012, p. 65): "Similar results have been found for other countries, and the reduction in volatility has been termed 'the Great Moderation' ".

component in the real ... GDP, whereas interest rates, share prices and money tend to lead the cycle in output"; op. cit. p. 51. In addition, Abildgren (2012) also presents important feedback mechanisms between the real economy and the financial sector of the economy. As such, he finds that "The results of the VAR analysis ... indicate that periods of financial crisis have been characterised by an extraordinary large increase in the banking sector's write-down ratio and a related persistent decline in real GDP ... which indicates that the economic recovery after a banking crisis tends to be slower than normal"; op. cit. p. 52[4.16]. The shocks that are identified as significant by his VAR-model are located in the years of the early 1990s and 2008, precisely when the Danish, and many other European banking sectors faced particularly difficult times.

In Fløttum, Halvorsen, Simpson, & Skoglund (2012) a thorough examination of the development of national accounts in Norway is given. There, as in Christensen et al. (1995), the pioneering work of Ragnar Frisch as well as that of Odd Aukrust (who led the National Accounts Unit as Statistics Norway, established in 1946), is highlighted. As such, Norway is given credit for being one of the first countries that early on from 1952 integrated input-output tables in their annual national accounts[4.17]. By use of this tool, much analytic work on various aspects of national budgeting and macroeconomic planning was founded in the 1960s with the aim of developing better macroeconomic models of the Norwegian economy. Furthermore, in 1990 the Norwegian national accounts system was updated with the purpose of fulfilling the recommendations in the SNA 1993 Inter-Secretariat Working Group of the European Communities (1993) and the more recent European standards of ESA 1995 Eurostat (1996)[4.18]. Regarding the sectoral balances, two important aspects were thereafter taken into account. First, the institutional sectoral accounts were established, which separated the economy into five sectors (non-financial corporations, financial corporations, public sector, households and rest of the world). Secondly, the

[4.16] Later on he explains further that: "a financial crisis is characterised by an extraordinarily large increase in the write-down ratio of the banking system - that is a larger increase than the economic development would normally warrant - and that this increase is related to a decline in domestic credit and real GDP"; Abildgren (2012, p. 72).

[4.17] With Fløttum et al. (2012, p. 30): "input-output tables were not just important for the use of national accounts, but also for compiling national accounts to ensure consistency between figures. This role in the compilation is still held in Norway, while most countries do not have such a tradition". See Simpson (2009) for a thorough presentation on the Statistics Norway's use of input-output tables.

[4.18] During the years, Statistics Norway has made six major revisions of the national accounts; the last one in 2011.

financial part of the national accounts was improved significantly. However, according to Fløttum et al. (2012), during the period of 1950s to 1990, although the work on incorporating the financial part of the national accounts was initiated, the focus was especially on how to develop the real side of the economy in the national accounts[4.19].

As indicated earlier, Sweden has a long tradition of conducting research in the area of national accounting. As an example, the work done on the commodity-flow method in the 1920s and 1930s inspired the methodology of national accounting in both Denmark and Norway. As such, Bohlin (2003, p. 74), who in part surveys the more recent contributions to the Swedish Historical National Accounts (HNA), partly discusses how these new data have updated the views on Swedish economic growth since the early nineteenth century[4.20], might be justified in claiming that "Sweden is a pioneer in national accounting", as many contributions have been made to estimate historical national accounts in order to study the historical development of economic growth in Sweden as a core element in economic history.

Waldenström (2016) presents his Swedish National Wealth Database, which shows data on national wealth and sectoral net lending from 1810-2014[4.21]. As such, his database includes major asset as well as liability categories and a set of sectoral gross and net saving rates; allowing him to provide an analysis of aggregate balance sheets in Sweden for the past two centuries. With his particular focus on net wealth aspects, Waldenström (2016, pp. 37–39) provides a contracted but very interesting presentation of previous work on national accounts in Sweden. Undoubtedly, Waldenström's own work should be seen as a modern major continuation of these earlier contributions.

From 1880 to 1901 both Karl Daniel Bollfras and Pontus Fahlbeck gave some estimates on the stock of wealth (and debt) in Sweden for PRI and GOV in total. In 1912 Flodström presented and in-depth investigation of Sweden's national wealth in the year 1908. Later, in the 1950s and 1970s, more attempts were

[4.19]In Fløttum (1981) the stock of a number of financial assets can be seen at a sector-level decades earlier, but without the financial account being a part of this statistic.

[4.20]As such, in highlighting the historical growth pattern of Sweden, which led Sweden to become one of the richest countries in Europe, Bohlin (2003, p. 91) noted that future revisions of older GDP estimates might well "lead to higher output figures since new research generally incorporates the output of productive activities that had been neglected in earlier calculations".

[4.21]For a more detailed presentation and discussion of this database, see Waldenström (2015).

made to estimate the balance sheet of the household sector, but without much attention to the other sectors of the economy[4.22]. In 1993, Lars Werin collected a database on financial assets and liabilities, creating a financial balance sheet for all the sectors from 1945-1990[4.23]. Waldenström also refers to the work done by Statistics Sweden in constructing official series of national wealth and points to Bergman, Djerf, & Lindström (2010) analysis examining household balance sheets between 1970 and 2008 as important contributions in the line of work on wealth matters[4.24].

Aside from presenting evidence on previous work, Waldenström (2016) conducts a thorough and very enlightening analysis of the development of the Swedish national wealth - split in three parts: an analysis of private wealth, government wealth and national wealth - for a rather long period of two centuries.

Alongside Waldenström, Lindmark & Andersson (2016) also focus on how to assess historical Swedish wealth patterns. In doing so, they point to the fact that most HNA based research focus on economic flows rather than trying to analyse the process of economic growth from a capital stock or an asset perspective. Thus, they aim to highlight various aspects of the development of the Swedish capital stock in the period 1830-2010[4.25]. Contrary to Waldenström, they explored different patterns of return between four sectors (the primary sector, the manufacturing sector, the sector of transport and communication and

[4.22]Waldenström (2016, p. 38): "A follow-up on Flodström's investigation was made by Englund (1956) to capture national wealth in 1952) … In the 1970s, Spånt (1979) published an extensive study of the evolution of the Swedish household wealth distribution since 1920 … An important contribution is Lennart Berg's estimation of annual household balance sheets made for the period 1950 onwards".

[4.23]Following the recommendation in the development of SNA and ESA, Statistics Sweden offers both national and financial accounts for all institutional sectors in the economy.

[4.24]As such, Bergman et al. (2010) considers alternative perspectives on the SNA for the Swedish economy. As they point out, such work has historically not been given the right attention. In Sweden, as elsewhere, work on balance sheets has not attracted much attention when doing national accounts. This is probably due, as they argue, to a number of reasons. One important reason is that such methods did not hitherto seem to have played a significant role in economic analysis of the Swedish economy. However, because of the resent global financial crisis, the authors expect that more attention will be drawn to this kind of analysis in the future in an effort to try to unfold the important interactions between an economy's financial and real economic variables (stock and flow wise).

[4.25]They deal in particular with two main questions: "what characterises the scope and the structure of capital stock over time and across sectors? … and … how does the ratio of income to capital evolve over time, and is the return on capital equal over time and across sectors"; Lindmark & Andersson (2016, p. 123). Regarding these questions, they conclude that the capital ratio level of Sweden has followed that of other European countries. Furthermore, the capital return grew significantly during the period of industrialisation with the manufacturing sector playing the key role in improving the capital return in total.

private services). In addition, Schön & Krantz (2012) investigated early modern economic growth. In their study, some detailed information and estimation on Swedish GDP data from 1560 and onwards is presented with a particular focus on the period prior to 1860 giving new estimates of Sweden's growth from the mid-sixteenth to the nineteenth century. As indicated in Schön & Krantz (2012, p. 539), the level of GDP per capita in the period 1560 to 1860 is remarkably steady, showing hardly any growth (however, with yearly fluctuations). As such, Sweden seems to fit well with the continental pattern of long run GDP per capita stagnation up to the early nineteenth century.

4.2.2 Accounting

In this section, the concept of net lending (*NL*) across different sectors is introduced both from the real side and the financial side of the economy.

To understand the properties of *NL* we start with the composition of GDP:

$$GDP = C + \ I_P + \ I_G + G + X - M \tag{4.1}$$

Where C is PRI consumption, I_p is PRI investment, I_g is GOV investment, G is GOV consumption, X is exports and M is imports.

If public investment is integrated into G this now represent public expenditures on final goods, the equation can be written as:

$$GDP = C + \ I_P + G + X - M \tag{4.2}$$

By taking net income and net transfers from abroad into account, the gross national income can be expressed as:

$$GNI = GDP + NIA = C + \ I_P + G + X - M + NIA \tag{4.3}$$

where NIA is the net income and current transfers received from abroad.

By introducing transfer payments across the domestic sectors, NT expresses the tax payment from PRI to GOV net of transfer payments and subsidies paid by GOV to PRI. If saving in PRI, S_p, is determined as the disposable income not spent on consumption, the three-sector balance can be derived as,

$$(S_P - I_P) + (NT - G) + (M - X - NIA) = 0 \tag{4.4}$$

The first bracket expresses the *NL* or sector balance for PRI, the second bracket expresses the sector balance or *NL* for GOV, and the third bracket represents the *NL* or sector balance for ROW[4.26].

Equation (4.4) clearly shows, why all sectors cannot be net savers or net borrowers at the same time. If one sector is in sectoral deficit, at least one other sector needs to be in sectoral surplus. It is important to notice, that nothing can be said about causality from this national account identity. As stated by Brink (1983), the changes in *NL* can be initiated in all sectors, and each of the sectors has a life on his own, implying that the ultimate annual net position is largely a residual of the cumulative activities in each sector. The concept of *NL* can also be derived from the financial side of the economy, where it measures the differences in and transaction of financial assets and liabilities for the different sectors.

$$NL = FA_{tr} - FL_{tr} \tag{4.5}$$

Where, FA_{tr} are the collective transactions in financial assets, while FL_{tr} are the collective transactions of financial liabilities. Since the sum of *NL* across the three sectors is zero, the total transaction value of financial assets and liabilities are equal: if one sector accumulates more financial assets than financial liabilities at least one other sector must accumulate the counterparts.

The accumulation of both financial assets and liabilities and non-financial assets, affects the stock of financial wealth in all sectors. Positive *NL* increases, ceteris paribus, the stock of wealth for the individual sector, which can be written as,

$$V = V_{t-1} + NL + CG \tag{4.6}$$

[4.26] We use the terms net lending and saving surplus as synonymous, despite the fact, that the two terms diverge due to *capital transfers* and *acquisitions less disposals of non-produced non-financial assets*. These two accounts are however very small. The values for net lending and saving surplus are thus very close to one another.

where V is the net wealth, NL is net lending, and CG is any capital gains (or revaluations). As pointed out by Waldenström (2016) and Knudsen (2017), fluctuations in net wealth over time are mainly due to changes in NL (net accumulation of financial assets) rather than capital gains, whereas short run fluctuations can be due to capital gains. Since the description of the three countries is based on a longer time perspective, capital gains are ignored in the descriptions in Section 4.4 below.

It is however important to point out, that while Equation (4.6), for wealth accumulation, indicates that NL affects wealth, the causality of course runs in both directions, since the NL also depends on the stock of wealth. This is largely due to financial and real property rental incomes and expenses. This means, that in order to analyse the NL behaviour correctly, the financial status (net wealth) of a given sector must also be taken into account.

4.3 Literature Review

The SBA as a tool for analysis, has received some attention in recent years, and is based on the system of national accounts (SNA)[4.27]. The British and American history of the standardised system of national accounts employed today can be traced back to James Meade and Richard Stone in the UK, and to Morris A. Copeland in the USA, who contributed greatly to the establishment of the 1953 United Nations System of National Accounts[4.28]. As noted by Godley & Lavoie (2012, p. 24), the initial interest of Copeland in the 1940s was to investigate the financing requirements of economic activity between and across the national sectors[4.29]. The SBA approach could be described as a continuation

[4.27] An early attempt to try to use a technique somewhat similar to the SFB is given by Mishkin (1978). Using US household balance sheets, Mishkin tried to shed new light on the Great Depression. As such, he emphasises the crucial interaction between the real economy and the financial sector. To Mishkin, the financial position of the household sector was a very important factor in patially explaining why the Great Depression happened and how it evolved through time. For instance, he pointed out that “The early years of the Great Depression stand out as a period when the consumer suffered a significant deterioration in his financial position ... The improvement of household’ financial status until 1937 coincides with the recovery from the trough of 1933 ... The comparison of the movement in real gross national product and changes in the balance sheets of households indicates that there might be more than a coincidental relationship between them”; Mishkin (1978, pp. 923–924).

[4.28] Glötzl & Rezai (2017) trace the development of the SNA back to an article published by Meade and Stone at the Great Britain Treasury – although they allude that inspiration should be attributed further back to Keynes.

[4.29] Adequate data for such a presentation of the financial side of the economy only became available much later in the 1970s and 1980s and was formalised in the System of National Accounts in 1993 (Inter-Secretariat Working Group of the European Communities, 1993).

of Copeland's goals with the aid of modern technology. The work of Wynne Godley together with other key authors, (see Godley & Cripps, 1983; Wynne Godley, 1999b; W Godley, 1999; Godley, 2004; Godley & Lavoie, 2001, 2012; Godley & Zezza, 1989, 1992), is recognised by many economists, e.g. by Bezemer (2009) and Fiebiger (2013), as the instigating factor in the re-emergence of SBA. In light of the relatively recent availability of comprehensive and relatively accurate data on the financial side of the economy, Godley, together with several collaborators, conducted pioneering work in integrating the real and financial sides of the economy in a unified, stock-flow consistent macroeconomic modelling framework.

As highlighted by Tissot (2016), as a consequence of the global financial crisis of 2007-09, the development of financial sectoral accounts has been high on the political agenda, as efforts to perform various financial stability analyses became a core concern of monetary authorities. As such, much work has been done to ensure access to the needed financial data[4.30]. It was realised that the crisis had underscored at least three aspects: 1) debt plays a central role in the build-up of crises; 2) focus should be given to the many innovations that are carried out within the financial system, as these innovations evolve constantly as well as rapidly; and 3) the fact that financial imbalances often occur more or less simultaneously across countries.

Despite the fact that the sector balances are often discussed, surprisingly few empirical analyses can be found in the literature. Recent studies using this approach are presented below. In a recent paper, Glötzl & Rezai (2017) present an analysis that follows the work presented by Barbosa-Filho et al. (2006) & Barbosa-Filho et al. (2008), where they use sector NL to discuss possible causalities between the sectors.

In Glötzl & Rezai (2017) the analysis covers 22 European countries using quarterly data from 1999 to 2013. The authors show, how the *NL* of the single sectors behave concerning the business cycles for the 22 countries focusing on

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These accounts were revised again in 2008, and for the European Union, the most recent version is the European regional and sector accounts 2010 (Statistical Office of the European Communities., 2013), and was published in the official law journal of the European Union in 2013 (Euponean Union Commission, 2013).

[4.30] Tissot (2016, p. 9) noted that "public authorities have realized that important information had been missing on the financial system and had to be collected ... As a result, all the G-20 economies have developed plans to improve their financial accounts statistics. A data template on sectoral accounts was finalised in 2012".

which sectors lag or lead the business cycle, as proxied by the output gap. The analysis is numerically driven, and does not lend itself to an in-depth exposition of each country.

Regarding Denmark, their analysis shows that the *NL* of the household sector (HH) and financial corporations sector (FC) seems to lead the business cycle, while *NL* of non-financial corporations sector (NFC) and ROW seem to react as a response to the business cycle. GOV shows no evidence of either lag or lead. In Sweden on the other hand, *NL* of GOV (and NFC) seems to lag the business cycle, whereas *NL* of HH seems to lead the business cycle. In both Denmark and Sweden, net borrowing of HH and NFC is pro-cyclical, while net borrowing in GOV is counter-cyclical. For Denmark *NL* of ROW is counter-cyclical and NL of financial corporations is pro-cyclical, neither of which show significant patterns for Sweden[4.31].

Barbosa-Filho et al. (2006) present a graphical illustration of *NL* of the five institutional sectors (HH, FC, NFC, GOV and ROW) for both the US, covering the period of 1947-2004, and a panel of developing countries, with data for the years 1980-2002, also to investigate possible explanations for the link between the sectors.

Ali Abbas, Bouhga-Hagbe, Fatás, Mauro, & Velloso (2011) performed a substantial empirical analysis of the potential relationship between public sector spending and current account net balances. Their presentation allows for a more nuanced understanding of the effectiveness of different policies given prevailing conditions in trade, with financial openness, and the monetary/exchange rate regime.

These above-mentioned papers are primarily focused on either to test the validity of suggested causalities in a group of countries or on efforts trying to explain the effects of fiscal policy in general. None of these papers try to provide information of specific events using the SBA as a tool.

With regards policy analysis, Semieniuk, Treeck, & Truger (2012) conducted empirical analysis of the three sector balances to discuss the possible outcomes of the European Stability Pact program from 2011-2014. The authors use the SBA to question the reliability of the predicted results from the European Commission of the Stability Pact.

[4.31] Norway is unfortunately not a part of the sample in any of the analysis presented here.

Looking further back in time, Brink (1983) used arguments analogous to the present NL discussions. He argued that the major reason for the persistent GOV *deficit* in Denmark during the 1970s and 1980s was low demand from abroad due to the global economic downturn and financial consolidation in PRI. In accordance with this view of sector inter-relations, Krugman (2009) more recently noted that governmental deficits are often a consequence of the workings of the automatic stabilizers rather than as a result of expansionary fiscal policy changes – both apparently portraying GOV balance as somewhat passive to changes in the other sectors. This, however, does not imply that discretionary policy changes have no effect on the sector balances, as policy changes directly affect the balances in PRI and ROW. In case of a lower propensity to import in GOV compared to PRI, an increase in GOV consumption financed by an increase in taxes leads to an increase in *NL* in PRI, while the *NL* in ROW falls – that is, one would see an improvement on the current account.

Tissot (2016) used the banking crisis in Sweden in the early 1990s as a case for highlighting the relevance of a SBA. As a result of the crisis, PRI in Sweden began to deleverage (reduce debt), which can be seen by the steep increase in *NL* in PRI in Sweden following the crisis[4.32]. As a result of this deleveraging in PRI, GOV was massively affected. The lack of demand from PRI is explained to have led to a deterioration of the GOV balance. After the initial phase the need for deleveraging in PRI faded out, which coincided with a gradual improvement in the GOV balance.

Finally, a working paper from Statistics Sweden, Bergman et al. (2010) analysed the changes in balance sheets across the different sectors of the economy during 2008-2009, following the recent financial and economic crisis. Focusing on foreign debt, Bergman et al. (2010) linked the changes in balance sheet across time with *NL* of ROW. Despite continuously negative *NL* for ROW, the Swedish debt to ROW has not fallen to the same degree. He explained this discrepancy with capital gains; the consequences of a revaluation of the Swedish stock of liabilities held abroad.

This review of the literature working with sectoral balances highlights a gap in the literature in the use of the SBA in explaining the development of an

[4.32] There is some debate as whether this reduction is driven primarily by demand (for credit) or supply (of credit) factors. See for example Bernanke & Gertler (1995), Bernanke (2007), and Disyatat (2011).

economy in retrospect.

4.4 The Three Economies

Before the sectoral balance approach can be used on the Scandinavian Economies, it is relevant to provide a short empirical presentation of the developments in *NL* as well as the net financial position of the three economies. In this section, the presentation is done individually for each country, starting with Denmark and followed by Sweden and Norway.

Figures 4.1 and 4.2 show *NL*, net financial wealth (NFW) and percentage growth in GDP for the three main sectors for Denmark. Overlaid in the background is real GDP growth as a fine red dotted line.

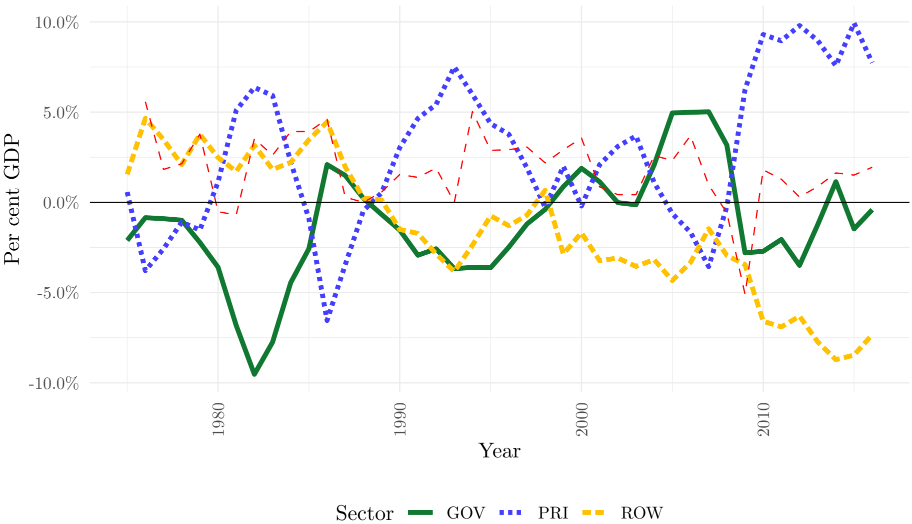

Figure 4.1: DK: Net Lending

Source: Eurostat, ADAM macroeconomic database, authors own workings. Lines represent annual net lending to GDP ratios.

As shown above in Figure 4.1, *NL* for GOV was negative from 1975 to the late 1990s, with the exception of a few years of positive *NL* in the late 1980s. In the years leading up to the Great Recession, GOV shows positive *NL* of up to 5% of GDP, clearly breaking away from former patterns of *NL* for GOV. After the crisis, *NL* turned negative again, which resulted in a warning from the European commission in 2010, after which, the *NL* for GOV has moved more towards zero.

NL of PRI has been more volatile over the years, however, since 1990, NL of PRI in Denmark has been almost entirely positive. The only exception being the years shortly prior to the Great Recession, where the level of PRI investment exceeded the level of savings. In the aftermath of the crisis, *NL* of PRI remained positive in every year at a rather high level of around 10% of GDP.

NL of ROW can be divided into two sub periods of time; before 1989 and after 1989. Before 1989 the Danish economy faced a current account deficit. Starting from the beginning of the early 1960s, Denmark experienced a prolonged period of more than 25 years of current account deficits, which resulted in the accumulation of foreign denominated GOV debt, and an associated net foreign liability position to ROW. After 1990, the situation changed significantly, indicating an important structural change in Denmark. As such, the *NL* of ROW has since remained negative for all the following years, except for 1999.

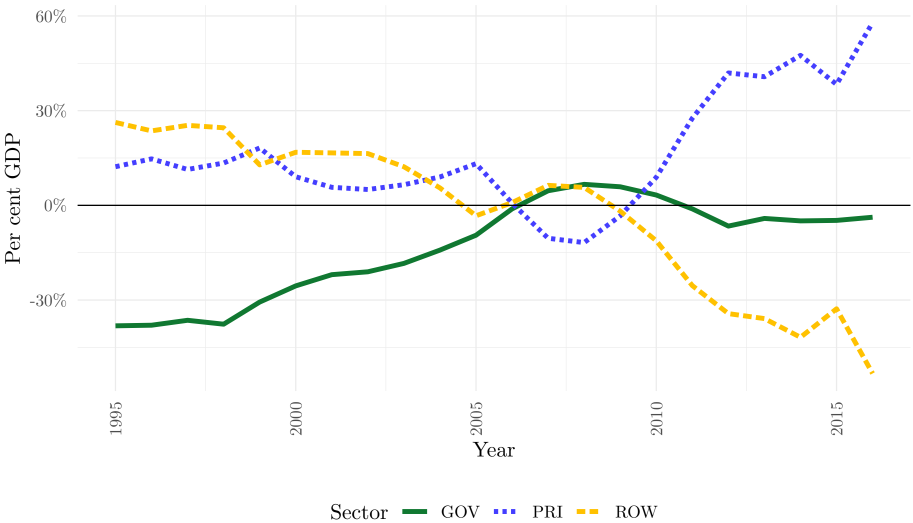

Figure 4.2: DK: Net Financial Wealth

Source: Eurostat, ADAM macroeconomic database, authors own workings. Lines represent annual net financial wealth to GDP ratios.

Figure 4.2 shows NFW of the individual sectors. Although the introduction of capital gains in general is beyond the scope of this paper, capital gains can be seen as the reason for the misalignment between the result in Figure 4.2 and an accumulation of the *NL* data presented in Figure 4.1. The effect of accumulated liabilities resulted in foreign denominated GOV debt right up to the beginning of the 1990s. The persistent foreign deficit, and the debt related to it, became a fundamental problem for Denmark during those years.

The net financial wealth (NFW) of GOV was -40% of GDP in 1995. Between 1995 to 2005 the net financial deficit was reduced more or less to a neutral position and remained fairly stable afterwards.

The NFW of ROW in Denmark declined continuously throughout the period, from 30% of GDP in 1995 to –50% of GDP at the end of the period. As such, from being a net borrower, Denmark became a net lender to ROW. Finally, the NFW of PRI illustrates what appear to be two entirely different regimes. The first period with a steady decline between 1995 and 2007, where total NFW was negative between 2007 and 2009[4.33]. The second period shows a rapid accumulation following 2009, where the sector as a whole increased its financial NFW to 60% of GDP — a dramatic consolidation of the sector[4.34].

Figures 4.3 and 4.4 show *NL*, percentage growth in GDP and NFW for the three main sectors for Sweden. Historically, as can be seen in Figure 4.3, *NL* for the Swedish economy fluctuated around 0% of GDP for all three sectors from 1950 to the middle of the 1970s with a slightly downward trend for PRI.

[4.33] Data for PRI lending illustrate accelerated expansion of debt leading up to 2007, in conjunction with a collapse in financial asset prices following the crisis in 2008-9. The ratio of financial assets to liabilities in PRI is somewhat neutralized by the offset of sub-sector holdings against one another, specifically FC holds the counterclaims of both HH and NFC, and NFC equity represents a counterclaim of many HH and FC assets.

[4.34] The recovery of financial asset prices following the crisis appears to have benefited PRI for all three of the countries in the analysis. Denmark in particular seems to have benefited from this process, with equity prices having risen by 228% since 2010 — followed closely by Norway and Sweden.

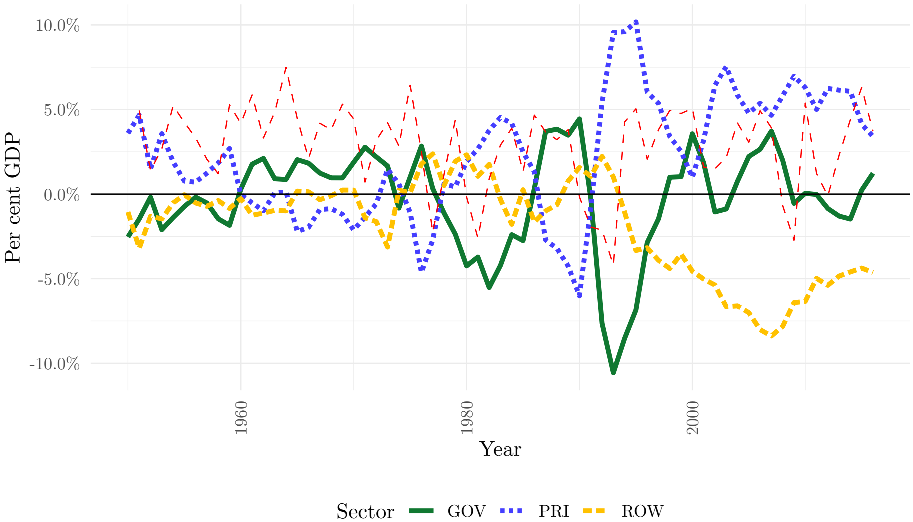

Figure 4.3: SE: Net Lending

> *Source: Eurostat, ADAM macroeconomic database, authors own workings. Lines represent annual net lending to GDP ratios.*

For both PRI and GOV the fluctuations increased until the first half of the 1990s, where a glut in PRI credit was followed by a banking crisis, and GOV was forced into a bailout. *NL* in PRI was nearly 10%, while *NL* of GOV was almost –10%.

After the imbalance connected to the banking crisis in the beginning of the 1990s, *NL* of GOV returned closer to zero, but with two periods of surplus budget positions in the early 2000 and 2007-2008. *NL* of PRI took a small dip in the middle of the 1990s but has remained positive at around 5% of GDP since this period. *NL* of ROW fluctuated between 5% and –5% in the period of 1975 to the end of the 1990s. Since 2000 *NL* of ROW has maintained a negative annual balance of more than 5% of GDP.

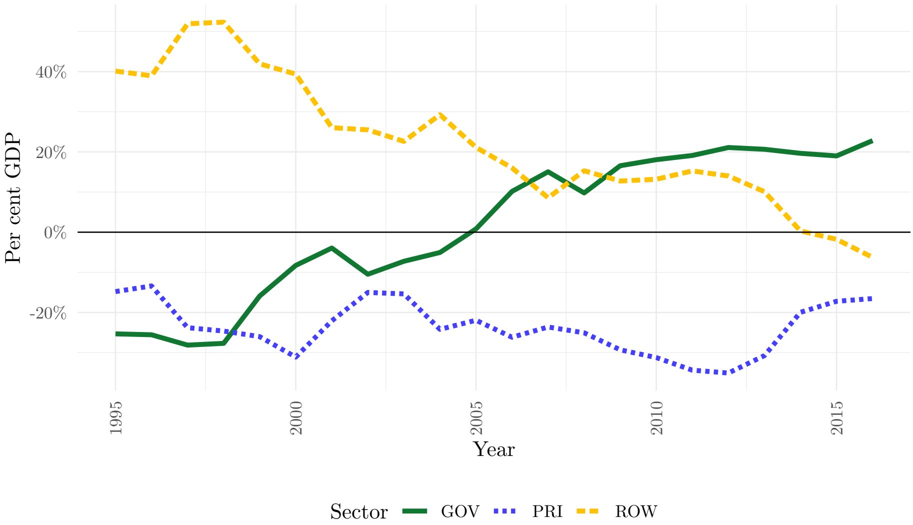

Figure 4.4: SE: Net Financial Wealth

Source: Eurostat, ADAM macroeconomic database, authors own workings. Lines represent annual net financial wealth to GDP ratios.

For Sweden the NFW position of PRI was negative in 1995, but unlike the case of Denmark, the position remains negative throughout the period in Figure 4.4. This could contrast with what might be expected from the positive *NL* balance of the sector over the entire period of 1995 to 2016[4.35]. The trend in the net asset position of ROW, however, follows the *NL* position, which is negative throughout the period. GOV *NL* in marginally positive and its NFW position improves throughout, initially negative, and gradually moving to positive 20% of GDP.

In Figures 4.5 and 4.6, *NL* as well as NFW for the three main sectors for Norway can be seen.

[4.35]This negative position can be explained by closer inspection of the underlying components of the net balance sheet positions of the sub-sectors of PRI. A detailed exposition of the underlying components of the net balances is, however, beyond the scope of this paper.

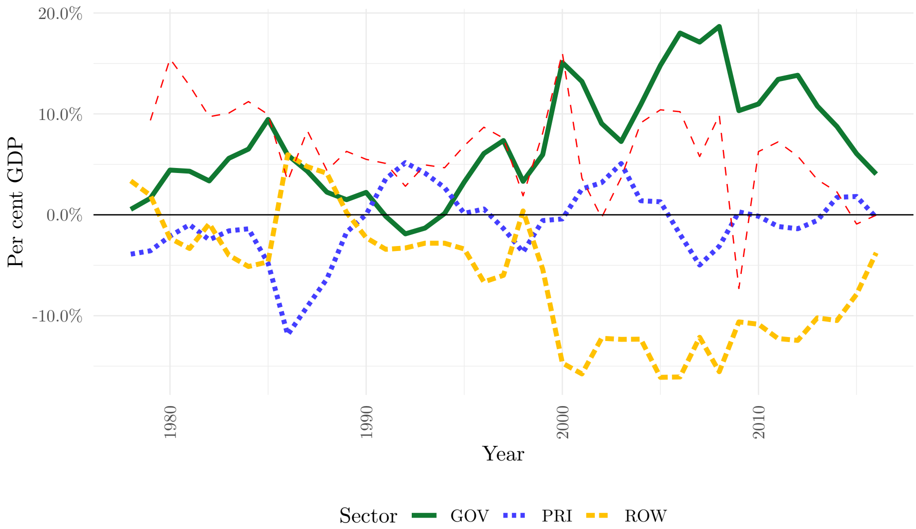

Figure 4.5: NO: Net Lending

Source: Eurostat, ADAM macroeconomic database, authors own workings. Lines represent annual net lending to GDP ratios.

In Figure 4.5 *NL* for all the three sectors of the Norwegian economy is markedly different from the Danish and Swedish cases. In contrast to Sweden and Denmark, *NL* of GOV does not fluctuate around zero, and has been significantly positive for almost the entire period except for a short period in the beginning of the 1990s[4.36]. *NL* for ROW was positive before 1980 and in the last half of the 1980s. In the first half of the 1980s and after 1988, the *NL* of ROW was negative.

NL of PRI was negative from 1978 to 1990, after which it has fluctuated around zero with changing positive and negative values. In the 2000s, the *NL* of PRI changes quite substantially from having an upward trend to downward trending until around 2008 where PRI once again begins to rise slightly, converging once again towards zero. Up to the crisis, the imbalances of *NL* in both GOV and ROW increased in size, thereafter both balances show decreasing tendencies, trending closer to balanced positions, but remaining negative and positive on an annual basis respectively.

[4.36]Note the significant change in scale of the vertical axes for Figures 4.5 and 4.6 for the Norwegian case.

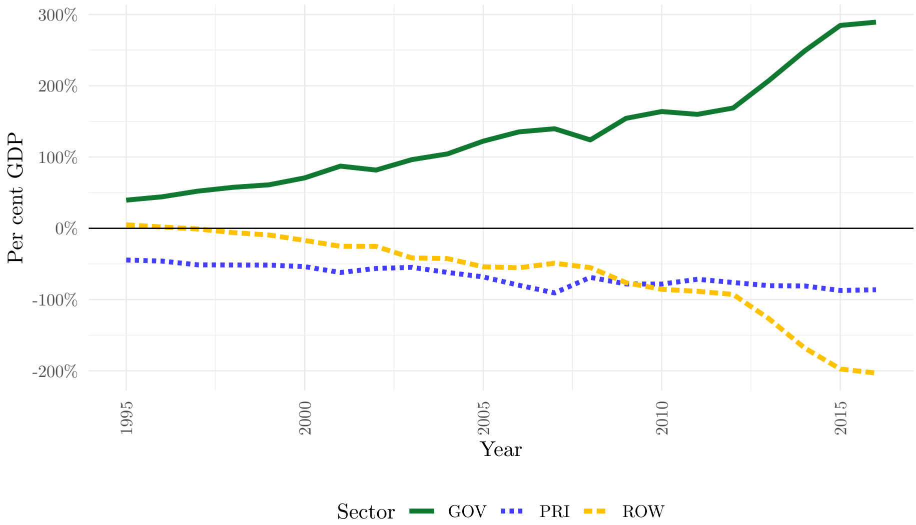

Figure 4.6: NO: Net Financial Wealth

Source: Eurostat, ADAM macroeconomic database, authors own workings. Lines represent annual net financial wealth to GDP ratios.

From the *NL* of the institutional sectors of Norway, the expectation is to have an increase in the NFW position GOV, an equivalent decline for ROW, and marginal changes for PRI. This is confirmed by Figure 4.6 , for GOV and ROW, although PRI experienced a steady decline in NFW, from roughly -40% to -80% of GDP, despite having periods of positive *NL*.

As can be seen from the above description of the three countries in Figures 4.1 to 4.6, during the period some major changes have occurred in the three Scandinavian countries, where especially the changes in the current account for all three countries calls on attention (all three being in the negative terrain for the later part of the period). In the next section a chosen number of these major changes are analysed with the use of SBA.

4.5 Analysis

In this section, the developments in *NL* as depicted in Section 4.4 are analysed for each of the three countries. From the data presented graphically in Section 4.4, some basic statistical properties can be calculated to support the analysis. *NL* for PRI for all three countries shows a negative correlation with economic activity. *NL* of GOV increases with economic activity and for ROW no clear story can be told, since the correlation values are mostly insignificant[4.37]. In all three countries the correlation between changes in *NL* for PRI and ROW are negative. Furthermore, for Denmark and Sweden, the correlation between *NL* for PRI and GOV are both negative, while this relationship is insignificant in Norway. The correlations between *NL* for GOV and ROW in Norway is negative, while these relationships are insignificant for both Denmark and Sweden.

As noted earlier, the purpose here is examine whether the SBA can be used on historical data to identify and explain major shifts in the three countries identified above. The analysis therefore discusses the major shifts identified by the empirics presented in Section 4.5. Rather than provide an exhaustive investigation, the intention is to highlight the benefits of the SBA in providing insight into how events unfolded, and to motivate future researchers to use SBA as a compliment to historical investigations. In addition to *NL* and NFW data, the discussions are supplemented by consulting key economic indicators, including GDP, employment data, consumption, investment (both PRI and GOV), government consumption expenditures, imports and exports. The last part of this section provides a comparison of the three countries, together with a brief comparison with some larger industrial nations.

4.5.1 Explanation of net lending in Denmark

Based on the empirical evidence in Figures 4.1 and 4.2, two periods of time attract attention and call for further explanation: firstly, the period around 1989, where the Danish economy is transformed from an economy with persistent current account deficit to an economy with current account surplus. Second, the period after 2003, where the sectoral balances diverged a persistent trend in several aspects.

In the period from 1976 to 1989, Denmark struggled with a current account deficit, which increased foreign debt throughout period. In general, the target of economic policy during this period continuously switched between stimulating the domestic economy and improving the status of the current account, which was characterized by a ‘stop and go’ fiscal policy, shifting between both stimulative and contractionary effects on aggregate demand, with a keen eye

[4.37] The results of these correlation coefficients can be seen for all three countries in the appendix, in Section 4.9.

to the development of the current account as the size of the deficit needed to be controlled. For example, in the mid-1970s a temporary reduction in the VAT for six months was introduced to stimulate consumption and investment activities, which contributed to an increase in aggregate demand but also to greater level of imports, which deteriorated the current account deficit further.

In the first half of the 1980s, PRI experienced a consolidation of its accounts, reflected by positive *NL*. This, combined with the lack of demand from abroad, worsened the financial balance of GOV, which declined to a deficit of almost 10% of GDP during this phase. In 1980s two initiatives were introduced to restore both the internal as well as the external balance: 1) the suspension of the 'cost of living adjustment', which should improve international competitiveness through a slow-down in wage inflation, and 2) stabilisation of the exchange rate, introducing an economic strategy to refrain from further devaluations within the European exchange rate arrangement. In 1985 and 1986, PRI consumption and investment activities increasingly stimulated imports. This corresponded with a deterioration in the current account and, simultaneously, largely due to high PRI expenditures, a substantial PRI *NL* deficit. On the other hand, *NL* of *GOV,* as the counterpart, improved significantly. The remedy at the time was believed to be tight fiscal policy, and the so-called 'potato diet' was introduced to reduce consumption and thereby imports (DØRS, 2008; Gaard & Kieler, 2005). This change in behaviour of the PRI can be seen from Figure 4.1, resulted in positive *NL*. The Danish trade balance had already turned positive in the mid-1980s, following rising foreign demand for Danish goods. This, together with lower demand for imports, marked a turning-point in the Danish international position, as the current account deficit shifted to surplus. This shift was reinforced by increased emphasis on export activities, which added to the income of the domestic sectors. PRI thus trended gradually towards positive *NL*[4.38]. Unsurprisingly, the suppressed activity in PRI together with high levels of unemployment, automatic fiscal stabilisers and stagnation in public consumption, was accompanied by negative *NL* for GOV.

The second episode highlighted in this analysis is the period after 2003. From 2003, PRI reflected improved optimism regarding the future, with increasing PRI expenditures (both consumption and investment) and negative *NL*. This

[4.38] A major contribution to this positive *NL* can be found in the expansion of the labour market pension scheme as a part of a collective bargaining agreement in 1991, see e.g. Autrup, Kramp, Pedersen, & Spange (2015).

of course boosted aggregated demand. The high growth rate in the economy increased the demand for labour, which affected employment positively and thereby affected both the income and social expenditures of GOV. As a result of the high demand, the automatic stabilizers forced *NL* in GOV, despite the use of expansionary fiscal policy, to climb as high as 5% of GDP before the 2007-8 crisis hit Denmark.

From 2007, growth in imports and exports seem to follow the same trend, which indicates that the improvements in the current account were driven by income generated by NFW held abroad, which can be seen in Figure 4.2. Net financial wealth held abroad was negative from 1995-2005, as a necessary consequence of the prolonged period of current account deficits, but has been positive since 2009. Despite positive net income from abroad, PRI appears to have continued the consolidation in the wake of the crisis, wherein the NFW in PRI was negative[4.39]. This means, that a smaller portion of income is used for consumption and investment, coinciding with a dramatic increase in *NL* (to almost 10% of GDP) in PRI and thereby a fall in the debt-to-income ratio for the sector. This reticence in PRI together with the lack of expansionary policies appears to have kept GDP growth rates at low levels, resulting in negative *NL* for GOV, as reflected by small annual deficits.

4.5.2 Explanation of net lending in Sweden

From Figures 4.3 and 4.4, two periods of time call for further investigation: the period preceding the banking crisis in the early 1990s, where sectoral imbalances increased continuously from the 1950s, and the period after the recent crisis, which appears to be imperceptible from the sectoral balances.

From an SBA point of view, the sectoral imbalances in the period from 1950 to 1970 were small compared to the imbalances identified in later periods. In general, a negative co-movement between PRI and GOV can be seen for almost the entire period.

While the period from 1950-1960 was characterized by a sectoral surplus for PRI and deficit for the two other sectors, the situation changed from 1960 to the first oil crisis, where PRI was in a financial deficit. Englund (1999)

[4.39] The negative net asset position can be explained by a significant accumulation of debt, and capital losses during the financial crisis. With Danish household debt to disposable income peaking at just over 300% in 2009.

argued that Sweden in the post-war period was quite a closed economy, where Keynesian-rooted policies mainly focused on supporting the domestic economy, creating high levels of economic activity.

After the oil crisis in the early 1970s, Sweden, like most other economies, faced high inflation rates, which, together with fixed exchange rate arrangements, resulted in steady real exchange rate appreciation and declining competitiveness of Swedish firms. In an attempt to restore the competitiveness, the Swedish Krona, like the Danish Krone, was devalued several times. At the end of the 1970s and beginning of the 1980s, the growth rate of real GDP fluctuated more dramatically, coinciding with a consolidation of PRI accounts, as indicated by low expenditures on both consumption and investment leading to a positive *NL* balance, while GOV, most likely due to the behaviour of PRI and the small deficit on the current account, went into financial deficit. This sectoral deficit lasted until the second half of the 1980s, where the high level of demand, mainly from PRI, created higher levels of economic activity and, via automatic stabilizers, a financial surplus in GOV.

Iversen & Larsson (2011) and Englund (1999) both noted extensive deregulation of Swedish capital and financial markets between 1970 and 1990, including deregulation of international capital flows and the establishment of a new money market with options and derivatives. These deregulations permitted Swedish HH to take advantage of the low interest rate environment, stimulating PRI activities. This ultimately led to a boom in the Swedish economy, driven primarily by increases in both asset and property prices. When the housing bubble burst in 1989, the banks in Sweden faced extensive losses. Englund (1999) explained that 1992 saw massive credit losses in PRI, which he ascribed to the debt boom and deregulations that preceded.

Combined with an international economic slowdown, a European currency crisis and a GOV financial crisis, this was followed by the reconstruction of the tax system. As a consequence of these events, the Swedish Krona departed from the fixed exchange rate system. This led to a massive depreciation of the Swedish Krona and triggered the worst crisis in Sweden since the 1930s, resulting in a substantial decline in GDP, forcing shrinkage of GOV and, via a collapse in imports, improved the current account from a deficit to a surplus position. The fall in inflation in 1990-1992 resulted in an increase in the real interest rate and affected the value of real assets negatively. Through what appears to have been a balance sheet recession, both PRI investment and consumption fell, corresponding to an increase in PRI savings, as seen in Figure 4.3. As explained by Tissot (2016), the expansionary fiscal policy changes related to the banking crisis shortened the recovery phase in comparison with other crises. Because of the consolidation in PRI during and after the crisis, GOV needed to intervene in order to prevent a dramatic fall in economic activity.

This expansionary policy led to a deficit for GOV, but it made the essential deleveraging process in PRI possible, and made a considerable contribution to the rapid recovery of the Swedish economy. It also marked a change in the composition of the three sectors; from then on, the current account remained in a surplus position, and PRI changed to persistently positive *NL*. The net financial debt for PRI increased from 1995 to 2000, despite positive *NL*, which can be explained by the liability counterpart of capital gains[4.40]. From 2000, the positive *NL* can be seen as a consolidation, since net financial debt decreased in this period. Because of the persistent current account surpluses, the NFW for ROW fell constantly, becoming negative in 2015. NFW for GOV was negative in the first half of the period, but became and remained positive in the second half of the period.

Focusing on the recent crisis, in 2009, where the real GDP fell by 5.2%, it is remarkable that only small changes in the sectoral balances can be identified. In PRI, real consumption even increased, albeit a minor increase, which resulted in a fall in aggregate savings. Contrarily, investment fell by more than 13%, which created an increase in *NL* of PRI. Despite a huge fall in imports, the current account declined in 2009, mainly as the result of a sharp drop in the exports associated with the global economic crisis that year. In the case of GOV, increases in real GOV consumption indicated slightly expansionary fiscal policy, which, together with a fall in tax income following automatic stabilizers, created a fall in *NL* of GOV.

[4.40] Equities represent extensive liabilities for issuers, these are held primarily by the NFC. The counterpart to these equities is to a large extent inventories, which are not included in the financial account, and thus are not offset against financial liabilities. Equity market gains since 2010 have been substantial in all three of the Scandinavian countries reviewed here. The increase in the OECD share price indices from 2010 to 2016 were respectively, Denmark 123%, Norway 79%, Sweden 76%. (OECD, n.d.)

4.5.3 Explanation of net lending in Norway

Figures 4.5 and 4.6 present the data for Norway. The events identifiable from the sector balances include, firstly, the changes in the composition of the sectoral balances in the period preceding 1990. Secondly, the reasons for persistent twin surplus on the current account and GOV after 1990, which is fundamental in understanding the recent evolution of the Norwegian Economy.

As indicated in Figure 4.5, in the period from 1978-1990 PRI ran a persistent financial deficit, while the GOV had a financial surplus. For ROW the balance fluctuated between being positive and negative. With a positive trade balance throughout the period, the current account deficit can only be explained by negative net income from abroad. Positive net exports increased aggregate demand in the Norwegian economy, which boosted the income of PRI, thereby increasing PRI consumption. The high level of economic activity in these years affected not only the income of PRI positively, but also, again due to automatic stabiliser mechanisms, *NL* of GOV.

As was the case in Sweden, the Norwegian economy was affected by the choice of exchange rate regime. According to Norwegian Petroleum Directorate (2013), in 1978 Norway decided to leave the currency snake and link the Norwegian Krone to a trade-weighted basket of currencies; see Alstadheim (2016). In the first half of the 1980s, several devaluations were enacted due to reduced competitiveness of Norwegian firms. In 1986, the Krone was devalued again as a result of sharp reversal from a current account surplus to a deficit, partly explained by lower oil prices and partly due to a surge in domestic demand, together with diminished cost competitiveness, both increasing the demand for imports.

In the latter half of the 1980s, the combination of low domestic demand (lower imports) and high demand abroad (not only for petroleum, but also for Norwegian goods and services) gradually gave rise to a surplus on the current account[4.41], which remained so for the rest of the period.

In 1990, the Government Petroleum Fund was founded, and as noted by Davis,

[4.41] The export of oil and gas can be seen as an important aspect of this transition, which can be demonstrated by looking at the history of the Norwegian oil production. In 1974 the export and oil and gas amounted to 2.4% of the total export of goods; 10 years later, in 1984, the share was increased to more than 50%, which was still the case in 2013; Norwegian Petroleum Directorate (2013).

Fedelino, & Ossowski (2003), this changed the state of the Norwegian economy. The surplus from oil production was invested abroad, which detached investment returns from the performance of the Norwegian economy. Furthermore, the interest and property income of the Fund could be used to stabilise the economy in times with low economic activity[4.42]. For a brief period, from 1990 to 1992, the Krone was pegged to the ECU, before switching to a managed floating exchange rate regime, not only to avoid speculative attacks on the currency, but also to avoid a depression after the European banking and currency crisis, see Jonung (2009) and Alstadheim (2016).

Since the Government Petroleum Fund is owned by GOV and the revenues related to oil production, for example different production taxes, act as an inflow to GOV, a clear link between production of oil, the status of the current account and the GOV financial situation can be established. Despite revenues related to oil, GOV ran a negative *NL* balance in the beginning of the 1990s, whereafter it became positive for the rest of the period. This negative *NL* can be explained by both an expansionary fiscal policy and the behaviour of PRI, the latter of which entered a phase of financial consolidation, while GOV intervened during the banking crisis in 1991 and 1992. After the banking crisis, the current situation in the Norwegian economy from a sectoral point of view was formed.

The economy stabilised with a substantial twin surplus. Reflecting a persistent current account surplus and positive *NL* in GOV. Unsurprisingly, the two balances show a high degree in co-movement from the beginning of the 1990s. The persistent current account surplus gave rise to a large GOV owned, foreign denominated asset, the Government Pension Fund Global. As stated above, the production of oil and gas created enormous revenues for GOV. This revenue, together with the income from foreign investments (including both financial and non-financial assets), boosted the income of GOV. The increase in net exports from 1986 to 2001 stimulated aggregate demand, which in turn created an increase in the income and consumption of PRI.

In the period from 1995-2000 the NFW of PRI fell marginally, while the changes in the NFW of the two other sectors were more dramatic; see Figure 4.6. Due to current account surpluses, the NFW position of the ROW towards Norway

[4.42] The decision to invest the surplus, rather than stimulating the economy immediately, was also to avoid overheating the economy and to preserve the oil revenues for future generations. Oil revenues take several forms for the Norwegian GOV, including oil taxes, licenses for exploration, dividends from the co-ownership of Statoil and interest from foreign investments went from slightly above zero in 1995 to substantial negative positions. GOV, as the primary counterpart to that deficit, exhibited a continuous rise in NFW throughout the period.

The current account surplus was quite stable between 2000 and 2010, while *NL* of PRI and ROW changed significantly. In the period prior to the Great Recession, PRI moved from positive *NL* to a negative *NL*, which coincided with expansion of domestic aggregate demand and thus positively affected the balance in GOV via both the income and the expenditures channels. While the NFW positions have changed dramatically when it comes to ROW and GOV, the situation differs for PRI, which exhibits a small decline in its NFW position. The negative NFW position for PRI in Norway diverges significantly from the situation in Denmark, where the NFW is very large and positive[4.43].

4.6 Comparison

This section is included to allow us to draw some comparisons both amongst the three countries in the analysis, and with four larger industrial countries, namely Germany, France the UK and the USA[4.44]. The comparisons are structured in two parts. The first is comparison of annual flows, that is, the composition of *NL* within each country. The second part is a focus on the effects that these flows have on the accumulation of stocks, which inevitably have feedback effects to flows.

For the Scandinavian countries, the most significant change to flows was with regards the change in *NL* of ROW, where all three economies moved into a persistent period of current account surplus around 1990s. Relying on this accounting identity, the shift in all three countries from a country with current account deficit to current account surplus also changed the conditions for the domestic balances. For the domestic sectors this resulted in a positive aggregate *NL* position. This represents a flow inwards of funds, or viewed differently, a flow of credit from the domestic sectors to ROW. The source of this positive *NL*, however, diverged amongst the three countries. In Denmark and Sweden, the activities of PRI were the main driver behind positive domestic *NL*, while

[4.43]This can possibly be seen as an artefact of the choice by GOV to retain ownership of the large public pension fund, which, for all intents and purposes, could be reflected as an asset of PRI.

[4.44]See Appendix A2 for charts of *NL*, *NFW* and GDP growth for each of Germany, France, the UK and the USA.

for Norway, GOV interaction with ROW was the main driver. The result for Norway should not come as a surprise, taking the revenues from oil and gas into account. The different contributions to the flows are then neatly captured by annual *NL* figures. The similarities and differences in the sectoral balances across the three countries can be summarised with use of the estimated correlation coefficients for *NL* of the various sectors. In all three countries the correlation between changes in *NL* for PRI and ROW are negative. Moreover, for Denmark and Sweden, the correlation between *NL* of PRI and GOV is negative, while this relationship is insignificant in Norway. The correlation between *NL* for GOV and ROW in Norway, for reasons discussed above, is negative, while these relationships are insignificant for both Denmark and Sweden. While simplistic, these statistics provide a useful point of departure.

In the comparison countries, Germany most resembles the Scandinavian countries, with a large current account surplus. The USA and the UK exhibit negative NL for GOV (that is, a government deficit) and a current account deficit for almost all periods, whereas the French current account improved from 1990 to around 2000 and has deteriorated since.

Another similarity between the three Scandinavian countries can be deduced from the analysis in Section 4.5, that is, the size and relevance of automatic stabilizers. As stated by Krugman (2009) the *NL* position of GOV is often a result of automatic stabilizers rather than discretionary policies. Related to this topic is the discussion on causality. In Glötzl & Rezai (2017) GOV is presented as the passive sector, mainly absorbing the actions from the rest of the economy.

Evidence for this can be found in Denmark from 2004-2007, where the *NL* in GOV was higher than ever before, despite slightly expansionary fiscal policy. The extra aggregate demand generated from sectoral deficits in PRI and ROW generated additional income to GOV (mainly through taxes on income), while at the same time, the high level of demand kept GOV expenditures, on, for example, unemployment benefits, down. This combination forced GOV *NL* into a sizable surplus. This might lead to the impression that *NL* for GOV fluctuates around zero for countries with powerful automatic stabilizers. A quick review of the Norwegian case illustrates why this cannot be assumed. For Norway, the income flow of GOV depends heavily on both property income from the continuously increasing GOV NFW, and the revenues from the production of oil and gas. Consequently, the effects of domestic automatic stabilizers on the balance for GOV are much smaller when compared with Denmark and Sweden. The size and relevance of different flows would perhaps be a better gauge than any one size fits all rule.

A similarity between France, US, Denmark and Sweden is the status of PRI. For all four countries *NL* of PRI is positive in almost all periods. One way to interpret this is as a flow of credit each year from the PRI towards other sectors. For Denmark and Sweden this flow of credit is mainly directed towards ROW to finance the sectoral deficit of ROW. The effect of this flow of credit on the NFW however, is quite different between the two countries. In Denmark it affected the NFW significantly before 2005, where a stock market crash led to a significant fall in NFW. From 2009 the NFW increased rapidly for PRI, partly because of positive *NL* and partly because of capital gains. In Sweden on the other hand, the longstanding positive *NL* of PRI seems not to have changed the NFW for the sector.

For France and the USA, the flow of credit from the PRI has mainly gone towards the GOV, reflected in large annual deficits. At the same time, because of the current account deficit, a flow of credit from ROW to GOV also existed. The effect of this flow of credit is an increasing indebtedness of GOV both towards the domestic economy and abroad. If these two economies are compared with Norway, the differences become even more pronounced. While the general tendency for France and US is a current account deficit, surplus in PRI and deficit in GOV. For Norway the situation is different: current account surplus, surplus on GOV and a PRI fluctuating around zero, where France and US witness a twin deficit, the Norwegian economy has a twin surplus.

In terms of stocks, the accumulation processes connected to current account imbalances are self-reinforcing. During extended periods of current account deficits, the domestic sectors build up foreign debt (reflected by increasing NFW of ROW), which creates an outflow of property income for the domestic economy. This outflow of property income can be seen as a reduction in the income available for consumption or investment. Just as the inflow of property income from positive NFW abroad (i.e. negative NFW for ROW) adds to income.

For the Scandinavian countries, and for Germany, prolonged periods of current account surplus have resulted in the accumulation of NFW against ROW, and as a consequence, property income inflows to the domestic economy have increased over time.

For the Norwegian economy the national NFW already went positive around 1995 and increased steadily to more than 200% of GDP in 2015. This resulted in enormous inflows, mainly to GOV as owner of the Petroleum Fund. For Denmark the persistent current account surplus resulted in a falling NFW position for ROW, which turned negative around 2009. This coincided with an improvement of the NFW position of PRI, resulting in large property income flows each year from ROW to PRI. For Sweden, the story differs, since the NFW of ROW, despite a continuous fall, was positive until 2015. At the same time, GOV has improved its NFW position, while the NFW position of PRI remained fairly constant around -20% of GDP. This results in a property income outflow from PRI towards both ROW and GOV. This example clearly shows the importance of stock-flow-consistency in an analysis, since these property income flows affect the *NL* of each sector, illustrating the interdependence between stocks and flows[4.45].

In the comparison countries, the effects of prolonged current account deficits can easily be observed in the NFW charts for each country, where France, the UK and USA all have net GOV debt approaching 100% of GDP. Continuing from the analysis of flows above, positive PRI NL has resulted in substantial accumulation of NFW, ranging from 76% of GDP for France to 122% of GDP in the USA. With substantial increases in PRI NFW to GDP in all countries since 2010.

This comparison with other economies clearly highlights a key element of the sectoral balance approach, despite the fact, that the interdependency between the sectors secures the sum of the *NL* to be zero, the composition amongst the sectors is driven by both country-specific characteristic as well as time-specific effects. A general theory of the composition of sectoral balances (aside from the accounting principle behind the sectoral balance approach), without taking idiosyncratic country and time effects into account cannot be formulated.

[4.45]It should be noted however, that although imbalances in flows contribute to stocks and vice versa, the size of net differences say nothing of the composition of or counterparts to the actual balance sheets of each sector – I.e. From a simple SBA, there is no way of knowing the composition of property income flows, that would be the subject of a far more comprehensive modelling exercise. The point made here is that substantial imbalances in flows and stocks contribute to and reinforce one another.

4.7 Discussion

To move beyond simple accounting identities, towards a more useful analysis, some foundation on the behaviour in the individual sectors must typically be included. To this extent, we observe two different methods could be used. 1) combining the accounting identities from the SNA with behavioural equations in a system of equations to set up a formal model, 2) to use basic descriptive statistics to establish fundamentals on how *NL* of different sectors acts or reacts to changes in other sectors or changes in key macro indicators, such as output. The first method is widely used in simultaneous equation models, mainly following the tradition of Wynne Godley (1999b). Within this tradition, models are built using a Keynesian theoretical background and a closed accounting framework, securing a stock-flow-consistent model. The second method, is the one used in this paper, relying on statistical evidence on how the *NL* of the three sectors interact with each other and a central macroeconomic variable – GDP. As presented in the beginning of the analysis and shown in the appendix. The conclusion derived from these correlation analyses is clearly supported by conventional economic theory. The correlations presented in the appendix between the sectors can be classified as long run relationships, which illustrates another method of identifying major changes in the three economies. Introducing rolling correlation over the business cycle (for example, 4, 6 or 8 years) capture short run deviations from the long run correlations previously identified. The identification of short run deviations from long run relationships is unfortunately beyond the scope of this paper.[4.46]

The choice to use the SBA in this paper to highlight major changes in the three economies provides an alternative to understand the historical evolution of an economy. The use of the sectoral balances, as opposed to more traditional key macroeconomic variables, such as GDP or the level of unemployment, reveals other stories. As an example, the seemingly high growth rates in the Danish economy in the middle of the 1980s would typically be held to indicate strong developments in the Danish economy. From an SBA perspective however, these high growth rates came at the expense of an increase in the net credit flows between the three sectors and thereby large imbalances for the single sectors. GOV *NL* fell as far as -10% of GDP, accompanied by hefty credit flows to

[4.46] An formal identification and explanation for short run deviation from the long run correlation is a topic of the paper that follows in this dissertation.

GOV a rapid accumulation of offshore debt. In 1987 the situation inverted, at that point, the growth in GDP relied on a negative *NL* of just over 5% of GDP, however, at that stage it was PRI that acquired credit inflows. In this way, the use of SBA tells a crucial story about the net flow of credit between the different sectors of the economy; a story that cannot be captured using traditional macroeconomic indicators.

4.8 Conclusion

A more effective use of the SNA as a tool of economic analysis has recently been requested by several authors, (Bergman (2015), Glötzl & Rezai (2017) and Krugman (2009)). In this paper, we try to respond to this call by using the SBA to analyse Denmark, Norway and Sweden from a historical point of view. The use of the SBA seems to be largely ignored in both theoretical and empirical contributions, and in particular when it comes to the Scandinavian economic literature, both in contemporary and historical research.

The SBA combines the accounting principles from the SNA with empirical observations for each sector, allowing for some theoretical behaviours to be suggested. In this paper we follow a similar approach, presenting some descriptive statistics in the appendix as supporting evidence. In isolation, the sectoral balances tell whether *NL* of a specific sector is positive or negative in a given year, which identifies imbalances in the economy, and reveals the net flow of credit between the underlying sectors.

From a sectoral balance point of view, two important changes in the Danish economy can be identified; the status of the current account and the Great Recession. The period from 1975-1989 was characterised by a persistent current account deficit and a negative *NL* in GOV, which resulted in an increase foreign GOV debt. The period from 1990-2007 is characterised by a current account surplus and positive *NL* in PRI, with the exception of 2003 to 2007. In the period after the Great Recession, the situation changed dramatically for the domestic economy. The current account remained positive, but PRI began consolidation of debt at an aggregate level.

For the Swedish economy two important changes can be found; the opening of financial markets and the banking and fiscal crises in the early 1990s. In the first period from 1950-1975 the Swedish financial and capital markets were relatively closed, which resulted in only small net flows of credit between the sectors, and thereby small imbalances. From a sectoral balance point of view, the banking crisis in the beginning of the 1990s together with the transition to current account surplus indicated a major change in the Swedish economy, leading to the present conditions of a persistent current account surplus, and positive *NL* in both PRI and a GOV.

In the case of Norway two related events are behind a major change in the Norwegian economy from a sector balance point of view: the status of the current account and the creation of the Norwegian Petroleum Fund. In the period from 1978-1988 the Norwegian economy was characterised by a net credit flow to the PRI, which boosted the demand and the income of GOV. With the export of oil as an important factor, the current account went into a persistent surplus from 1989, which created a huge inflow of capital to the GOV, especially after the Norwegian Petroleum Fund was established in 1991. The formed the present situation in the Norwegian economy with a current account surplus, a positive balance of GOV and a PRI fluctuating around zero.

4.9 Appendix

4.9.1 DK: Correlation results

Table 4.1: DK: Cross-correlation table: Long run correlations

	ROW	GOV	PRI	OGap
ROW		-0.24	-0.70 ***	0.27 *
GOV	-0.24		-0.52 ***	0.73 ***
PRI	-0.70 ***	-0.52 ***		-0.77 ***
OGap	0.27 *	0.73 ***	-0.77 ***	

Table 4.2: DK: Lagged correlations with the output gap

	PRI	GOV	ROW
-3	0.11	-0.17	0.01
-2	-0.20	0.17	0.08
-1	-0.52 ***	0.49 ***	0.19
0	-0.77 ***	0.73 ***	0.27 *
1	-0.66 ***	0.61 ***	0.24
2	-0.37 **	0.35 **	0.13
3	-0.07	0.07	0.02

4.9.2 NO: Correlation results

Table 4.3: NO: Cross-correlation table: Long run correlations

	ROW	GOV	PRI	OGap
ROW		-0.83 ***	-0.48 ***	-0.05
GOV	-0.83 ***		-0.09	0.45 ***
PRI	-0.48 ***	-0.09		-0.61 ***
OGap	-0.05	0.45 ***	-0.61 ***	

Table 4.4: NO: Lagged correlations with the output gap

	PRI	GOV	ROW
-3	0.40 **	0.04	-0.26 *
-2	0.04	0.20	-0.20
-1	-0.34 **	0.38 **	-0.14
0	-0.61 ***	0.45 ***	-0.05
1	-0.62 ***	0.34 **	0.05
2	-0.42 ***	0.24	0.03
3	-0.11	0.22	-0.13

4.9.3 SE: Correlation results

Table 4.5: SE: Cross-correlation table: Long run correlations

	ROW	GOV	PRI	OGap
ROW		-0.25 **	-0.59 ***	-0.04
GOV	-0.25 **		-0.63 ***	0.71 ***
PRI	-0.59 ***	-0.63 ***		-0.56 ***
OGap	-0.04	0.71 ***	-0.56 ***	

Table 4.6: SE: Lagged correlations with the output gap

	PRI	GOV	ROW
-3	0.06	0.17	-0.24 **
-2	-0.15	0.37 ***	-0.20
-1	-0.38 ***	0.58 ***	-0.13
0	-0.56 ***	0.71 ***	-0.04
1	-0.52 ***	0.51 ***	0.11
2	-0.22 *	0.11	0.17
3	0.07	-0.26 **	0.18

5 Article 3: Sectoral balance analysis: Short run deviations from long run patterns

Introductory remarks

Article 2 investigated the long run interactions between the sectors, and suggested that the extent to which sectors interact with each other is heavily path dependent. The historical developments in each country created a particular set of economic circumstances, resulting in shifts in the balance of flows for each of the broad sectors. Institutional factors, such as counter-cyclical income and unemployment protection, then played a powerful role in how the net lending of the sectors co-moved. The following article further addresses the second objective of the thesis and provides additional empirical evidence. In particular, it uses rolling correlation windows to explore the persistence of the long-run relationships established in Article 2.

Sectoral balance analysis: Short run deviations from long run patterns

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(REDACTED)

Supervisor: Professor Finn Olesen

A version of this article is under review at:

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This article has been redacted from this version of the thesis, as it is currently in the second round of review.

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Keywords: Sector balances, sector balance analysis, economic history, rolling correlation.

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6 Article 4: Sektorbalancer i Danmark efter krisen

Introductory remarks

On the basis of the analysis presented in articles two and three, there appear to be both long and short-run dynamics that need to be considered when using SBA for economic analysis. This article extends the SBA approach by disaggregating PRI into HH, NFC and FC in order to evaluate the logic of the Danish austerity policies introduced after the GFC. The article focuses on the automatic stabilising functions built into the Danish welfare state, and the decomposition of PRI permits a more complex description of the flows between the sectors. This takes the analysis a step closer to understanding HH accumulations in a macroeconomic context. In so doing, it predominantly addresses the third objective, to explore some of the implications of the interaction of sector level balances previously identified. Like articles two and three, it also contributes to the structural knowledge required for the fourth objective, to examine economic transmission mechanisms.

Sektorbalancer i Danmark efter krisen

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6.1 Indledning

> "Alt for ofte i den økonomisk politiske debat overses det grundlæggende forhold, at der til ethvert sektoralt underskud per definition må eksistere et sektoralt overskud af præcis samme størrelse." (Jespersen, 2011)

Ovenstående rationale er taget ud fra Jespersens vurdering af regeringens 2020 plan, hvor han problematiserer det ensporede fokus på underskuddet i den offentlige sektor i stedet for ligeledes at fokusere på fx overskuddet i den private sektor[6.3]. Netop denne form for analyse af en enkelt sektor i isolation kritiseres ligeledes i Glötzl & Rezai (2017) for at medføre en inkonsistent og biased fortolkning af de faktiske dynamikker i økonomien. I stedet bør en analyse tage udgangspunkt i den samlede økonomi, hvor en ændring i én sektor medfører ændringer i mindst en anden sektor: er der sektoralt underskud i én sektor, må det samlede sektorale overskud i de resterende sektorer have en tilsvarende størrelse. Selvom der er tale om en nationalregnskabsidentitet, hvor summen af balancerne er 0, er ingen af balancerne ifølge Wynne Godley et al. (2007) et residual af de andre; alle balancerne har gennem en given adfærd deres eget liv.

Overført til diskussionen i Jespersen (2011) medfører dette, at underskuddet i den offentlige sektor ikke kan analyseres individuelt, men i stedet må analyseres i sammenhæng med situationen såvel i den private sektor, som i udenlandssektoren. Mens de hjemlige sektorer under ét har haft et opsparingsoverskud over for udlandet, påpeges især det faldende niveau for investeringer i den private sektor, sammen med den øgede opsparingstilbøjelighed, som hovedårsagerne til det store opsparingsoverskud i den private sektor, i kølvandet på den seneste økonomiske krise. Hvordan medfører dette et sektoralt underskud i den offentlige sektor? Den faldende efterspørgsel i den private sektor medfører et stigning i arbejdsløsheden, hvilket rammer den offentlige sektors budgetter på såvel indtægtssiden som udgiftssiden gennem højere sociale udgifter og lavere skatteindtægter. Genopretningen af det offentlige budget går derfor igennem en genopretning af beskæftigelsen i specielt den private sektor.

Underskuddet i den offentlige sektor kan derfor ikke analyseres isoleret set, men må i stedet for analyseres i sammenhæng med situationen i såvel den private sektor som udenlands-sektoren. Mens de hjemlige sektorer i Danmark under ét

[6.3] Begreberne sektoralt overskud, nettofordringserhvervelse og opsparingsoverskud anvendes trods forskellige opgørelsesmetoder, som synonymer i dette papir.

har haft et opsparingsoverskud over for udlandet siden slutningen af 1980'erne, medfører især det faldende niveau for investeringerne i den private sektor sammen med den øgede opsparingstilbøjelighed et stort opsparingsoverskud i den private sektor i kølvandet på den seneste økonomiske krise. Hvordan medfører dette et sektoralt underskud i den offentlige sektor? Den faldende efterspørgsel i den private sektor medfører en stigning i arbejdsløsheden, hvilket rammer den offentlige sektors budgetter på såvel indtægtssiden som udgiftssiden gennem højere sociale udgifter og lavere skatteindtægter. Genopretningen af det offentlige budget går derfor igennem en genopretning af beskæftigelsen i specielt den private sektor.

I flere tilfælde er det dog ikke tilstrækkeligt at se på effekten i den private sektor under ét, i stedet bør der her foretages en mere disaggregeret analyse, hvor den private sektor opsplittes i tre undergrupper: de ikke- finansielle virksomheder, de finansielle virksomheder og husholdningerne. Denne disaggregering øger naturligvis kompleksiteten af en samlet analyse af en given økonomi, idet antallet af sektorer er forøget fra tre til fem. Omvendt kommer denne kompleksitet med muligheden for at analysere interessante udviklinger i de enkelte sektorer, fx husholdningernes adfærd eller de ikke-finansielle virksomheders adfærd.

I denne artikel diskuteres nødvendigheden af at analysere alle sektorerne simultant samt sammenspillet mellem disse sektorer for at forstå udviklingen i den sektorale balance for de enkelte sektorer. I afsnit 2 præsenteres de tre overordnede sektorer i den danske økonomi: den offentlige sektor, udlandet samt den private sektor. Herefter disaggregeres den private sektor i finansielle virksomheder, ikke-finansielle virksomheder samt husholdninger. Til slut fremføres en række konkluderende bemærkninger i afsnit 4.

6.2 Sektorale balancer

Forståelsen af de sektorale balancer kan udledes direkte af nationalregnskabsidentiteterne. For at holde det simpelt, udledes kun sektorbalancerne for den aggregerede økonomi med tre sektorer: den private sektor, den offentlige sektor og udlandet. Startende med forsyningsbalancen

$$Y = C + I_p + I_g + G + X - M$$

Hvor Y er den samlede efterspørgsel, C er det private forbrug, I_p de private investeringer, I_g de offentlige investeringer, G er det offentlige forbrug, X er eksport, mens M angiver import.

Ved at introducere overførsler på tværs af de enkelte sektorer samt inkludere offentlige investeringer i det samlede offentlige forbrug G, kan tre-sektor-balancen udledes:

$$(S_p - I_p) + (NT - G) + (M - X - NIA) = 0$$

Hvor S_p angiver privat opsparing, udtryk for forskellen mellem den disponible indkomst og forbruget i den private sektor. NT den offentlige sektor nettoskatteindtægter, når der er taget højde for alle former for overførsler.NIA angiver nettooverførsler modtaget fra udlandet. I dette tilfælde angiver udtrykket i første parentes den sektorale balance for den private sektor, sektorbalancen for den offentlige sektor udtrykkes i anden parentes, mens tredje parentes udtrykker sektorbalancen for udenlandssektoren.[6.4]

For at kunne analysere udviklingen i de enkelte balancer, bør en række karakteristika ved de enkelte nøglevariable diskuteres, fx hvordan forventes de enkelte balancer at reagere i forhold til ændringer i den samlede økonomiske aktivitet? I Knudsen (2017) diskuteres adfærden i de enkelte sektorer fra et empirisk synspunkt. Investeringer i den private sektor svinger ifølge Knudsen medløbende med konjunkturerne; en stigning i output medfører en stigning i investeringerne. Den private opsparing, derimod, udviser den stik modsatte adfærd af investeringerne, idet den som følge af en procyklisk forbrugeradfærd udviser en modcyklisk adfærd i forhold til den økonomiske aktivitet. I den offentlige sektor reagerer opsparingen modsat den private sektor, idet lavkonjunktur er forbundet med lav opsparing i den offentlige sektor som følge af lavere skatteindtægter og et højere niveau af overførsler. Knudsen (2017) finder dog ingen tydelig sammenhæng mellem udviklingen i offentlige investeringer og konjunkturerne.

I Mikael Randrup Byrialsen & Smith (2018) (Article 2) undersøges korrelationen

[6.4] Udlandets nettofordringserhvervelse er ligeledes et udtryk for status på betalingsbalancens løbende poster for den danske økonomi – dog med modsat fortegn. En negativ nettofordringserhvervelse for udlandet er derfor lig et overskud på betalingsbalancens løbende poster set fra et dansk synspunkt.

mellem nettofordringserhvervelsen i de enkelte sektorer og output gappet, hvor ovenstående adfærd bekræftes; nettofordringserhvervelsen i den private sektor er negative i højkonjunktur, men nettofordringserhvervelsen i den offentlige sektor er positiv i højkonjunktur. Der findes imidlertid ikke en klar sammenhæng mellem nettofordringserhvervelsen for den udenlandske sektor og konjunkturudviklingen i Danmark. Resultatet fra disse undersøgelser vil i næste afsnit blive anvendt til diskutere situationen de danske sektorer de seneste ti år.

6.3 Situationen efter krisen

I dette afsnit analyseres situationen fra et sektoralt perspektiv for den danske økonomi. Indledningsvist vil der blive vist data for nettofordringserhvervelsen for de overordnede sektorer i den danske økonomi, hvorefter denne udvikling vil blive diskuteret med udgangspunkt i en simpel keynesiansk analyseramme.

I nedenstående figur illustreres udviklingen i nettofordringserhvervelsen for de tre overordnede sektorer i den danske økonomi i perioden 2006-2016, hvor den private sektor, den offentlige sektor og resten af verden er illustreret.

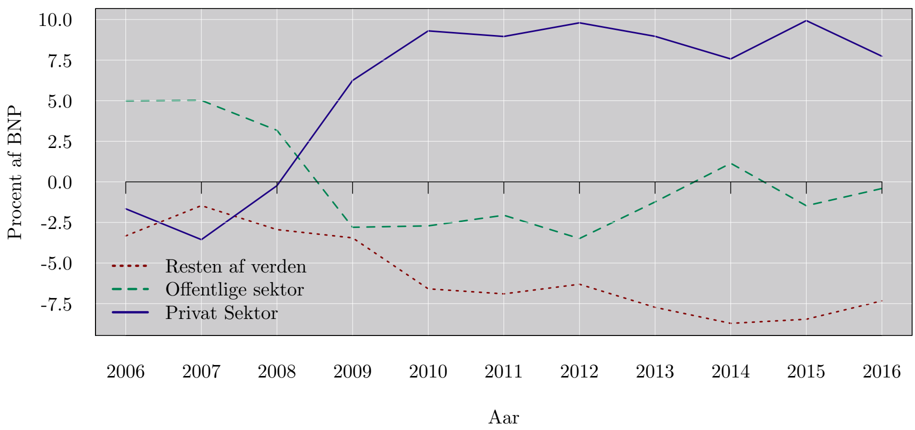

Figure 6.1: Tre-sektor-balance for Danmark 2006-2016

Fokus er i denne fremstilling at se på situationen efter krisen, hvorfor der udelukkende ses på data efter 2006. Fælles for alle tre kurver er, at der sker store fluktuationer i løbet af tidsperioden, hvor balancen for den offentlige sektor går fra et relativt stort overskud til at have et konstant underskud; med undtagelse af 2014, hvor der var et lille overskud. Den private sektor var i 2006-2008 i sektoralt underskud, men har siden udvist et stabil stort opsparingsoverskud på omkring 10% af BNP. Den sidste balance, udlandets nettofordringserhvervelse er negativ gennem hele perioden, dog med et stigende underskud, hvilket illustreres gennem det store overskud på betalingsbalancens løbende poster for den danske økonomi.

Som påpeget i Jespersen (2011) afhænger den offentlige sektors balance af balancerne i de to andre sektorer: det store overskud på den offentlige balance i 2006 var således ikke et udtryk for en meget kontraktiv finanspolitik, men derimod nærmere et udtryk for 'overforbrug/overinvestering' i såvel den private sektor som udlandet. Denne øgede efterspørgsel hævede beskæftigelse i den danske økonomi og påvirkede dermed såvel den offentlige sektors indtægtsside som udgiftsside til fordel for den offentlige sektor. Følges samme argumentation, vil en austerity-orienteret finanspolitik ikke pr. definition forbedre de offentlige finanser, hvilket kan illustreres gennem en simpel keynesiansk analyse.

$$(NT - G) = (S_p - I_p) - (M - X - NIA)$$

For at holde analysen så simpel som muligt antages det, at niveauet for det offentlige forbrug og investering bestemmes udelukkende af politikerne (er eksogent bestemt), ligesom niveauet for eksporten ikke kan påvirkes af udviklingen i den danske økonomi. De resterende variable antages alle at afhænge af den økonomiske aktivitet i den danske økonomi i overensstemmelse med resultaterne fra Knudsen (2017) og Mikael Randrup Byrialsen & Smith (2018).

Hvordan påvirkes de enkelte sektorers balancer af et fald i det offentlige forbrug? Et fald i det offentlige forbrug vil i en simpel keynesiansk analyse medføre et fald i den samlede efterspørgsel og dermed i den samlede økonomiske aktivitet, hvor den samlede effekt afhænger af størrelsen på indkomstmultiplikatoren. Den direkte effekt af dette er et fald i den samlede indkomst (bl.a. pga. øget arbejdsløshed), hvilket påvirker såvel indkomsten i den private sektor som importen i nedadgående retning. Faldet i indkomsten sænker såvel den disponible indkomst (og herigennem forbruget), som skattebetalingen. En del af faldet i indkomsten kompenseres dog gennem forskellige overførsler fra det offentlige, fx dagpenge. De store automatiske stabilisatorer vil således sikre, at faldet i den økonomiske aktivitet mindskes. Som nævnt tidligere reagerer opsparingen i den private sektor modcyklisk i forhold til den økonomiske aktivitet, hvorfor opsparingstilbøjeligheden bør forventes at stige. Investeringerne derimod, forventes at reagere procyklisk, sådan at niveauet for investeringerne via acceleratorprincippet falder i perioder med faldende økonomisk aktivitet.

Dette betyder i henhold til overstående ligning, at opsparingsoverskuddet i den private sektor bør forventes at stige efter faldet i det offentlige forbrug, mens opsparingsoverskuddet i udlandet reagerer negativt, som følge af lavere dansk efterspørgsel efter import. Da de to effekter dermed er modsatrettede, gives dermed ingen entydige forventning til den samlede effekt for den offentlige sektor.

Den offentlige sektor påvirkes således gennem såvel indtægter (lavere skatter) som udgifter (flere overførsler). Ses der isoleret på den offentlige sektors balance afhænger den samlede effekt af et fald i det offentlige forbrug derfor af en række faktorer, bl.a. størrelsen på indkomstmultiplikatoren (herunder skattesatsen, forbrugstilbøjeligheden og importtilbøjeligheden), påvirkningen på niveauet for arbejdsløsheden samt dagpengesatsen.

I en velfærdsstat med en høj indkomstmultiplikator vil de automatiske stabilisatorer som følge af et fald i det offentlige forbrug således medføre en belastning af det offentlige budget. Overstiger denne forværring faldet i det offentlige forbrug, vil opsparingsoverskuddet(underskuddet) i den offentlige sektor således blive forværret stik mod ambitionen. Om forværringen overstiger faldet i det offentlige forbrug, afhænger dog, som nævnt ovenfor, af en lang række faktorer.

Selvom ovenstående ræsonnement er baseret på en simpel analyse, illustreres alligevel hvordan udviklingen i den offentlige sektors balance er afhængig af udviklingen i de andre sektorer.

Som illustreret i Figur 1 og problematiseret i Jespersen (2011), så kræver en genopretning af den offentlige balance et fokus, der ikke kun begrænses til at se på den offentlige sektor, men også en forståelse af årsagerne til det store opsparingsoverskud i den private sektor siden krisen: hvordan skal det store opsparingsoverskud i den private sektor forstås?

Eftersom privat opsparing historisk set reagerer modcyklisk og privat investering reagerer procyklisk, er det ikke så overraskende, at det samlede opsparingsoverskud for den private sektor er positiv under en lavkonjunktur som set siden krisen. Selvom opsparingen i den private sektor er steget siden krisen, så skal hovedårsagen til stigningen i opsparingsoverskuddet findes i det lave investeringsniveau i den private sektor siden krisen. Specielt den markante ændring fra 2008-2009 skal findes i det store fald i investeringerne i den private sektor. Det store fald i investeringerne mindsker dermed den samlede efterspørgsel og dermed forstærker den økonomiske lavkonjunktur, som via acceleratorprincippet vil sænke investeringsniveauet yderligere. Såvel stigningen i opsparingstilbøjeligheden og faldet i investeringerne kan ligeledes tilskrives den øgede usikkerhed, der fulgte med den økonomiske krise. Usikkerheden medfører, at fx husholdningerne vil forbruge mindre, og i stedet prioritere at spare op. Såvel virksomhedernes som husholdningernes investering påvirkes negativt, da den store usikkerhed dæmper investeringslysten. Er forventningerne til fremtiden samtidig pessimistiske, vil dette lægge en endnu større dæmper på investeringerne i den private sektor.

En opdeling af den private sektor i ikke-finansielle virksomheder, finansielle virksomheder og husholdninger kan give en mere dyb forklaring af den pludselige ændring i opsparingsoverskuddet efter krisen. I 6.2 ses umiddelbart, at opsparingsoverskuddet hos de finansielle virksomheder er positiv over hele perioden. Selvom den udviser stigning fra 2006 til 2009, er det dog ikke der, den interessante historie skal findes. Nettofordringserhvervelsen for de ikke-finansielle virksomheder derimod har historisk set været positiv svingende omkring 5% af BNP, men faldt i løbet af 00'erne og var endda negativ i 2007, hvorefter den har fundet tilbage mod sit gamle niveau. Også husholdningerne har ændret deres adfærd; i hele perioden fra 1995 til 2010 er nettofordringserhvervelsen for husholdningerne negativ, men herefter har den stabiliseret sig omkring 0, ovenikøbet med en marginal opadgående trend. Forklaringen på denne udvikling følger den generelle forklaring for den private sektor: opsparingen stiger under lavkonjunktur (som følge af lavere forbrug), mens investeringerne falder.

For husholdningernes vedkommende kan dette forklares på flere måder. Stigningen i opsparingen skal hovedsaligt findes i husholdningernes forbrug, hvor den øgede usikkerhed har medført aftagende vækstraterne og i enkelte perioder negative vækstrater siden krisen. Samtidig er investeringsniveauet stadig lavere end niveauet før krisen, hvor specielt 2005-2006 var kendetegnet ved store vækstrater i investeringsniveauet. Denne adfærdsændring kan som nævnt ovenfor tolkes som et udtryk for en øget usikkerhed til fremtiden hos husholdningerne, hvor forventningerne fremadrettet ikke er positive, som før krisen. Denne tilbageholdenhed, både hvad angår forbrug og investering, kan således udtrykke et øget behov for at konsolidere sig efter krisen, hvor husholdningerne (og virksomhederne) er mere fokuseret på at nedbringe de gældspositioner, som er opbygget i tidligere år. I Danmarks tilfælde er husholdningernes rate mellem gæld og disponibel indkomst faldet kraftigt siden 2009, hvilket skyldes kombinationen af stagnation i beholdning af finansielle passiver og en stigning i den disponible indkomst, [Madsen & Byrialsen (2017). Mens selvsamme gældsrate for virksomhederne ser ud til at være stabiliseret.

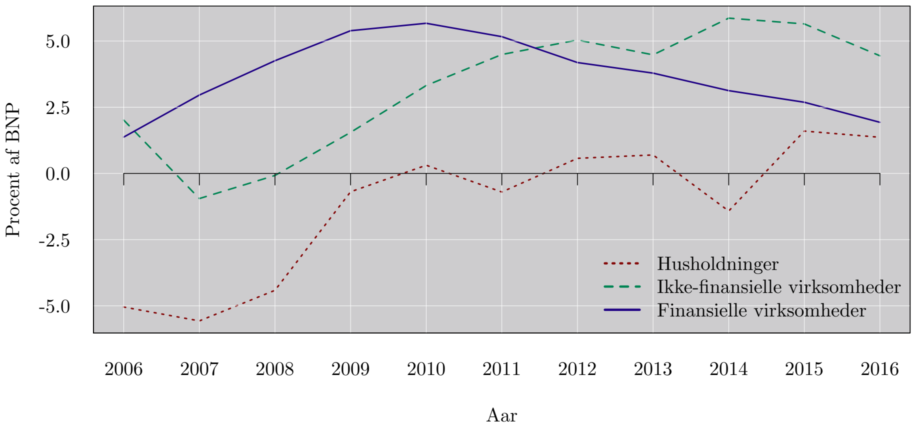

Figure 6.2: Privat-sektor-balance for Danmark 2006-2016

Af ovenstående fremgår således, at årsagerne til den store stigning i opsparingsoverskuddet for den private sektor i kølvandet på den økonomiske krise kan lokaliseres til de ikke-finansielle virksomheder samt til husholdningerne. I regeringens 2020 plan fokuseres på genopretning af den danske økonomi gennem balance på de offentlige budgetter, der kommer via en reduktion i det offentlige underskud. Som illustreret i denne artikel, så medfører et negativt opsparingsoverskud i den offentlige sektor at summen af opsparingsoverskuddet i den private sektor og udlandet er positivt. Empirisk set, (Mikael Randrup Byrialsen & Smith, 2018), er der en negativ korrelation mellem opsparingsoverskuddet i den private og offentlige sektor, hvorfor underskuddet i den offentlige sektor associeres med et overskud i den private sektor. I stedet for at fokusere på at nedbringe underskuddet i den offentlige sektor, bør politikere og økonomer i stedet overveje, hvorledes opsparingsoverskuddet kan nedbringes i den private sektor, fx via mindre usikkerhed, hvilket forøger privat forbrug og investeringer. Dette er ligeledes konklusionen i Jespersen (2011), hvor han dumper regeringens

2020 plan og bidrager til diskussionen med ordene:

> "Hvor ligger så nøglen til genopretningen af dansk økonomi? Hertil må svaret blive primært i den private sektor. Hvis der kan komme gang i de private investeringer og den private opsparing kunne reduceres, så ville det have en genoprettende effekt på de offentlige budgetter."(Jespersen, 2011)

6.4 Afrunding

Siden den seneste økonomiske krise har fokus, ikke kun i Danmark men også i eurozonen, været rettet mod underskuddet på de offentlige budgetter. Spørgsmål som, *hvordan der sikres balance i det offentlige budget?* har været centrale. Som det kan udledes direkte fra nationalregnskabsidentiteterne, så medfører et opsparingsunderskud i den offentlige sektor, at et tilsvarende opsparingsoverskud findes i økonomiens resterende sektorer. I dette papir illustreres dette entydige fokus på en enkelt sektor gennem Jespersens kritik af regeringens 2020-plan, hvor der udelukkende ses på, hvorledes der skabes balance på de offentlige budgetter gennem en reducering af det offentlige underskud. I dette papir sættes opsparingsunderskuddet i den offentlige sektor i relation til opsparingsoverskuddet i de resterende sektorer i økonomien med den konklusion, at hovedudfordringen for den danske økonomi ikke udelukkende findes i den offentlige sektor, men derimod i det store opsparingsoverskud i den private sektor. Så længe opsparingsoverskuddet i den private sektor overstiger opsparingsunderskuddet i udlandet, vil den offentlige sektor ligeledes have opsparingsunderskud. Balance i det offentlige budget skal således ikke findes gennem reduktion af offentlige forbrug eller udgifter, men i stedet gennem en stigende efterspørgsel i specielt den private sektor, som allerede forklaret af Keynes tilbage i 1933:

> "You will never balance the Budget through measures which reduce the national income. The Chancellor would simply be chasing his own tail – or cloven hoof! ... It is the burden of unemployment and the decline in the national income which are upsetting the Budget. Look after the unemployment, and the Budget will look after itself."
> (John Maynard Keynes, 1933, pp. 149–150)

7 Article 5: Flexible rate mortgage loans: An SFC model of the impact of mortgage credit innovations on Danish balance sheet stability

Introductory remarks

The next and final step in the objectives of this thesis is to assimilate the behaviours and structural limitations identified in the preceding articles, together with a number of additional resources, into a cohesive framework. The aim is then to use that framework to investigate the innovations to the mortgage financing industry in Denmark leading up to the GFC, with a focus on the two key risk factors identified in the introduction: an increase in interest rates; and, a possible property market response.

The interactions between sectors observed in the preceding articles allude to a combination of accounting artefacts and causal relationships. On the one hand, accounting rules dictate that there are some components of the national accounts that are simply related to one another by way of an accounting identity. On the other, over the course of time, certain economic developments drive or facilitate developments in other areas of the economy. In both cases, the effects will be observable in the data.

These two kinds of dependency are quite different when events are considered in real time. Accounting artefacts can further be subdivided into unobservable (simultaneous) bilateral accounting transactions that happen between two parties for each transaction in real time, and the observable accounting relationships at the aggregate level, which are an *ex post* aggregation of economic transactions. It is these aggregate measures that will be used in the analysis that follows.

Accounting relationships are simply identities, and are true by construction. The second type of relationship, causal relationships, refer to drivers that trigger initial transactions, or transmit effects through the system. In contrast to accounting relationships, these are the subject of human behaviour, and are thus sequential when considered in real time. For example, a borrower for house purchase must first desire a house, then borrow money, then purchase the house. Those funds are received by the seller, who can only then make a decision on what to do with those funds. These relationships are the subject of economic theory, about which there are substantial disagreements in economic literature.

At least part of the trouble is caused by aggregation from microeconomic behaviour, which may (or may not) be observable in real time, to macroeconomic inter-relationships, which are only observable after the collection and validation of data is completed. In addition to the time aspect of data, the content is also of great importance. Since the establishment of the System of National Accounts, the definitions of fundamental economic terms affected and have been directly affected by the nature of data that could be collected in order to represent them. This was recognised by Copeland (1935, p. 381) prior to the establishment of the national accounts. To be sure, the following analysis considers economic definitions in the now broadly accepted "narrow sense", as he described, they "conceive our society and its organic and inorganic environment in collectivist terms as a system, a system serving exclusively human wants, and serving only those human wants the means of satisfying which can be measured in Dollars."

This implies that only economic activity that has triggered some kind of monetary transaction is considered for this analysis. He also responded to those that might object to such definitions that, "statistical measurement of wealth and value-production is not responsible for the ethical nature of these concepts; the concepts of economic theory were just as ethical before data and techniques of measurement were available; the techniques only define the nature of these concepts more precisely." (Copeland, 1935, p. 381)

Aggregate economic data, and by extension economic models, necessarily neglect significant parts of society that are of great social and economic importance. They are agnostic to institutional developments in law, property rights, politics, infrastructure, education and all other aspects of culture in an economy. They are equally unable to capture any work or activity that was unpaid, or did not result in a monetary record of transaction. This is simply to say, that it is within the very limited scope of macroeconomic monetary interactions that any conclusions should be drawn from the present model.

With that strong caveat in mind, this article is the main contribution of this thesis, and addresses the risks related to Household debt within a post-Keynesian SFC framework. With the use of the System of National Accounts (SNA), the article implements a fully empirical stock flow consistent (SFC) model of the Danish economy, estimated on data for the period 1995 to 2016.

Flexible rate mortgage loans: An SFC model of the impact of mortgage credit innovations on Danish balance sheet stability

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Abstract

Innovations in mortgage lending options have expounded in recent decades, resulting primarily in a reduction in the initial monthly costs associated with borrowing, and made home ownership possible for socio-economic groups that were previously excluded from the market. These changes have also drastically changed the composition of household balance sheets, both at a micro and a macro level, and the volume of outstanding debt relative to household income expanded aggressively leading up to the global financial crisis in 2007-8. The innovations unfortunately also simultaneously transferred significant risks to borrowers. This paper investigates the present day macroeconomic consequences of the change in composition from fixed- to adjustable-rate mortgage (ARM) debt that occurred in Denmark between 2003 and 2009. A state-of-the-art Stock-Flow Consistent model is adapted to allow for changes in the composition of debt, and to permit shifts in the proportion of debt between fixed-interest and ARM products. The risks to financial stability are evaluated through the imposition of two plausible shocks to the economy: the first is a two percentage point rise in borrowing costs; and, the second is a 20 per cent decline in property prices. The model allows for a clear observation of the transmission channels, and the stocks and flows most at risk, and the results suggest that the expansion of ARM mortgage credit has increased the instability of the household sector. An interesting observation was that a positive net lending response can be misinterpreted as positive developments in the absence of the broader economic context. The paper is supplemented by a new presentation method for SFC model responses, where a cross-section of proportional responses are ranked, ordered and categorised in tabular form.

7.1 Introduction

Private sector debt continues to be a concern in many developed countries, in particular mortgage debt. Debt levels expanded in most developed countries during the period leading up to the financial crisis, in the household sector this was driven primarily by the extension of mortgage credit (as can be seen in Figure 7.30, Section 7.9.1). The proportion of mortgage debt to total debt increased in all countries from around 1960, but accelerated dramatically during the 1990s and 2000s (Jordà, Schularick, & Taylor, 2017). That growth was unfortunately not matched by growth in household incomes, and debt-to-income continued to expand for all countries until the great financial crisis in 2007-08 (see Figure 7.31 in Section 7.9.2). In most countries, the supply of credit slowed or even reversed as liquidity in overnight markets dried up during the financial crisis[7.2].

The growing debt, particularly relative to income, carries several significant risks to financial stability. These include several demand related risks, such as the future need to deleverage and the associated intertemporal substitution of demand (Justiniano, Primiceri, & Tambalotti, 2015; Raberto, Teglio, & Cincotti, 2012; Seppecher & Salle, 2015), deterioration of balance sheets and potential risks to refinancing requirements (Bernanke, 2007; Disyatat, 2011; Scanlon et al., 2008), and sensitivity of interest payments to rate changes (Sheehy, 2014). There are also possible contagion effects across financial markets of default (or non-performance on loans), asset price adjustments and possible deterioration of financial intermediary capital positions (Danmarks Nationalbank, 2016). As seen in credit-default-swap market during the 2007-08 financial crisis, the possible collapse of liquidity in certain markets can also generate global instability. At a sectoral level there is also the general risk of the accumulation of large imbalances, such as government or foreign deficits, that can take many years to unwind.

While there are a number of parallels between various housing finance systems, the stability of each is unique to a variety of in and out of country conditions. The European Network of Housing Research (ENHR) (Lunde & Whitehead, 2014) found that Political, geographical and institutional factors were not sufficient to explain significant differences in developments across 21 OECD countries since 1989. They (Lunde & Whitehead, 2014, p. 4) noted that "housing finance systems are very specific to each country, reflecting different histories, legal systems, institutions, economic conditions, policies and politics." It is therefore necessary to explore the particular dynamics that are at play in each country.

This paper focuses on the Danish system, which makes an excellent country for a number of reasons. Firstly, the Danish housing finance system has been no stranger to innovation, with a number of legislative and product changes

[7.2] It should also be noted that since GDP fell in 2007-08 in most countries, the peak in debt-to-GDP ratios in 2007-08 does not necessarily represent growth in debt, but partly a fall in GDP.

introduced since 2003. It is also a relatively small and open economy with strong international trade ties and close ties with the European Union. Thus, a number of parallels can be drawn between the Danish system and several other countries with advanced mortgage financing systems. Denmark is also one of the very few countries that has reliable data for institutional sector balance sheets in granular detail from 1995, and sub-sector level data from 2003. This data allows one to study the problem from comprehensive empirical data. It also allows one to construct a model that integrates the complex interactions and feedback mechanisms of the five institutional sectors that is founded on observable empirical relationships[7.3].

In this paper I modify an existing empirical stock flow consistent (SFC) model for the Danish economy first presented by Byrialsen & Raza (2019). As explained by Godley & Lavoie (2012), these models maintain strict stock and flow consistency, in the sense that all flows are accounted for in a complete system of accumulations in the stocks of all five major institutional sectors. It attempts to capture the aggregate drivers of macroeconomic interactions as they happen in real time, although it uses *ex post* aggregate accounting values to estimate these relationships.

The completeness of the model requires that some of the variables in the model are passive to changes in others. The choice of the active variables over the passive (residual) variables is determined by a combination of accounting identities and economic theory, in this case, Post Keynesian theory. The grounds for this decision are discussed in Section 7.2.

Since the household sector is at the core of the analysis in the model, most sectors are passive to changes in the household sector, and it combines the attractive features of econometrics (structural econometric models, SEMs) with path dependency and Post Keynesian behaviours. In the strict sense the model does not demonstrate causality. Rather, it estimates the expected co-movement of certain economic aggregates based on historical evidence and theoretical expectations. These estimates inform several parameters in a medium sized system of equations[7.4].

[7.3] In addition, administrative registers make it possible to explore the trajectory of various product ranges in far greater detail, although these are only available after 2009 for mortgage bond debt.

[7.4] This model has 131 equations, there are thus 131 endogenous variables (including checks) and 78 exogenous. There are in also several equations included as checks and balances, but

The core focus of the investigation in this version of the model is the Danish mortgage system, and the expected macroeconomic consequences of innovations in the mortgage product range offered to Danish borrowers. The model in Byrialsen & Raza (2019) is the most advanced empirical SFC model available for Denmark, and thus provides the best possible point of departure. The model is under continuous development, and there are some limitations imposed by the largely exogenous nature of rates of return (including interest rates) and asset prices. A secondary goal is to identify any potential improvements to the existing model with respect to mortgage credit markets.

The original structure is modified to include a split in household debt between fixed and flexible rate products. This allows for the evaluation of the effects of proportional shifts in credit composition. In particular, to investigate the short-term implications for the accumulation of stocks in the household sector of a shift in the proportion of debt from flexible-interest-rate debt to fixed-interest-rate debt, and vice versa[7.5]. The exogenous nature of rates of return and financial asset prices is both an advantage and disadvantage. On the one hand they allow for specific channels in the model to be highlighted, free of disturbance of from inter-connected markets. On the other hand, it implies that market rates and price fluctuations are not propagated automatically. This makes the overall model results less realistic.

One of the major benefits of the SFC framework is that it allows for path dependent accumulation of imbalances. Although there are some limitations (as discussed below), it is thus possible to fully account for feedback effects from accumulations in selected asset classes, albeit within a simple structure. The analysis that follows may also be of value in the assessment of mortgage financing structures in a macroeconomic framework, and contributes to the growing literature on empirical SFC models.

The remainder of the paper is structured as follows, Section 7.2 presents a review of the literature, and Section 7.3 provides context for the Danish mortgage market. Section 7.4 describes the model, and explains some of the key

which do not impact the functioning of the model.

[7.5]By making a simple split in the proportion of debt in flexible and fixed rate instruments, and adjusting the rate of interest on each separately, it offers a relatively simple means by which to incorporate a wide variety of credit market and macro-prudential policy tools into an empirical SFC model - many of which can be achieved via a weighted proportional adjustment of the interest rate on each of the debt types.

innovations made in this paper, and Section 7.5 explains the scenarios for shocks applied to the model. In Section 7.6 the effects of the shocks are described for each of the scenarios, taken from the perspective of each of the main institutional sectors. Section 7.7 contains a discussion of the main observations from the model, and Section 7.8 concludes. The first appendix, Section 7.9, contains a number of additional charts and figures, and the second appendix, Section 7.10, provides a full exposition of the model employed, together with explanations for the major innovations.

7.2 Literature and theory

7.2.1 Stock flow consistent models

Stock flow consistent (SFC) models are a relatively new branch of macroeconomic model, and as mentioned above, are characterised by strict adherence to double entry accounting rules. They resemble structural econometric models, but the expected behaviours that are modelled are typically informed by Post Keynesian theory. W Godley & Lavoie (2007)[7.6] is widely regarded as the catalyst for the recent growth in research using the SFC framework, and since 2007 the number of models has grown rapidly.

As noted by Nikiforos & Zezza (2017, p. 3), "accounting consistency is just one side of the SFC approach, with a demand-led economy and an explicit treatment of the financial side being the other." Dos Santos (2006), Caverzasi & Godin (2013), Caverzasi & Godin (2015b) and Nikiforos & Zezza (2017) provide surveys of the literature, each progressively covering the most recent publications. These studies provide a comprehensive review of both the topic and methodological coverage of SFC research. SFC models can be separated into three broad categories; theoretical models, which are typically much simpler and are used for the exploration of theoretical propositions; simulated calibrated models, which are larger models that are constructed to have similar features to real economies, but where the underlying data is constructed for illustrative purposes; and, empirical models, where the entire model is based on real-world data. While each form presents challenges, empirical models face additional challenges with regards availability and reliability of data. Where data is available, the researcher is faced with the challenge of appropriate aggregation.

[7.6] The original work has been revised and re-published as Godley & Lavoie (2012).

There are relatively few fully empirical SFC models in the literature, and the number of models for which comprehensive data was available is even lower. The model presented below is an empirical model, based on the one constructed by Byrialsen & Raza (2019). Unlike many other empirical SFC models, it is constructed from the ground up, rather than adapted from one of the more broadly used Godley & Lavoie (2012) models. This approach mirrors that suggested by Zezza & Zezza (2019), where the full complexity of national accounts data is used as the point of departure. The explicit treatment of the financial side entails significant simplification of the wide variety of financial instruments that are available.

Much like many other modelling forms, the complexity of an SFC model has implications for how easily the results can be interpreted. The greater the number of interdependent features, the lower the transparency of transmission mechanisms. In summary of a central banker forum, Pill (2001, p. 25) noted that some participants argued that large “eclectic” macroeconomic models often “lack the simplicity, internal consistency and intuitive appeal which are prerequisites for providing good policy advice”. In contrast, others “suggested that preparing policy guidance in the context of a single model allowed a holistic and rich picture of the economic situation to be obtained.” This conflict between holistic context and intuitive simplicity was a key part of the decision to keep rates of return exogenous in the present model. It also provides some explanation of the aggregation process. A careful investigation of the size and relative importance of various stocks and flows was conducted to render the model to workable size. Further details regarding the actual aggregation of different categories financial and real flows are provided in Section 7.4.

This process requires detailed data, particularly in terms of the balance sheets and flow-of-funds between the institutional sectors. This data is available for very few countries for a long enough time-period to be able to estimate statistical relationships, and Denmark is one of those countries. The model is based on annual data from 1995 to 2017, and there are thus a maximum of twenty two observations in any estimation and the extent to which the model effectively follows the data is comprehensively illustrated in Byrialsen & Raza (2019).

7.2.2 Post Keynesian theoretical foundations

The theoretical basis of the model informs the behaviours in and ordering of equations. Since the publication of Godley & Lavoie (2012)'s first edition in 2007, the number of SFC models developed globally has grown exponentially, and due to the Post Keynesian roots of the framework, the bulk of these models could be referred to as Post Keynesian Stock Flow Consistent models (PK-SFC models), PK will henceforth be used refer to the "Post Keynesian" school of thought. PK theory is typically juxtaposed with the New Neo-Classical synthesis, or New Keynesianism in order to highlight the points of difference. Such a discussion is beyond the scope of this paper[7.7], and a brief summary of the key characteristics of PK systems will need to suffice here, with a special focus on those parts used to inform the model below.

In terms of the trajectory of the economy, PKs typically reject the notion of a long run equilibrium in favour of path dependency, and argue that present decisions and institutional structures materially change the nature of the economy in the future. For the present model, this is reflected in the focus on short to medium term (typically the first period or two after a shock, but up to approximately 5 years). They argue also that the economy is significantly more complex than the sum of its parts (Chick, 2003), and sometimes liken it to an organic entity, or the complex interactions of an ecosystem. Economic trajectories can therefore be altered by active intervention and long term historical averages are therefore not predictive of future events. This is reflected in the model below by a lack of long-run mean reversion or stabilising elements in the model. The most significant omission relative to mainstream literature is the inter-temporal optimisation of household consumption. There are no utility functions, and there is no long-run or inter-temporal optimisation of behaviour.

For economic policy concerns, the implication is that financial and social imbalances cannot self-correct (at least not without significant social, political or economic consequences), and market mechanisms are not able to manage these issues automatically. To the contrary, unchecked imbalances that are perpetuated by market structures are problematic. Just as the accumulation of poor quality private debt prior to the 2007-08 GFC proved to be.

PKs often refer to Keynes (1937), who stated that the future is fundamentally

[7.7] For a full discussion of these comparisons the reader is referred to Dow (1985), Dow (2001), Chick & Dow (2001) and Chick (2003).

uncertain. It is therefore crucial to understand the economy as it presently stands, and to have some idea of what future economic conditions are desirable. It should thereafter be possible to actively plan for and develop a desirable future economic landscape, without the need for projections of the distant future, or acceptance of any long-run equilibria or natural rates. From a modelling perspective it is therefore not necessary that a model be stationary in order to be useful, it is more important that it should be representative of the present reality.

In terms of the sequence of events inside PK models, they emphasise the importance of demand (or rather effective demand[7.8]) in the economy, and are predominantly demand driven rather than supply driven - although, more recent works have put more emphasis on supply side constrains (Ryoo & Skott, 2008). Keynes's animal spirits and short term expectations drive investors to either increase or decrease investment. This is also related to the PK theory of an endogenous demand and supply of money in the economy. The demands of possible borrowers are tested against credit worthiness and all viable demand for credit is (or can be) accommodated by the banking sector. New lending creates new money, and therefore the demand for investment funding drives the growth in money. In this model, this analogy is applied to the household sector in that the demand for new housing investment drives the demand for mortgage credit.

There are several estimated equations in the model, and the motivations for each are discussed in a full presentation of the model in Section 7.10, in the appendix. The structure of the estimated equations are informed by PK and country specific literature, and refined to reflect the reality of the data.

7.2.3 Credit markets and global financial conditions

From a broader international perspective, the period leading up to the crisis has been called "the great moderation" (as noted by, Buttiglione, Lane, Reichlin, &

[7.8]Intended here to include both consumption and investment, as explained by Keynes (1937). A slightly broader definition than Smith (1776, p. 73)'s effectual demand, which refers to commodity purchase, but with a very similar line of reasoning, where in Smith's commodity markets buyers with the capacity to pay for a good "may be called the effectual demanders, and their demand the effectual demand; since it may be sufficient to effectuate the bringing of the commodity to market. It is different from the absolute demand. A very poor man may be said in some sense to have a demand for a coach and six; he might like to have it; but his demand is not an effectual demand, as the commodity can never be brought to market in order to satisfy it."

Reinhart (2014, p. 28)) and was an extended period of unprecedented economic growth and apparent stability of financial markets. As noted by Englund (1999), this was accompanied by the relaxation of lending requirements and credit worthiness checks, and as Scanlon et al. (2008) identified, rising property prices and expectations of capital gains. There was a gradual reduction of interest rates, and the cost of borrowing (the long-run cost of capital falling steadily from the 1970s). According to Scanlon et al. (2008), a simultaneous development on a global scale was an increased belief in the market mechanism, extensive privatisation and deregulation of financial markets[7.9]. The onset of the global financial crisis (GFC) later revealed significant flaws and systemically risky interdependencies between markets. Even though the initial effects were felt by all countries, the effects, both in terms of intensity and real economic and financial trajectories, differed greatly. (Lunde & Whitehead, 2014)

In the post-crisis period, there have been significant changes to the regulatory landscape, and the extent of mortgage lending has slowed or reversed in many countries. At the height of the crisis, liquidity in key financial instruments, particularly credit default swaps, dried up almost instantly (Nationalbank, 2009). Ultimately this triggered quantitative easing (QE) policies in both the USA and Europe, with the Fed and the ECB buying immense quantities of financial assets and market-making with the assistance of larger banks. On the regulatory front, banking prudential and capital adequacy requirements were tightened significantly. The period from 2009 to 2018, while not as extreme as the period preceding the crisis, has however, continued to show strong growth in property prices, with more than half of the OECD countries in the sample showing year-on-year growth rates of over 2%, as can be seen in 7.4.

US and European QE policies also led to excess liquidity in global financial markets. The low short-term rates have gradually resulted in record low long-term rates of return, placing added pressure on fund management and investment companies to search for yield in unconventional investments[7.10].

[7.9] One such development in Denmark was the 1993 relaxation of home equity extraction laws (Andersen & Leth-Petersen, 2019).

[7.10] Where performance guarantees have been provided, such as for defined benefit pension schemes, some institutions face negative spreads and the risk that they might not be able to foot the bill at the end of the day. Now in 2019, eleven years after the financial crisis, ECB (2019) announced, on 12 September 2019, a further reduction of ECB deposit facility rates to −0.5%, and the marginal lending facility to remain at 0.25%. In addition, net purchases of financial assets will begin again in the "asset purchase programme (APP) at a monthly pace of €20 billion as from 1 November".

These policies and other commitments by European central banks and the ECB have contributed significantly to persistent low interest rates in market based mortgage lending systems. While the rate of growth in the level of debt relative to income appears to stabilised in many countries, the magnitude of household debt continues to expand. The risks associated with this debt depend not only on the magnitude of the debt, but also very strongly on its composition.

A correlated development has been the expansion of the product range offered by mortgage lenders. Leading up to 2007, innovations were made to almost every aspect of mortgage lending, and the vast majority of these changes have contributed to a reduction in the initial payments on mortgages for the borrower. According to Scanlon et al. (2008), while the innovations were different according to each specific country, some broader characteristics were similar across developed nations. Two key aspects to these innovations were that they made initial payments on mortgages cheaper, and secondly, they increased the flexibility and range of options available, and thus transferred significant elements of risk to the borrower. André (2016) also explains that house price bubbles are often related to periods of financial de-regulation, and highlights the introduction of interest-only (periods without capital repayments) loans in Denmark in 2003 as an example.

These international developments were not applied uniformly to all countries, or even in specific geographical areas. Lunde & Whitehead (2014) found, rather surprisingly, that in contrast to a geo-political grouping, for example with other Scandinavian countries, Denmark was closer to Finland, Poland and Russia in terms of real economic and housing financing conditions after the 2007-08 financial crisis. An additional point was that the introduction of adjustable rate mortgage (ARM) products introduced a small but significant possibility of systemic risk to the Danish mortgage system[7.11]. ARMs were first introduced in 1996, but and are just one of several innovations that were introduced to the Danish market.

Affordability of housing also became a prominent issue and tax incentives for interest payments on mortgages were common. According to Scanlon, Lunde, & Whitehead (2011), real house prices in Denmark fell 14.9% from the peak in 2007

[7.11]In particular, they referred to potential for market failure through liquidity risks for products with 30 year loan guarantees but with interest reset each year. Lunde & Whitehead (2014) to Q4 2008. House prices rose in all OECD countries from 2000 to 2007[7.12], with Slovakia (22.41% year-on-year (yoy)), Ireland (16.65% yoy), Estonia (15.89% yoy), Hungary (13.52% yoy) and Latvia (11.22% yoy) as the most extreme examples, while Denmark rose at 3.11% yoy. From 2007 to 2009, house prices stabilised in most countries, and collapsed in a few with Estonia (-17.06% yoy) and Ireland (-12.57% yoy) showing the largest collapses. As noted above, Danish house prices reached a trough in Q4 2008 at -14.9%.

The asset and property price bubbles and collapses of recent years appear therefore to be closely related to developments in credit markets, and as is briefly explained below, the over-extension of private balance sheets and the risk of significant declines in property prices (the bursting of a bubble) could have serious consequences for both individual borrowers and the broader economy. Some of the key credit market innovations that occurred are discussed in the next section, together with some of their main advantages and disadvantages.

7.2.4 Key innovations and developments in product scope

Amongst the most common innovations noted by Scanlon et al. (2008) included the following. The introduction of flexible-interest rates, and a variety of length of interest rate fixation periods. The introduction of interest-only periods, where repayment of capital or principal are postponed temporarily. Full term interest-only loans, with the principal payable on maturity - these are sometimes linked to investment vehicles designed to accumulate greater capital than the amount contributed (i.e. with an expected positive spread above the rate of interest). Longer terms of debt, some up to 50 years. Reduced up-front cash (or own) contribution requirements. Increased percentages allowed to be allocated to bond financing, typically at a significantly lower interest rate than would otherwise be available from a bank. Exceptionally low interest rate levels have also seen some innovations in terms of price. Zero-interest 20 year fixed-rate loans as well as negative interest rate flexible-rate (ARM) bonds are at the time of writing available in the Danish market.

Some of the key drivers of these innovations were, as noted by Alpanda & Zubairy (2017), the availability of new technology, which permitted significantly more complex products to be managed effectively. Government deregulation,

[7.12] Data for OECD countries for the periods 2000 - 2007, 2007 - 2008, and 2008 - 2018 can be seen in Table 7.4, in Section 7.9.3.

and the associated greater market orientation. Rising asset prices and problems with housing affordability. In the post-crisis period, innovations have been driven by some additional factors, including record low interest rates and quantitative easing. Interest rates in developed economies, particularly northern Europe, have been set to record low levels. This has had the dual impact of reducing the cost of borrowing and significantly reducing lender revenues.

7.2.4.1 Advantages of innovations

The advantages of these innovations have been felt most by borrowers, particularly those groups of borrowers that were previously unable to afford initial payments on home loans (Scanlon et al., 2008). As mentioned above, mortgage repayments are in many countries now more affordable in the short term. The flexibility of repayment options has made it possible for borrowers to structure their mortgages according to their expected cash flow requirements, this is especially helpful for borrowers with irregular incomes.

The introduction of interest-only periods, allow borrowers that have limited capacity to change their income levels, particularly the elderly, to maintain a stable standard of living (Scanlon et al., 2008) - in effect consuming part of their home equity without the need to liquidate the asset. Interest-only periods also allow younger families to absorb temporary increases in living costs, without necessitating the sale of the family home. For example the cost of children, education, or other foreseeable and unforeseeable expenses.

The lengthening of the term of mortgage debts also reduces payments for the full term of the debt, making housing more accessible to groups that would otherwise not have been able to afford it. More sophisticated investors also have the opportunity to benefit from the innovations, where in very low interest environments, they might be able to borrow and invest at higher rates of return than the cost of borrowing. Unfortunately these advantages come with a cost.

7.2.4.2 Disadvantages of innovations

The disadvantages described below are considered as compared with a standard fixed-rate annuity mortgage. In general, the innovations in mortgages place significantly greater onus on the borrower to fully understand the product that they choose to take. Several of the benefits described above are also only true for the initial stages of the debt contract, as principal repayment is often built into later stages. These products also introduce additional risk in several forms, including interest rate risk, credit risk, market risk and significant potential opportunity costs - each will be discussed briefly below.

Interest rate risk
Perhaps the simplest and most direct effect, which would not be felt by a fix interest rate borrower, is that flexibility of interest rates expose the borrower to future increases in interest expenses, and therefore negative effects to disposable income if interest rates rise.

Credit risk
Interest-only periods may reduce monthly outlays, but they also prevent the accumulation of equity by the borrower. This means that there is less of a buffer, making them more sensitive to negative shocks. Negative shocks may include an increase interest rates, the loss of income, illness of self or family members, breakdown of relationships (possibly divorce) or a fall in property prices.

Market risk
Borrower solvency is determined on the basis of outstanding debt relative to the value of the property held as collateral, or loan-to-value (LTV) ratio. In the case of property price declines, traditional borrowers would have built a buffer to absorb a decline in collateral value. By contrast, the lack of equity accumulation for interest-only borrowers means that the outstanding debt would not have fallen relative to collateral. Any borrowers with LTVs close to the limit would risk falling into negative equity, and possibly insolvency. Scanlon et al. (2011) found that the groups that were most likely to be negatively affected in a crisis were those who had withdrawn equity (potentially via refinancing), or those who had bought close to the top of the market - resulting in high loan-to-value ratios and increased probability of falling into negative equity.

Opportunity cost
Taking Denmark as an example, the borrower is endowed with several rights, one of which is that any mortgage bond is callable at any time, and at which time, the borrow can choose to either pay the remaining par value of debt, or to repurchase the same (or similar) bond sold at time of borrowing. What this means is that if interest rates rise after the date of borrowing, there is an opportunity for mortgage borrowers to settle their debt at a significantly reduced

capital value. This reduction of debt can also be accomplished by refinancing at a later stage if interest rates were to rise sufficiently to outweigh the costs of refinancing. Borrowers with flexible rate mortgages lose this opportunity, since interest rates on flexible rate bonds are reset more frequently basis, and thus price adjustments are negligible.

In summary, the increased complexity introduced by innovations requires the borrower to have a more sophisticated knowledge of financial matters and to take on more responsibility for the security of collateral and repayment of capital. As has been reported by Scanlon et al. (2008), it is doubtful whether most borrowers are sufficiently equipped to deal with these challenges. Where they do not have sufficient knowledge or skill, households become dependent on financial advisers and service providers to ensure that they have the most appropriate products.

The credit-asset-price virtuous cycle

The self-reinforcing cycle of ease in credit markets and growth in asset prices is well documented. Bernanke, Gertler, & Gilchrist (1999) and Disyatat (2011) explained this in the context of the financial accelerator, rising property, and asset prices more generally, incentivise borrowing via balance sheet improvements and positive sentiment. In some cases borrowing is speculative, in order to benefit from the rising tide. Low interest rates and greater ease of access to mortgage debt simultaneously increase the pool of participants that demand assets, driving prices progressively higher. This virtuous cycle is mirrored by a similar decline in property prices and availability of credit on the way down. Conditions in credit markets and asset prices are thus difficult to separate.

7.3 Mortgage credit in Denmark

As mentioned above, the Danish mortgage lending market has also experienced a number of the innovations, and is a particularly interesting case due to a relatively unique approach to mortgage lending. The system is characterised by what is called the balance principle, which Laustsen (2009) describes as a traditional fund matching principle for mortgage lending. Denmark is unique in that this traditional principle has been respected for over 200 years. As noted by Laustsen (2009, p. 1), it results in "Transparent pricing in the form of a direct transfer of market-based prices to the individual borrower and market-based prepayment terms. And to the issuer: Limited and transparent risks."[7.13] As noted by Haldrup (2017, p. 2), a mortgage deed in Denmark is a "money-creating debt contract", but in Denmark, this is financed from the existing money stock[7.14].

These stable mortgage lending and covered bond markets have, since 1996, experienced a number of product[7.15], operational[7.16] and legislative[7.17] innovations. The IMF (Sheehy, 2014) conducted an assessment of the risk related to the structure of mortgage debt in Denmark in 2014, and found that there was a strong shift after 2003 towards flexible rate mortgages. This strong shift was warned against, and the financial supervisory authority, in collaboration with banks, began to reduce the exposure of HH to flexible rate products. While the problem was recognised, the level of flexible rate mortgage bond exposure remains high, with roughly 70% of outstanding mortgage debt to be repriced within the next five years. As in most other countries, the rights and protections of the borrower have been enhanced by several additional legislative changes[7.18],

[7.13]The mitigation of risk includes differences in term structure of assets and liabilities, refinancing risk, option risk across variations of bond type, liquidity risk, foreign exchange risk, and interest rate risk. The instruments issued include SDOs (særligt dækkede obligationer, covered bonds), SDROs (særligt dækkede realkreditobligationer, covered mortgage bonds) or ROs (traditionelle realkreditobligationer, traditional mortgage bonds). (Laustsen, 2009)

[7.14]Another important consideration is that mortgage bond financing is only available for a portion of the debt, depending on the nature of the property, and the nature of the purchase. See Falch, Sørensen, Holbek, Østergaard, & Andersen (2017) and Skinhøj, Kunde, & Rasmussen (2018) for a detailed description of the covered bond and covered mortgage bond market in Denmark. Further information is available on similar Nordic products in Holbek et al. (2017).

[7.15]2003, loans with interest-only (IO) periods. 2004, loans with interest rate caps and adjustable rate mortgages (ARMs, or floating-to-fixed rate options). 2007, ratchet coupons.

[7.16]2006 additional auctions in March and September. 2014, additional auction in June.

[7.17]English translations of financial regulation acts are available from https://www.dfsa.dk/en/Rules-and-Practice/Translated_regulations/Acts, however, there have been additional alterations since then. Legislation permitting multiple purpose use of mortgage debt against fixed property was introduced as early 1993.

[7.18]As noted by Laustsen (2009, p. 12), these include 1.) EU Capital Requirements Directive (CRD) and the UCITS Directive together set out the EU's definition of covered bonds. EU Directive 2006/48/EC of 14 June 2006 relating to the taking up and pursuit of the business of credit institutions, and EU Directive 2006/49/EC of 14 June 2006 on the capital adequacy of investment firms and credit institutions (dubbed the Capital Requirement Directive – CRD). 2.) Executive Order no 718 of 21 June 2007 – Executive Order on bond issuance, balance principle and risk management. 3.) The par rule, applied from the final report of the committee on business and commerce of the Danish parliament prior to the adoption of the act in May 2007. Prepayment of loans funded by SDO issuance must "... take place on reasonable terms and according to a practice that does not deviate from the terms applicable to housing loans today. this means that prepayment may take place by way of a buyback of the underlying bonds or at a price that does not deviate significantly from par, in part out of consideration for ARMs-like products. If a loan is not linked to listed bonds, prepayment may take place at par." 4.) Act no 577 of 6 June 2007 – Act amending the Financial Business several of which have been implemented in order to keep up with the rapid innovations in mortgage markets described above.

7.3.0.1 Composition of Danish mortgage debt

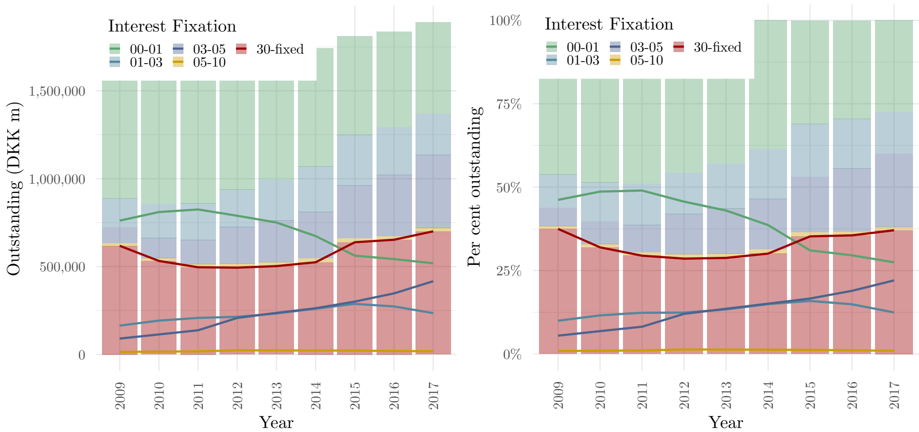
The composition of Danish real estate debt is rather complex to measure in its entirety, as there is a strong possibility that first-time home buyers will take an additional bank loan against their physical property for approximately 15% of the market value. In the data below, this portion of the debt is not included, and thus, the total debt outstanding represents a somewhat lower total than that official measures of total household debt used in the model that follows[7.19].

The following data are constructed from administrative registers, which allows for a more granular view of recent developments than is typically available. The actual data are significantly more detailed than that presented here, but further disaggregation makes visual comparison difficult due to the relative (in)significance of some subcategories of debt. The two main dimensions on which we are interested in splitting mortgage debt are the term remaining on the debt and the length of time for which the interest rate is fixed (referred to as '*interest fixation*' below). The interest fixation for ARM products shortened dramatically leading up to 2007, but has lengthened somewhat since the crisis, Unfortunately, the detailed micro-data is only available after 2009, which means that details during the expansion of mortgage debt are not available.

At a national level, the total level of debt split by interest fixation, can be seen in Figure 7.1. The first thing to note is that the nominal level of mortgage debt, in panel (a), has continued to rise throughout the period from 2009 through 2017.

Act and various other acts (SDOs) – and pertaining explanatory notes and final report.

[7.19]The data used for the model is aggregate data sourced from Eurostat, and does not provide the level of granularity presented here. It does, however, separate long- and short-term debt, and the majority of bank loans for the purpose of property purchase are included in the long term category. These bank loans are also flexible-interest rate products, and could thus be included in the flexible portion of mortgage debts outstanding. Unfortunately we do not have data that makes it possible to identify this debt separately, and thus it is excluded in the present section.



Source: Statistics Denmark (Danmarks Statistik), own calculations

(a) Levels

Source: Statistics Denmark (Danmarks Statistik), own calculations

(b) Proportional split

Figure 7.1: Mortgage debt in Denmark: All term lengths

This can also be considered in proportional terms, where the percentage of debt outstanding in each category is easier to read. As can be seen in Figure 7.1 part (b) above, the 30-fixed category, which covers all fixed rate products[7.20], was still in decline as a proportion of total outstanding mortgage debt from 2009 to 2012.

The most concerning factor, and one raised by Sheehy (2014), in an IMF stability report, was the growing proportion of debt that would reprice within relatively short intervals. At the start of 2011, debt with an interest fixation of less than and up to 1 year (the green line) was by far the largest contributor. This was recognised by both domestic and foreign prudential regulators as a risky development, and in collaboration with the banking sector and real estate finance companies a variety of measures were implemented to reverse this trajectory. (Sheehy, 2014)

These patterns can further be decomposed into a variety of term structures. As can be seen from Figure 7.2, the proportional composition of debt is significantly different for each of the term groupings[7.21]. We will not explore this too deeply,

[7.20] Due to the choice of data categorisation in the real-kredit register from Statistics Denmark, all contracts with fixed-interest are recorded as a 30 year fixation period.

[7.21] Debt is separated by term to maturity of between 0 and 10 years, from 10 to 20 years, from 20 to 25 years and those with a term greater than 25 years.

as the relative importance of each category varies dramatically.

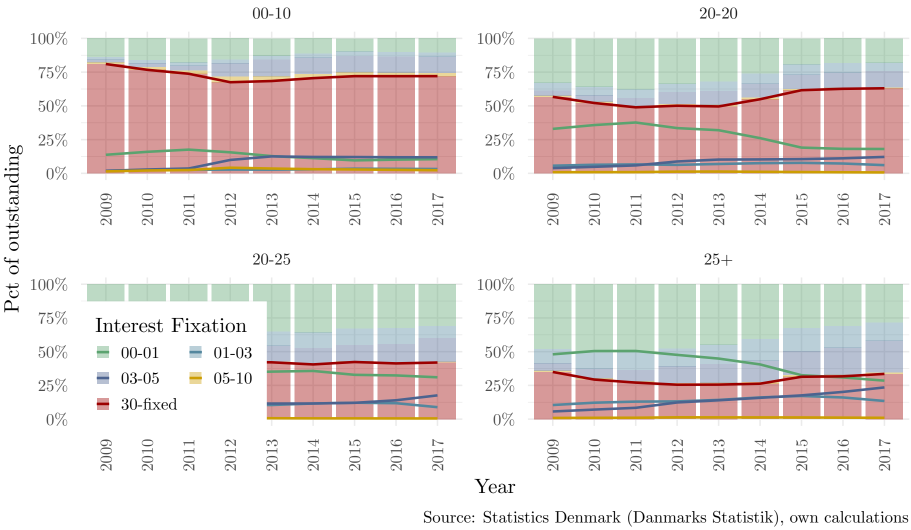


Figure 7.2: Composition of mortgage debt in Denmark: Split by term

Figure 7.3 illustrates the total outstanding debt in each of the term categories, it can quite easily be seen that by far the largest portion of debt has a term to maturity of over 25 years. In Denmark, the maximum term for which mortgage debt can be acquired is 30 years, thus all debt in this category in each year was issued under five years prior to the year in question. Roughly only one sixth of all outstanding mortgage debt has a term to maturity of less than 25 years.

Of the debt with greater than 25 years to maturity, it can be seen from Figure 7.2, that only approximately 30% of this outstanding debt has an interest fixation period of longer than 5 years. This together with approximately half of the other 15% results in a total of just over 37% of all outstanding mortgage bond debt. This means that the remaining 63% of mortgage debt will adjust together with interest rates. The outstanding mortgage bonds will also adjust in price, which effectively means that in the event of an increase in interest rates, nominal debt outstanding will remain fairly constant for the 63% that has flexible interest products, and debt service costs will rise commensurate with the rise in rates. The aggregate opportunity cost related to capital adjustments for borrowers in this case is potentially very large.

By 2017, the proportion of debt with an interest fixation period of 1 year or less had fallen to approximately 25% of all outstanding debt. A significant improvement from just under 50% for 2010 and 2011.

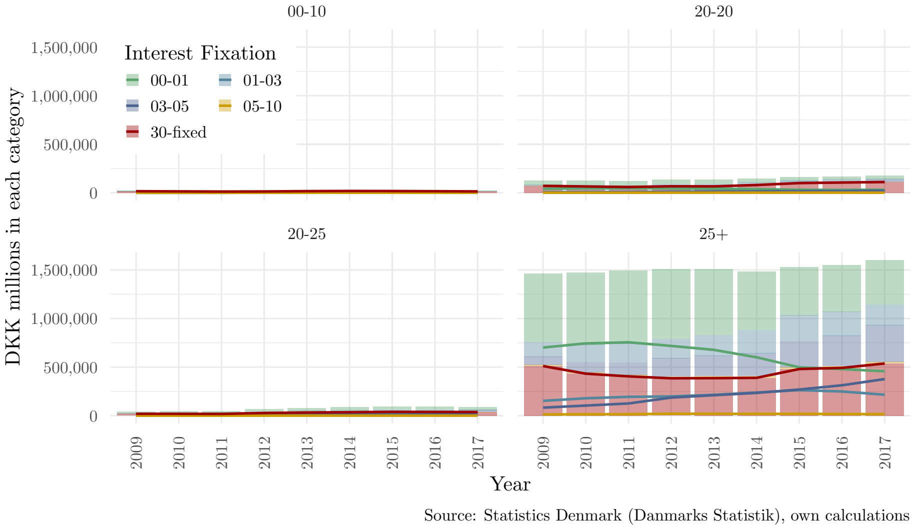


Figure 7.3: Levels of mortgage debt in Denmark: Split by term

Based on the distribution that can be seen in Figure 7.3 above, the remainder of the paper uses a much simpler term and interest fixation categorisation. In order to capture all long term debt, all outstanding debt with a term longer than 10 years is included in long term debt, while all shorter terms maturity are included in the short term category. Similarly, interest fixation periods of less than 10 years are included in the short fixation period category, of which the overwhelming majority is fixed for less than five years. All interest fixation periods of longer than 10 years are included in the fixed-interest category. Because the level of mortgage debt with a shorter term is so low (largely irrelevant), this additional categorisation is dropped. Any shorter term mortgage debt is also likely to have similar characteristics of longer term debt that has short interest fixation periods. As such, it is assumed that the only fixed interest debt held by HH is held in the form of mortgage debt. It is therefore possible to categorise all debt in terms of the "interest fixation" dimension.

This is supported by Figure 7.4, where the proportion of debt in the shorter term category is essentially negligible in comparison with the longer term outstanding portion.

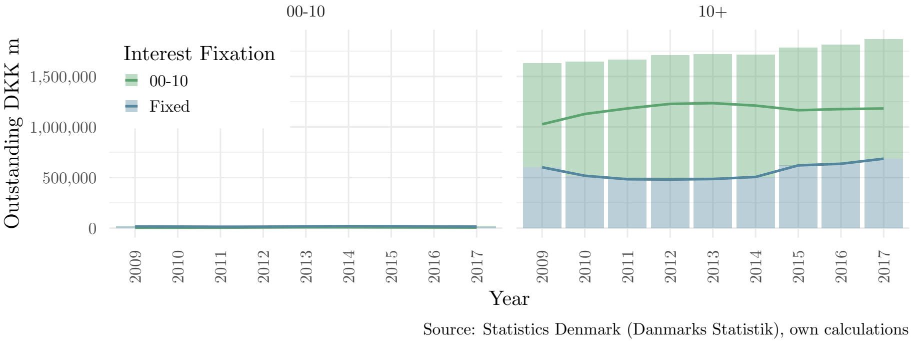
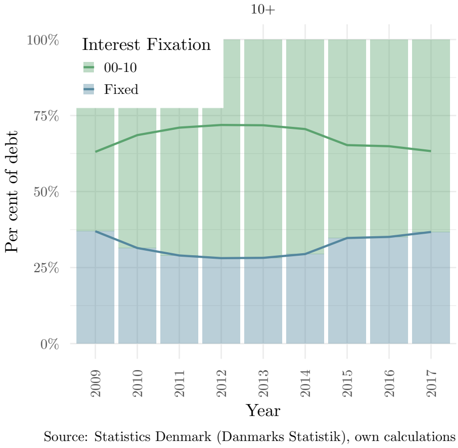


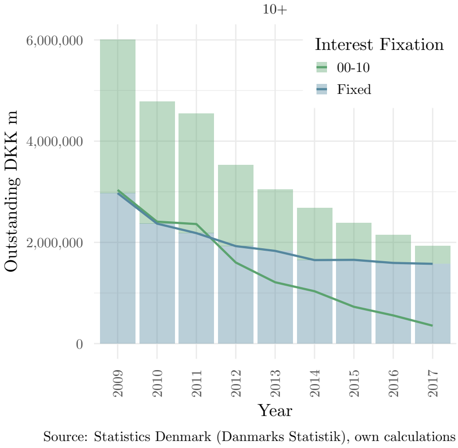
Figure 7.4: Composition of mortgage debt in Denmark: Simplified, panels by term

Figure 7.4 shows the nominal outstanding amounts in the short and long term to maturity categories. As can noted above, the short-term-to-maturity debt to the left is of negligible interest for the analysis that follows, and so most of the figures below focus purely on the long term-to-maturity (10+ category) to the right.

Figure 7.5, part (a), reflects the relative proportions of fixed and flexible-interest fixation periods in each interest fixation category. The debt with interest-fixation periods of less than 10 years will be referred to as adjustable rate mortgages (ARMs) or flexible-rate mortgages below.



(a) Outstanding debt



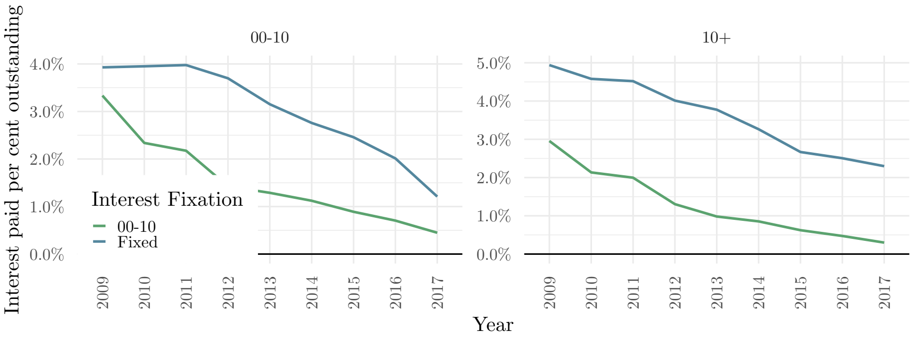
(b) Interest payments

Figure 7.5: Outstanding mortgage debt and interest payments: Term of 10+ years

The cost of the outstanding debt has not followed the same pattern. Figure 7.5 part (b) above, shows that the total interest expenses paid on shorter ARM debt has declined in nominal terms from roughly equivalent to the fixed-interest debt in 2011 to just a fraction of total interest paid on fixed-interest products by the end of 2017.

This can then be represented as an average rate of interest by calculating the amount paid divided by the total outstanding debt. In Figure 7.6, the short-term-to-maturity characteristics are shown on the left to illustrate the these products follow market rates more closely. Again, however, it is the panel to the right that we are most interested in, where it is possible to see that longer term ARM debt paid an average rate of just under 0.5%, while fixed rate longer term debt paid on average approximately 2.4% in 2017. The spread has interestingly remained relatively constant between the two average rates, but the proportional decline in the ARM average rate has been approximately -86%, while the same for fixed rate products has been approximately -50%. It appears, from this illustration, that a fall in official interest rates has passed through to mortgage markets at roughly the same speed in fixed and ARM products[7.22].

[7.22] Although it is beyond the scope of this study, a useful experiment would be to estimate the total expected effect on household equity positions for an increase in interest rates, taking refinancing opportunities into account. Unfortunately data is not available to simply measure



Source: Statistics Denmark (Danmarks Statistik), own calculations

Figure 7.6: Interest paid per cent of mortgage debt outstanding: By term

As can be expected, in the Danish environment, as interest rates fall and the option to refinance remains available to households, the rate of interest on fixed-interest securities has followed the flexible rate of interest downwards - with a relatively constant spread of approximately 2% points. Unfortunately we do not have data on how this spread alters during a rising interest rate period. It can be seen that there was some delay in convergence in shorter terms to maturity. This is expected as the costs associated with refinancing existing contracts are likely to outweigh the benefits of a reduction in interest expense on smaller capital values, or on products with shorter terms to maturity (i.e. fewer interest payments remaining).

In a rising rate environment borrowers again have the incentive to refinance in order to take advantage of falling bond prices, since in Denmark the borrower has the option to either pay back the cash capital value or to repurchase an equivalent bond to the one issued on the date of borrowing (otherwise known as a prepayment or buy-back option). If interest rates rise sufficiently to make it profitable, and if they have accumulated sufficient equity, the borrower has the opportunity to make a substantial reduction in the outstanding capital amount. Thus, unless rates remain unchanged, or only vary marginally, for an extended period of time, the proportion of outstanding debt that has been recently refinanced will typically be quite high[7.23].

this impact directly, but it could be accomplished with reasonable assumptions. Measuring interest payments relative to debt in isolation unfortunately cannot capture this effect.

[7.23]This is indeed the case at present, after interest rates declined gradually, but ultimately to a record low level in 2019. At the time of writing it is possible to borrow at a fixed rate for 30 years (the longest term to maturity available at present) of 0.5% p.a. against 80%

7.3.0.2 Affordability of debt

The debt-service ratio (DSR) is shown in Figure 7.7, and calculated as the ratio between total outgoing property income payments to annual HH disposable income. In aggregate terms, it is unsurprising that the DSR has fallen continuously for the Danish household sector since the GFC. It is presently at the lowest level since 1995, and according to data collated by Abildgren (2017), the lowest level ever. Thus in relative terms, while debt may be at record high levels relative to income, the aggregate cost of servicing that debt is at an all time low.

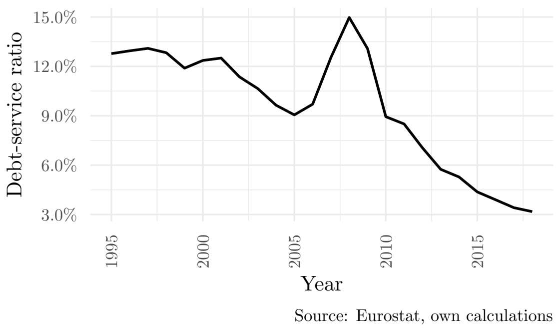


Figure 7.7: Debt-service ratio: Denmark

This paradox between the level of debt outstanding and the declining DSR is discussed in analysis in Section 7.6 The implications for the economy as a whole and for the household sector depend on the macroeconomic linkages between the sectors and the drivers of agent decision-making in the model structure.

7.4 The model

The model implemented in this section is based on Byrialsen & Raza (2019), which is at the time of writing the most advanced empirical Stock-Flow-Consistent (SFC) macroeconomic model of Denmark. The full model together with an explanation for each equation and the logical connections between each of the sectors, flows and stocks is provided in Section 7.10, in the appendix.

of the market value of a primary residence. As can be seen from Figure 7.3 in the text above, approximately 85% of mortgage debt outstanding has more than 25 years remaining to maturity. In other words, 85% of all mortgage contracts in Denmark (by value) were issued inside of the previous 5 years.

Throughout this section some of the equations and explanations thereof are duplicated for explanatory purposes. It will provide only a brief summary of the core features of the model, and the highlight the main changes made for this analysis.

The model consists of the five main institutional sectors, namely the household sector (HH) non-financial corporate sector (NFC), the financial corporate sector (FC), the general government (G), and the rest of the world (ROW). It was developed between 2017 and 2019 with a focus on the Danish HH. As such, the behaviours of all sectors are significantly simplified, except in so far as they engage directly with HH. The model is fully empirical, in the sense that all variables included in the model are available as a dataset, against which the performance of the model can be tested.

One feature is worth noting up front. As mentioned in the introduction, the full model has 131 endogenous and 78 exogenous variables. Included in the exogenous variables are all rates of return and all financial asset prices. The most important implication is that correlated asset price and market movements are not endogenous in the model, and this limits the analysis to very short-term model responses.

7.4.1 Data

The data used for the model in this article is sourced from a combination of Eurostat data, OECD data, and AMECO data. The period for which annual data is available in sufficient detail is from 1995 to 2017. This data is then processed in a series of aggregations. The data and the model accounting structures follow the ESA 2010 (Statistical Office of the European Communities., 2013) accounting structure, and the contents of the financial balance sheet can be summarised as:

Monetary gold and special drawing rights (F1), Currency and deposits (F2), Debt securities (F3), Loans (F4), Equity and investment fund shares (F5), Insurance, pensions and standardized guarantee schemes (F6), Financial derivatives and employees stock options (F7) and Other accounts (F8). These data are aggregated according to Table 7.1.

The financial markets are thus highly aggregated in the model with effectively only three asset classes. IB covers all securities that provide a financial return

Table 7.1: Aggregation of ESA balance sheet categories

Assets	Eurostat Code (ESA 2010)
Interest bearing (IB)	F_1, F_2, F_3, F_4, F_7 or F_8
Net interest bearing (NIB)	F_1, F_2, F_3, F_4, F_7 or F_8
Net equities (NEQ)	F_5
Pension (PEN)	F_6

that is analogous to interest, as does NIB. The only difference is that for NFC, GOV and ROW, as part of the aggregation process, only the net position in these assets and liabilities are considered.

The other two major asset classes are equities and pension funds. All except HH equities are expressed as net equity assets and liabilities, NEQ, and for HH they are expressed as equity assets, EQA, as they cannot issue equity liabilities by definition. Pension assets are expressed as PEN, and are recorded as net pension assets ($NPEN$) for ROW.

7.4.2 Major changes

The most significant change in this version of the model is the introduction of a split between fixed and flexible rate mortgage debt. This relatively simple alteration allows one to test the sensitivity of HH balance sheets to a change in debt composition. The drivers of debt remain the same, and the rates of return on all other assets have been left unchanged.

This is to isolate the channel through which the change in the cost of borrowing affects households in the short term. This makes it possible to identify the transmission channels and magnitude of each shock more clearly. It is one of the advantages of fully exogenous rates of return and asset prices, but comes at the cost of more realistic inter-market ("pass-through") responses.

7.4.3 Balance sheet and transactions flow matrices

As with all SFC models, the balance sheet matrix represents the distribution of ownership of assets (+) and liabilities (−) in the modelled economy. As can be seen from Table 7.2, the sum of all rows, with the exception of fixed capital, are zero. This reflects that each asset (except fixed assets, K) is exactly offset by a liability held by another sector.

The financial asset classes mentioned above are assigned to each sector according to assumptions of which sector issues or holds each type of security. FC holds the majority of counterpart financial securities, and in all sectors except HH, financial assets and liabilities are recorded in net terms (assets minus liabilities).

The interest bearing liabilities of HH are, as noted in the previous section, by a vast majority, long term debt. This is separated into fixed-interest ($IBL(FI)^F$) and flexible-interest ($IBL(FL)^F$) (or, ARM) mortgage liabilities.

Horizontal consistency captures the idea that all accounts are recorded as dual entry accounting records, and the sum of all sector positions in any financial asset class should be zero. Vertical consistency represents the financial position of each sector, where financial net wealth (FNW) is the sum of all assets and liabilities and will either be a net positive or negative value. The sum across sectors of the FNW of all sectors is also zero.

Table 7.2: Balance sheet matrix: BSM

Stocks	NFC	FC		GOV	HH		ROW	Σ
		Assets	Liabilities		Assets	Liabilities		
Financial Stocks								
Interest bearing (IBA / IBL)			$-IBL^F$		$+IBA^H$			0
Interest bearing Fixed		$+IBA(FI)^F$				$-IBL(FI)^H$		0
Interest bearing Flexible		$+IBA(FL)^F$				$-IBL(FL)^H$		0
Net interest bearing (NIB)	NIB^N	NIB^F		NIB^G			NIB^W	0
Net equities (NEQ)	NEQ^N	NEQ^F			NEQ^H		NEQ^W	0
Pensions (PEN)			$-PEN^F$		$+PEN^H$		$NPEN^W$	0
Financial net wealth (FNW)	FNW^N	FNW^F		FNW^G	FNW^H		FNW^W	0
Fixed Stocks								
Fixed assets (K)	K^N	K^F		K^G	K^H			K^T

The transactions flow matrix is presented below. This matrix, much like the balance sheet matrix presented above, observes the requirements of horizontal and vertical consistency. In this table, all items that result in a positive flow of funds for the sector in question are marked with a plus sign (+), and all those that result in a flow outwards of funds are marked with a minus sign (−).

The expenditure approach to GDP is captured in the first five lines of the table, and can be captured as,

$$Y = C + I + G + (X - M) \tag{7.1}$$

Where C is consumption, I is investment, G is government expenditure, X is exports and M is imports. All in nominal terms to reflect the actual flows of funds in each period. The income approach to national expenditure is captured in the following six lines in the table up until the row called *Savings*. Each row name reflects the flow that is applicable to each sector. The full detail of how these flows are defined can be found in the full model description in Section 7.10, in the appendix.

Capital income (rK), transfers (STR), capital transfers (KTR), acquisitions less disposal of fixed assets (NP) and net lending (NL) are presented without a particular sign attached to each sector. The reason for which is that each sector both receives and pays social transfers, and although GOV is the primary counterpart for all of these, the size and net sign of these transfers can change over time. The same is true for KTR and NP. Net lending (NL) is a passive (residual) value and is determined by the balance of funding requirements between the sectors over time, and can therefore also swing between negative or positive as a flow.

Table 7.3: Transactions flow matrix: TFM

Flows	NFC		FC		GOV		HH		ROW		Σ
	Current	Capital	Current	Capital	Current	Capital	Current	Capital	Current	Capital	
Private consumption	$+C$						$-C$				0
Government consumption	$+G$				$-G$						0
Investment	$+I$	$-I^N$		$-I^F$		$-I^G$		$-I^H$			0
Exports	$+X$								$-X$		0
Imports	$-M$								$+M$		0
GDP	Y										0
Taxes	$-T^N$		$-T^F$		$+T^G$		$-T^H$		$-T^W$		0
Gross operating surplus	$-B2^N$		$+B2^F$		$+B2^G$		$+B2^H$				0
Wages	$-WB^N$						$+WB^H$		WB^W		0
Capital income	rK^N		rK^F		rK^G		rK^H		rK^W		0
Transfers	STR^N		STR^F		STR^G		STR^H		STR^W		0
Pension adjustments			$-CPEN^F$				$+CPEN^F$				0
Savings (per sector)	$-SN$	$+SN$	$-SF$	$+SF$	$-SG$	$+SG$	$-SH$	$+SH$	$-SW$	$+SW$	0
Capital transfers		KTR^N		KTR^F		KTR^G		KTR^H		KTR^W	0
Acquisitions less disposal FA		NP^N		NP^F		NP^G		NP^H		NP^W	0
Net lending		NL^N		NL^F		NL^G		NL^H		NL^W	0
Σ	0	0	0	0	0	0	0	0	0	0	0

The three rows after the *Savings* row illustrate adjustments to the level of savings (S) as a result of capital transfers (KTR), purchase and sale of fixed assets (NP) and (from the third row of the table) the level of investment (I) of each sector - summed vertically in the *capital* accounts column for each sector. The sum of all of these items is reflected in a net financing requirement for each sector, in the table is called *Net lending*. The sum of all net lending positions in the economy is again necessarily equal to zero, as one sector's surplus is at least one other sector's deficit. The sum of all columns and all rows are thus all equal to zero, and this criterion is respected by the data collected from Eurostat on an annual basis.

Financial and fixed assets in the model are subject to both transactions and revaluations (or capital gains or losses). The accumulation of certain types of assets or liabilities depends in part on the action of the sector in question and in part on the effects of the other sectors. As can be read in the full model description in the appendix, the nominal values that are sourced from the Eurostat database and or AMECO can then be deflated using appropriate price indices. There are 19 different price indices used in the model, some of which are calculated, but the majority of which are sourced either from Statistics Denmark, AMECO or the OECD. The details of the model structure and the performance of the model relative to the data available can be found in Byrialsen & Raza (2019), and the details of the behavioural equations available in Section 7.10, in the appendix.

What we are most interested in here, however, is the specific channels through which the scenarios proposed below transmit. As mentioned above, the model contains active behaviours and passive behaviours. In each period, in order to ensure closure in the model, there is one variable in each sector that is passive to the budget constraints of each year.

The passive accumulator flows (or residual, buffer variables) for each sector are as follows: transactions in net interest bearing securities for NFC ($NIBTR_t^N$), GOV ($NIBTR_t^G$), and ROW ($NIBTR_t^W$);and, transactions in interest bearing assets for HH ($IBATR_t^H$). While specific behavioural equations determine the holding of all other financial assets, NIB securities act as a catch all category for NFC, GOV and ROW. The sum of those positions is then absorbed by FC. As will be discussed below, the final closure of the model is provided through the indirect provision of equity assets to HH by FC on demand. This is fitting, since HH purchases of mutual funds or unit trusts are likely to be fulfilled by FC, rather than directly by NFC.

7.5 Scenarios

This section briefly explains the four scenarios investigated using the model. Apart from alterations to the structure of household mortgage liabilities, the model operates in the same manner as in Byrialsen & Raza (2019). The shocks presented below are measured as a percentage change from the baseline scenario.

This allows for a simpler comparison between scenarios, and the aggregate nominal and real values of stocks and flows are illustrated where relevant.

The first shock (and Scenario 1) is an increase in interest rates in 2020, the second shock (and Scenario 2) is a decline in property prices in 2022. Scenario 3 compounds the first two, in that the first shock is kept in the model before the shock to property prices is imposed. The last scenario, Scenario 4, is a reduction in the level of ARMs in 2017. Effectively, the last scenario changes the pre-conditions for the first two shocks, but applies them in exactly the same manner. It is therefore possible to make a direct comparison between Scenario 3 and Scenario 4, given two different starting points.

This ordering allows the answer to a counter-factual question: What if HH had not taken on as much flexible rate mortgage debt? How would this shift in interest rate exposure affect outcomes, both for HH and the broader economy? In essence, what might have been the case if the innovations leading up to 2003 had not impacted borrowing decisions to the same degree? There are however, some limitations to the current model that are relevant for this exercise.

7.5.1 Limitations for interpretation of results

Adjustable Rate Mortgages (ARMs) typically do not adjust immediately

As noted above, the bulk of ARMs in Denmark adjust fewer than 5 years into the future. This allows households an extended period of time to observe interest rate fluctuations and make a decision regarding refinancing or property sale. It also means that the effects of an interest rate change will only impact HH cash flows after between one and five years.

A decline in house prices is unlikely to happen in isolation

A fall in house prices is not expected to occur in isolation. Unlike in the model below, a collapse in property prices is unlikely to be an isolated event. It would more likely accompany broader systemic problems or be triggered by some form of financial or economic crisis.

The structure of the economy at end 2017 is integrated with the volume and structure of household debt

For the fourth scenario, it is assumed that we can simply shift the structure of debt and leave the remainder of the economy unchanged. In reality, the total level of debt outstanding would probably be significantly lower if ARM and interest-only products had not been made available. This would have affected a significant array of economic variables, not least of all, domestic demand and house prices. Although this is true, HH have already accumulated significant levels of debt. As such, Scenario 4 is less a question of, what if things had been different, and more a question of how to structure policy in order to best influence future refinancing decisions of HH.

Interest rate changes would change the composition of debt

Refinancing in response to interest rate changes in Denmark is extensive. In a rising interest rate environment, the incentive is to repurchase the previously issued bond at a reduced price, settle the older debt, and then refinance at similar monthly instalments, but with a lower capital value outstanding.

With falling interest rates, the incentive is to refinance at lower monthly instalments, and if possible using a bond with fixed-interest, thus creating the opportunity to refinance if rates rise significantly in the future, and thus reduce the level of debt outstanding. It is therefore unlikely that the structure of debt would remain constant after a shift in rates[7.24]. Due to the costs involved in refinancing, a change in interest rates is expected impact debt structures gradually, remaining fairly stable for the first year or two, and adjusting to a greater degree in the medium term (approximately up to 5 years).

7.5.2 Scenario 1 - An increase in interest rates

The first shock is a simple interest rate change. The point is to illustrate the expected impact on the level of household disposable income and the household balance sheet.

In this shock we consider a 2 percentage point (2% points) rise in official rates. This is assumed to be passed through perfectly to ARM mortgages (interest

[7.24] Micro-level contractual data is presently only available from 2009 onwards, thus at an individual level, there is no data that can be used to model household behaviour in response to an increase in interest rates. If the home owner intends to sell their property inside of 5 years, interest rates must fall dramatically for it to be financially beneficial to refinance due to the costs involved. In a rising interest rate environment, a fixed-interest bond holder that sells their property will always be able to benefit from capital losses on their outstanding bond, but might face difficulties in selling their property as demand is expected to be suppressed due to higher borrowing costs. In the same situation, a fixed rate borrower will again need quite significant changes in the level of interest rates for a prepayment or buy-back operation to be profitable in under 5 years.

rate on flexible-interest-rate mortgage debt, i.e. flexible rate products, with subscript (FL), ($r^H_{L(FL)_t}$). The cost of fixed-interest mortgage debt ($r^H_{L(FI)_t}$) is increased by a proportionally lower adjustment of point five percentage points (0.5% points) to reflect lower sensitivity of adjustments of the overall stock of fixedinterest rate products. This is a strong assumption, and is not likely to hold over longer periods of time, fixed-interest rate debt holders are expected to retain their debt at lower interest rates, while the majority of flexible-interest rate holders are expected to participate fully in the rise in interest rates after a period of three years[7.25].

In the model baseline, the current rate is calculated as interest payments relative to outstanding debts. This gives a weighted average at the end of 2017 of 1.41% for all debts[7.26]. After the shock, the adjustment is from this average rate upwards - thus flexible-interest rates are adjusted up to 2.41% and fixed-interest rates up to 1.91%. This constitutes a 141.75 per cent increase in flexible rates, and taking into account changes in the level of outstanding debt in 2021, a 136.29% increase in interest payments. For fixed-interest debt, it constitutes a 35.44 per cent increase in fixed rates, and a 32.38% increase in interest payments.

The interest rates in the model include, interest on fixed ($r^H_{L(FI)}$) and flexible rate ($r^H_{L(FL)}$) mortgages, and the counterpart assets ($r^F_{A(FI)}$, $r^F_{A(FL)}$), the general rate of return on net interest bearing assets (r_N), and the return on interest bearing assets for households (r^H_A). The other rates of return are the domestic and foreign rate of return on equities (χ_t), and pension assets (ψ_t). All rates of return in the model are determined exogenously, which means that any adjustment must be applied manually. As noted above, the change is limited to the cost of borrowing for HH only.

[7.25] These time periods are purely for illustrative purposes, since, as mentioned just above, the Danish market is expected to have extensive refinancing as rates shift. This is however expected to be somewhat muted by the expectation that the demand for new debt, and therefore the demand for houses are expected to fall - potentially leading to a fall in house prices, or at the very least, slower capital gains. Selling conditions are generally expected to be worse in a higher interest rate environment, where the rise in the cost of house purchase will naturally exclude a large number of potential buyers.

[7.26] As noted earlier, interest rates are currently at historically low levels. The actual average rates of interest paid on flexible and fixed-interest mortgage products were 0.29% and 2.29% per annum at the close of 2017. These values, however exclude a variety of debt types such as bank debt, vehicle finance and consumer credit. The use of the average payment on all debt types is a simplification that is made to suit the aggregation of data, and the reader should be aware that this does not take into account the multitude of behavioural incentives that apply to each underlying debt type.

In the case of household debt, it is FC that holds the counter-balance assets. Thus,

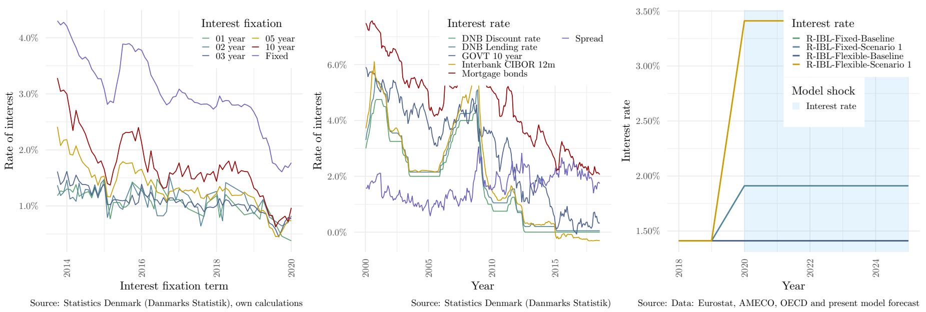
$$r^F_{A(FI)_t} = r^H_{L(FI)_t}$$

and,

$$r^F_{A(FL)_t} = r^H_{L(FL)_t}$$

FC receives $r^F_{A(FI)_{t-1}}(IBA^{F\sim H}_{A(FI)_{t-1}})$, and the two interest rates are simply made equivalent. An increase in rates results in an increase in costs for HH and an increase in revenues for FC.

Figure 7.8 illustrates, in part (a) the actual monthly interest rates available for new debt on Danish mortgage markets since 2013 (separated by term of interest fixation). Part (b) shows the progression of official interest rates in Denmark since 2000, where the "Mortgage bond" rate is the dark-red line, and is comparable with *Fixed* mortgage bonds in panel (a), the purple line, from 2013 onwards. Part (c) illustrates the impact of the shock to interest rates in the model in 2020.



(a) Interest rates by maturity (b) National bank rates (c) Interest rate shocks in model

Figure 7.8: Interest rates in Denmark

As can be seen from part (a), the rates available to fixed rate borrowers have followed market rates downwards throughout the period, although this illustrates only those rates available, rather than those paid. Figure 7.6 showing the amounts actually paid in the section above, however, illustrates that the amount paid has also declined at a similar pace, although with a marginal delay.

The interest rates in the model are split into fixed and flexible rates for the purpose of testing the effects of a shock to interest rate on alternative compositions of mortgage debt. The baseline value of interest rates remains just below 1.5% on average for all debt.

The expected outcome is that where the proportion of fixed-interest outstanding debt is higher, the effects of a shock will be weaker, and vice versa. This of course can only have an impact in the case where mortgage debt is itself split into fixed- and flexible-rate debt.

The total level of outstanding IBL for HH is split into fixed-interest (IBL_{FI}) and flexible-interest bearing liabilities (IBL_{FL}). The proportion of interest bearing assets held as IBL_{FI} is α.

$$IBL^H_{FI_t} = \alpha(IBL^H_t) \tag{7.2}$$

and thus,

$$IBL^H_{FL_t} = (1 - \alpha)(IBL^H_t) \tag{7.3}$$

The level of α is calculated from data acquired from multiple data sources at Statistics Denmark, and varies over time. The split was first introduced in 1996, but initial volumes were low. As discussed in Section 7.3, while the composition of this debt is significantly more complex than this, a strong argument can be made for an aggregation up to just these two categories. This split has no effect on the model prior to the shock in 2020, as the rate of interest on each is considered to be equal to the average rate used in the baseline scenario up to that point.

It is also possible to shock all other rates of return to a similar degree. Given the integration of financial markets, this would produce results in the model that are more realistic. Unfortunately, it would also conceal the effects that are purely due to dynamics linked to the interest cost of borrowing for households[7.27].

[7.27] Several alternative formulations of the shock were tested, but the inclusion of changes to other rates of return require a number of additional assumptions. For example, an increase in domestic bond rates are only likely in Denmark if European interest rates also rise. Also, the speed and proportion to which rates pass through from official rates to each market are likely to differ across products, but also over time.

7.5.3 Scenario 2 - A fall in house prices

The second scenario is a fall in house prices. This is effected through a negative twenty per cent adjustment to the house price index (−20%). This is a large change to house prices, but is equivalent to the stress test applied by the IMF (Sheehy, 2014). At a national level, Figure 7.9 illustrates that the average nominal house price index (HPI) for dwellings in Denmark has risen at a relatively steady pace since the GFC.

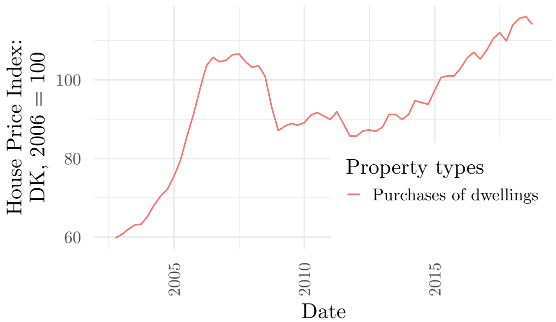


Figure 7.9: National House price index (HPI), 2006 = 100

This follows a collapse of house prices during the GFC, where prices of Danish dwellings fell approximately 20% from the peak in 2006 to the trough in 2011. This average was not uniform across property types or regions. As shown in Figure 7.10, the prices of owner occupied flats in the Capital and North Denmark Regions have risen at roughly the same pace as prior to the GFC. This is not predictive of a correction or price collapse, but does suggest a possible housing price bubble in those markets. All other regions, appear to have only just recovered to pre-crisis prices[7.28].

[7.28] The capital region holds a disproportionately large share of real estate assets by value, and thus the impact of property prices there carry a greater weight for an average for the country as a whole.

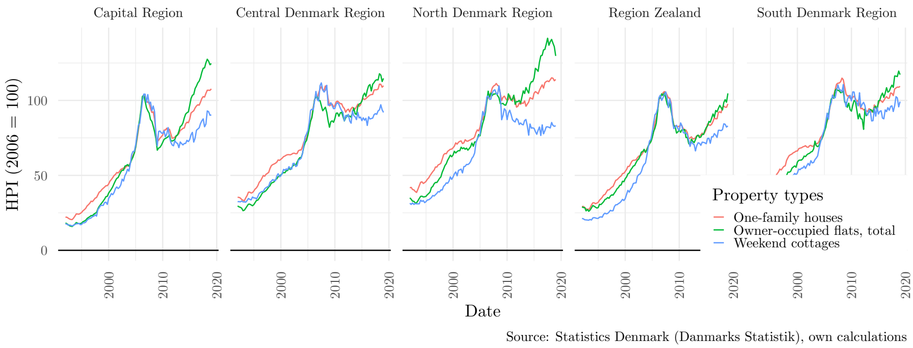


Figure 7.10: House price index (HPI), 2006 = 100

A more serious concern for potential borrowers is that several markets, particularly those for weekend cottages (otherwise known as summer houses) have not recovered in the period following the GFC. Thus, any property purchased between 2005 and the collapse in 2007 would have a high probability of falling into negative equity[7.29].

In this model, households are only permitted to make productive investment in housing, which, as in Zezza (2008), Fontana & Godin (2013) and Beckta (2015), is considered only as a primary market. The major difference here is that households are assumed to produce the houses, whereas firms are housing producers for all three of the above-mentioned studies. The secondary market for houses is assumed to affect prices, but not the demand for additional housing investment. Demand for housing investment is determined by by a Tobin's-Q-like function, partially driven by changes in disposable income and previous period housing investment, and partially driven by a relative shift in sales price (P^H_{t-i}) and construction cost (P^i_{t-i}) indices.

Real investment in fixed assets (dwellings), in Equation 7.4, is estimated as a log-linear function that depends on conditions in previous periods. This assumes that the decision to invest in houses occurs based on recent developments, but that actual changes in investment in fixed assets takes some time to materialise. It thus takes one period before the effects of the house price shock can be observed.

[7.29] Although the risk that the LTV ratio rises above 1 is lower for cottages, since the cap on bond financing has until very recently been significantly lower than for primary residences (60% as opposed to 80%).

$$ln(i_t^H) = \beta_i + \beta_i ln(i_{t-i}^H) + \beta_i ln\left(\frac{P_{t-i}^H}{P_{t-i}^i}\right) + \beta_i ln(yd_{t-i}^H) \tag{7.4}$$

The shock imposed on the model is to the numerator of the Tobin's Q ratio[7.30]. The imposed decline in house prices affects sales prices negatively, relative to the cost of production, and thus has a contractionary effect on the Tobin's q ratio, $\left(\frac{P_{t-i}^H}{P_{t-i}^i}\right)$, and thus on HH real investment (i_t^H). The shock is implemented as a permanent decline in prices, and thus changes the value of the ratio for all periods following the shock. Growth in house prices continues according to the same trajectory as in the baseline in order to make for a more effective comparison.

The nominal level of investment in housing can be calculated by inflating the real investment in housing series (i_t^H) by the investment price index (P_t^i, which is sourced from Statistics Denmark):

$$I_t^H = i_t^H(P_t^i) \tag{7.5}$$

The nominal stock of housing (K^H), as with other assets to come, follows the simple process of previous stock (K_{t-1}^H), plus acquisition (in this case investment in new houses), less depreciation (D_t^H) plus capital gains $(K_{CG_t}^H)$.

$$K_t^H = K_{t-1}^H + I_t^H - D_t^H + K_{CG_t}^H \tag{7.6}$$

Capital gains on houses, in turn, can be calculated in an *ex post* manner as:

$$K_{CG}^H = \Delta P_t^H(K_{t-1}^H) \tag{7.7}$$

Which is simply the change in the price of houses applied to the level of stock at the end of the preceding period.

[7.30] In the present structure of the model, investment is regressed against real investment of the previous period i_{t-1}^H; real disposable income y_d^H, and the same at $t-2$ $(y_{d_{t-2}}^H)$; the Tobin's Q ratio at level terms $\left(\frac{P_t^H}{P_t^i}\right)$, and with a one period lag $\left(\frac{P_{t-1}^H}{P_{t-1}^i}\right)$; a constant; and, a trend component.

The change in house prices (ΔP_t^H) leading into the current period is then by definition the same ratio proportion of capital gains to previous housing capital.

$$\Delta P_t^H = \frac{KH_{CG}}{K_{t-1}^H} \tag{7.8}$$

Nominal housing capital held by HH at the end of the current period can be expressed as the price adjusted stock at the end of the previous period, plus net investment and depreciation. Equation 7.9 is effectively a restatement of Equation 7.6, but with greater emphasis on the variable shocked in the analysis.

$$K_t^H = K_{t-1}^H(1 + \Delta P_t^H) + I_t^H - D_t^H \tag{7.9}$$

The deflated real capital index can then be found, as in Equation (7.10) by dividing the series by the investment (housing) price index, from Equation (7.8).

$$k_t^H = \frac{K_t^H}{P_t^i} \tag{7.10}$$

Housing capital then forms part of HH net wealth, which feeds back into consumption decisions in subsequent periods. A decline in net wealth in period t leads to a decline in consumption in period $t + 1$.

The effects of changes in net wealth (NW), are then felt directly in the level of HH consumption, but with a lag on one period (as can be seen in Equation (7.58) in the appendix). Although a fall in house prices does not affect household disposable income to a substantial degree is contributes to a decline in overall economic activity, and therefore reduces the demand for labour in subsequent periods. This ultimately does affect household income but the effect is not as immediate as was the case for the interest-rate shock.

7.5.4 Scenario 3 - Combination of Scenarios 1 and 2

The third scenario consecutively applies the shocks from Scenarios 1 and 2. First the interest rate increase in 2020, and then the decline in property prices in 2022. This combination sets up the comparison to be introduced in Scenario 4 below.

7.5.5 Scenario 4 - Comparison for Scenario 3, proportion of fixed-interest debt 80%

The final alteration to the model is an increase in the proportion of mortgage debt held as fixed debt (α) from the 2016 level of 33.42% up to 80% in 2017. This shift allows us to test the hypothetical difference of the impact of a shock to interest rates in an artificial scenario, where the proportion of flexible debt amounts to only 20% of outstanding household mortgage liabilities.

7.6 Simulations

This section explains the transmission of the two shocks in the scenarios described above. First, the components of the economy that are most dramatically affected are identified, and thereafter the key transmission channels that cause these effects are briefly discussed.

The key take-aways from this section are that shock 1 and 2 both propagate through the economy as described above, and that Scenario 3 results in greater volatility in the responses of the economy than Scenario 4. This has implications for the stability of the balance sheets of each sector and for the economy as a whole.

The effects of each shock are summarised in tables in Section 7.9.4 for each of the above-mentioned scenarios[7.31]. This approach allows a quick summary of the impacts of a shock. It shows all affected variables, and thus provides a snapshot of how broadly the shock propagates. One drawback is that it is a cross section in time, and thus is not able to show the progression of feedback effects over time. These tables are both used as a guide to the most important transmissions, and as a consistency check, to ensure that the model behaves within reason.

The model responds largely as expected to the first shock, with the exception of the rather extreme response of the financial sector. This is because FC transactions in net interest bearing assets ($NIBTR^F$) absorbs all financial

[7.31]Those tables are organised, firstly, according to whether the affected variable is a stock, flow, parameter, rate, or index of some kind; and secondly, in order of largest variation from the baseline scenario (as a proportion of the baseline). Transactions in and revaluations in stocks, which occur on an annual basis, are considered flow variables. To capture accumulation effects, tables are provided at the end of period 2021 ($t + 1$) for Scenarios 1 and at the end of periods 2022 (t) and 2025 ($t + 3$) for Scenarios 2, 3 and 4.

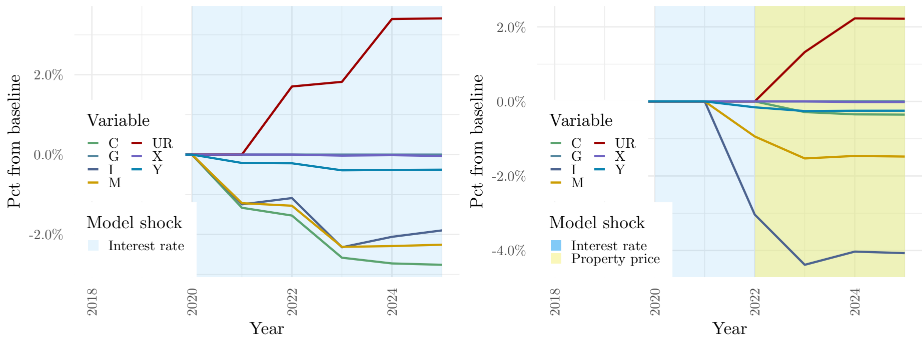
transactions of the other sectors - or, stated differently, accumulates all financial imbalances. The second shock, to property prices, has a more interesting result with regard HH savings and will be discussed in more detail in the HH section below.

As noted above, each of the sectors has a buffer flow that summarises the collective effect of each shock, and each of the shocks are quite extreme in nature. It is therefore unsurprising that the effect on the passive elements is somewhat exaggerated. Even though shocks of the same magnitude have occurred in the past, they are not common events and have only been used here to enhance the potential risks associated with the different debt structures.

7.6.1 General economy

The first shock (to interest rates) has a delayed effect that is first visible in the shift from period 2020 to period 2021; as can be seen for Scenarios 1, 3 and 4. The second shock (to property prices) takes effect immediately in 2022, and can therefore be seen to take effect from period 2021 to period 2022 for Scenarios 2, 3 and 4. At a broader economic level, the strongest impact on the major components of GDP from the first shock are a decline in gross fixed capital formation (I) of -1.25% and in imports (M) of -1.22% (and as a result, net exports rise by just over 10.52%). Figure 7.11 shows how C, I, G, X and M would evolve relative to the baseline, for scenarios 1 and 2, and Figure 7.12 that shows the same for Scenarios 3 and 4.

The shock to interest rates only impacts the model at $t + 1$ and so there is no change from the baseline in year 2020, whereas the impact of a property price shock takes immediate effect in 2022. Exports remain relatively unchanged under both shocks, only marginally affected due to a shift in domestic prices. Y, or GDP, is more affected by the shock to interest rates in Scenario 1 than by property prices in Scenario 2, largely as a result of the limited impact of the property price shock on C and M. The rapid rise in interest costs clearly result in a decline in all demand components except for G, which is exogenous and therefore remains completely unchanged in all scenarios.



Source: Data: Eurostat, AMECO, OECD and present model forecast

(a) Scenario 1

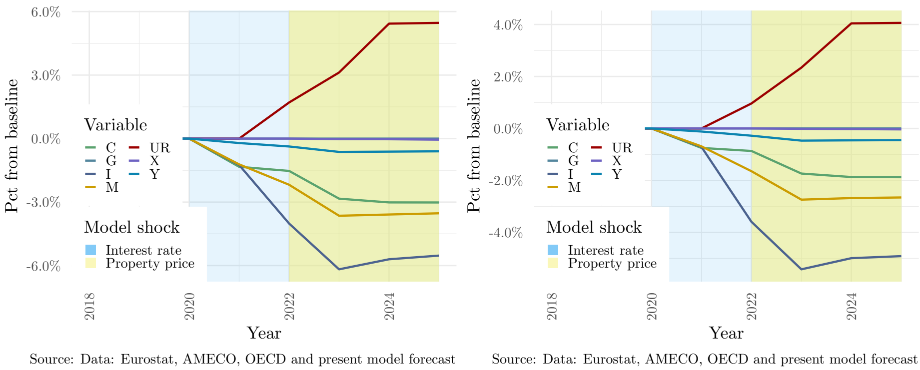
Source: Data: Eurostat, AMECO, OECD and present model forecast

(b) Scenario 2

Figure 7.11: National income indicators

As described above, Scenarios 3 and 4 illustrate the compound effect of the two shocks under two different household debt positions. In Scenarios 1 to 3, proportion of fixed-interest debt (α) is 38.91%, in Scenario 4, α is set to 80%. The primary impact of this shift is a reduction in the sensitivity of household disposable income to a dramatic rise in interest rates.

As expected, the effects of the combination of the two shocks are significantly dampened when α is higher. This is clear from the scales in Figure 7.12, where on the left for Scenario 3, investment drops just below -6% compared with -5.5% on the right for Scenario 4. This pattern repeats itself throughout this results section.



(a) Scenario 3 (b) Scenario 4

Figure 7.12: National income indicators

GDP is also somewhat better protected from the shock in the latter case. The unemployment rate (UR) increase is a compound effect of the two shocks, and is also significantly higher in Scenario 3 than in Scenario 4. The number of persons employed are determined by the NFC, and is a function of the level of Y in the previous period and changes in the size of the labour force. Exogenous growth in the size of the labour force combined with a decline in economic activity, drive the proportion of unemployed persons upwards. This also results in a rise in the level of social benefits drawn by HH from GOV, but this will be discussed in the sections for each sector below.

In many of the charts that follow, all scenarios are displayed for each of the variables. This allows for a comparison of the impact of the shocks. The baseline scenario is illustrated by a solid black line, Scenario 1 by a light-grey, dashed line. Scenario 2 by a medium-dark-grey, dashed line. Scenario 3 by the dark-grey short-dashed line and Scenario 4 by the red short-dashed line.

For each sector we will highlight the components that move most dramatically for shocks 1 and 2, and thereafter will focus on the comparative difference of these effects in Scenarios 3 and 4. This highlights the major transmissions for each shock in each sector. It also allows us to compare the impact of a hypothetical change in the allocation of debt between fixed- and flexible-interest rate products. Essentially we are able to show the impact of financial innovations, within the bounds of the assumptions discussed above.

A summary of the impact of the shocks, as captured by the net financing requirements (Net lending, NL) of each sector for each year following the shocks, can be seen in Figure 7.13.

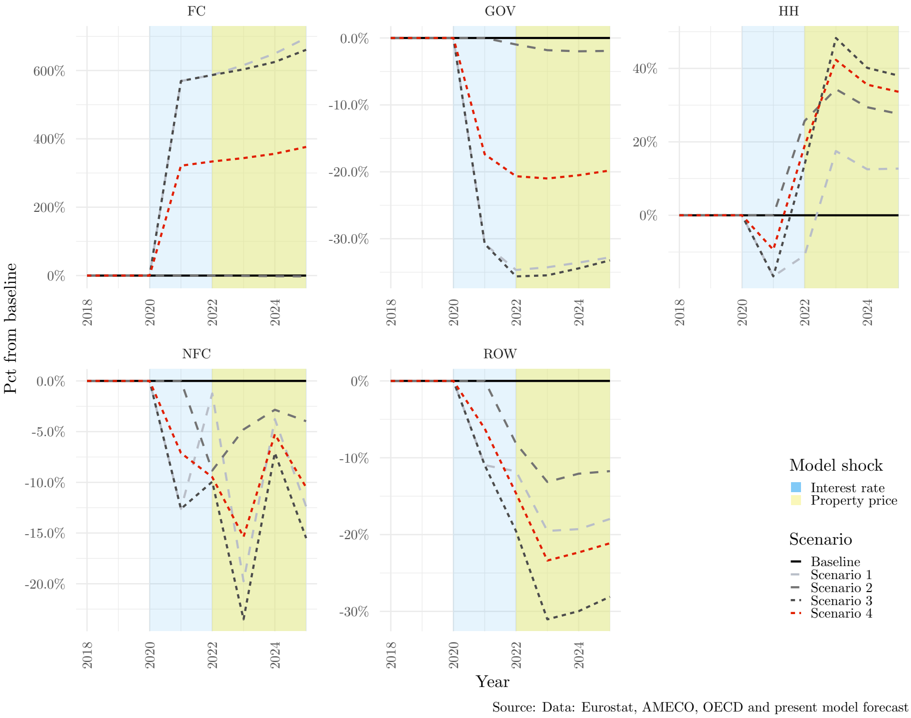


Figure 7.13: Net lending

Base purely on NL, as shown in Figure 7.13, it would appear that HH are net borrowers (have negative NL) as a result of the interest rate rise, as might be expected, but rather counter-intuitively[7.32] move into a strong net lending position following the property price collapse in 2022. ROW moves into positive NL in all scenarios, as does FC, with the exception of Scenario 2, which leaves FC NL unchanged. The scale of the changes in FC's NL are a cause for concern, and will be addressed in the FC section below. NFC and GOV move into negative NL in all circumstances, but NFC has much more erratic movements.

[7.32]This result is perfectly logical in the context of the model, but at first glance appears to be illogical.

For all sectors, Scenario 4 is again similar to Scenario 3, but with significantly less dramatic effects. The next section will help to highlight a problem with a focus purely on NL. In summary, such a focus may not be indicative of the actual economic consequences of these shocks for each sector.

For each sector the analysis includes a brief summary the most affected components from each shock, plus a graphical analysis of the most important transmission channels. For Scenario 1, these can be seen in Tables 7.5 to 7.10 for $(t+1)$ 2021, and Tables 7.11 to 7.16 for $(t+3)$, which is 2023.

For Scenario 2, they can be seen in Tables 7.17 to 7.22 for 2022, and Tables 7.23 to 7.28 for $(t+3)$, which is 2025. Similar tables can be seen for Scenarios 3 and 4 from Table 7.29 to Table 7.52, where the effects are summarised for the years 2021, which allows for a comparison of the first shock, and 2025, which captures the difference in the compound effect of both shocks.

7.6.2 Effects for the HH sector

For HH, in 2021, the most obvious effect of the first shock is the increase in interest paid on mortgage debt (or property income paid) of 95.85%. The immediate reduction in transactions for new interest-bearing assets ($\downarrow IBATR^H$) and liabilities ($\downarrow IBLTR^H$) by -78.28% and -73.94% respectively, and transactions in equity assets ($\downarrow EQATR^H$) fall by -68.34%. These are dramatic proportional shifts, largely due to the very low base of the baseline figures. These changes are not only driven by portfolio allocation decisions but also by changes in the real economy, as aggregate demand is reduced due tot he change in interest rates.

HH investment (gross fixed capital formation, $\downarrow I^H$, which is only houses in this model) falls by -6.81% and savings by -10.3% (thus the decline in $\downarrow NL$ of around -16.64%). This follows a decline in disposable income of -2.58% and consequently in consumption of about -1.33%. In terms of stocks, households immediately reduce holdings of IBL by -2.26% and IBA by -3.23%.

The residual financial flow for HH is transactions in interest bearing assets, $IBATR_t^H$, which are assumed to be deposits. It is directly affected by changes in the level of net lending (NL^H), changes in transactions in IBL ($IBLTR_t^H$), transactions in equities ($EQATR_t^H$) and net transactions in pension assets ($PENATR_t^H$). The link between new debt IBL^H and new deposits IBA^H is analogous to the PK theory of endogenous money supply since an increase in debt is associated with an increase in deposits. This is represented in Equation 7.11.

$$IBATR_t^H = NL^H + IBLTR_t^H - EQATR_t^H - PENATR_t^H \tag{7.11}$$

The progression of each of these transaction flows is presented in Figure 7.14 below. The decline in $\downarrow IBATR^H$ of -78.28% is easily discernible. The reader should note that the scale on each plot differs, and the change to $PENATR^H$ is largely irrelevant at less than 1%, and the declines in $IBLTR^H$, $EQATR^H$ and $IBATR^H$ are of far greater interest. This is appropriate, as each item should be read independently.

Following the dark-grey dotted line describes Scenario 1, where, in all but pension asset transactions, the initial decline is dramatic, but in subsequent years there is a fairly rapid recovery. $IBATR^H$ is represented in the top centre panel, and is the sum of the remaining four items. In Scenarios 1,3 and 4, the interest rate shock results in significant negative savings, but with the introduction of the property price collapse in 2022, for Scenarios 2 to 4, NL swings positive. This is explored further below.

Comparing Scenarios 3 (dark-grey short-dashed line) and 4 (red short-dashed line) reveals that the effect of the combination of the two shocks is 50% smaller for Scenario 4 after the interest rate shock (shock 1), and roughly 10% to 20% smaller for the property shock (shock 2).

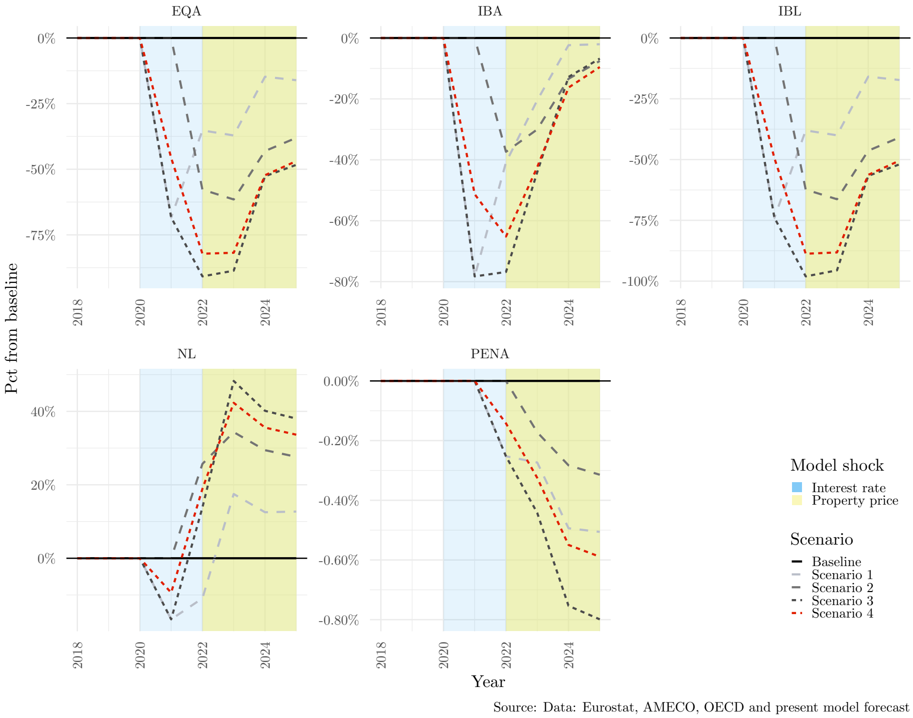


Figure 7.14: Households: Transactions in assets

The level of net lending NL_t^H is essentially driven by changes in savings (S_t^H) and investment levels (I_t^H). The changes in net purchases and sales of fixed assets (NP^H) and net capital transfers (KTR^H) are exogenous, and so do not differ from the baseline (this is repeated for all sectors). The level of net lending for HH is calculated as follows.

$$NL_t^H = S_t^H - I_t^H - NP_t^H + KTR_t^H \tag{7.12}$$

The I^H and S^H components of NL can be seen in Figure 7.15. I^H (INV in the plot) recovers in the second period after the shock but then declines again in the fourth. S^H and NL fall by about around 10% in Scenarios 1 and 3, but only by about half of that for Scenario 4. I^H (which is entirely in houses) declines even more dramatically in Scenarios 2 with the collapse in house prices, and this is compounded with the fall of shock 1 in Scenarios 3 and 4. There is a decline of over 30% from baseline investment by 2023 when the level of ARM (flexible-rate mortgages) is allowed to remain high in Scenario 3.

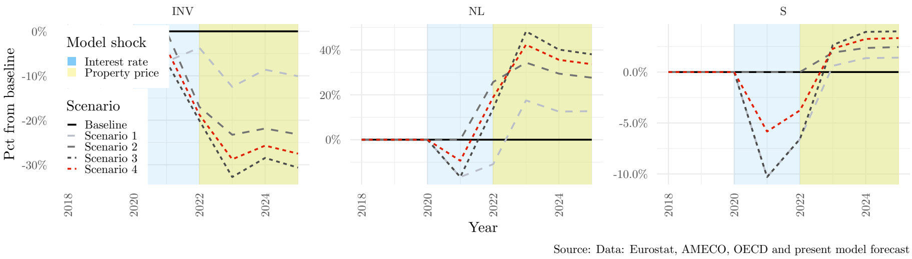


Figure 7.15: Household Net Lending components

Savings (S^H) are almost entirely determined by the level of disposable income of HH, and since the tax proportion is held constant, it is the income portion that drives most of the changes. While savings recover in the periods after the shock, investment activity declines further, which is the main driver behind the correction of NL. Thus, it is unfortunately a decline in economic activity that allows for the financial recovery. The decline in I^H also means that capital formation fails to offset depreciation, and thus, HH capital levels decline.

Equation (7.13) describes the incomes and expenditures of HH that ultimately determine the gross income for the sector (Y_t^H). The primary sources of which are wages (WB^H, W in the plot below), profits ($B2$, which is exogenous), property income (or returns on financial capital, which stems from interest bearing assets, IBA^H, pensions, $PENA^H$, and equities, EQA^H), and social transfers (STR^H, STRA in the plot below).

$$\begin{aligned} Y_t^H =& WB_t^H + B2_t^H + r_{A_{t-1}}^H(IBA_{t-1}^H) \\ &- r_{L(FI)_{t-1}}^H(IBL(FI)_{t-1}^H) \\ &- r_{L(FL)_{t-1}}^H(IBL(FL)_{t-1}^H) \\ &+ \chi_t(EQA_{t-1}^H) + \psi_t(PENA_{t-1}^H) + STR_t^H + \epsilon^H \end{aligned} \tag{7.13}$$

Interest rates are represented by r^H, and the "A" ("L") subscript referring to the assets (liabilities), and (χ_t) and (ψ_t) are the rates of return on equities and pensions. As part of the key change in this model, the level of interest paid on IBL in this model is split between fixed and flexible rate mortgages into $r^H_{L(FI)_{t-1}}(IBL(FI)^H_{t-1})$ (PIP-IBL-Fixed, in the plot below) and $r^H_{L(FL)_{t-1}}(IBL(FL)^H_{t-1})$ (PIP-IBL-Flexible, in the plot below). A similar split is present in the financial corporate sector (FC) below.

The ϵ^H refers to adjustments made to ensure stock and flow consistency in the level of property income received or paid during the periods where data was available[7.33].

Figure 7.16 displays the endogenous components of HH income. Property income received on financial assets, are labelled PIR-EQA for EQA^H, PIR-IBA for IBA^H, PIR-PENA for $PENA^H$. PIP-IBL is the sum of interest paid on $IBL(FI)^H$ and $IBL(FL)^H$, which is all interest paid on mortgage debt. Also included in the figure are consumption (C^H) and income tax (T^H, TAX in the plot below).

[7.33] This convention is used for all sectors. The returns on financial assets are estimated with varying degrees of accuracy for each of the sectors. In order to ensure that the model is consistent in all periods, any difference between the estimated returns and actual returns (on a net basis for each asset class) are added to the adjustment term. These errors in estimation are minimised in the estimation specification for each asset class individually.

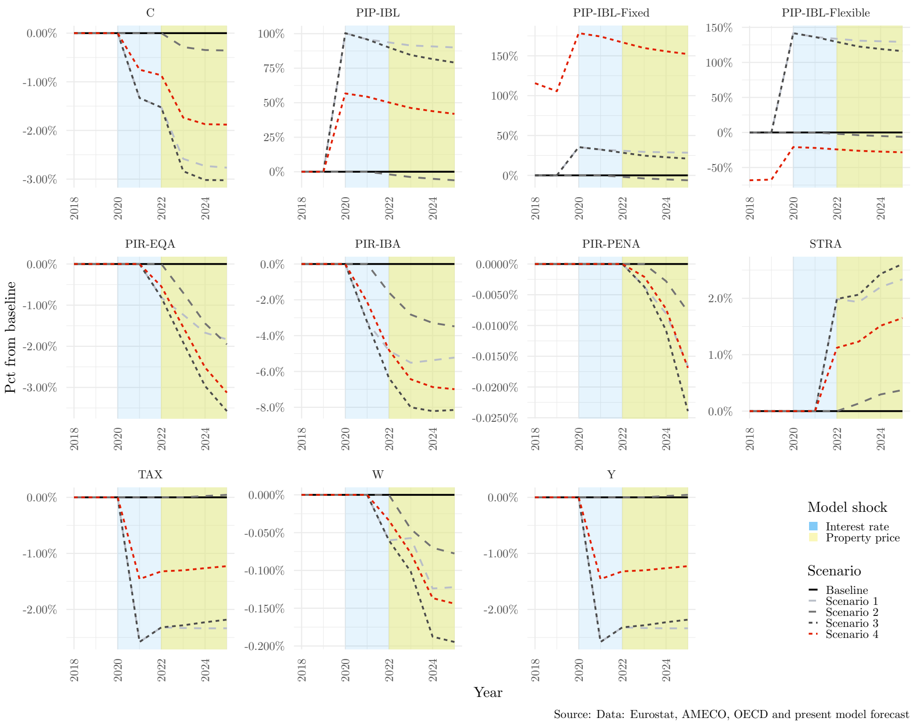


Figure 7.16: Household income components

The sum of all changes in the model accumulate in the level of Y^H in the bottom right hand panel of Figure 7.16, Scenario 2 has almost zero impact on Y^H, while Scenarios 1, 3 and 4, which include the interest rate change, all result in a significant net decline. PIP-IBL, in the panel to the right of consumption (C) in the top left corner, is the total interest paid on debt by HH, and highlights the most dramatic change. It also illustrates the key difference introduced in Scenario 4, which is a reduction in the sensitivity of HH income to changes in interest rates relative to Scenario 3.

The largest contributors to HH income are wages (W^H) and social transfers (STR^H, STRA in the plot above). Since 2007, approximately 35% to 37% of social transfers represent a tax funded pension income, and most of the remainder covers medical and disability support[7.34]. To give a sense of scale,

[7.34] Based on data from Statistics Denmark, since 2007, approximately 35% - 37% of all social benefits were for old age payments. A further 20% - 22.3% are attributed to medical benefits, an almost constant 14.4% to disability and 10% - 13.2% to family and child benefits. Unemployment (app. 5%), social exclusion (app. 5%), housing (app. 2%) and survivorship

Figure 7.17 shows the actual values of the major contributors, where NPIR is a net sum of all property income received and paid, and remains positive, but falls by roughly 50% due to the rise in interest costs on mortgages[7.35].

Wages (W), taxes (T^H, TAX) and consumption (C) all decline with Y^H.

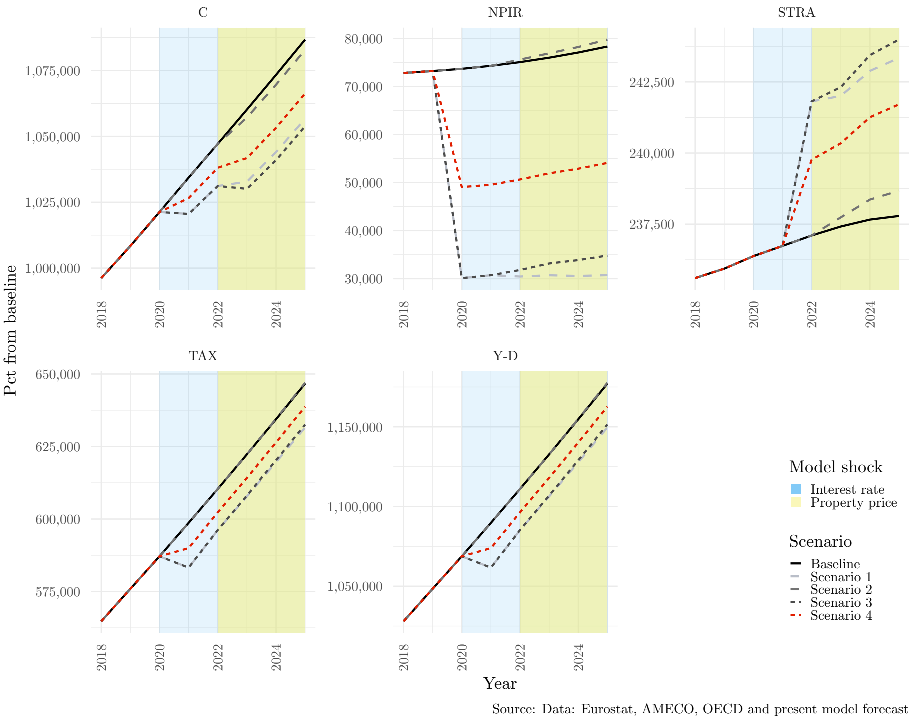


Figure 7.17: Household savings components

From this it is possible to see that the rise in STR^H is not sufficient to offset the fall in property income. Scenario 2 is the obvious exception, where income rises marginally. Disposable income (Y_d, shown as Y-D above) declines in Scenarios 1 and 3, but in Scenario 4 only stagnates before trending upwards again. The trend in consumption follows the shift in Y_d. The effects of the shocks on the

(app. 1%) benefits making up the balance. The bulk of these transfers can be thought of as supplementary income, rather than unemployment support.

[7.35] The impact of the shift in α can be seen in the two panels to the top right. PIP-IBL-Fixed, and PIP-IBL-Flexible are drastically different in Scenario 4 to all other Scenarios. This is because Scenarios 1 to 3 all keep the baseline allocations of debt between fixed and flexible. The difference from baseline illustrated in Figure 7.16 above are predominantly due to the change in α in 2017 - hence the separation prior to the first shock in 2020.

HH financial balance sheet can be seen in Figure 7.18.

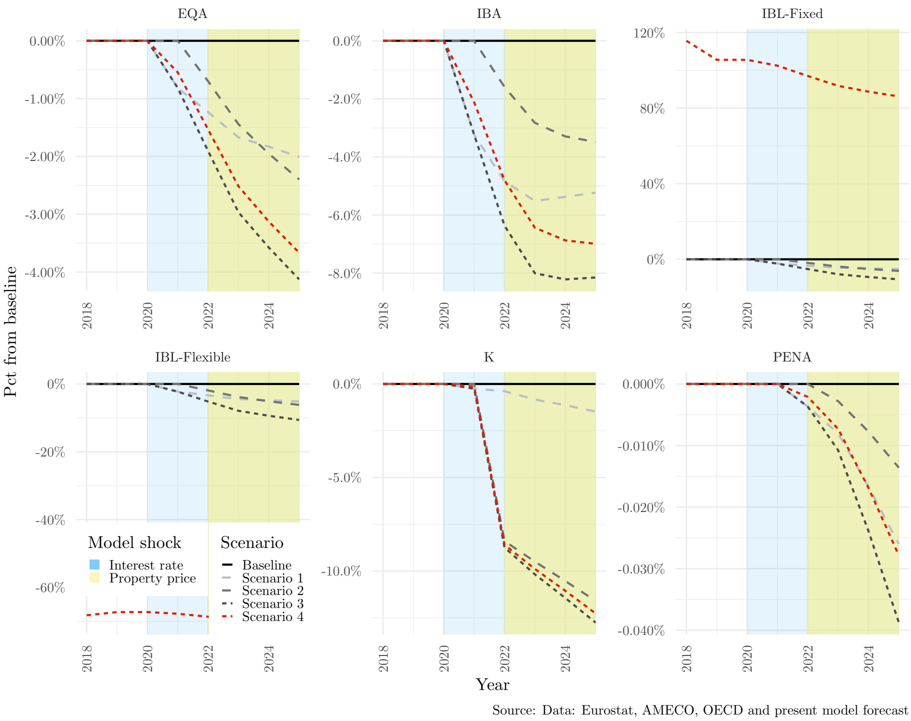


Figure 7.18: Household balance sheet

The decline in $PENA$ are negligible relative to the baseline, but the decline in capital (K^H) that occurs due to the shock to housing prices, has a significant impact on both consumption and investment in subsequent periods. The consequence of the rise in interest rates, and decline in housing investment can be seen in the panel for K above, where Scenario 1 shows a gradual decline relative to the baseline. The impact of a shock to housing prices, however, has a far more dramatic impact in 2022.

In the scenario three, three years after the compounding of the property price decline, net HH wealth falls by 3.34%, but this understates the impact on the HH, since, as mentioned in the introduction, net measurements fail to take into account the impact on gross balances. In gross terms, stock of interest bearing liabilities falls by 10.6%, HH wealth in financial assets falls by 3.55% while stock of capital held in houses falls by 12.76%. These are substantial declines in the total level of wealth, but probably overstates the effect on property, since although property prices are allowed rise gradually, the recovery is more gradual that was observed for the Danish economy. The contraction in liabilites is also substantially higher than the modest effect observed over the GFC. One major difference, however, is that HH benefitted from global suppression of interest rates, which would be quite the opposite if interest rates were to rise.

In summary, on the basis of the model, an interest rate hike and a collapse in property prices would both force the HH balance sheet to contract. The main transmission channel that this would occur through is a direct reduction in disposable income due to debt costs, or the credit channel. It also shows that if it were possible to instigate a change in the composition of debt from flexible- towards fixed-interest products, the lower sensitivity of fixed-rate debt products might protect HH from the majority of these impacts.

7.6.3 Effects for the NFC sector

The changes in Scenario 1 for NFC are rather limited at first, as can be seen in Table 7.7, but by 2023, as shown in Table 7.13, the effects of the shocks have spread far enough that changes in real economic activity have an impact on the level of employment and output.

In 2021 $NIBTR^N$ falls by -12.62%, which is equal to the fall in NL. S^N falls by -1.1%, T^N by -0.2% and profits ($B2^N$) by -0.19%.

By 2023 the real economy effects feed into NFC, and $NIBTR^N$ has fallen by -19.75%, which is equal to the fall in NL. I^N has fallen by -0.22%, and S^N by -1.61%. T^N by -0.33% and profits ($B2^N$) by -0.31%. The net flow of all property income is -0.17% lower and the stock of NIB^N is -1.48% lower than baseline. There is also a -0.08% fall in total capital of NFC.

NFC's residual financial flow is $NIBTR^N$, and the contributors to it are net lending (NL^N) and net equity transactions ($NEQTR^N$). Unlike the household sector, the financial activity of the NFC is not modelled directly, and $NEQTR^N$ are therefore exogenously determined for periods where data is available, and revert exogenously to zero for all periods of estimation. $NIBTR^N$ therefore depend only on NL.

$$NIBTR_t^N = NL_t^N - NEQTR_t^N \tag{7.14}$$

Net lending again depends on Savings and investment,

$$NL_t^N = S_t^N - I_t^N - NP_t^N + KTR^N \tag{7.15}$$

Investment is estimated in real terms, and is positively dependent on real gross income (y_{t-i}), and negatively dependent on the real level of capital (k_{t-i}^N), each with a variable number of lags in the estimate[7.36]. In this context, the proportion, $\left(\frac{y_{t-i}}{k_{t-i}^N}\right)$, represents capacity utilisation.

$$ln(i_t^N) = \beta_i + ln\beta_i \left(\frac{y_{t-i}}{k_{t-i}^N}\right) \tag{7.16}$$

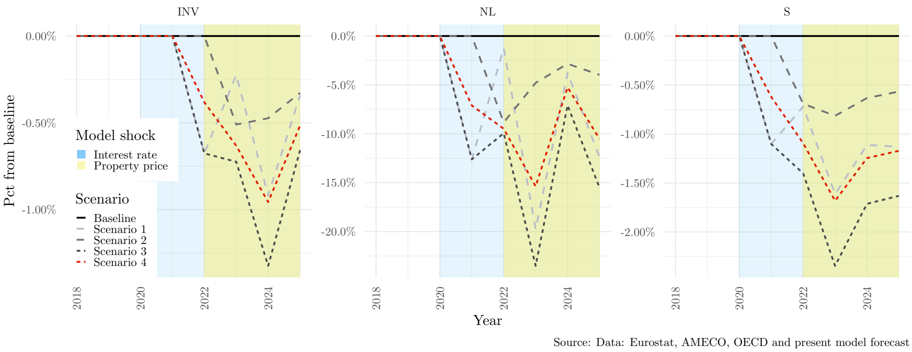


Figure 7.19: NFC Net Lending components

The major determinants of investment are therefore the major determinants of GDP, together with previous capital accumulation in NFC (previous capital, plus investment less depreciation). As can be seen in Figure 7.19, I^N (INV in the plot) is fist affected by Scenario 1 (interest rates) in 2022, this the change in NL observable is 2021 is purely due to the decline in savings. Although the shapes of the panels in Figure 7.19 are very similar, the scales are quite different. The actual underlying values of each category are also significantly different. Plotted as actual values in Figure 7.20, the changes would be almost indiscernible from the baseline.

[7.36] In this versions of the model, k_{t-i}^N and y_{t-i} are both estimated at $t-1$, together with a significant dummy variable for 2009.

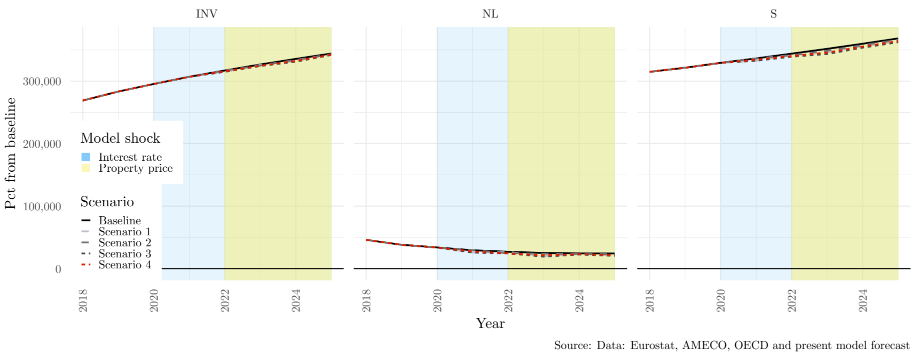


Figure 7.20: NFC Net Lending components

NFC savings (S_t^N), can be calculated as the net sum primary and secondary income and expenditures.

$$\begin{aligned} S_t^N =& Y_t - WB_t^N + (B2_t^N - B2_t) + r_{t-1}^N(NIB_{t-1}^N) \\ &+ \chi_t(NEQ_{t-1}^N) - T_t^N + STR_t^N + \epsilon^N \end{aligned} \tag{7.17}$$

$NPIR - NEQ$ and $STRA$ are exogenous, and revert to zero values after the last period of available data, 2017.

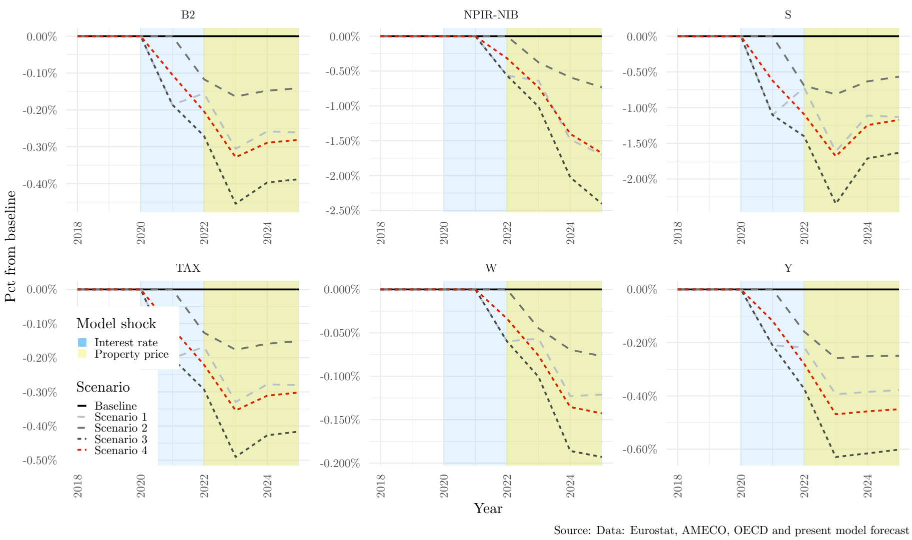


Figure 7.21: NFC Savings components

7.6.4 Effects for the GOV sector

For Scenario 1, in 2021 $NIBTR^G$ is -30.78 % lower than the baseline. The source of this decline can be traced through the plots below. Figure 7.22 shows the decline in net lending and savings.

Contributing to the decline in NL^G is a decline of -11.85% in S^G. The main contributor to which is a fall in T^G of -1.56%. The net issue of IBL results in a fall in NIB^G of -9.16% and for net wealth to decline by -1.3%.

By 2023 the first shock has spread through the economy and NL is -34.27% below the baseline levels. The delayed effect of the change in interest rates is by that stage in effect, and results in a decline in net property income of -15.36%. This contributes to a reduced level of S^G of -14.07% below. The major contributor is a -1.47% lower level of tax revenue.

Social transfers for each sector, $STRA^G$ in the case of GOV, are a net value of receipts less payments. $STRA^G$ declines by -1.21%, indicating that the level of payments has increased relative to receipts. This contributes further to the negative balance in GOV. The decline in $NIBTR^G$ above accumulates in NIB^G that is -19.27% lower than the baseline, and net wealth, NW^G, that is -4.02% lower.

Shock 2 in 2022, the property price decline, has very little impact on GOV, with only a marginal decline in S^G, flowing from limited impacts to the underlying components. NL^G falls by only -0.97%. This since tax revenues are only marginally affected when HH disposable income remains fairly constant, and the ultimate effect on NIB^G is only -0.24%. In reality this could have been substantially worse if the property price collapse resulted in non-performing loans and GOV was required to step in, as was the case for the banking crisis in Sweden in 1993. (Englund, 1999)

By 2025, the effects remain modest, with NL^G only -1.93% down from the baseline level, and NW^G only -0.27% lower.

The largest changes in Scenario 1 for GOV in 2021 are in the residual financial flow for GOV, transactions in net interest bearing assets ($NIBTR^G$). These changes come almost entirely from changes in NL, another term for which would be a government deficit or surplus, for negative and positive NL respectively. GOV issues debt ($NIBTR^G$) to cover the deficit. These assets are accumulated by FC (below), together with property income flows according to the return on these assets (r_N). As can be seen from Equation (7.18) below,

$$NIBTR_t^G = NL_t^G \tag{7.18}$$

Government investment (I^G), (and, as with NFC) NP^G and KTR^G are exogenous, so in Equation (7.19) below, it is only changes in savings (S^G) that are influential after the shocks in each scenario.

$$NL_t^G = S_t^G - I_t^G - NP_t^G + KTR_t^G \tag{7.19}$$

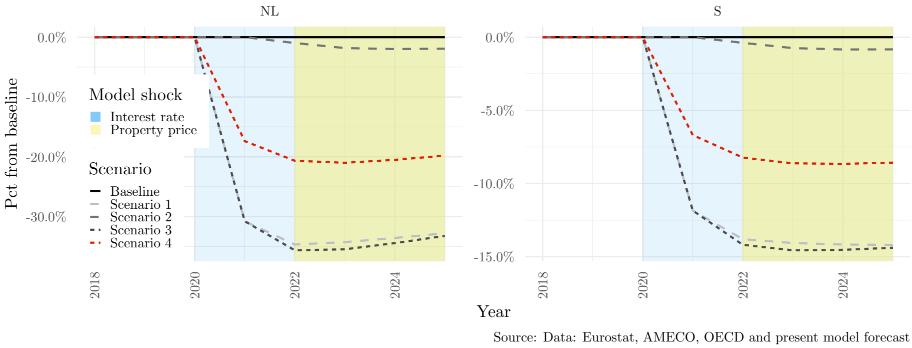


Figure 7.22: GOV Net Lending components

Equation (7.20) highlights the core components of GOV income. Of these $B2^G+$ net property income received, ($r_{N_{t-1}}(NIB_{t-1}^G)$, and NPIR in the plot below) and tax T^G are the incomes received by GOV. Social transfers (STR^G, STRA in the plot below) and GOV expenditure (G). The exogenous component from the incomes is $B2$, and from expenditure G.

$$S_t^G = B2_t^G + r_{N_{t-1}}(NIB_{t-1}^G) + T_t^G + STR_t^G - G_t + \epsilon^G \tag{7.20}$$

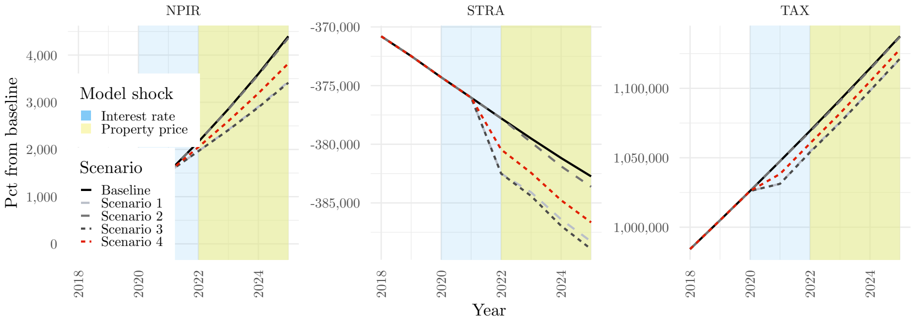


Figure 7.23: GOV Savings components

Considering Scenarios 3 and 4, the difference in the impact of shocks is about half as strong for Scenario 4, where α is at 80%. Scenarios 1 and 3 however result in stronger effects. The impacts to GOV are directly a result of the deterioration in HH cash flows and needs for social support. While STR^G is the expenditure of GOV that flows to HH, based on total net benefit and contribution flows. Rising STR^G expenses are exacerbated by a fall in revenues in the form of both net property income received (NPIR) and taxation T^G (TAX in the plot above.)

7.6.5 Effects for the ROW sector

The ROW sector is primarily driven by exports, which are exogenous, and imports, which are endogenous to changes in the level of household income. The sharp decline in household income causes an immediate improvement in the current account balance, which is reflected as a negative NL balance for ROW[7.37].

For shock 1, in 2021, ROW is driven into a further deficit to Denmark, with a decline of -10.97% in $NIBTR^W$, which captures the -10.97% decline in NL^W and S^W. This has a negative effect of -0.7% on the level of net wealth (NW^W) held by ROW in Denmark.

The deficit in NL^W continues to grow, and by 2023 is -10.97% lower than the baseline value. The net flow of property income on all financial assets is lower

[7.37] The flows for ROW are recorded from the perspective of ROW. Thus, if ROW net-lends, it is the same as to say that Denmark net borrows. A positive current account for Denmark is therefore the equivalent of a net borrowing (or, negative net lending) position for ROW.

by %, which reflects a -1.21% fall in the stock of NIB^W. From a balance sheet perspective, there is a decline of -0.7% in net wealth (NW^W).

The second shock, to property prices has less of an impact on ROW, with $NIBTR^W$ still lower, but in 2022, this is only by -8.14%. This is again driven by an equal decline in S^W, which leads to an equal decline in NL^W. The fall in $NIBTR^W$ is reflected as a decline in NIB^W by -0.87%.

By 2025, the shock has spread through the economy, and the impact on S^W, NL^W and $NIBTR^W$ is lower again at -11.74% less than the baseline value. The changes in interest earning assets reduce the level of property income from NIB^W by -3.14%, and from all financial assets by -1.71%. The level of NIB^W continues to fall further into deficit by -3.98% relative to the baseline. After the three year period of accumulative effects, NW^W would be -2.69% lower.

The transmission of these shocks, working backwards from the accumulative effect on transactions in NIB^W, begins with Equation (7.21).

$$NIBTR_t^W = NL_t^W - NEQTR_t^W - NPENTR_t^W \tag{7.21}$$

Equation (7.21) describes the source of changes in $NIBTR^W$, where $NEQTR^W$ and $NPENTR^W$ are exogenous in the model. This leaves only NL as a possible source of change. Unlike the domestic sectors, ROW is assumed not invest in the domestic economy, which means that the net lending function is somewhat simpler, with only savings as the possible source of change.

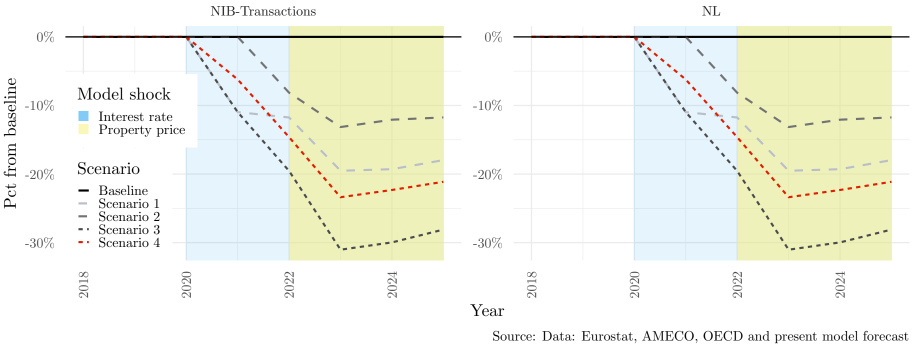


Figure 7.24: ROW: NIBTR: Transactions in assets and net lending

Equation (7.22) highlights the components of NL, and much like the previous sectors, only S^W is endogenous in the model.

$$NL_t^W = S_t^W - NP_t^W + KTR^W \tag{7.22}$$

It is therefore only savings that drives changes in NL. The total level of NL is then, as mentioned earlier, equivalent to the current account balances - although what is positive in the current account must be negative in the ROW NL account.

$$CAB_t = -NL_t^W \tag{7.23}$$

Savings are described by Equation (7.24).

$$\begin{aligned} S_t^W =& M_t - X_t + \chi_t(NEQ_{t-1}^W) + \psi_t(NPEN^W t - 1) + r_{N_{t-1}}(NIB_{t-1}^W) \\ &+ WB_t^W - T_t^W + STR_t^W + \epsilon^W \end{aligned} \tag{7.24}$$

ROW is assumed to be largely independent of developments in the domestic economy, and thus WB^W, $\chi_t(NEQ_{t-1}^W)$, $\psi_t(NPEN^W t - 1)$, STR^W, and T^W are considered to be exogenous. This is with the exception that the rates of return on each of the asset classes is assumed to be the same as those available domestically. The reason for this is that Denmark is a AAA rated country and maintains a fixed exchange rate regime with the EU, and arbitrage keeps rates of return very close to those available in neighbouring Europe.

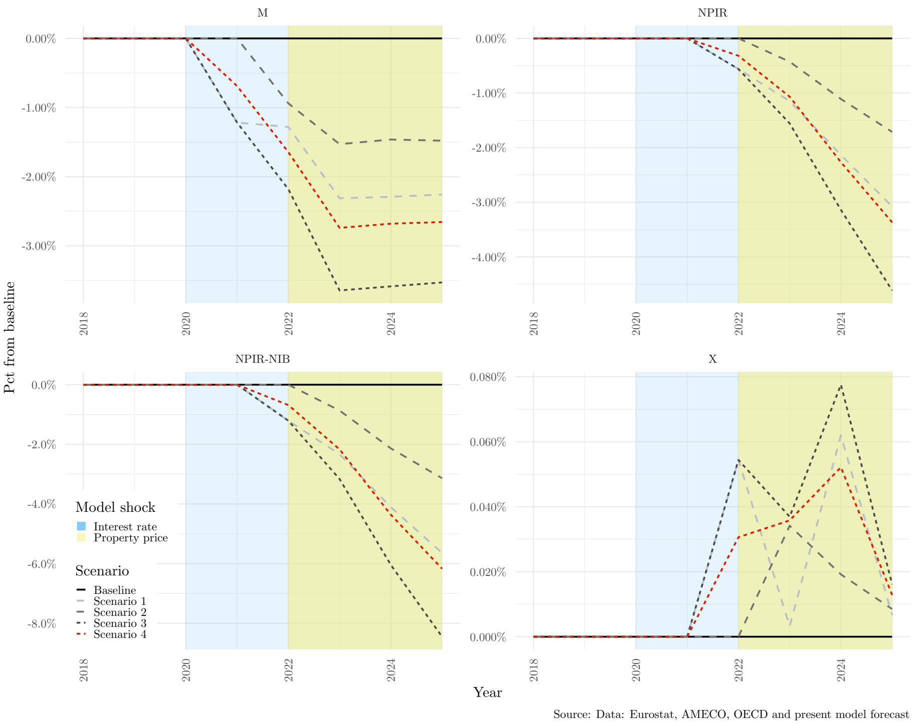


Figure 7.25: ROW Savings components

Imports (M) from the model are a revenue for ROW and exports (X) an expenditure. The return on net interest bearing stocks, $r_{N_{t-1}}(NIB^W_{t-1})$, (NPIR-NIB in the plot above) depends on whether NIB^W is positive or negative.

Imports are estimated in real terms in the log-linear form in Equation (7.25), and depend on the level of domestic demand in the previous period, and a relative price index between domestic and foreign goods from the previous period $\left(\frac{P^y_{t-1}}{P^m_{t-1}}\right)$.

$$ln(m_t) = \beta_i + \beta_i ln\left(\frac{P^y_{t-1}}{P^m_{t-1}}\right) + \beta_i ln(c_{t-1} + i_{t-1} + x_{t-1}) \tag{7.25}$$

As noted by Byrialsen & Raza (2019), the "export function is based on the Armington (1969) model where the market share of the Danish exports is explained by relative prices."

This relation is captured below as annual Danish exports relative to a weighted index of all trading partners (m_t^W), which should be determined by domestic prices (the export price index, P_t^x) relative to foreign prices (the import price index, P_t^m), but moderated by price elasticity (β).

$$\frac{x_t}{m_t^W} = \left(\frac{P_t^x}{P_t^m}\right)^{\beta} \tag{7.26}$$

Exports thus stay relatively stable in the model, and are only affected by minor changes in the relative price ratio. The lower right panel in Figure 7.25 above is a little deceptive, as the scale is very small. The most important change for ROW is a strong decline in Danish imports, which is primarily driven by the fall in HH disposable income

7.6.6 Effects for the FC sector

FC absorbs all of the imbalances in the other four sectors, and the relatively extreme shock to interest rates culminates in large changes to each. Transactions in net interest bearing assets, $NIBTR^F$, are simply an inversion of the accumulation of $NIBTR$ in three of the four sectors (GOV, NFC and ROW), and $IBLTR^{F\sim H}$ is a reflection of household accumulation of deposits, $IBATR^H$.

$$NIBTR_t^F = -(NIBTR_t^N + NIBTR_t^G + NIBTR_t^W) \tag{7.27}$$

The second, and rather indirect accumulation is that of equities to offset any equity investment by HH. The full explanation is available in the appendix, in Section 7.10.3. An abbreviated summary is that all other components of Equation (7.28) are accounted for by accounting identities between FC and the other sectors, and the value of $EQATR^H$ is carried into FC via $IBLTR^{F\sim H}$. Once all other terms are netted out, the $NEQTR^F$ value is equivalent to $EQATR^H$. This equivalence is the redundant equation in the model, and is not specified in order to avoid over-identification.

$$NEQTR_t^F = NL_t^F + IBLTR_t^{F\sim H} + PENLTR_t^F - IBATR_t^{F\sim H} - NIBTR_t^F \tag{7.28}$$

Because $NIBTR^F$ captures the net flows of all other sectors, it also represents any excess or shortfall (i.e. net lending) experienced by FC. This is because all flows of all other sectors with each other will already be captured and netted out by the sum of their $NIBTR$ in Equation (7.27) above. The only unaccounted for flow is the net value of FC flows, which is captured in NL^F. Again, NP^F, I^F[7.38] and KTR^F are exogenous.

$$NL_t^F = S_t^F - I_t^F - NP_t^F + KTR_t^F \tag{7.29}$$

Rather than show the percentage changes, Figure 7.26 shows the actual increase in FC NL and savings as a result of the shocks in each scenario. As can be seen, the impact of the second shock is almost negligible. Scenarios 1 and 3 are almost identical, and Scenario 2 remains very close to the baseline level. It is thus the interest rate change that has the dominating effect on FC's flows and thus balance sheet. It should be unsurprising therefore that there is a substantial difference between Scenarios 3 and 4. In Scenario 4, where a greater portion of HH debt is *less* sensitive to changes in interest rates, the transfer of wealth from HH to FC is substantially reduced.

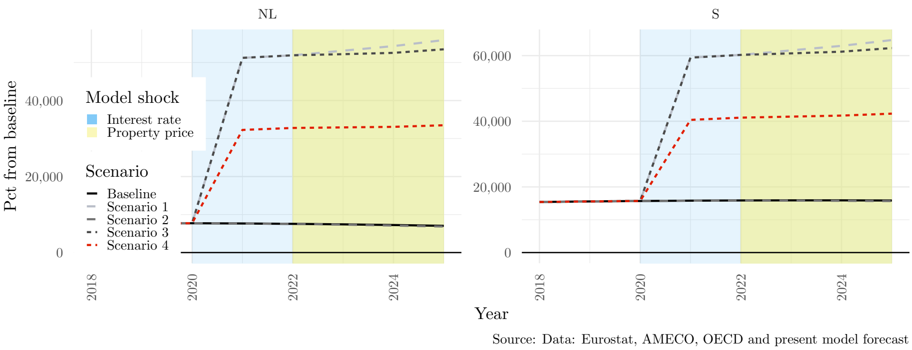


Figure 7.26: FC Net Lending components

From a very low base, NL^F rises by 569.17%, or is roughly five and a half times larger. The shifts in the values of the underlying FC components are sensibly also substantial. Transactions in most assets are net positive, and in liabilities negative - both relative to the baseline and in absolute terms.

[7.38] FC investment is assumed to grow at a constant 2% per annum.

The exception is a decline in loan assets as HH deleverage in 2021 by -3.23%. Apart from this single entry, HH borrowing is positive in all periods. Relative to the baseline after the first shock, $IBLTR^{F\sim H}$ is down by -78.28%, and $IBATR^{F\sim H}$ is down by -73.94%. FC is a net issuer of equity and interest bearing assets, with transactions in equity, $NEQTR^{F}$, up 68.34%, and in NIB up 61.82%. FC thus begins to accumulate assets rapidly.

In terms of property income flows, the rise in interest rates in this example is only allowed to affect the asset returns of FC, and thus the net increase is more extreme than if we adjusted all rates of return. The total net property income received by FC, $NPIR^{F}$, is 323.58% higher. This comes from the increase in fixed and flexible rate interest receipts, which rise by 32.38%, and 136.29% respectively.

As noted above, FC accumulates assets rapidly. NEQ^{F} rises by 46.26% and NIB^{F} by 2.02%. The fall in $IBA^{F\sim H}$ by -2.26% and in $IBL^{F\sim H}$ by -3.23% almost offset each other entirely, and the final impact on net wealth of FC is an increase of 42.82%.

Equation (7.30) highlights the income and expenditure components that contribute to FC savings, and Figure 7.27 illustrates these components in nominal values.

$$\begin{aligned} S_t^F =& B2_t^F \\ &+ r^F_{A(FI)_{t-1}}(IBA^{F\sim H}_{A(FI)_{t-1}}) + r^F_{A(FL)_{t-1}}(IBA^{F\sim H}_{A(FL)_{t-1}}) \\ &- r^F_{L_{t-1}}(IBL^{F\sim H}_{L_{t-1}}) + r_{N_{t-1}}(NIB^F_{t-1}) \\ &+ \chi_t(NEQ^F_{t-1}) - \psi_t(PENL^F_{t-1}) - T_t^F + STR_t^F - CPEN_t^F + \epsilon^F \end{aligned} \tag{7.30}$$

From Equation (7.30), $B2^{F}$ and T^{F} are exogenous, and the change in FC output, Y^{F}, is less than -1%. Nominal values are illustrated here in order to give better context to the changes implied by the shocks. The percentage changes that are discussed above for Scenario 1 do not appear to be as unrealistic when viewed in these terms.

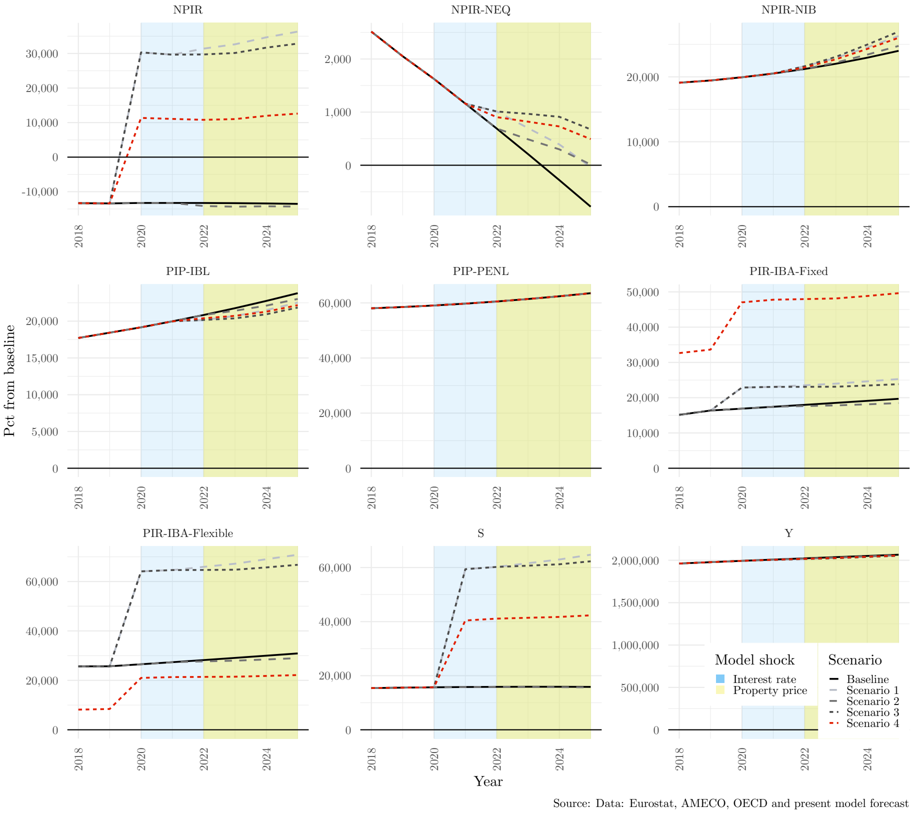


Figure 7.27: FC Savings components

The panel titled net property income (NPIR) in the plot above is a sum of all property income flows, and is similar to Equation (7.30) above for S^F, but with all other terms removed. The total impact on property income helps to identify the source of changes in FC savings. NPIR is calculated as follows.

$$\begin{aligned} NPIR_t^F = &+ r^F_{A(FI)_{t-1}}(IBA^{F\sim H}_{A(FI)_{t-1}}) + r^F_{A(FL)_{t-1}}(IBA^{F\sim H}_{A(FL)_{t-1}}) \\ &+ r_{N_{t-1}}(NIB^F_{t-1}) + \chi_t(NEQ^F_{t-1}) \\ &- \psi_t(PENL^F_{t-1}) - r^F_{L_{t-1}}(IBL^{F\sim H}_{L_{t-1}}) \end{aligned} \tag{7.31}$$

The bulk of FC flows are property income paid (PIP), property income received (PIR), or NPIR. The representations in Figure 7.27 above are categories of these property income flows. NPIR-NEQ for $\chi_t(NEQ^F_{t-1})$ (on equities), NPIR-NIB for $r_{N_{t-1}}(NIB^F_{t-1})$ (on net interest bearing assets with all sectors other than HH), PIR-IBA-Fixed for $r^F_{A(FI)_{t-1}}(IBA^{F\sim H}_{A(FI)_{t-1}})$ (on fixed-rate HH debt), PIR-IBA-Flexible for $r^F_{A(FL)_{t-1}}(IBA^{F\sim H}_{A(FL)_{t-1}})$ (on flexible-rate HH debt), PIP-IBL for $r^F_{L_{t-1}}(IBL^{F\sim H}_{L_{t-1}})$ (on deposit liabilities).

The shock to interest rates in Scenarios 1, 3 and 4 all result in positive NPIR for FC. The substantially lower level of NPIR in Scenario 4 (the red line) can be traced back to PIR-IBA-Fixed and PIR-IBA-Flexible. The sum of the total revenue generated by the rise in interest rates is the summarised in NPIR. The steady decline of net return on equities, NPIR-NEQ, is due to the systematic issuance of equity to HH as HH demands equity. This demand is retarded slightly in all scenarios. Equity investment by HH is dependent on previous returns, previous returns on house investment and previous changes in the quantity of loans acquired. For both shock 1 and 2, it is due to the reduction in $IBLTR^H$ and for shock 2 it is also driven by a fall in returns on houses.

The effect on FC savings, S^F, is to triple the value in Scenarios 1 and 3, and double the value in Scenario 4.

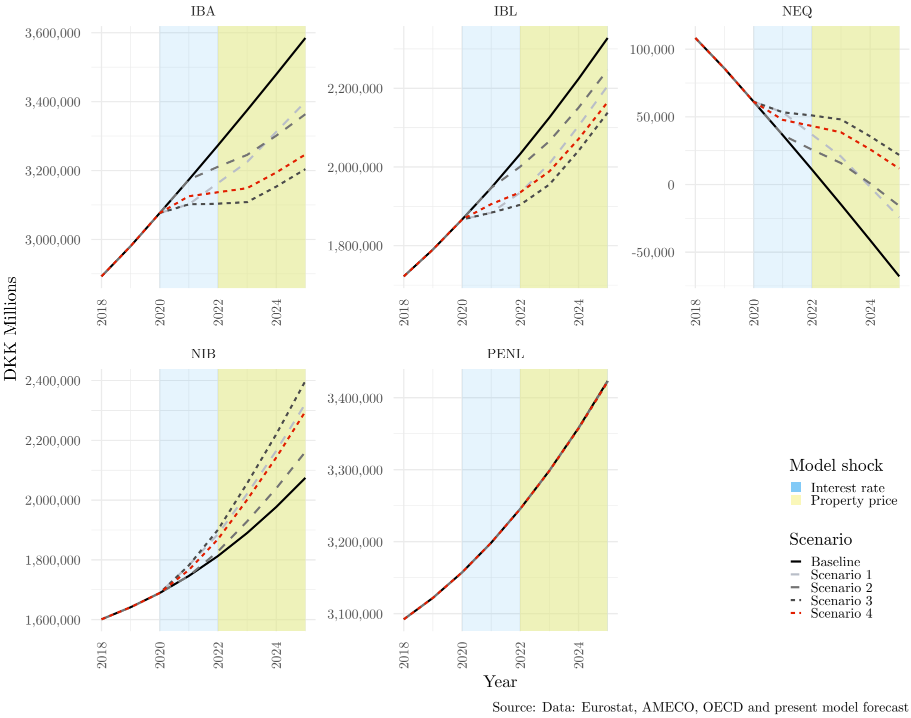
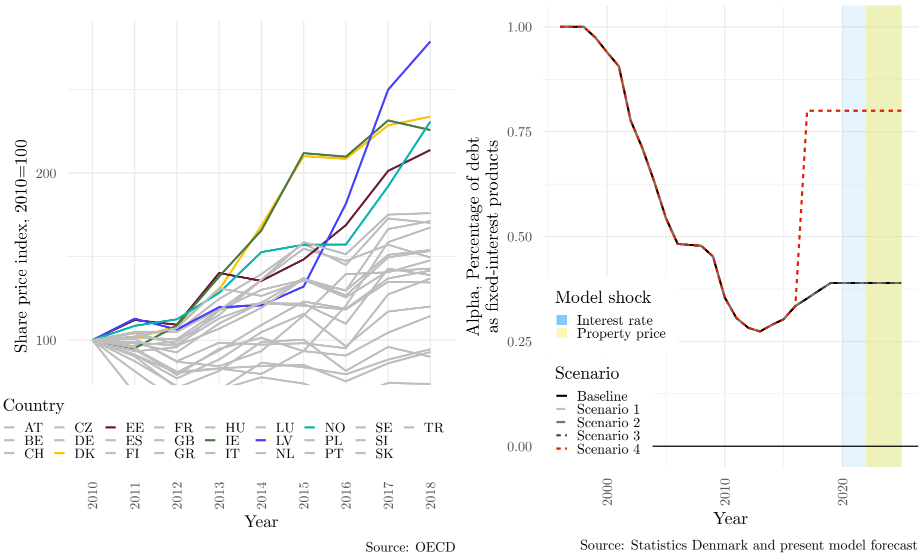


Figure 7.28: FC balance sheet

7.7 Discussion

As noted in Section 7.3, many of the innovations that occurred around the world during the past decades also occurred in the Danish mortgage lending system. In addition, since the GFC, interest rates have reduced to and remained at historically low levels. These conditions provided the platform for rapid expansion of household mortgage debt leading up to the crisis, and to continued expansion of that debt in more recent years. This has coincided with the rapid recovery and inflation of asset prices. Property prices are discussed in Section 7.5.3 above, and as can be seen from panel (a) in Figure 7.29, Danish equity prices (the yellow line) have risen over 230% from 2010 to 2018, with only one other European country (Latvia, the blue line) with a higher increase in its equity price index.

The main effects of the innovations that occurred were a reduction in initial payments for borrowers, a decline in the level of payments towards the outstanding principal debt (and thus a decline in the level of equity accumulation) and a significant shift of risk from investors to lenders. Danish HH responded rapidly to the innovations, and the composition of debt changed from 100% fixed interest debt, in 2000 to less than 30% by 2012, as can be seen in panel (b) of Figure 7.29[7.39].



(a) European share price indices (b) Fixed-interest share of debt

Figure 7.29: Share prices and mortgage composition

The major benefits of fixed interest products include stability of expenditures, insulation against unforseen interest rate hikes, and the possibility to refinance at various favourable instances (stemming from the buy-back, and prepayment rights assigned to borrowers (Skinhøj et al., 2019)). Flexible interest rate products on the other hand, provide low initial cost of borrowing, but transfer interest rate risk to the borrower. Revisions to the coupon rate on the counter-balancing bonds also create a significant opportunity cost for ARM borrowers if rates rise. This is opportunity cost is enhanced if it is a distressed borrower, or the borrower faces negative shocks, such as a loss of income or an injury. A

[7.39] The gradual shift out of fixed interest bonds prior to 2003 is due to the introduction of index-linked bonds, which made up a relatively small share of less than 10% the market, and this share reduced rapidly after 2003. There has also been a gradual move back towards more fixed-interest rate products since 2012.

fixed rate borrower (even without amortization) would be able to accept a lower sale value for their property, since the bond that represents the outstanding debt would reprice downwards as interest rates rise. In the case of an interest rate increase, flexible rate borrowers face the same possibility of unfavourable property market conditions, but the price of bonds outstanding will remain relatively constant, due to the re-setting of the short-term fixation of coupon payments. Flexible rate borrowers, and borrowers with interest-only periods thus face a much higher risk of falling into negative equity if house prices fall.

Many of these dynamics are captured in the model presented in this article, as are several economic relationships between the real and financial sides of the economy. These connections make it possible to show some of the expected "real" economic feedback effects of each shock. Although it is a highly simplified version of the Danish mortgage market, it is still able to provide a realistic scale for the core transmission channels for each of the shocks, and due to the simple structure of the model, it was relatively easy to incorporate a split in the composition of debt of HH.

One of the goals at the outset was to test the sensitivity of HH balance sheets for different compositions of debt. Two shocks were introduced across four scenarios. The primary effect of the first shock, an increase in interest rates by 2% in 2020, was an immediate reduction in HH income. The primary effect of the second shock, a decline in property prices by 20% in 2022, was to reduce the level of HH capital and the attractiveness of housing as an investment alternative. These two shocks were then compounded in Scenarios 3 and 4, but in Scenario 4 the level of debt held in fixed-interest products (α) was increased from around 37% to 80%, as shown in panel (b) of Figure 7.29 above.

The model behaved as expected, and in Scenario 3, with the higher proportion of ARMs, HH are exposed to significantly greater income volatility than in Scenario 4, a result that is corroborated by Danmarks Nationalbank (2016) and Skinhøj et al. (2019). This transmits to both the real and financial sides of the economy, with lower economic output and higher unemployment as a result of the increased sensitivity. The results in Section 7.6 above suggest that for a significant rise in interest rates, or a collapse in property prices, HH would be in a more favourable financial position as a sector if the proportion of mortgage debt held in fixed-interest products (α) was higher. This suggests that policies with a focus on increasing the coverage of fixed-interest-rate products in the mortgage financing system would result in a more resilient HH, and economy as a whole.

The specific movements of variables, however, should be interpreted with caution, as the shocks in this model are not designed to provide a comprehensive economic response within the model structure. Especially since it is only the rates that affect the cost of borrowing that are adjusted in shock 1.

In terms of the transmission channels in the model, HH is a key driver. The primary transmission channel in the interest rate shock is the credit channel, and it is clearly more impactful where interest rates are more sensitive. In a more realistic setting, the rise in interest rates would also affect HH incomes positively. In Denmark, pension funds hold a large portion of the outstanding covered covered bonds on behalf of households, and fees of the mortgage lending companies are generally a fixed rate. This would mean that increased mortgage costs should translate directly to increased pension incomes. HH pension assets are also substantially larger than HH debt, which means that if an interest rate hike resulted in a rise of the rates of return on most asset classes, then HH could experience a net gain. One argument against this is that pension assets are not directly accessible, and therefore would not contribute to short term disposable income of HH. HH in this case do not have discretion over the consumption of all wealth, and therefore those parts that are inaccessible should be excluded.

The current form of the model is also important to consider. Presently, HH consume out of wealth, and there is a positive return on IBA, which are assumed to be deposits. If we adjust the rate of return on IBA (r^H_N) upwards, it would change relative rates of return available for HH investment allocation, and would lead to a rapid accumulation of IBA. It would also drive a large positive effect on HH income, which would conceal the negative effects to disposable income that are displayed in the current form. This would, at least in the short run, not be in line with realistic expectations regarding accessible disposable income of HH.

Even if other asset class returns are adjusted to mitigate the fall in HH disposable income, investment will necessarily be lower as the cost of borrowing rises. In the case of an interest rate rise, aggregate demand and output would still decline, pushing unemployment upwards and providing downward pressure on the wage rate. after several years, the relative improvement in competitiveness in export prices would have a positive influence on exports and negative on imports. Ultimately this would strengthen the current account balance, but at the expense of higher unemployment in the domestic economy. The positive feedback of rising imports on wage income and output would depend on the elasticities of wages to changes in output, and imports and exports to relative price changes. The effect of a fall in house prices on housing investment would also remain in the short-term, as it is dependent on previous returns.

Another transmission channel that would be concealed is the negative pressure that a fall in demand has on the tax base, and therefore on GOV revenues. In the analysis above, it is clear that the fall in overall demand would lead to a fall in employment, a fall in tax revenues and therefore a large negative shift in the GOV net financing requirement. If the Danish GOV enforces a balanced budget, there would need to be a reduction in GOV spending, and the vast majority of this spending is split between a tax funded pension scheme, healthcare, disability support, family and child support. A reduction in any of these categories would result in a further reduction of output and ultimately in HH income.

Even with the simplifications, it should be safe to conclude that larger portions of debt in fixed-interest products would result in much lower volatility of HH disposable income. The use of a more comprehensive model, rather than a simple test of income volatility, allows us to observe the expected accumulation effects of the two shocks for different levels of α. The exogeneity of asset prices and rates of return are potential drawbacks, however, it is not obvious that creating endogenous links between financial markets, assets and rates of return (i.e. a more integrated financial sector) would be an improvement on the current model structure. At present, the most immediate transmission channels for each of the shocks are transparent, and because of the empirical nature of the model, it is possible to get an accurate scale of the initial effects of the shocks, without the complication of complex interdependencies between markets. There is a clear trade-off between complexity with greater accuracy, and better interpretability with greater transparency.

The more complete macroeconomic SFC model presented above requires attention to the gross levels of economic stocks and flows, and thus makes it possible to identify that the rise in HH NL following the second shock (the fall in property prices) was not due to positive changes in HH. Contrarily, HH experienced a decline in investment demand, together with rising unemployment. The model presented here helps to prevent such misinterpretations, and to provide a more complete picture of the possible impact of shocks[7.40].

The model unfortunately does not presently incorporate some key issues from the mortgage system, including the effect of changes in loan-to-value (LTV) ratios, or second round credit risk effects that might occur due to loss of income due to unemployment. The inclusion of a measure of non-performing loans or some other measure of credit risk might be able to capture these effects. Perhaps the most relevant omission, for the present discussion, is the effect of refinancing behaviour on the composition of debt, although this is not a simple matter to include, as noted by Skinhøj et al. (2019, p. 19), “The stochastic modelling of prepayment behaviour is a complex task and is outside the scope for most international investors.”

The possibility to explore a variety of modifications and alterations is also one of the major benefits that the baseline version of the model offers. It has made it possible to explore some of the complex economic feedback mechanisms described above. This version is also under continuous development by the MaMTEP group[7.41], and as additional economic components are explored in greater detail it will be possible to include any alterations that strengthen the core structure.

[7.40] In addition to the alterations made, the output of the model is presented in an alternative format. The tables in the appendix provide an exhaustive list of all elements applicable to each sector that are affected by each shock. This cross-section provides at least two things to the modeller. Firstly it identifies the components applicable to each sector that are most dramatically impacted. Secondly, the comprehensive list of affected components expand as a shock propagates through the economy and assists in the identification of timing errors in the model structure.

[7.41] The Macroeconomic Methodology, Theory and Economic Policy Research Group, Aalborg University.

7.8 Conclusion

The Danish mortgage financing system has experienced several innovations in recent decades. Collectively these innovations have had a variety of benefits for borrowers, but these come with a transfer of responsibility and risk to the borrower. One of the most prominent innovations was the introduction of adjustable rate mortgages (ARMs) with periods of interest fixation of a variety of lengths.

Access to individual level administrative data-sets allowed for the construction of aggregate outstanding mortgage data from 2009 to 2017, and highlights the increased concentration of flexible-rate mortgage debt. By the end of 2017, after the introduction of ARM products, approximately 63% of all mortgage debt outstanding was subject to an interest rate adjustment within 5 years. These products were collectively considered to be flexible-interest rate products in the analysis above, and the remaining debt considered to be fixed rate.

The model in this article was adapted from Byrialsen & Raza (2019) to explore the effects of this shift on the stability of incomes and balance sheets of the Danish economy. The primary innovation in the model was to introduce the split in debt, and to test the effect of the changes on the overall sensitivity of incomes and balance sheets, with a particular focus on HH. There are some additional changes that could be incorporated in future versions of the model that might strengthen the outputs of the model. Firstly, additional data could be sourced to provide a further split in HH debt between mortgage institute, bank and consumer debt. Secondly, it might be possible to actively model the refinancing behaviour of Danish property buyers[7.42]. It might also be possible to include some measure of credit supply constraints, and or borrower risk, for example, non-performing loans. Further developments of the model could make this possible.

The core aim of the analysis was to test the sensitivity of HH and economic conditions of a potential shift in the composition of debt from ARM type products to fixed-interest products. This is an intuitively simple proposition, but the accurately scaled empirical model presented in this article provides a clear indication of the potential scale of these impacts. For a shift in the fixed proportion from 37% up to 80%, in the case of a 2% point increase in

[7.42] There is unfortunately no data available at an individual level that would be representative of a rising interest rate environment.

interest rates and a 20% decline in property prices, the difference in aggregate unemployment effects could be as much as 2%. The effects discussed for each sector mirror this increase in sensitivity. Both in the initial effects and in terms of volatility in subsequent periods.

The results thus provide evidence to support reports made by the IMF (Sheehy, 2014), the Danish national bank (Danmarks Nationalbank, 2016) and the leading mortgage credit institution in Denmark, Nykredit Realkredit (Skinhøj et al., 2019), that the increased concentration of household debt in ARM (flexible-rate) products has resulted in greater sensitivity (and thus less stability) of both HH and the Danish economy in general. This does not imply that the level of outstanding debt poses a systemic economic risk. Again in support of reports presented by the above institutions, it should be noted that simultaneous and sizable shocks to both the cost of borrowing and to property prices only resulted in modest effects on overall output, even where the shock is restricted to borrowing costs.

In contrast to suggestions regarding the systemic risk of household debt in itself, the analysis suggests that the potential risks related to the present high ratio of HH debt to disposable income in Denmark can be dramatically reduced through a migration of HH mortgage debt away from ARM type products towards fixed interest rate products. The all-time low levels of interest rates that are currently available also present an excellent opportunity to support this transition.

7.9 Appendix

7.9.1 Mortgage debt as a percentage of total loans to non-financial private sector (nominal, local currency)

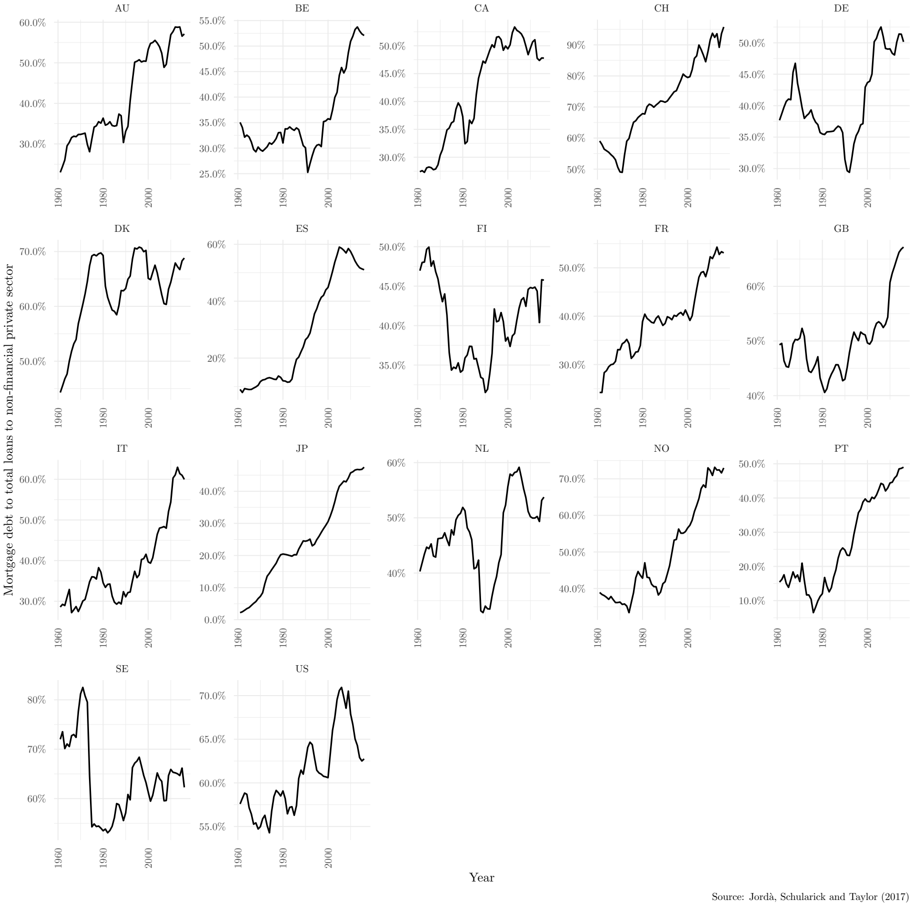


Figure 7.30: Mortgage debt as percentage of total loans

7.9.2 Mortgage debt to GDP

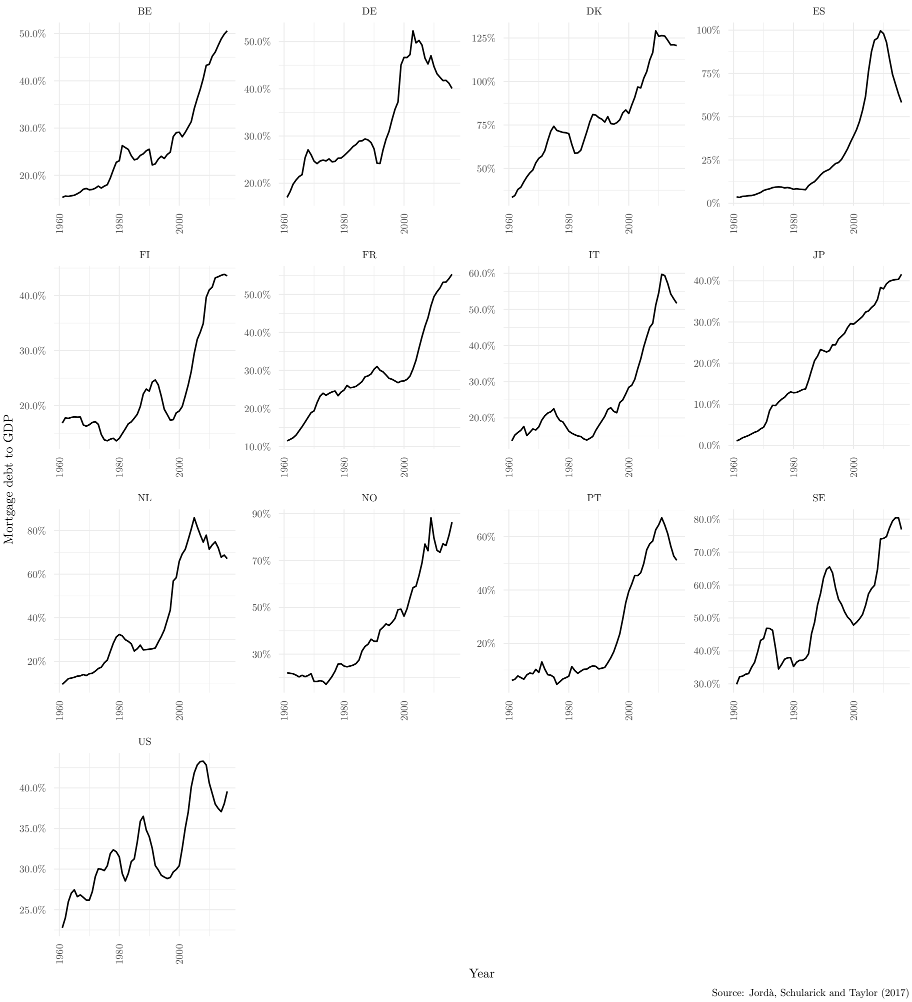


Figure 7.31: Mortgage debt to GDP

7.9.3 House Prices

Table 7.4: OECD House price index changes, Year on year

Country	2000 to 2007	2007 to 2009	2009 to 2018
Estonia	15.89%	-17.06%	11.33%
Costa Rica	08.94%	06.07%	04.11%
Austria	03.63%	03.01%	03.97%
Colombia	04.58%	04.79%	03.85%
Hungary	13.52%	08.14%	03.01%
Czech Republic	05.25%	16.46%	02.83%
United States	04.10%	01.82%	02.78%
Netherlands	03.35%	02.03%	02.62%
Ireland	16.65%	-12.57%	02.50%
Finland	02.96%	00.33%	02.43%
Israel	00.55%	05.02%	02.40%
Korea, Republic of	03.01%	01.93%	02.39%
Norway	03.72%	03.27%	02.35%
Poland	08.40%	05.06%	02.23%
Mexico	06.03%	03.23%	02.15%
New Zealand	00.97%	02.29%	02.07%
Denmark	03.11%	02.95%	01.98%
United Kingdom	03.52%	02.65%	01.95%
Portugal	03.37%	02.90%	01.76%
Sweden	02.56%	02.92%	01.56%
Latvia	11.22%	03.58%	01.39%
Luxembourg	02.87%	02.79%	01.31%
Germany	01.30%	01.17%	01.23%
Canada	01.64%	01.63%	01.09%
Slovenia	12.31%	02.53%	01.00%
France	03.36%	02.15%	00.82%
Italy	03.07%	02.95%	00.80%
Switzerland	01.87%	02.46%	00.75%
Slovakia	22.41%	04.09%	00.42%
Spain	05.69%	03.72%	00.29%

Greece	06.25%	03.82%	-2.33%
Japan	-0.27%	-0.22%	-0.31%

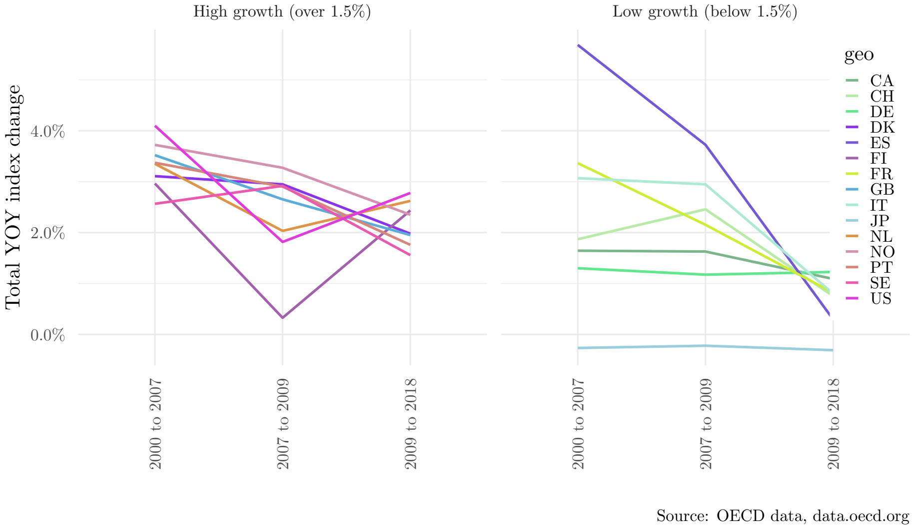


Figure 7.32: OECD house prices: Year-on-year changes

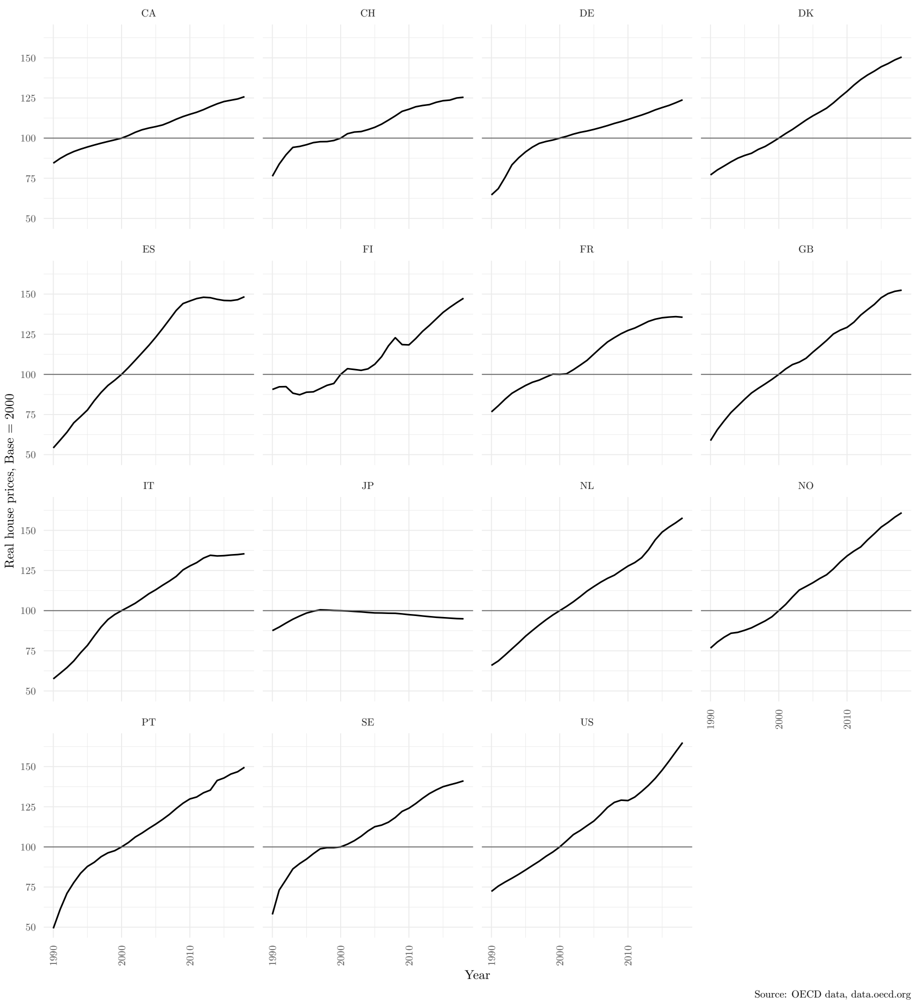


Figure 7.33: OECD house prices: Real price index

7.9.4 Simulation most affected variables in each shock

7.9.4.1 Scenario 1: Percentage from baseline: An increase in 2020 interest rates, measured in 2021

Table 7.5: Most affected variables: Perc change from baseline: Scenario 1, 2021: Economy wide

Variables	Type	Description	Change
PY	Deflation index	Price deflator: GDP	00.0082%
CAB	Flow	Current account balance	10.9700%
FAB	Flow	Financial account balance	-10.9700%
NX	Flow	Net Exports	10.5161%
I-Real prices	Flow	Gross fixed capital formation	-1.2468%
I	Flow	Gross fixed capital formation	-1.2468%
M	Flow	Imports	-1.2173%
M-Real prices	Flow	Imports	-1.2173%
PRIVATE	Flow	Gross income	-0.6908%
S-Real prices	Flow	Savings	-0.5725%
S	Flow	Savings	-0.5638%
Y-Real prices	Flow	Total income	-0.2097%
Y	Flow	Total income	-0.2016%
B2	Flow	Gross operating surplus	-0.1126%
ULC	Rate	Labour force: Unit labour cost: Price index: Index for the price deflator with reference to 2010 (all other price deflator indices are referenced to 2010)	00.2021%
UL-COST	Rate	Labour force: Unit labour cost	00.2020%
CU	Ratio	Capacity Utilisation (Real GNI / real capital stock)	-0.2098%
WS	Ratio	Wage share	00.0442%

Table 7.6: Most affected variables: Perc change from baseline: Scenario 1, 2021: HH

Variables	Type	Description	Change
PIP-IBL-HH-Flexible	Flow	Property income paid: IBL	136.2914%
PIP-IBL-HH	Flow	Property income paid: IBL	95.8530%
IBA-HH-Transactions	Flow	Financial Assets: Interest bearing assets	-78.2793%
FL-HH-Transactions	Flow	Financial liabilities	-73.9372%

IBL-HH-Transactions	Flow	Financial Liabilities: Interest bearing liabilities	-73.9372%
EQA-HH-Transactions	Flow	Financial Assets: Equity assets	-68.3376%
NPIR-HH	Flow	Net property income received: Total	-58.6600%
FA-HH-Transactions	Flow	Financial Assets	-54.5574%
PIP-IBL-HH-Fixed	Flow	Property income paid: IBL	32.3802%
FNL-HH	Flow	Financial Net Lending (Balance)	-16.6354%
NL-HH	Flow	Sector Balance	-16.6354%
S-HH	Flow	Savings	-10.3028%
INV-HH-Real prices	Flow	Gross fixed capital formation	-6.8066%
INV-HH	Flow	Gross fixed capital formation	-6.8066%
PIR-IBA-HH	Flow	Property income received: IBA	-3.2347%
Y-D-HH	Flow	Disposable Income	-2.5806%
Y-HH	Flow	Total income	-2.5806%
TAX-HH	Flow	Tax	-2.5806%
Y-D-HH-Real prices	Flow	Disposable Income	-2.5806%
C-HH-Real prices	Flow	Consumption	-1.3327%
C-HH	Flow	Consumption	-1.3326%
R-IBL-HH-Flexible	Rate	Rate of interest: Interest bearing liabilities	141.7474%
R-IBL-HH-Fixed	Rate	Rate of interest: Interest bearing liabilities	35.4369%
IBA-HH	Stock	Financial Assets: Interest bearing assets	-3.2347%
IBL-HH	Stock	Financial Liabilities: Interest bearing liabilities	-2.2569%
IBL-HH-Fixed	Stock	Financial Liabilities: Interest bearing liabilities	-2.2569%
IBL-HH-Flexible	Stock	Financial Liabilities: Interest bearing liabilities	-2.2569%
FA-HH	Stock	Financial Assets	-1.1087%
EQA-HH	Stock	Financial Assets: Equity assets	-0.8157%
K-HH	Stock	Stock of Capital	-0.2520%
K-HH-Real prices	Stock	Stock of Capital	-0.2520%
NW-HH	Stock	Net Wealth	-0.2223%
NW-HH-Real prices	Stock	Net Wealth	-0.2222%
FNW-HH-Real prices	Stock	Financial net wealth	-0.2044%

FNW-HH	Stock	Financial net wealth	-0.2044%

Table 7.7: Most affected variables: Perc change from baseline: Scenario 1, 2021: NFC

Variables	Type	Description	Change
FNL-NFC	Flow	Financial Net Lending (Balance)	-12.6166%
NIB-NFC-Transactions	Flow	Net financial stock: Interest bearing	-12.6166%
NL-NFC	Flow	Sector Balance	-12.6166%
S-NFC	Flow	Savings	-1.1026%
TAX-NFC	Flow	Tax	-0.2016%
B2-NFC	Flow	Gross operating surplus	-0.1858%
NIB-NFC	Stock	Net financial stock: Interest bearing	-0.5636%
NW-NFC	Stock	Net Wealth	-0.2341%
FNW-NFC	Stock	Financial net wealth	-0.2042%

Table 7.8: Most affected variables: Perc change from baseline: Scenario 1, 2021: FC

Variables	Type	Description	Change
FNL-FC	Flow	Financial Net Lending (Balance)	569.1674%
NL-FC	Flow	Sector Balance	569.1674%
NPIR-FC	Flow	Net property income received: Total	323.5769%
S-FC	Flow	Savings	275.5754%
PIR-IBA-FC-HH-Flexible	Flow	Property income received: IBA	136.2914%
IBL-FC-HH-Transactions	Flow	Financial Liabilities: Interest bearing liabilities	-78.2793%
IBA-FC-HH-Transactions	Flow	Financial Assets: Interest bearing assets	-73.9372%
NEQ-FC-Transactions	Flow	Net financial stock: Equity	68.3376%
NIB-FC-Transactions	Flow	Net financial stock: Interest bearing	61.8225%
PIR-IBA-FC-HH-Fixed	Flow	Property income received: IBA	32.3802%
Y-FC	Flow	Total income	-0.0442%
NEQ-FC	Stock	Net financial stock: Equity	46.2640%
NW-FC	Stock	Net Wealth	42.8191%
FNW-FC	Stock	Financial net wealth	23.0242%
IBL-FC-HH	Stock	Financial Liabilities: Interest bearing liabilities	-3.2347%

IBA-FC-HH	Stock	Financial Assets: Interest bearing assets	-2.2569%
NIB-FC	Stock	Net financial stock: Interest bearing	02.0236%

Table 7.9: Most affected variables: Perc change from baseline: Scenario 1, 2021: GOV

Variables	Type	Description	Change
FNL-GOV	Flow	Financial Net Lending (Balance)	-30.7775%
NIB-GOV-Transactions	Flow	Net financial stock: Interest bearing	-30.7775%
NL-GOV	Flow	Sector Balance	-30.7775%
S-GOV	Flow	Savings	-11.8501%
TAX-GOV	Flow	Tax	-1.5577%
FNW-GOV	Stock	Financial net wealth	-9.1649%
NIB-GOV	Stock	Net financial stock: Interest bearing	-9.1649%
NW-GOV	Stock	Net Wealth	-1.2954%

Table 7.10: Most affected variables: Perc change from baseline: Scenario 1, 2021: ROW

Variables	Type	Description	Change
FNL-ROW	Flow	Financial Net Lending (Balance)	-10.9700%
NIB-ROW-Transactions	Flow	Net financial stock: Interest bearing	-10.9700%
NL-ROW	Flow	Sector Balance	-10.9700%
S-ROW	Flow	Savings	-10.9700%
NIB-ROW	Stock	Net financial stock: Interest bearing	-1.2091%
FNW-ROW	Stock	Financial net wealth	-0.6953%
NW-ROW	Stock	Net Wealth	-0.6953%

7.9.4.2 Scenario 1: Percentage from baseline: An increase in 2020 interest rates, measured in 2023

Table 7.11: Most affected variables: Perc change from baseline: Scenario 1: Economy wide, 2023

Variables	Type	Description	Change
PY	Deflation index	Price deflator: GDP	00.0645%
PX	Deflation index	Price deflator: Exports	00.0293%
CAB	Flow	Current account balance	19.5257%
FAB	Flow	Financial account balance	-19.5257%
NX	Flow	Net Exports	18.9600%
I-Real prices	Flow	Gross fixed capital formation	-2.3220%
I	Flow	Gross fixed capital formation	-2.3220%
M-Real prices	Flow	Imports	-2.3121%
M	Flow	Imports	-2.3120%
PRIVATE	Flow	Gross income	-1.3215%
S-Real prices	Flow	Savings	-1.0950%
S	Flow	Savings	-1.0518%
Y-Real prices	Flow	Total income	-0.3939%
Y	Flow	Total income	-0.3297%
B2	Flow	Gross operating surplus	-0.1848%
X-Real prices	Flow	Exports	-0.0261%
X	Flow	Exports	00.0032%
UL-COST	Rate	Labour force: Unit labour cost	00.2739%
ULC	Rate	Labour force: Unit labour cost: Price index: Index for the price deflator with reference to 2010 (all other price deflator indices are referenced to 2010)	00.2739%
WAGE	Rate	Labour force: Wage rate	-0.0066%
UR	Ratio	Labour force: Unemployment rate	01.8221%
CU	Ratio	Capacity Utilisation (Real GNI / real capital stock)	-0.3141%
WS	Ratio	Wage share	00.0501%
UN	Stock	Labour force: Unemployed persons	01.8219%
N	Stock	Labour force: Denmark for workers in production	-0.0506%
NF	Stock	Labour force: Employed persons: Danish waged	-0.0501%
NU	Stock	Labour force: Employed persons: Danish nationals: Employed abroad	00.0066%

Table 7.12: Most affected variables: Perc change from baseline: Scenario 1: HH, 2023

Variables	Type	Description	Change
PIP-IBL-HH-Flexible	Flow	Property income paid: IBL	130.9800%
PIP-IBL-HH	Flow	Property income paid: IBL	91.4505%
NPIR-HH	Flow	Net property income received: Total	-59.5976%
FL-HH-Transactions	Flow	Financial liabilities	-40.0111%
IBL-HH-Transactions	Flow	Financial Liabilities: Interest bearing liabilities	-40.0111%
EQA-HH-Transactions	Flow	Financial Assets: Equity assets	-37.1202%
PIP-IBL-HH-Fixed	Flow	Property income paid: IBL	29.4045%
IBA-HH-Transactions	Flow	Financial Assets: Interest bearing assets	-20.4450%
FNL-HH	Flow	Financial Net Lending (Balance)	17.4954%
NL-HH	Flow	Sector Balance	17.4954%
FA-HH-Transactions	Flow	Financial Assets	-16.7101%
INV-HH	Flow	Gross fixed capital formation	-12.4945%
INV-HH-Real prices	Flow	Gross fixed capital formation	-12.4945%
PIR-IBA-HH	Flow	Property income received: IBA	-5.5128%
C-HH-Real prices	Flow	Consumption	-2.5833%
C-HH	Flow	Consumption	-2.5833%
TAX-HH	Flow	Tax	-2.3318%
Y-D-HH-Real prices	Flow	Disposable Income	-2.3318%
Y-D-HH	Flow	Disposable Income	-2.3318%
Y-HH	Flow	Total income	-2.3317%
SCO-HH	Flow	Social benefit contributions	-2.3195%
STRA-HH	Flow	Social transfers	01.9329%
PIR-EQA-HH	Flow	Property income received: EQA	-1.2325%
S-HH	Flow	Savings	00.6134%
PENA-HH-Transactions	Flow	Financial Assets: Pension assets	-0.2734%
SBE-HH	Flow	Social benefit transfers	00.1583%
W-HH	Flow	Wages	-0.0572%
PIR-PENA-HH	Flow	Property income received: PENA	-0.0037%
R-IBL-HH-Flexible	Rate	Rate of interest: Interest bearing liabilities	141.7474%

R-IBL-HH-Fixed	Rate	Rate of interest: Interest bearing liabilities	35.4369%
IBA-HH	Stock	Financial Assets: Interest bearing assets	-5.5128%
IBL-HH-Fixed	Stock	Financial Liabilities: Interest bearing liabilities	-4.4541%
IBL-HH	Stock	Financial Liabilities: Interest bearing liabilities	-4.4540%
IBL-HH-Flexible	Stock	Financial Liabilities: Interest bearing liabilities	-4.4540%
FA-HH	Stock	Financial Assets	-2.0294%
EQA-HH	Stock	Financial Assets: Equity assets	-1.6706%
K-HH	Stock	Stock of Capital	-0.8297%
K-HH-Real prices	Stock	Stock of Capital	-0.8297%
NW-HH	Stock	Net Wealth	-0.3508%
NW-HH-Real prices	Stock	Net Wealth	-0.3508%
FNW-HH	Stock	Financial net wealth	-0.0614%
FNW-HH-Real prices	Stock	Financial net wealth	-0.0614%
PENA-HH	Stock	Financial Assets: Pension assets	-0.0080%

Table 7.13: Most affected variables: Perc change from baseline: Scenario 1: NFC, 2023

Variables	Type	Description	Change
FNL-NFC	Flow	Financial Net Lending (Balance)	-19.7550%
NIB-NFC-Transactions	Flow	Net financial stock: Interest bearing	-19.7550%
NL-NFC	Flow	Sector Balance	-19.7550%
S-NFC	Flow	Savings	-1.6144%
NPIR-NIB-NFC	Flow	Net property income received: NIB	-0.6404%
TAX-NFC	Flow	Tax	-0.3297%
B2-NFC	Flow	Gross operating surplus	-0.3054%
INV-NFC-Real prices	Flow	Gross fixed capital formation	-0.2240%
INV-NFC	Flow	Gross fixed capital formation	-0.2240%
NPIR-NFC	Flow	Net property income received: Total	-0.1657%
W-NFC	Flow	Wages	-0.0567%
NIB-NFC	Stock	Net financial stock: Interest bearing	-1.4829%
NW-NFC	Stock	Net Wealth	-0.6495%
FNW-NFC	Stock	Financial net wealth	-0.5094%
K-NFC	Stock	Stock of Capital	-0.0801%

K-NFC-Real prices	Stock	Stock of Capital	-0.0801%

Table 7.14: Most affected variables: Perc change from baseline: Scenario 1: FC, 2023

Variables	Type	Description	Change
FNL-FC	Flow	Financial Net Lending (Balance)	615.6131%
NL-FC	Flow	Sector Balance	615.6131%
NPIR-FC	Flow	Net property income received: Total	345.2026%
S-FC	Flow	Savings	287.2370%
NPIR-NEQ-FC	Flow	Net property income received: NEQ	232.6801%
PIR-IBA-FC-HH-Flexible	Flow	Property income received: IBA	130.9800%
NIB-FC-Transactions	Flow	Net financial stock: Interest bearing	75.2630%
IBA-FC-HH-Transactions	Flow	Financial Assets: Interest bearing assets	-40.0111%
NEQ-FC-Transactions	Flow	Net financial stock: Equity	37.1202%
PIR-IBA-FC-HH-Fixed	Flow	Property income received: IBA	29.4045%
IBL-FC-HH-Transactions	Flow	Financial Liabilities: Interest bearing liabilities	-20.4450%
PIP-IBL-FC	Flow	Property income paid: IBL	-4.8349%
NPIR-NIB-FC	Flow	Net property income received: NIB	04.0381%
PENL-FC-Transactions	Flow	Financial Liabilities: Pension liabilities	-0.2734%
Y-FC	Flow	Total income	-0.1069%
PIP-PENL-FC	Flow	Property income paid: PENL	-0.0037%
NEQ-FC	Stock	Net financial stock: Equity	239.4789%
NW-FC	Stock	Net Wealth	157.9216%
FNW-FC	Stock	Financial net wealth	76.6691%
NIB-FC	Stock	Net financial stock: Interest bearing	06.9344%
IBL-FC-HH	Stock	Financial Liabilities: Interest bearing liabilities	-5.5128%
IBA-FC-HH	Stock	Financial Assets: Interest bearing assets	-4.4540%
PENL-FC	Stock	Financial Liabilities: Pension liabilities	-0.0080%

Table 7.15: Most affected variables: Perc change from baseline: Scenario 1: GOV, 2023

Variables	Type	Description	Change
FNL-GOV	Flow	Financial Net Lending (Balance)	-34.2672%
NIB-GOV-Transactions	Flow	Net financial stock: Interest bearing	-34.2672%
NL-GOV	Flow	Sector Balance	-34.2672%
NPIR-GOV	Flow	Net property income received: Total	-15.3614%
NPIR-NIB-GOV	Flow	Net property income received: NIB	-15.3614%
S-GOV	Flow	Savings	-14.0661%
TAX-GOV	Flow	Tax	-1.4651%
STRA-GOV	Flow	Social transfers	-1.2092%
FNW-GOV	Stock	Financial net wealth	-19.2726%
NIB-GOV	Stock	Net financial stock: Interest bearing	-19.2726%
NW-GOV	Stock	Net Wealth	-4.0170%

Table 7.16: Most affected variables: Perc change from baseline: Scenario 1: ROW, 2023

Variables	Type	Description	Change
FNL-ROW	Flow	Financial Net Lending (Balance)	-19.5257%
NIB-ROW-Transactions	Flow	Net financial stock: Interest bearing	-19.5257%
NL-ROW	Flow	Sector Balance	-19.5257%
S-ROW	Flow	Savings	-19.5257%
NPIR-NIB-ROW	Flow	Net property income received: NIB	-2.3317%
NPIR-ROW	Flow	Net property income received: Total	-1.1482%
NIB-ROW	Stock	Net financial stock: Interest bearing	-4.1077%
FNW-ROW	Stock	Financial net wealth	-2.5799%
NW-ROW	Stock	Net Wealth	-2.5799%

7.9.4.3 Scenario 2: Percentage from baseline: Fall in 2022 property prices, measured in 2022

Table 7.17: Most affected variables: Perc change from baseline: Scenario 2, 2022: Economy wide

Variables	Type	Description	Change
PY	Deflation index	Price deflator: GDP	00.0316%
CAB	Flow	Current account balance	08.1425%
FAB	Flow	Financial account balance	-8.1425%
NX	Flow	Net Exports	07.9087%
I	Flow	Gross fixed capital formation	-3.0357%
I-Real prices	Flow	Gross fixed capital formation	-3.0357%
M-Real prices	Flow	Imports	-0.9393%
M	Flow	Imports	-0.9393%
PRIVATE	Flow	Gross income	-0.5328%
S-Real prices	Flow	Savings	-0.4415%
S	Flow	Savings	-0.4195%
Y-Real prices	Flow	Total income	-0.1581%
Y	Flow	Total income	-0.1265%
B2	Flow	Gross operating surplus	-0.0708%
ZZ1	Index	Index: House price: Imported from DST	-495.5506%
ZZ-I	Index	Index: House price: Imported from DST	-20.0000%
TOBIN-Q	Index	Index: House price index: Tobin's Q = Ratio between the house price index and the construction cost of housing index	-20.0000%
ULC	Rate	Labour force: Unit labour cost: Price index: Index for the price deflator with reference to 2010 (all other price deflator indices are referenced to 2010)	00.1267%
UL-COST	Rate	Labour force: Unit labour cost	00.1267%
CU	Ratio	Capacity Utilisation (Real GNI / real capital stock)	-0.1581%
WS	Ratio	Wage share	00.0277%

Table 7.18: Most affected variables: Perc change from baseline: Scenario 2, 2022: HH

Variables	Type	Description	Change
FL-HH-Transactions	Flow	Financial liabilities	-62.3432%
IBL-HH-Transactions	Flow	Financial Liabilities: Interest bearing liabilities	-62.3432%

EQA-HH-Transactions	Flow	Financial Assets: Equity assets	-57.7498%
IBA-HH-Transactions	Flow	Financial Assets: Interest bearing assets	-37.3670%
FA-HH-Transactions	Flow	Financial Assets	-29.5485%
FNL-HH	Flow	Financial Net Lending (Balance)	25.6920%
NL-HH	Flow	Sector Balance	25.6920%
INV-HH	Flow	Gross fixed capital formation	-16.9799%
INV-HH-Real prices	Flow	Gross fixed capital formation	-16.9799%
PIP-IBL-HH-Fixed	Flow	Property income paid: IBL	-1.9007%
PIP-IBL-HH	Flow	Property income paid: IBL	-1.9007%
PIP-IBL-HH-Flexible	Flow	Property income paid: IBL	-1.9006%
PIR-IBA-HH	Flow	Property income received: IBA	-1.5899%
NPIR-HH	Flow	Net property income received: Total	00.7082%
K-HH	Stock	Stock of Capital	-8.3997%
K-HH-Real prices	Stock	Stock of Capital	-8.3997%
NW-HH	Stock	Net Wealth	-2.9289%
NW-HH-Real prices	Stock	Net Wealth	-2.9289%
IBL-HH-Flexible	Stock	Financial Liabilities: Interest bearing liabilities	-1.9007%
IBL-HH	Stock	Financial Liabilities: Interest bearing liabilities	-1.9006%
IBL-HH-Fixed	Stock	Financial Liabilities: Interest bearing liabilities	-1.9006%
IBA-HH	Stock	Financial Assets: Interest bearing assets	-1.5899%
EQA-HH	Stock	Financial Assets: Equity assets	-0.6999%
FA-HH	Stock	Financial Assets	-0.6383%
FNW-HH-Real prices	Stock	Financial net wealth	00.3723%
FNW-HH	Stock	Financial net wealth	00.3722%

Table 7.19: Most affected variables: Perc change from baseline: Scenario 2, 2022: NFC

Variables	Type	Description	Change
FNL-NFC	Flow	Financial Net Lending (Balance)	-8.8374%
NIB-NFC-Transactions	Flow	Net financial stock: Interest bearing	-8.8374%

NL-NFC	Flow	Sector Balance	-8.8374%
S-NFC	Flow	Savings	-0.6918%
TAX-NFC	Flow	Tax	-0.1265%
B2-NFC	Flow	Gross operating surplus	-0.1169%
NIB-NFC	Stock	Net financial stock: Interest bearing	-0.3771%
NW-NFC	Stock	Net Wealth	-0.1397%
FNW-NFC	Stock	Financial net wealth	-0.1330%

Table 7.20: Most affected variables: Perc change from baseline: Scenario 2, 2022: FC

Variables	Type	Description	Change
IBA-FC-HH-Transactions	Flow	Financial Assets: Interest bearing assets	-62.3432%
NEQ-FC-Transactions	Flow	Net financial stock: Equity	57.7498%
IBL-FC-HH-Transactions	Flow	Financial Liabilities: Interest bearing liabilities	-37.3670%
NIB-FC-Transactions	Flow	Net financial stock: Interest bearing	22.7852%
NPIR-FC	Flow	Net property income received: Total	-6.6143%
PIR-IBA-FC-HH-Fixed	Flow	Property income received: IBA	-1.9007%
PIR-IBA-FC-HH-Flexible	Flow	Property income received: IBA	-1.9006%
Y-FC	Flow	Total income	-0.0278%
NEQ-FC	Stock	Net financial stock: Equity	132.1362%
IBA-FC-HH	Stock	Financial Assets: Interest bearing assets	-1.9006%
IBL-FC-HH	Stock	Financial Liabilities: Interest bearing liabilities	-1.5899%
NIB-FC	Stock	Net financial stock: Interest bearing	00.8395%

Table 7.21: Most affected variables: Perc change from baseline: Scenario 2, 2022: GOV

Variables	Type	Description	Change
FNL-GOV	Flow	Financial Net Lending (Balance)	-0.9744%
NIB-GOV-Transactions	Flow	Net financial stock: Interest bearing	-0.9744%
NL-GOV	Flow	Sector Balance	-0.9744%
S-GOV	Flow	Savings	-0.3880%
TAX-GOV	Flow	Tax	-0.0521%

FNW-GOV	Stock	Financial net wealth	-0.2368%
NIB-GOV	Stock	Net financial stock: Interest bearing	-0.2368%
NW-GOV	Stock	Net Wealth	-0.0415%

Table 7.22: Most affected variables: Perc change from baseline: Scenario 2, 2022: ROW

Variables	Type	Description	Change
FNL-ROW	Flow	Financial Net Lending (Balance)	-8.1425%
NIB-ROW-Transactions	Flow	Net financial stock: Interest bearing	-8.1425%
NL-ROW	Flow	Sector Balance	-8.1425%
S-ROW	Flow	Savings	-8.1425%
NIB-ROW	Stock	Net financial stock: Interest bearing	-0.8668%
FNW-ROW	Stock	Financial net wealth	-0.5220%
NW-ROW	Stock	Net Wealth	-0.5220%

7.9.4.4 Scenario 2: Percentage from baseline: Fall in 2022 property prices, measured in 2025

Table 7.23: Most affected variables: Perc change from baseline: Scenario 2, 2025: Economy wide

Variables	Type	Description	Change
PY	Deflation index	Price deflator: GDP	00.0981%
PX	Deflation index	Price deflator: Exports	00.0256%
PC	Deflation index	Price deflator: Consumption	-0.0023%
CAB	Flow	Current account balance	11.7439%
FAB	Flow	Financial account balance	-11.7439%
NX	Flow	Net Exports	11.4623%
I	Flow	Gross fixed capital formation	-4.0697%
I-Real prices	Flow	Gross fixed capital formation	-4.0697%
M	Flow	Imports	-1.4791%
M-Real prices	Flow	Imports	-1.4790%
PRIVATE	Flow	Gross income	-0.8513%
S-Real prices	Flow	Savings	-0.7053%
S	Flow	Savings	-0.6449%
Y-Real prices	Flow	Total income	-0.2493%
Y	Flow	Total income	-0.1514%
B2	Flow	Gross operating surplus	-0.0852%
X-Real prices	Flow	Exports	-0.0171%
X	Flow	Exports	00.0085%
TOBIN-Q	Index	Index: House price index: Tobin's Q = Ratio between the house price index and the construction cost of housing index	-20.0000%
ZZ1	Index	Index: House price: Imported from DST	-20.0000%
ZZ-I	Index	Index: House price: Imported from DST	-20.0000%
UL-COST	Rate	Labour force: Unit labour cost	00.0746%
ULC	Rate	Labour force: Unit labour cost: Price index: Index for the price deflator with reference to 2010 (all other price deflator indices are referenced to 2010)	00.0746%
WAGE	Rate	Labour force: Wage rate	-0.0193%
UR	Ratio	Labour force: Unemployment rate	02.2183%
CU	Ratio	Capacity Utilisation (Real GNI / real capital stock)	-0.1342%
WS	Ratio	Wage share	00.0032%
UN	Stock	Labour force: Unemployed persons	02.2183%
N	Stock	Labour force: Denmark for workers in production	-0.0582%
NF	Stock	Labour force: Employed persons: Danish waged	-0.0576%

NU	Stock	Labour force: Employed persons: Danish nationals: Employed abroad	00.0193%

Table 7.24: Most affected variables: Perc change from baseline: Scenario 2, 2025: HH

Variables	Type	Description	Change
FL-HH-Transactions	Flow	Financial liabilities	-40.8998%
IBL-HH-Transactions	Flow	Financial Liabilities: Interest bearing liabilities	-40.8998%
EQA-HH-Transactions	Flow	Financial Assets: Equity assets	-38.0412%
FNL-HH	Flow	Financial Net Lending (Balance)	27.6257%
NL-HH	Flow	Sector Balance	27.6257%
INV-HH-Real prices	Flow	Gross fixed capital formation	-23.1670%
INV-HH	Flow	Gross fixed capital formation	-23.1670%
FA-HH-Transactions	Flow	Financial Assets	-9.2935%
IBA-HH-Transactions	Flow	Financial Assets: Interest bearing assets	-7.5369%
PIP-IBL-HH-Flexible	Flow	Property income paid: IBL	-6.1696%
PIP-IBL-HH	Flow	Property income paid: IBL	-6.1696%
PIP-IBL-HH-Fixed	Flow	Property income paid: IBL	-6.1696%
PIR-IBA-HH	Flow	Property income received: IBA	-3.4809%
S-HH	Flow	Savings	02.4518%
PIR-EQA-HH	Flow	Property income received: EQA	-1.9534%
NPIR-HH	Flow	Net property income received: Total	01.8554%
STRA-HH	Flow	Social transfers	00.3734%
C-HH	Flow	Consumption	-0.3563%
C-HH-Real prices	Flow	Consumption	-0.3540%
PENA-HH-Transactions	Flow	Financial Assets: Pension assets	-0.3143%
SBE-HH	Flow	Social benefit transfers	00.2243%
W-HH	Flow	Wages	-0.0775%
Y-D-HH-Real prices	Flow	Disposable Income	00.0467%
Y-HH	Flow	Total income	00.0445%
TAX-HH	Flow	Tax	00.0444%
Y-D-HH	Flow	Disposable Income	00.0444%

SCO-HH	Flow	Social benefit contributions	00.0236%
PIR-PENA-HH	Flow	Property income received: PENA	-0.0077%
K-HH-Real prices	Stock	Stock of Capital	-11.5971%
K-HH	Stock	Stock of Capital	-11.5971%
IBL-HH-Fixed	Stock	Financial Liabilities: Interest bearing liabilities	-6.1696%
IBL-HH	Stock	Financial Liabilities: Interest bearing liabilities	-6.1696%
IBL-HH-Flexible	Stock	Financial Liabilities: Interest bearing liabilities	-6.1695%
IBA-HH	Stock	Financial Assets: Interest bearing assets	-3.4809%
NW-HH	Stock	Net Wealth	-3.0871%
NW-HH-Real prices	Stock	Net Wealth	-3.0849%
EQA-HH	Stock	Financial Assets: Equity assets	-2.3977%
FNW-HH-Real prices	Stock	Financial net wealth	02.0247%
FNW-HH	Stock	Financial net wealth	02.0224%
FA-HH	Stock	Financial Assets	-1.6886%
PENA-HH	Stock	Financial Assets: Pension assets	-0.0136%

Table 7.25: Most affected variables: Perc change from baseline: Scenario 2, 2025: NFC

Variables	Type	Description	Change
FNL-NFC	Flow	Financial Net Lending (Balance)	-3.9717%
NIB-NFC-Transactions	Flow	Net financial stock: Interest bearing	-3.9717%
NL-NFC	Flow	Sector Balance	-3.9717%
NPIR-NIB-NFC	Flow	Net property income received: NIB	-0.7335%
S-NFC	Flow	Savings	-0.5667%
INV-NFC-Real prices	Flow	Gross fixed capital formation	-0.3277%
INV-NFC	Flow	Gross fixed capital formation	-0.3277%
NPIR-NFC	Flow	Net property income received: Total	-0.1786%
TAX-NFC	Flow	Tax	-0.1514%
B2-NFC	Flow	Gross operating surplus	-0.1411%
W-NFC	Flow	Wages	-0.0769%
NIB-NFC	Stock	Net financial stock: Interest bearing	-0.9374%
NW-NFC	Stock	Net Wealth	-0.4605%
FNW-NFC	Stock	Financial net wealth	-0.3047%
K-NFC-Real prices	Stock	Stock of Capital	-0.1153%

K-NFC	Stock	Stock of Capital	-0.1153%

Table 7.26: Most affected variables: Perc change from baseline: Scenario 2, 2025: FC

Variables	Type	Description	Change
NPIR-NEQ-FC	Flow	Net property income received: NEQ	101.8950%
IBA-FC-HH-Transactions	Flow	Financial Assets: Interest bearing assets	-40.8998%
NEQ-FC-Transactions	Flow	Net financial stock: Equity	38.0412%
NIB-FC-Transactions	Flow	Net financial stock: Interest bearing	25.4575%
IBL-FC-HH-Transactions	Flow	Financial Liabilities: Interest bearing liabilities	-7.5369%
PIR-IBA-FC-HH-Flexible	Flow	Property income received: IBA	-6.1696%
PIR-IBA-FC-HH-Fixed	Flow	Property income received: IBA	-6.1696%
NPIR-FC	Flow	Net property income received: Total	-5.7659%
PIP-IBL-FC	Flow	Property income paid: IBL	-3.2914%
NPIR-NIB-FC	Flow	Net property income received: NIB	03.1540%
FNL-FC	Flow	Financial Net Lending (Balance)	-2.4247%
NL-FC	Flow	Sector Balance	-2.4247%
S-FC	Flow	Savings	-1.0750%
PENL-FC-Transactions	Flow	Financial Liabilities: Pension liabilities	-0.3143%
Y-FC	Flow	Total income	-0.0801%
PIP-PENL-FC	Flow	Property income paid: PENL	-0.0077%
NEQ-FC	Stock	Net financial stock: Equity	76.7352%
IBA-FC-HH	Stock	Financial Assets: Interest bearing assets	-6.1696%
NIB-FC	Stock	Net financial stock: Interest bearing	04.2019%
IBL-FC-HH	Stock	Financial Liabilities: Interest bearing liabilities	-3.4809%
NW-FC	Stock	Net Wealth	-0.5494%
FNW-FC	Stock	Financial net wealth	-0.2333%
PENL-FC	Stock	Financial Liabilities: Pension liabilities	-0.0136%

Table 7.27: Most affected variables: Perc change from baseline: Scenario 2, 2025: GOV

Variables	Type	Description	Change

FNL-GOV	Flow	Financial Net Lending (Balance)	-1.9261%
NIB-GOV-Transactions	Flow	Net financial stock: Interest bearing	-1.9261%
NL-GOV	Flow	Sector Balance	-1.9261%
S-GOV	Flow	Savings	-0.8339%
NPIR-GOV	Flow	Net property income received: Total	-0.8226%
NPIR-NIB-GOV	Flow	Net property income received: NIB	-0.8226%
STRA-GOV	Flow	Social transfers	-0.2320%
TAX-GOV	Flow	Tax	-0.0374%
FNW-GOV	Stock	Financial net wealth	-1.0013%
NIB-GOV	Stock	Net financial stock: Interest bearing	-1.0013%
NW-GOV	Stock	Net Wealth	-0.2694%

Table 7.28: Most affected variables: Perc change from baseline: Scenario 2, 2025: ROW

Variables	Type	Description	Change
FNL-ROW	Flow	Financial Net Lending (Balance)	-11.7439%
NIB-ROW-Transactions	Flow	Net financial stock: Interest bearing	-11.7439%
NL-ROW	Flow	Sector Balance	-11.7439%
S-ROW	Flow	Savings	-11.7439%
NPIR-NIB-ROW	Flow	Net property income received: NIB	-3.1359%
NPIR-ROW	Flow	Net property income received: Total	-1.7125%
NIB-ROW	Stock	Net financial stock: Interest bearing	-3.9822%
FNW-ROW	Stock	Financial net wealth	-2.6903%
NW-ROW	Stock	Net Wealth	-2.6903%

7.9.4.5 Scenario 3: Percentage from baseline: Combined scenario 1 and 2, measured in 2021

Table 7.29: Most affected variables: Perc change from baseline: Scenario 3, 2021: Economy wide

Variables	Type	Description	Change
PY	Deflation index	Price deflator: GDP	00.0082%
CAB	Flow	Current account balance	10.9700%
FAB	Flow	Financial account balance	-10.9700%
NX	Flow	Net Exports	10.5161%
I-Real prices	Flow	Gross fixed capital formation	-1.2468%
I	Flow	Gross fixed capital formation	-1.2468%
M	Flow	Imports	-1.2173%
M-Real prices	Flow	Imports	-1.2173%
PRIVATE	Flow	Gross income	-0.6908%
S-Real prices	Flow	Savings	-0.5725%
S	Flow	Savings	-0.5638%
Y-Real prices	Flow	Total income	-0.2097%
Y	Flow	Total income	-0.2016%
B2	Flow	Gross operating surplus	-0.1126%
ULC	Rate	Labour force: Unit labour cost: Price index: Index for the price deflator with reference to 2010 (all other price deflator indices are referenced to 2010)	00.2021%
UL-COST	Rate	Labour force: Unit labour cost	00.2020%
CU	Ratio	Capacity Utilisation (Real GNI / real capital stock)	-0.2098%
WS	Ratio	Wage share	00.0442%

Table 7.30: Most affected variables: Perc change from baseline: Scenario 3, 2021: HH

Variables	Type	Description	Change
PIP-IBL-HH-Flexible	Flow	Property income paid: IBL	136.2914%
PIP-IBL-HH	Flow	Property income paid: IBL	95.8530%
IBA-HH-Transactions	Flow	Financial Assets: Interest bearing assets	-78.2793%
FL-HH-Transactions	Flow	Financial liabilities	-73.9372%
IBL-HH-Transactions	Flow	Financial Liabilities: Interest bearing liabilities	-73.9372%

EQA-HH-Transactions	Flow	Financial Assets: Equity assets	-68.3376%
NPIR-HH	Flow	Net property income received: Total	-58.6600%
FA-HH-Transactions	Flow	Financial Assets	-54.5574%
PIP-IBL-HH-Fixed	Flow	Property income paid: IBL	32.3802%
FNL-HH	Flow	Financial Net Lending (Balance)	-16.6354%
NL-HH	Flow	Sector Balance	-16.6354%
S-HH	Flow	Savings	-10.3028%
INV-HH-Real prices	Flow	Gross fixed capital formation	-6.8066%
INV-HH	Flow	Gross fixed capital formation	-6.8066%
PIR-IBA-HH	Flow	Property income received: IBA	-3.2347%
Y-D-HH	Flow	Disposable Income	-2.5806%
Y-HH	Flow	Total income	-2.5806%
TAX-HH	Flow	Tax	-2.5806%
Y-D-HH-Real prices	Flow	Disposable Income	-2.5806%
C-HH-Real prices	Flow	Consumption	-1.3327%
C-HH	Flow	Consumption	-1.3326%
R-IBL-HH-Flexible	Rate	Rate of interest: Interest bearing liabilities	141.7474%
R-IBL-HH-Fixed	Rate	Rate of interest: Interest bearing liabilities	35.4369%
IBA-HH	Stock	Financial Assets: Interest bearing assets	-3.2347%
IBL-HH	Stock	Financial Liabilities: Interest bearing liabilities	-2.2569%
IBL-HH-Fixed	Stock	Financial Liabilities: Interest bearing liabilities	-2.2569%
IBL-HH-Flexible	Stock	Financial Liabilities: Interest bearing liabilities	-2.2569%
FA-HH	Stock	Financial Assets	-1.1087%
EQA-HH	Stock	Financial Assets: Equity assets	-0.8157%
K-HH	Stock	Stock of Capital	-0.2520%
K-HH-Real prices	Stock	Stock of Capital	-0.2520%
NW-HH	Stock	Net Wealth	-0.2223%
NW-HH-Real prices	Stock	Net Wealth	-0.2222%
FNW-HH-Real prices	Stock	Financial net wealth	-0.2044%
FNW-HH	Stock	Financial net wealth	-0.2044%

Table 7.31: Most affected variables: Perc change from baseline: Scenario 3, 2021: NFC

Variables	Type	Description	Change
FNL-NFC	Flow	Financial Net Lending (Balance)	-12.6166%
NIB-NFC-Transactions	Flow	Net financial stock: Interest bearing	-12.6166%
NL-NFC	Flow	Sector Balance	-12.6166%
S-NFC	Flow	Savings	-1.1026%
TAX-NFC	Flow	Tax	-0.2016%
B2-NFC	Flow	Gross operating surplus	-0.1858%
NIB-NFC	Stock	Net financial stock: Interest bearing	-0.5636%
NW-NFC	Stock	Net Wealth	-0.2341%
FNW-NFC	Stock	Financial net wealth	-0.2042%

Table 7.32: Most affected variables: Perc change from baseline: Scenario 3, 2021: FC

Variables	Type	Description	Change
FNL-FC	Flow	Financial Net Lending (Balance)	569.1674%
NL-FC	Flow	Sector Balance	569.1674%
NPIR-FC	Flow	Net property income received: Total	323.5769%
S-FC	Flow	Savings	275.5754%
PIR-IBA-FC-HH-Flexible	Flow	Property income received: IBA	136.2914%
IBL-FC-HH-Transactions	Flow	Financial Liabilities: Interest bearing liabilities	-78.2793%
IBA-FC-HH-Transactions	Flow	Financial Assets: Interest bearing assets	-73.9372%
NEQ-FC-Transactions	Flow	Net financial stock: Equity	68.3376%
NIB-FC-Transactions	Flow	Net financial stock: Interest bearing	61.8225%
PIR-IBA-FC-HH-Fixed	Flow	Property income received: IBA	32.3802%
Y-FC	Flow	Total income	-0.0442%
NEQ-FC	Stock	Net financial stock: Equity	46.2640%
NW-FC	Stock	Net Wealth	42.8191%
FNW-FC	Stock	Financial net wealth	23.0242%
IBL-FC-HH	Stock	Financial Liabilities: Interest bearing liabilities	-3.2347%
IBA-FC-HH	Stock	Financial Assets: Interest bearing assets	-2.2569%
NIB-FC	Stock	Net financial stock: Interest bearing	02.0236%

Table 7.33: Most affected variables: Perc change from baseline: Scenario 3, 2021: GOV

Variables	Type	Description	Change
FNL-GOV	Flow	Financial Net Lending (Balance)	-30.7775%
NIB-GOV-Transactions	Flow	Net financial stock: Interest bearing	-30.7775%
NL-GOV	Flow	Sector Balance	-30.7775%
S-GOV	Flow	Savings	-11.8501%
TAX-GOV	Flow	Tax	-1.5577%
FNW-GOV	Stock	Financial net wealth	-9.1649%
NIB-GOV	Stock	Net financial stock: Interest bearing	-9.1649%
NW-GOV	Stock	Net Wealth	-1.2954%

Table 7.34: Most affected variables: Perc change from baseline: Scenario 3, 2021: ROW

Variables	Type	Description	Change
FNL-ROW	Flow	Financial Net Lending (Balance)	-10.9700%
NIB-ROW-Transactions	Flow	Net financial stock: Interest bearing	-10.9700%
NL-ROW	Flow	Sector Balance	-10.9700%
S-ROW	Flow	Savings	-10.9700%
NIB-ROW	Stock	Net financial stock: Interest bearing	-1.2091%
FNW-ROW	Stock	Financial net wealth	-0.6953%
NW-ROW	Stock	Net Wealth	-0.6953%

7.9.4.6 Scenario 3: Percentage from baseline: Combined scenario 1 and 2, measured in 2025

Table 7.35: Most affected variables: Perc change from baseline: Scenario 3, 2025: Economy wide

Variables	Type	Description	Change
PY	Deflation index	Price deflator: GDP	00.1865%
PX	Deflation index	Price deflator: Exports	00.0678%
PC	Deflation index	Price deflator: Consumption	-0.0055%
CAB	Flow	Current account balance	28.0969%
FAB	Flow	Financial account balance	-28.0969%
NX	Flow	Net Exports	27.3172%
I	Flow	Gross fixed capital formation	-5.5278%
I-Real prices	Flow	Gross fixed capital formation	-5.5278%
M	Flow	Imports	-3.5297%
M-Real prices	Flow	Imports	-3.5296%
PRIVATE	Flow	Gross income	-2.0369%
S-Real prices	Flow	Savings	-1.6873%
S	Flow	Savings	-1.5737%
Y-Real prices	Flow	Total income	-0.6018%
Y	Flow	Total income	-0.4163%
B2	Flow	Gross operating surplus	-0.2342%
X-Real prices	Flow	Exports	-0.0517%
X	Flow	Exports	00.0161%
TOBIN-Q	Index	Index: House price index: Tobin's Q = Ratio between the house price index and the construction cost of housing index	-20.0000%
ZZ1	Index	Index: House price: Imported from DST	-20.0000%
ZZ-I	Index	Index: House price: Imported from DST	-20.0000%
UL-COST	Rate	Labour force: Unit labour cost	00.2243%
ULC	Rate	Labour force: Unit labour cost: Price index: Index for the price deflator with reference to 2010 (all other price deflator indices are referenced to 2010)	00.2243%
WAGE	Rate	Labour force: Wage rate	-0.0512%
UR	Ratio	Labour force: Unemployment rate	05.4667%
CU	Ratio	Capacity Utilisation (Real GNI / real capital stock)	-0.3077%
WS	Ratio	Wage share	00.0161%
UN	Stock	Labour force: Unemployed persons	05.4667%
N	Stock	Labour force: Denmark for workers in production	-0.1435%
NF	Stock	Labour force: Employed persons: Danish waged	-0.1419%

NU	Stock	Labour force: Employed persons: Danish nationals: Employed abroad	00.0512%

Table 7.36: Most affected variables: Perc change from baseline: Scenario 3, 2025: HH

Variables	Type	Description	Change
PIP-IBL-HH-Flexible	Flow	Property income paid: IBL	116.0762%
PIP-IBL-HH	Flow	Property income paid: IBL	79.0974%
NPIR-HH	Flow	Net property income received: Total	-55.5466%
FL-HH-Transactions	Flow	Financial liabilities	-51.9626%
IBL-HH-Transactions	Flow	Financial Liabilities: Interest bearing liabilities	-51.9626%
EQA-HH-Transactions	Flow	Financial Assets: Equity assets	-48.3308%
FNL-HH	Flow	Financial Net Lending (Balance)	38.0367%
NL-HH	Flow	Sector Balance	38.0367%
INV-HH	Flow	Gross fixed capital formation	-30.6438%
INV-HH-Real prices	Flow	Gross fixed capital formation	-30.6438%
PIP-IBL-HH-Fixed	Flow	Property income paid: IBL	21.0548%
FA-HH-Transactions	Flow	Financial Assets	-10.4517%
PIR-IBA-HH	Flow	Property income received: IBA	-8.1491%
IBA-HH-Transactions	Flow	Financial Assets: Interest bearing assets	-6.7667%
S-HH	Flow	Savings	03.9972%
PIR-EQA-HH	Flow	Property income received: EQA	-3.5759%
C-HH	Flow	Consumption	-3.0237%
C-HH-Real prices	Flow	Consumption	-3.0184%
STRA-HH	Flow	Social transfers	02.6078%
SCO-HH	Flow	Social benefit contributions	-2.2286%
Y-D-HH	Flow	Disposable Income	-2.1827%
TAX-HH	Flow	Tax	-2.1827%
Y-HH	Flow	Total income	-2.1827%
Y-D-HH-Real prices	Flow	Disposable Income	-2.1774%
PENA-HH-Transactions	Flow	Financial Assets: Pension assets	-0.7989%
SBE-HH	Flow	Social benefit transfers	00.5458%

W-HH	Flow	Wages	-0.1946%
PIR-PENA-HH	Flow	Property income received: PENA	-0.0239%
R-IBL-HH-Flexible	Rate	Rate of interest: Interest bearing liabilities	141.7474%
R-IBL-HH-Fixed	Rate	Rate of interest: Interest bearing liabilities	35.4369%
K-HH	Stock	Stock of Capital	-12.7563%
K-HH-Real prices	Stock	Stock of Capital	-12.7562%
IBL-HH-Flexible	Stock	Financial Liabilities: Interest bearing liabilities	-10.6191%
IBL-HH	Stock	Financial Liabilities: Interest bearing liabilities	-10.6190%
IBL-HH-Fixed	Stock	Financial Liabilities: Interest bearing liabilities	-10.6190%
IBA-HH	Stock	Financial Assets: Interest bearing assets	-8.1491%
EQA-HH	Stock	Financial Assets: Equity assets	-4.1269%
FA-HH	Stock	Financial Assets	-3.5478%
NW-HH	Stock	Net Wealth	-3.3432%
NW-HH-Real prices	Stock	Net Wealth	-3.3380%
FNW-HH-Real prices	Stock	Financial net wealth	02.3140%
FNW-HH	Stock	Financial net wealth	02.3084%
PENA-HH	Stock	Financial Assets: Pension assets	-0.0388%

Table 7.37: Most affected variables: Perc change from baseline: Scenario 3, 2025: NFC

Variables	Type	Description	Change
FNL-NFC	Flow	Financial Net Lending (Balance)	-15.5018%
NIB-NFC-Transactions	Flow	Net financial stock: Interest bearing	-15.5018%
NL-NFC	Flow	Sector Balance	-15.5018%
NPIR-NIB-NFC	Flow	Net property income received: NIB	-2.4045%
S-NFC	Flow	Savings	-1.6316%
INV-NFC	Flow	Gross fixed capital formation	-0.6578%
INV-NFC-Real prices	Flow	Gross fixed capital formation	-0.6578%
NPIR-NFC	Flow	Net property income received: Total	-0.5855%
TAX-NFC	Flow	Tax	-0.4163%
B2-NFC	Flow	Gross operating surplus	-0.3880%
W-NFC	Flow	Wages	-0.1930%
NIB-NFC	Stock	Net financial stock: Interest bearing	-3.1805%

NW-NFC	Stock	Net Wealth	-1.3873%
FNW-NFC	Stock	Financial net wealth	-1.0337%
K-NFC-Real prices	Stock	Stock of Capital	-0.2950%
K-NFC	Stock	Stock of Capital	-0.2950%

Table 7.38: Most affected variables: Perc change from baseline: Scenario 3, 2025: FC

Variables	Type	Description	Change
FNL-FC	Flow	Financial Net Lending (Balance)	660.5146%
NL-FC	Flow	Sector Balance	660.5146%
NPIR-FC	Flow	Net property income received: Total	342.8977%
S-FC	Flow	Savings	292.8453%
NPIR-NEQ-FC	Flow	Net property income received: NEQ	186.5300%
PIR-IBA-FC-HH-Flexible	Flow	Property income received: IBA	116.0762%
NIB-FC-Transactions	Flow	Net financial stock: Interest bearing	82.9489%
IBA-FC-HH-Transactions	Flow	Financial Assets: Interest bearing assets	-51.9626%
NEQ-FC-Transactions	Flow	Net financial stock: Equity	48.3308%
PIR-IBA-FC-HH-Fixed	Flow	Property income received: IBA	21.0548%
NPIR-NIB-FC	Flow	Net property income received: NIB	12.3172%
PIP-IBL-FC	Flow	Property income paid: IBL	-8.2137%
IBL-FC-HH-Transactions	Flow	Financial Liabilities: Interest bearing liabilities	-6.7667%
PENL-FC-Transactions	Flow	Financial Liabilities: Pension liabilities	-0.7989%
Y-FC	Flow	Total income	-0.2090%
PIP-PENL-FC	Flow	Property income paid: PENL	-0.0238%
NW-FC	Stock	Net Wealth	330.4677%
FNW-FC	Stock	Financial net wealth	140.2816%
NEQ-FC	Stock	Net financial stock: Equity	132.0764%
NIB-FC	Stock	Net financial stock: Interest bearing	15.6355%
IBA-FC-HH	Stock	Financial Assets: Interest bearing assets	-10.6190%
IBL-FC-HH	Stock	Financial Liabilities: Interest bearing liabilities	-8.1491%
PENL-FC	Stock	Financial Liabilities: Pension liabilities	-0.0386%

Table 7.39: Most affected variables: Perc change from baseline: Scenario 3, 2025: GOV

Variables	Type	Description	Change
FNL-GOV	Flow	Financial Net Lending (Balance)	-33.2304%
NIB-GOV-Transactions	Flow	Net financial stock: Interest bearing	-33.2304%
NL-GOV	Flow	Sector Balance	-33.2304%
NPIR-GOV	Flow	Net property income received: Total	-22.3750%
NPIR-NIB-GOV	Flow	Net property income received: NIB	-22.3750%
S-GOV	Flow	Savings	-14.3875%
STRA-GOV	Flow	Social transfers	-1.6202%
TAX-GOV	Flow	Tax	-1.4130%
FNW-GOV	Stock	Financial net wealth	-24.1332%
NIB-GOV	Stock	Net financial stock: Interest bearing	-24.1332%
NW-GOV	Stock	Net Wealth	-6.4939%

Table 7.40: Most affected variables: Perc change from baseline: Scenario 3, 2025: ROW

Variables	Type	Description	Change
FNL-ROW	Flow	Financial Net Lending (Balance)	-28.0969%
NIB-ROW-Transactions	Flow	Net financial stock: Interest bearing	-28.0969%
NL-ROW	Flow	Sector Balance	-28.0969%
S-ROW	Flow	Savings	-28.0969%
NPIR-NIB-ROW	Flow	Net property income received: NIB	-8.4498%
NPIR-ROW	Flow	Net property income received: Total	-4.6143%
NIB-ROW	Stock	Net financial stock: Interest bearing	-10.3814%
FNW-ROW	Stock	Financial net wealth	-7.0134%
NW-ROW	Stock	Net Wealth	-7.0134%

7.9.4.7 Scenario 4: Percentage from baseline: Scenario 3, plus α increased to 80% in 2017, measured in 2021

Table 7.41: Most affected variables: Perc change from baseline: Scenario 4, 2021: Economy wide

Variables	Type	Description	Change
PY	Deflation index	Price deflator: GDP	00.0047%
CAB	Flow	Current account balance	06.2108%
FAB	Flow	Financial account balance	-6.2108%
NX	Flow	Net Exports	05.9538%
I	Flow	Gross fixed capital formation	-0.7111%
I-Real prices	Flow	Gross fixed capital formation	-0.7111%
M	Flow	Imports	-0.6892%
M-Real prices	Flow	Imports	-0.6892%
PRIVATE	Flow	Gross income	-0.3907%
S-Real prices	Flow	Savings	-0.3238%
S	Flow	Savings	-0.3188%
Y-Real prices	Flow	Total income	-0.1182%
Y	Flow	Total income	-0.1135%
B2	Flow	Gross operating surplus	-0.0634%
ULC	Rate	Labour force: Unit labour cost: Price index: Index for the price deflator with reference to 2010 (all other price deflator indices are referenced to 2010)	00.1137%
UL-COST	Rate	Labour force: Unit labour cost	00.1137%
ALPHA	Ratio	Ratio of fixed interest mortgage debt	105.5694%
CU	Ratio	Capacity Utilisation (Real GNI / real capital stock)	-0.1182%
WS	Ratio	Wage share	00.0249%

Table 7.42: Most affected variables: Perc change from baseline: Scenario 4, 2021: HH

Variables	Type	Description	Change
PIP-IBL-HH-Fixed	Flow	Property income paid: IBL	174.2141%
PIP-IBL-HH	Flow	Property income paid: IBL	54.3337%
IBA-HH-Transactions	Flow	Financial Assets: Interest bearing assets	-51.2763%
FL-HH-Transactions	Flow	Financial liabilities	-49.4508%
IBL-HH-Transactions	Flow	Financial Liabilities: Interest bearing liabilities	-49.4508%

EQA-HH-Transactions	Flow	Financial Assets: Equity assets	-45.7057%
FA-HH-Transactions	Flow	Financial Assets	-35.8964%
NPIR-HH	Flow	Net property income received: Total	-33.3311%
PIP-IBL-HH-Flexible	Flow	Property income paid: IBL	-22.0419%
FNL-HH	Flow	Financial Net Lending (Balance)	-9.3732%
NL-HH	Flow	Sector Balance	-9.3732%
S-HH	Flow	Savings	-5.8352%
INV-HH	Flow	Gross fixed capital formation	-3.8819%
INV-HH-Real prices	Flow	Gross fixed capital formation	-3.8819%
PIR-IBA-HH	Flow	Property income received: IBA	-2.1188%
Y-D-HH	Flow	Disposable Income	-1.4577%
TAX-HH	Flow	Tax	-1.4577%
Y-D-HH-Real prices	Flow	Disposable Income	-1.4577%
Y-HH	Flow	Total income	-1.4577%
C-HH	Flow	Consumption	-0.7507%
C-HH-Real prices	Flow	Consumption	-0.7507%
R-IBL-SENS-HH	Rate	Rate of interest: Interest bearing liabilities: Weighted mortgage interest rate	195.7235%
R-IBL-HH-Flexible	Rate	Rate of interest: Interest bearing liabilities	141.7474%
R-IBL-HH-Fixed	Rate	Rate of interest: Interest bearing liabilities	35.4369%
IBL-HH-Fixed	Stock	Financial Liabilities: Interest bearing liabilities	102.4664%
IBL-HH-Flexible	Stock	Financial Liabilities: Interest bearing liabilities	-67.7523%
IBA-HH	Stock	Financial Assets: Interest bearing assets	-2.1188%
IBL-HH	Stock	Financial Liabilities: Interest bearing liabilities	-1.5094%
FA-HH	Stock	Financial Assets	-0.7294%
EQA-HH	Stock	Financial Assets: Equity assets	-0.5455%
K-HH	Stock	Stock of Capital	-0.1437%
K-HH-Real prices	Stock	Stock of Capital	-0.1437%
NW-HH-Real prices	Stock	Net Wealth	-0.1259%
NW-HH	Stock	Net Wealth	-0.1259%
FNW-HH-Real prices	Stock	Financial net wealth	-0.1152%

FNW-HH	Stock	Financial net wealth	-0.1152%

Table 7.43: Most affected variables: Perc change from baseline: Scenario 4, 2021: NFC

Variables	Type	Description	Change
FNL-NFC	Flow	Financial Net Lending (Balance)	-7.1043%
NIB-NFC-Transactions	Flow	Net financial stock: Interest bearing	-7.1043%
NL-NFC	Flow	Sector Balance	-7.1043%
S-NFC	Flow	Savings	-0.6208%
TAX-NFC	Flow	Tax	-0.1135%
B2-NFC	Flow	Gross operating surplus	-0.1046%
NIB-NFC	Stock	Net financial stock: Interest bearing	-0.3174%
NW-NFC	Stock	Net Wealth	-0.1318%
FNW-NFC	Stock	Financial net wealth	-0.1150%

Table 7.44: Most affected variables: Perc change from baseline: Scenario 4, 2021: FC

Variables	Type	Description	Change
FNL-FC	Flow	Financial Net Lending (Balance)	321.5055%
NL-FC	Flow	Sector Balance	321.5055%
NPIR-FC	Flow	Net property income received: Total	183.4174%
PIR-IBA-FC-HH-Fixed	Flow	Property income received: IBA	174.2141%
S-FC	Flow	Savings	155.6643%
IBL-FC-HH-Transactions	Flow	Financial Liabilities: Interest bearing liabilities	-51.2763%
IBA-FC-HH-Transactions	Flow	Financial Assets: Interest bearing assets	-49.4508%
NEQ-FC-Transactions	Flow	Net financial stock: Equity	45.7057%
NIB-FC-Transactions	Flow	Net financial stock: Interest bearing	34.9421%
PIR-IBA-FC-HH-Flexible	Flow	Property income received: IBA	-22.0419%
Y-FC	Flow	Total income	-0.0249%
NEQ-FC	Stock	Net financial stock: Equity	30.9423%
NW-FC	Stock	Net Wealth	24.1872%
FNW-FC	Stock	Financial net wealth	13.0057%
IBL-FC-HH	Stock	Financial Liabilities: Interest bearing liabilities	-2.1188%

IBA-FC-HH	Stock	Financial Assets: Interest bearing assets	-1.5094%
NIB-FC	Stock	Net financial stock: Interest bearing	01.1437%

Table 7.45: Most affected variables: Perc change from baseline: Scenario 4, 2021: GOV

Variables	Type	Description	Change
FNL-GOV	Flow	Financial Net Lending (Balance)	-17.3824%
NIB-GOV-Transactions	Flow	Net financial stock: Interest bearing	-17.3824%
NL-GOV	Flow	Sector Balance	-17.3824%
S-GOV	Flow	Savings	-6.6926%
TAX-GOV	Flow	Tax	-0.8798%
FNW-GOV	Stock	Financial net wealth	-5.1761%
NIB-GOV	Stock	Net financial stock: Interest bearing	-5.1761%
NW-GOV	Stock	Net Wealth	-0.7316%

Table 7.46: Most affected variables: Perc change from baseline: Scenario 4, 2021: ROW

Variables	Type	Description	Change
FNL-ROW	Flow	Financial Net Lending (Balance)	-6.2108%
NIB-ROW-Transactions	Flow	Net financial stock: Interest bearing	-6.2108%
NL-ROW	Flow	Sector Balance	-6.2108%
S-ROW	Flow	Savings	-6.2108%
NIB-ROW	Stock	Net financial stock: Interest bearing	-0.6846%
FNW-ROW	Stock	Financial net wealth	-0.3937%
NW-ROW	Stock	Net Wealth	-0.3937%

7.9.4.8 Scenario 4: Percentage from baseline: Scenario 3, plus α increased to 80% in 2017, measured in 2025

Table 7.47: Most affected variables: Perc change from baseline: Scenario 4, 2025: Economy wide

Variables	Type	Description	Change
PY	Deflation index	Price deflator: GDP	00.1487%
PX	Deflation index	Price deflator: Exports	00.0496%
PC	Deflation index	Price deflator: Consumption	-0.0041%
CAB	Flow	Current account balance	21.1286%
FAB	Flow	Financial account balance	-21.1286%
NX	Flow	Net Exports	20.5631%
I-Real prices	Flow	Gross fixed capital formation	-4.9136%
I	Flow	Gross fixed capital formation	-4.9136%
M	Flow	Imports	-2.6561%
M-Real prices	Flow	Imports	-2.6560%
PRIVATE	Flow	Gross income	-1.5305%
S-Real prices	Flow	Savings	-1.2678%
S	Flow	Savings	-1.1770%
Y-Real prices	Flow	Total income	-0.4498%
Y	Flow	Total income	-0.3018%
B2	Flow	Gross operating surplus	-0.1698%
X-Real prices	Flow	Exports	-0.0367%
X	Flow	Exports	00.0129%
TOBIN-Q	Index	Index: House price index: Tobin's Q = Ratio between the house price index and the construction cost of housing index	-20.0000%
ZZ1	Index	Index: House price: Imported from DST	-20.0000%
ZZ-I	Index	Index: House price: Imported from DST	-20.0000%
UL-COST	Rate	Labour force: Unit labour cost	00.1596%
ULC	Rate	Labour force: Unit labour cost: Price index: Index for the price deflator with reference to 2010 (all other price deflator indices are referenced to 2010)	00.1596%
WAGE	Rate	Labour force: Wage rate	-0.0373%
ALPHA	Ratio	Ratio of fixed interest mortgage debt	105.5694%
UR	Ratio	Labour force: Unemployment rate	04.0622%
CU	Ratio	Capacity Utilisation (Real GNI / real capital stock)	-0.2331%
WS	Ratio	Wage share	00.0106%
UN	Stock	Labour force: Unemployed persons	04.0624%
N	Stock	Labour force: Denmark for workers in production	-0.1067%

NF	Stock	Labour force: Employed persons: Danish waged	-0.1054%
NU	Stock	Labour force: Employed persons: Danish nationals: Employed abroad	00.0374%

Table 7.48: Most affected variables: Perc change from baseline: Scenario 4, 2025: HH

Variables	Type	Description	Change
PIP-IBL-HH-Fixed	Flow	Property income paid: IBL	152.1575%
FL-HH-Transactions	Flow	Financial liabilities	-50.4361%
IBL-HH-Transactions	Flow	Financial Liabilities: Interest bearing liabilities	-50.4361%
EQA-HH-Transactions	Flow	Financial Assets: Equity assets	-46.9109%
PIP-IBL-HH	Flow	Property income paid: IBL	41.9197%
FNL-HH	Flow	Financial Net Lending (Balance)	33.6388%
NL-HH	Flow	Sector Balance	33.6388%
NPIR-HH	Flow	Net property income received: Total	-30.9309%
PIP-IBL-HH-Flexible	Flow	Property income paid: IBL	-28.3125%
INV-HH	Flow	Gross fixed capital formation	-27.5045%
INV-HH-Real prices	Flow	Gross fixed capital formation	-27.5045%
FA-HH-Transactions	Flow	Financial Assets	-11.6577%
IBA-HH-Transactions	Flow	Financial Assets: Interest bearing assets	-9.5399%
PIR-IBA-HH	Flow	Property income received: IBA	-6.9890%
S-HH	Flow	Savings	03.3349%
PIR-EQA-HH	Flow	Property income received: EQA	-3.1264%
C-HH	Flow	Consumption	-1.8803%
C-HH-Real prices	Flow	Consumption	-1.8762%
STRA-HH	Flow	Social transfers	01.6500%
SCO-HH	Flow	Social benefit contributions	-1.2637%
Y-D-HH	Flow	Disposable Income	-1.2280%
TAX-HH	Flow	Tax	-1.2279%
Y-HH	Flow	Total income	-1.2279%
Y-D-HH-Real prices	Flow	Disposable Income	-1.2239%
PENA-HH-Transactions	Flow	Financial Assets: Pension assets	-0.5891%

SBE-HH	Flow	Social benefit transfers	00.4077%
W-HH	Flow	Wages	-0.1440%
PIR-PENA-HH	Flow	Property income received: PENA	-0.0169%
R-IBL-SENS-HH	Rate	Rate of interest: Interest bearing liabilities: Weighted mortgage interest rate	195.7235%
R-IBL-HH-Flexible	Rate	Rate of interest: Interest bearing liabilities	141.7474%
R-IBL-HH-Fixed	Rate	Rate of interest: Interest bearing liabilities	35.4369%
IBL-HH-Fixed	Stock	Financial Liabilities: Interest bearing liabilities	86.1809%
IBL-HH-Flexible	Stock	Financial Liabilities: Interest bearing liabilities	-70.3461%
K-HH	Stock	Stock of Capital	-12.2667%
K-HH-Real prices	Stock	Stock of Capital	-12.2667%
IBL-HH	Stock	Financial Liabilities: Interest bearing liabilities	-9.4316%
IBA-HH	Stock	Financial Assets: Interest bearing assets	-6.9890%
EQA-HH	Stock	Financial Assets: Equity assets	-3.6655%
NW-HH	Stock	Net Wealth	-3.2340%
NW-HH-Real prices	Stock	Net Wealth	-3.2300%
FA-HH	Stock	Financial Assets	-3.0751%
FNW-HH-Real prices	Stock	Financial net wealth	02.1935%
FNW-HH	Stock	Financial net wealth	02.1893%
PENA-HH	Stock	Financial Assets: Pension assets	-0.0279%

Table 7.49: Most affected variables: Perc change from baseline: Scenario 4, 2025: NFC

Variables	Type	Description	Change
FNL-NFC	Flow	Financial Net Lending (Balance)	-10.5069%
NIB-NFC-Transactions	Flow	Net financial stock: Interest bearing	-10.5069%
NL-NFC	Flow	Sector Balance	-10.5069%
NPIR-NIB-NFC	Flow	Net property income received: NIB	-1.6785%
S-NFC	Flow	Savings	-1.1715%
INV-NFC	Flow	Gross fixed capital formation	-0.5161%
INV-NFC-Real prices	Flow	Gross fixed capital formation	-0.5160%
NPIR-NFC	Flow	Net property income received: Total	-0.4088%

TAX-NFC	Flow	Tax	-0.3018%
B2-NFC	Flow	Gross operating surplus	-0.2813%
W-NFC	Flow	Wages	-0.1427%
NIB-NFC	Stock	Net financial stock: Interest bearing	-2.2066%
NW-NFC	Stock	Net Wealth	-0.9854%
FNW-NFC	Stock	Financial net wealth	-0.7171%
K-NFC-Real prices	Stock	Stock of Capital	-0.2172%
K-NFC	Stock	Stock of Capital	-0.2172%

Table 7.50: Most affected variables: Perc change from baseline: Scenario 4, 2025: FC

Variables	Type	Description	Change
FNL-FC	Flow	Financial Net Lending (Balance)	376.3513%
NL-FC	Flow	Sector Balance	376.3513%
NPIR-FC	Flow	Net property income received: Total	193.1527%
S-FC	Flow	Savings	166.8588%
NPIR-NEQ-FC	Flow	Net property income received: NEQ	163.0814%
PIR-IBA-FC-HH-Fixed	Flow	Property income received: IBA	152.1575%
NIB-FC-Transactions	Flow	Net financial stock: Interest bearing	58.3658%
IBA-FC-HH-Transactions	Flow	Financial Assets: Interest bearing assets	-50.4361%
NEQ-FC-Transactions	Flow	Net financial stock: Equity	46.9109%
PIR-IBA-FC-HH-Flexible	Flow	Property income received: IBA	-28.3125%
IBL-FC-HH-Transactions	Flow	Financial Liabilities: Interest bearing liabilities	-9.5399%
NPIR-NIB-FC	Flow	Net property income received: NIB	08.3725%
PIP-IBL-FC	Flow	Property income paid: IBL	-6.8698%
PENL-FC-Transactions	Flow	Financial Liabilities: Pension liabilities	-0.5891%
Y-FC	Flow	Total income	-0.1533%
PIP-PENL-FC	Flow	Property income paid: PENL	-0.0168%
NW-FC	Stock	Net Wealth	187.9476%
NEQ-FC	Stock	Net financial stock: Equity	117.3077%
FNW-FC	Stock	Financial net wealth	79.7827%
NIB-FC	Stock	Net financial stock: Interest bearing	10.7212%
IBA-FC-HH	Stock	Financial Assets: Interest bearing assets	-9.4316%
IBL-FC-HH	Stock	Financial Liabilities: Interest bearing liabilities	-6.9890%

PENL-FC	Stock	Financial Liabilities: Pension liabilities	-0.0278%

Table 7.51: Most affected variables: Perc change from baseline: Scenario 4, 2025: GOV

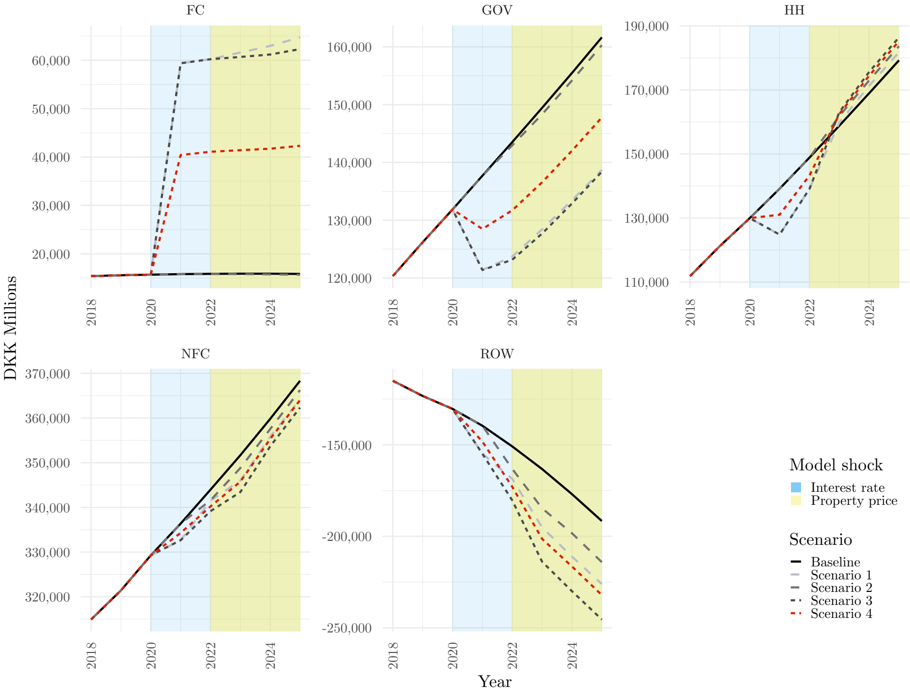
Variables	Type	Description	Change
FNL-GOV	Flow	Financial Net Lending (Balance)	-19.8010%
NIB-GOV-Transactions	Flow	Net financial stock: Interest bearing	-19.8010%
NL-GOV	Flow	Sector Balance	-19.8010%
NPIR-GOV	Flow	Net property income received: Total	-13.0776%
NPIR-NIB-GOV	Flow	Net property income received: NIB	-13.0776%
S-GOV	Flow	Savings	-8.5730%
STRA-GOV	Flow	Social transfers	-1.0251%
TAX-GOV	Flow	Tax	-0.8229%
FNW-GOV	Stock	Financial net wealth	-14.1666%
NIB-GOV	Stock	Net financial stock: Interest bearing	-14.1666%
NW-GOV	Stock	Net Wealth	-3.8120%

Table 7.52: Most affected variables: Perc change from baseline: Scenario 4, 2025: ROW

Variables	Type	Description	Change
FNL-ROW	Flow	Financial Net Lending (Balance)	-21.1286%
NIB-ROW-Transactions	Flow	Net financial stock: Interest bearing	-21.1286%
NL-ROW	Flow	Sector Balance	-21.1286%
S-ROW	Flow	Savings	-21.1286%
NPIR-NIB-ROW	Flow	Net property income received: NIB	-6.1683%
NPIR-ROW	Flow	Net property income received: Total	-3.3684%
NIB-ROW	Stock	Net financial stock: Interest bearing	-7.6392%
FNW-ROW	Stock	Financial net wealth	-5.1608%
NW-ROW	Stock	Net Wealth	-5.1608%

7.9.5 Additional illustrations of Scenarios

7.9.5.1 Summary flows: All sectors



Source: Data: Eurostat, AMECO, OECD and present model forecast

Figure 7.34: Savings

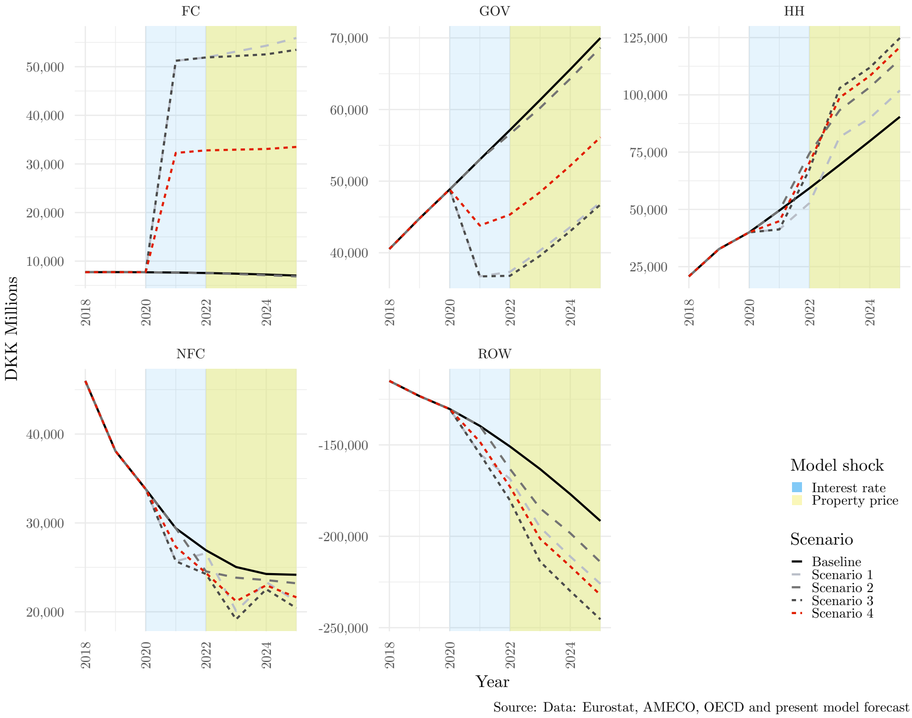
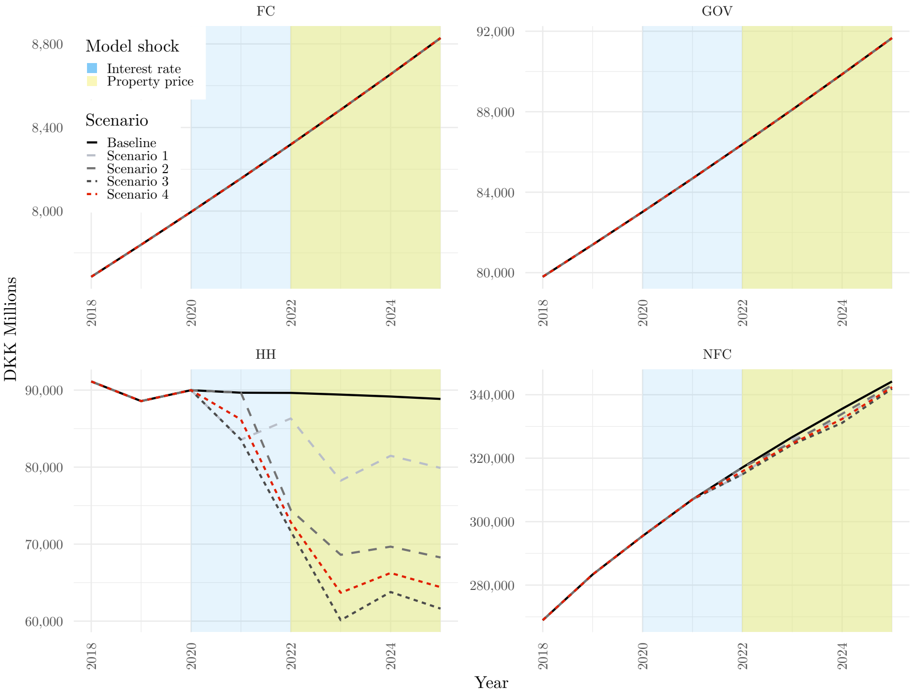


Figure 7.35: Net Lending



Source: Data: Eurostat, AMECO, OECD and present model forecast

Figure 7.36: Investment

7.9.5.2 Residual sector flows

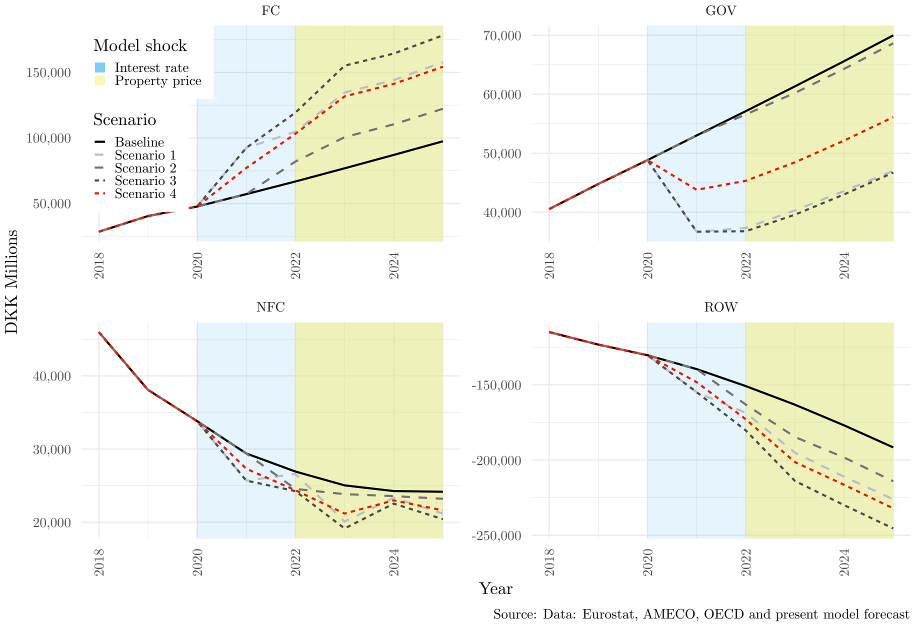
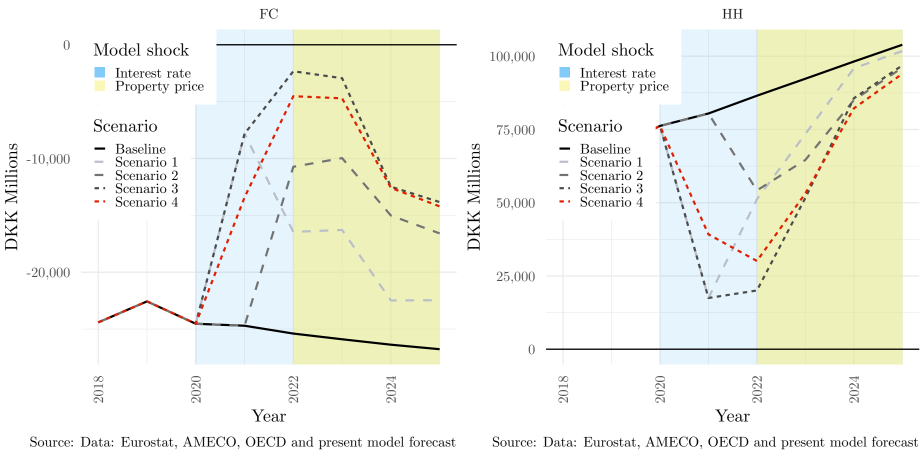


Figure 7.37: Net interest bearing asset transactions



(a) FC: NEQ transactions

(b) HH: IBA transactions

Figure 7.38: Residual flows for FC and HH

7.9.5.3 NW: Nominal prices: All sectors

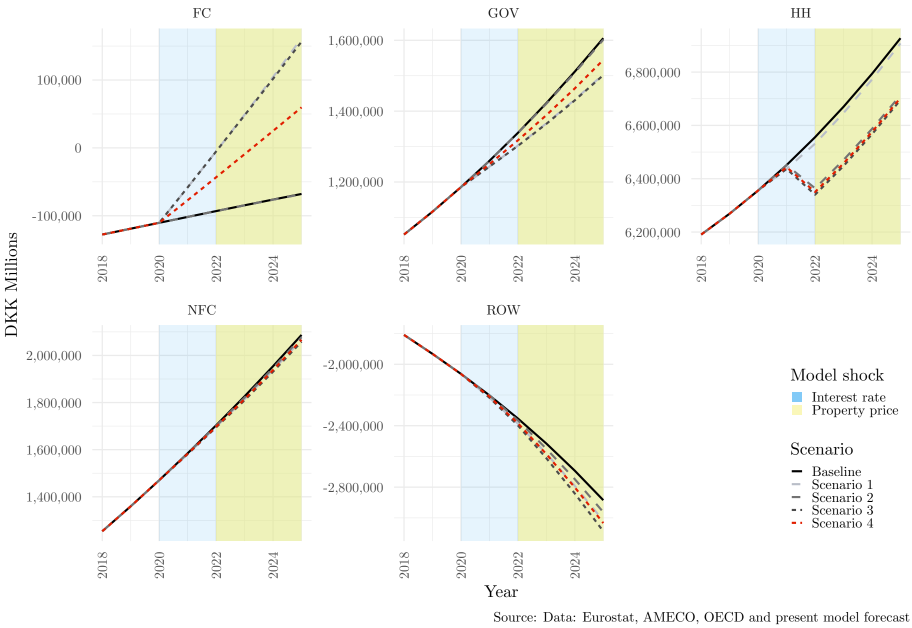


Figure 7.39: NW: Nominal prices: All sectors

7.9.5.4 Capital Stock: Nominal prices: HH, NFC

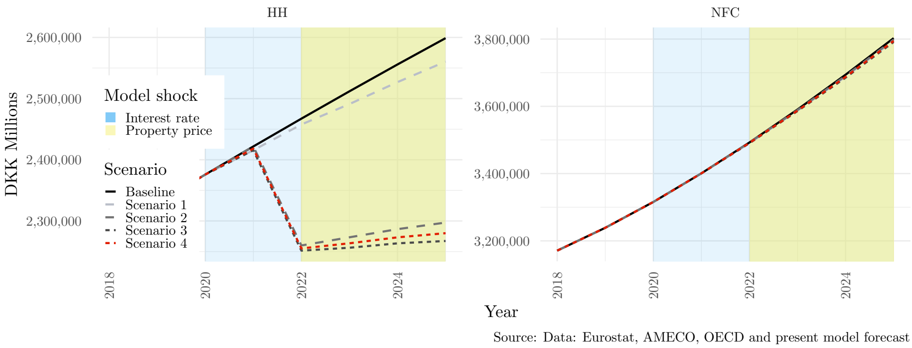


Figure 7.40: Capital Stock: Nominal prices: HH, NFC

7.9.5.5 Financial transactions: Nominal prices: HH

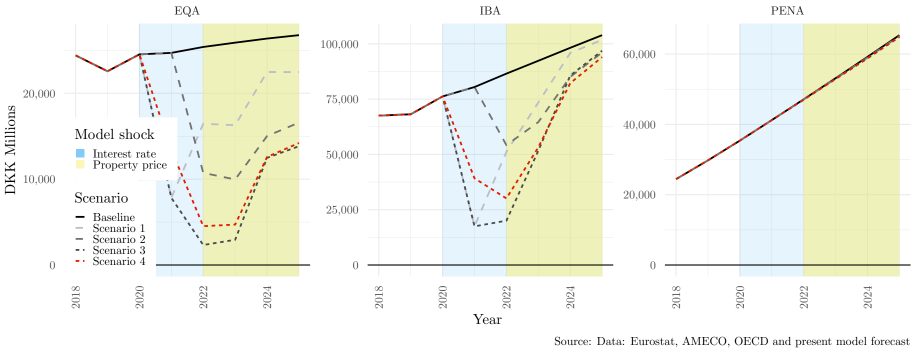


Figure 7.41: Financial transactions: Nominal prices: HH

7.9.5.6 Financial transactions: Nominal prices: NFC

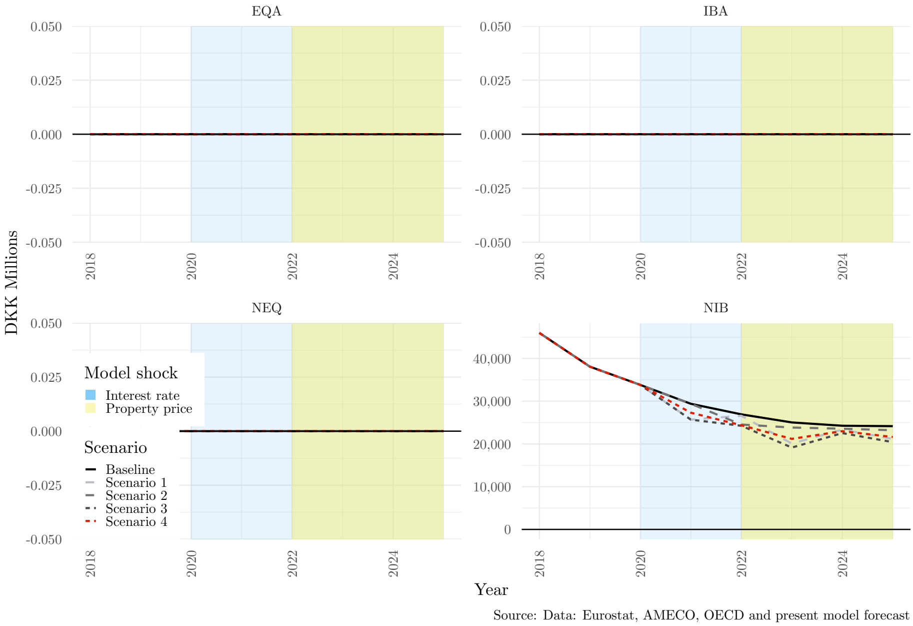


Figure 7.42: Financial transactions: Nominal prices: NFC

7.9.5.7 Financial transactions: Nominal prices: FC

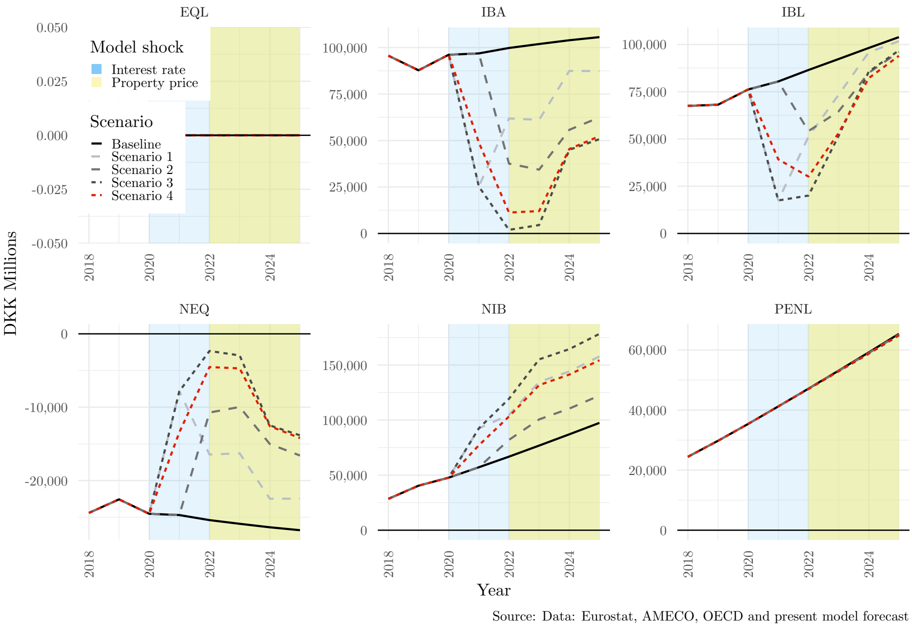


Figure 7.43: Financial transactions: Nominal prices: FC

7.9.5.8 Financial transactions: Nominal prices: GOV

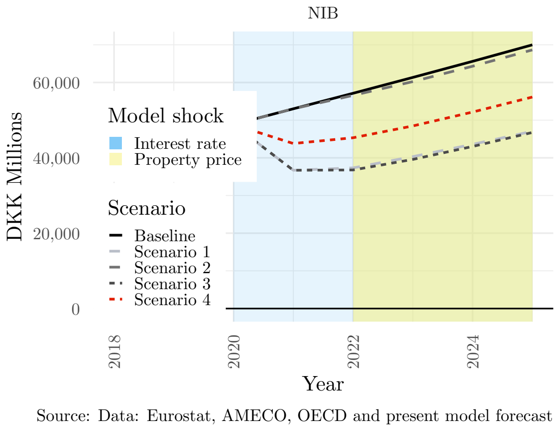


Figure 7.44: Financial transactions: Nominal prices: GOV

7.9.5.9 Financial transactions: Nominal prices: ROW

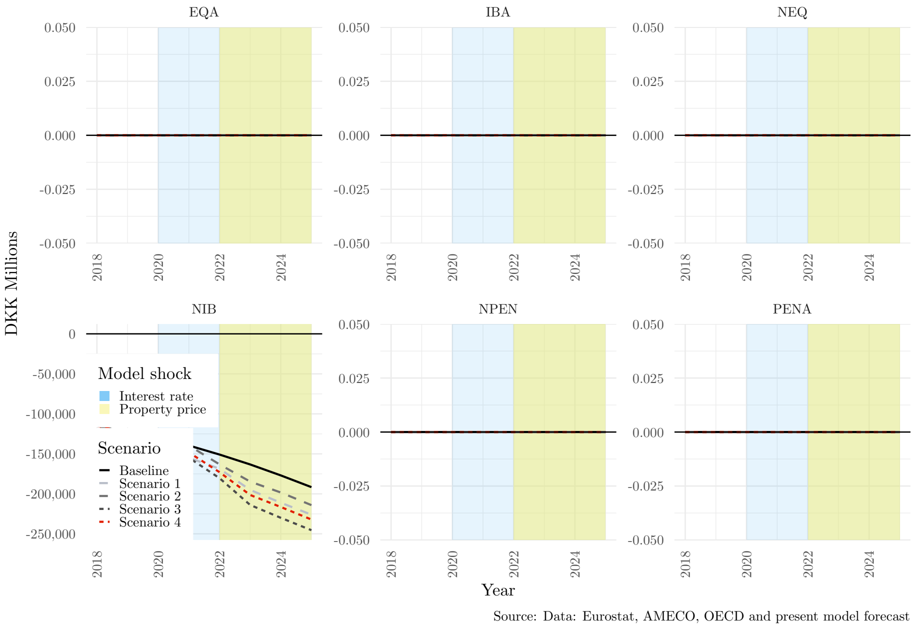


Figure 7.45: Financial transactions: Nominal prices: ROW

7.9.5.10 IBA and IBL: Stock: FC

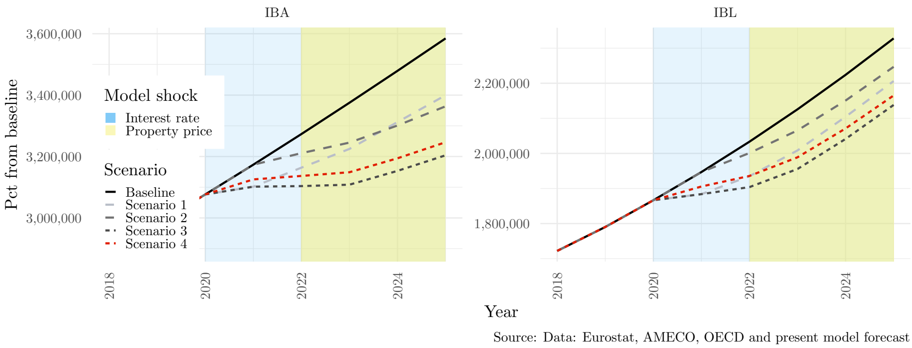


Figure 7.46: IBA and IBL: Stock: FC

7.9.5.11 IBL: Fixed and Flexible: Stocks: HH

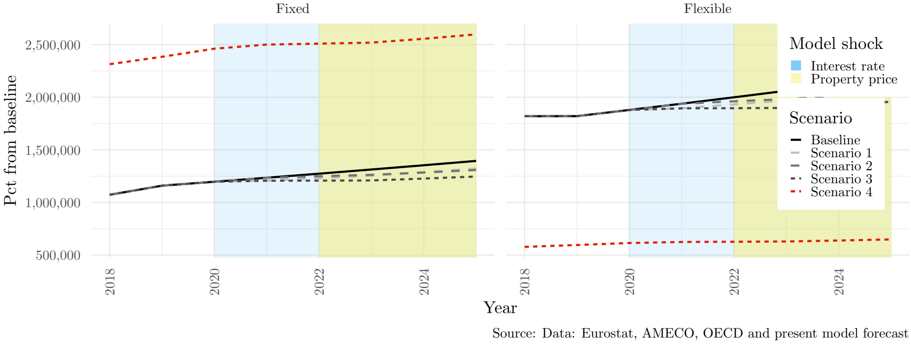


Figure 7.47: IBL: Fixed and Flexible: Stocks: HH

7.9.6 Lists of variables from scenarios

Table 7.53: List of variables in scenario tables

Variable	Type	Description
ALPHA	Ratio	Ratio of fixed interest mortgage debt
B2	Flow	Gross operating surplus
BETA,DATA	Parameter	Parameter
BOP	Flow	Balance of payments
C	Flow	Consumption
CAB	Flow	Current account balance
CGK	Flow	Capital gains
CGS	Flow	Capital gains
CHECK,B2	Check	Consistency check: Gross operating surplus
CHECK,CTR	Check	Consistency check: Capital transactions
CHECK,EQ	Flow	Consistency check: Equity Transactions
CHECK,ERROR1	Check	Consistency check: Error 1
CHECK,ERROR2	Check	Consistency check: Error 2
CHECK,ERROR3	Check	Consistency check: Error 3
CHECK,IB	Flow	Consistency check: Interest bearing transactions
CHECK,IB,TFLOW	Check	Consistency check: Interest bearing: Flows
CHECK,INVEST	Check	Consistency check: Investment
CHECK,NEQ	Flow	Consistency check: Net equity
CHECK,NIB	Check	Consistency check: Net interest bearing
CHECK,NIB	Flow	Consistency check: Net interest bearing

CHECK,NIB,TFLOW	Check	Consistency check: Net interest bearing: Flows
CHECK,NP	Check	Consistency check: Net purchases of non-financial assets (NP)
CHECK,NPEN	Flow	Consistency check: Net pensions: Revaluations
CHECK,PEN	Flow	Consistency check: Pensions: Transactions
CHECK,STRA	Check	Consistency check: Social transfers
CHECK,TAX	Check	Consistency check: Tax
CHECK,WAGE	Check	Consistency check: Wages
CPEN	Flow	Financial Liabilities: Change in pension entitlements
CTR	Flow	Capital transfers
CU	Ratio	Capacity Utilisation (Real GNI / real capital stock)
D,1998	Dummy	Dummy variable: 1998
D,200	Dummy	Dummy variable: 2000
D,2004	Dummy	Dummy variable: 2004
D,2006	Dummy	Dummy variable: 2006
D,2007	Dummy	Dummy variable: 2007
D,2008	Dummy	Dummy variable: 2008
D,2009	Dummy	Dummy variable: 2009
D,2010	Dummy	Dummy variable: 2010
D,2011	Dummy	Dummy variable: 2011
D,2014	Dummy	Dummy variable: High taxes: 2014
D,2015	Dummy	Dummy variable: 2015
D,2016	Dummy	Dummy variable: 2016
D21	Flow	Taxes on products
D29	Flow	Other taxes on production
D31	Flow	Subsidies D31
D39	Flow	Subsidies D39
D41,P	Flow	Interest: Paid
D41,R	Flow	Interest: Received
D41B	Flow	Interest: Received
D42,P	Flow	Distributed income of corporations: Paid
D42,R	Flow	Distributed income of corporations: Received
D44,P	Flow	Other investment income: Paid
D44,R	Flow	Other investment income: Received
DELTA	Ratio	Equity to assets ratio
DEP	Flow	Depreciation of fixed capital
EQA	Flow	Financial Assets: Equity assets
EQA	Stock	Financial Assets: Equity assets

EQA,R	Ratio	Equity ratio
EQL	Flow	Financial Liabilities: Equity liabilities
EQL	Stock	Financial Liabilities: Equity liabilities
ERROR,CHECK1	Check	Error check
ERROR,CHECK2	Check	Error check
ERROR,CHECK3	Check	Error check
FA	Flow	Financial Assets
FA	Stock	Financial Assets
FAB	Flow	Financial account balance
FEE59	Ratio	Danish exports to trading partners: Weighted average total exports (imports by foreign trading partners)
FL	Flow	Financial liabilities
FL	Stock	Financial liabilities
FNL	Flow	Financial Net Lending (Balance)
FNW	Stock	Financial net wealth
G	Flow	Government expenditure
GDP	Flow	Gross domestic product
HFHF	Check	Test variable: Not used
I	Flow	Gross fixed capital formation
IBA	Flow	Financial Assets: Interest bearing assets
IBA	Stock	Financial Assets: Interest bearing assets
IBL	Flow	Financial Liabilities: Interest bearing liabilities
IBL	Stock	Financial Liabilities: Interest bearing liabilities
IBL,RV1	Flow	Financial Liabilities: Interest bearing liabilities
INFL	Rate	Inflation rate: Price inflation
INFL,M	Rate	Inflation rate: Price inflation: Foreign
INV	Flow	Gross fixed capital formation
K	Stock	Stock of Capital
K,CG	Flow	Capital Gains
KCG	Flow	Capital Gains
KCG,SUM	Flow	Capital Gains - Cummulative sum
LEV	Ratio	Leverage ratio: NFC: Funding liabilities to GDP
LEV1	Ratio	Leverage ratio: NFC: Funding liabilities
LF	Stock	Labour force: Total number of employable persons
M	Flow	Imports
N	Stock	Labour force: Denmark for workers in production
NEQ	Flow	Net financial stock: Equity

NEQ	Stock	Net financial stock: Equity
NF	Stock	Labour force: Employed persons: Danish waged
NIB	Flow	Net financial stock: Interest bearing
NIB	Stock	Net financial stock: Interest bearing
NL	Flow	Sector Balance
NL,CHECK	Check	Consistency check: Net lending
NP	Flow	Net purchases of non-financial assets (NP)
NPEN	Flow	Net financial stock: Pension
NPEN	Stock	Net financial stock: Pension
NPIR	Flow	Net property income received: Total
NPIR,NEQ	Flow	Net property income received: NEQ
NPIR,NIB	Flow	Net property income received: NIB
NPIR,NPEN	Flow	Net property income received: NPEN
NU	Stock	Labour force: Employed persons: Danish nationals: Employed abroad
NW	Stock	Net Wealth
NX	Flow	Net Exports
OTR	Flow	Other current transfers
P,CGK	Deflation index	Price index: Capital gains
P,NEQ	Deflation index	Price index: Net Equity
P,NIB	Deflation index	Price index: Net interest bearing assets
P,PEN	Deflation index	Price index: Pensions
PC	Deflation index	Price deflator: Consumption
PE	Deflation index	Price deflator: Unknown
PENA	Flow	Financial Assets: Pension assets
PENA	Stock	Financial Assets: Pension assets
PENL	Flow	Financial Liabilities: Pension liabilities
PENL	Stock	Financial Liabilities: Pension liabilities
PG	Deflation index	Price deflator: Government consumption
PH	Deflation index	Price deflator: Houses
PH01	Deflation index	Price deflator: Houses (Alternative)
PHI1	Flow	Social contributions to income
PHI2	Flow	Pension transactions to social contributions
PI	Deflation index	Price deflator: Investment (weighted average of deflators for housing(pk) and all other investment (pk)) . Proportion of dwellings in total investment is approx 0.22, and pi closely resembles the deflator for total investment reported by ameco.
PIP	Flow	Property income paid

PIP,IBL	Flow	Property income paid: IBL
PIP,PENL	Flow	Property income paid: PENL
PIR	Flow	Property income received
PIR,EQA	Flow	Property income received: EQA
PIR,IBA	Flow	Property income received: IBA
PIR,PENA	Flow	Property income received: PENA
PK	Deflation index	Price deflator: Investment (excluding dwellings)
PM	Deflation index	Price deflator: Imports
PNFC	Deflation index	Price deflator: NFC K
POP	Stock	Population
PP	Check	Unknown
PRIVATE	Flow	Gross income
PROD	Stock	Labour Force: Labour productivity
PROFIT	Ratio	Profit share (Residual of wage share)
PX	Deflation index	Price deflator: Exports
PY	Deflation index	Price deflator: GDP
R,EQ	Rate	Rate of return: Equities
R,ERROR1	Check	Property income error
R,ERROR2	Check	Property income error
R,ERROR3	Check	Property income error
R,IBA	Rate	Rate of interest: Interest bearing assets
R,IBL	Rate	Rate of interest: Interest bearing liabilities
R,IBL,SENS	Rate	Rate of interest: Interest bearing liabilities: Weighted mortgage interest rate
R,N	Rate	Rate of return: Mean
R,NET,ERROR1	Check	Property income error
R,NET,ERROR101	Check	Property income error
R,NET,ERROR2	Check	Property income error
R,NET,ERROR201	Check	Property income error
R,NET,ERROR3	Check	Property income error
R,NET,ERROR301	Check	Property income error
R,PEN	Rate	Rate of return: Pensions
R,R,IBL	Rate	Rate of interest: Interest bearing liabilities
RHO	Ratio	Equity ratio
RR	Rate	Rate of return
S	Flow	Savings
SBE	Flow	Social benefit transfers
SCO	Flow	Social benefit contributions
STRA	Flow	Social transfers

T	Flow	Taxes on products
TAX	Flow	Tax
TEST	Check	Test variable: Stock of Capital (Change in)
TOBIN,Q	Index	Index: House price index: Tobin's Q = Ratio between the house price index and the construction cost of housing index
TOP	Ratio	Ratio of foreign to domestic trade
UL,COST	Rate	Labour force: Unit labour cost
ULC	Rate	Labour force: Unit labour cost: Price index: Index for the price deflator with reference to 2010 (all other price deflator indices are referenced to 2010)
UN	Stock	Labour force: Unemployed persons
UR	Ratio	Labour force: Unemployment rate
W	Flow	Wages
WAGE	Rate	Labour force: Wage rate
WI	Rate	Inflation rate: Wage inflation
WS	Ratio	Wage share
X	Flow	Exports
XR	Rate	Exchange rate
Y	Flow	Total income
Y,D	Flow	Disposable Income
YEAR		
ZZ	Index	Index: House price index
ZZ,I	Index	Index: House price: Imported from DST
ZZ,INDEX	Index	Index: House price: Mark-up pricing on construction costs
ZZ1	Index	Index: House price: Imported from DST

7.10 Complete set of model equations

7.10.1 Non-Financial Corporate Sector

The following appendix is adapted from Byrialsen & Raza (2019), except otherwise indicated. It is included here for completeness in the explanation of the structure of the model. As in their model, the non-financial corporate sector (NFC) is responsible for all production, where total nominal production is represented as:

$$Y_t = C_t + I_t + G_t + X_t - M_t \tag{7.32}$$

This can be rewritten in terms of sales, or rather, from an income perspective:

$$S_t = C_t + I_t + G_t + X_t \tag{7.33}$$

The production equation from Equation (7.32) can be deflated to real prices;

$$y_t = c_t + i_t + g_t + x_t - m_t \tag{7.34}$$

Where the GDP deflator can be represented as:

$$P_t^y = \frac{Y_t}{y_t} \tag{7.35}$$

Outflows for NFC include taxes paid to GOV, wages (WB) paid to domestic and foreign households, and profits ($B2$[7.43]).

$$WB_t^N = W_t(N_t^N) \tag{7.36}$$

The nominal wage bill is calculated as the wage rate (W_t) times the level of employment (NN_t), where NN_t includes all domestic employment of citizens plus the net employment of foreigners in Denmark and Danish citizens abroad.

Taxes paid by NFC are predominantly production based and are therefore calculated as a proportion of total production in each period (Y_t).

$$T_t^N = \beta_3(Y_t) \tag{7.37}$$

It is assumed that firms target a fairly stable level of mark-up on production, and thus $B2$ is calculated as an estimated proportion of Y_t.

$$B2_t = \beta Y_t \tag{7.38}$$

The stock of NFC fixed capital, (K_t^N), is diverse, and is calculated via the standard accounting method, allowing for capital accumulation via investment

[7.43] Profits here refer to the gross operating surplus for the sector, ESA non financial transactions item $B2$.

(I_t^N), depreciation (D_t^N) and capital gains $(K_{CG_t}^N)$.

$$K_t^N = K_{t-1}^N + I_t^N - D_t^N + K_{CG_t}^N \tag{7.39}$$

Depreciation of capital is assumed to apply to stock held at the end of the previous period.

$$D_t^N = \delta(K_{t-1}^N) \tag{7.40}$$

The capital deflator (P_t^i) can then be used to calculate the real value of the stock of capital in each period.

$$k_t^N = \frac{K_t^N}{P_t^i} \tag{7.41}$$

Investment is estimated in real terms as a function of capacity utilisation.

$$ln(i_t^N) = \beta_i + ln\beta_i.\left(\frac{y_{t-i}}{k_{t-i}^N}\right) \tag{7.42}$$

It can then be inflated to current prices using the same capital price deflator as in Equation (7.41), P_t^i.

$$I_t^N = i_t^N(P_t^i) \tag{7.43}$$

NFC savings (S_t^N), not to be confused with sales (S_t) in Equation (7.33), can be calculated as the net sum primary and secondary income and expenditures.

$$\begin{aligned} S_t^N =& Y_t - WB_t^N + (B2_t^N - B2_t) + r_{t-1}^N(NIB_{t-1}^N) \\ &+ \chi_t(NEQ_{t-1}^N) - T_t^N + STR_t^N + \epsilon^N \end{aligned} \tag{7.44}$$

Net lending (NL^N) takes into account the additional sources of change originating from fixed asset adjustments. In particular, NP is the net sale and acquisition of non-financial assets, savings and investment reflect *ex post* portfolio decisions, and finally KTR^N represents any additional capital transfers.[7.44] NFC is also assumed to receive all income from production in the economy, and thus the level of operating surplus must be adjusted to take into account that of all other sectors, thus NFC retains $(B2_t^N - B2_t)$ gross operating surplus. The ϵ^N refers to adjustments made to ensure stock and flow consistency in the level of property income received or paid during the periods where data was available[7.45].

$$NL_t^N = S_t^N - I_t^N - NP_t^N + KTR^N \tag{7.45}$$

The calculation of stocks for each of the classes held by NFC are in equations (7.46) and (7.47).

Net equities:

$$NEQ_t^N = NEQ_{t-1}^N + NEQTR_t^N + NEQ_{CG_t}^N \tag{7.46}$$

Net interest bearing stocks:

$$NIB_t^N = NIB_{t-1}^N + NIBTR_t^N + NIB_{CG_t}^N \tag{7.47}$$

Net interest bearing assets, like several others in this model, are determined by a combination of previous stocks (NIB_{t-1}^N), transactions ($NIBTR_t^N$) and capital gains ($NIB_{CG_t}^N$). The transactions component of interest bearing assets for NFC is determined passively. It is calculated as the remainder of Savings, after capital transfers, and after portfolio allocation towards equities. Transactions in equities ($NEQTR^N$) are thus the active component of the composition of the NFC balance sheet portfolio.

[7.44] This structure follows for each of the sectors, with the exception of the rest of the world sector (ROW), where ownership of fixed assets is not included, and therefore, by definition, neither is investment. NP is determined exogenously, and is for the most part of negligible size.

[7.45] This convention is used for all sectors. The returns on financial assets are estimated with varying degrees of accuracy for each of the sectors. In order to ensure that the model is consistent in all periods, any difference between the estimated returns and actual returns (on a net basis for each asset class) are added to the adjustment term. These errors in estimation are minimised in the estimation specification for each asset class individually.

$$NIBTR_t^N = NL_t^N - NEQTR_t^N \tag{7.48}$$

Since NFC only holds these two financial assets in the model, the sum constitutes the financial net wealth (FNW^N) of NFC.

$$FNW_t^N = NIB_t^N + NEQ_t^N \tag{7.49}$$

This is different to the total net wealth (NW^N), which also includes the fixed capital (K^N) owned by NFC.

$$NW_t^N = FNW_t^N + K^N \tag{7.50}$$

7.10.2 Household Sector

The household sector (HH) is the primary focus of this model, in particular the interest bearing liabilities of the household sector, and the drivers thereof. It is therefore the sector with most endogenous components. Equation (7.51) describes the incomes and expenditures of HH. The primary sources of which are wages (WB^H), profits ($B2$), property income (or returns on financial capital, which stems from interest bearing assets, IBA^H, pensions, $PENA^H$, and equities, EQA^H), and social transfers(STR^H).

$$\begin{aligned} Y_t^H =& WB_t^H + B2_t^H + r^H_{A_{t-1}}(IBA^H_{t-1}) \\ & - r^H_{L(FI)_{t-1}}(IBL(FI)^H_{t-1}) \\ & - r^H_{L(FL)_{t-1}}(IBL(FL)^H_{t-1}) \\ & + \chi_t(EQA^H_{t-1}) + \psi_t(PENA^H_{t-1}) + STR_t^H + \epsilon^H \end{aligned} \tag{7.51}$$

Interest rates are represented by r^H, and the “A” (“L”) subscript referring to the assets (liabilities), and (χ_t) and (ψ_t) are the rates of return on equities and pensions. As part of the key change in this model, the level of interest paid on IBL in this model is split between fixed and flexible rate mortgages into $r^H_{L(FI)_{t-1}}(IBL(FI)^H_{t-1})$ and $r^H_{L(FL)_{t-1}}(IBL(FL)^H_{t-1})$. A similar split is present in the financial corporate sector (FC) below.

Social transfers received by the households in the above equations is the sum of social contribution ($SCON^H$) paid by the households, social benefits ($SBEN_t^H$), and other transfers (OTR^H) received by the households: Social transfers:

$$STR_t^H = SBEN_t^H + OTR_t^H - SCON^H \tag{7.52}$$

Total taxes paid by households are a relatively constant proportion of income over time, and are deducted from total income to give disposable income:

$$YD_t^H = Y_t^H - T_t^H \tag{7.53}$$

The total value of tax payment by households is assumed to be a constant portion (β_i) of household primary and secondary income.

$$T_t^H = \beta_i(Y_t^H) \tag{7.54}$$

The level of social contributions are a proportion of disposable income, adjusted over time.

$$SCON_t^H = \beta_7(YD_{t-i}^H) \tag{7.55}$$

The largest components of $SBEN^H$ are pension and medical payments. Byrialsen & Raza (2019), modelled changes in benefits against changes in the the wage rate and the level of unemployment. Although not directly related to the main components of benefits, they appear to be good proxies for changes in pension distributions, which in some cases may be based on emoluments.

$$ln(SBEN_t^H) = \beta_i + \beta_i ln(U_t^N) + \beta_i ln(W_{t-i}^H) \tag{7.56}$$

Since 2007, approximately 35% - 37% of all social benefits were for old age payments. A further 20% - 22.3% are attributed to medical benefits, an almost constant 14.4% to disability and 10% - 13.2% to family and child benefits. Unemployment (app. 5%), social exclusion (app. 5%), housing (app. 2%) and survivorship (app. 1%) benefits making up the balance.

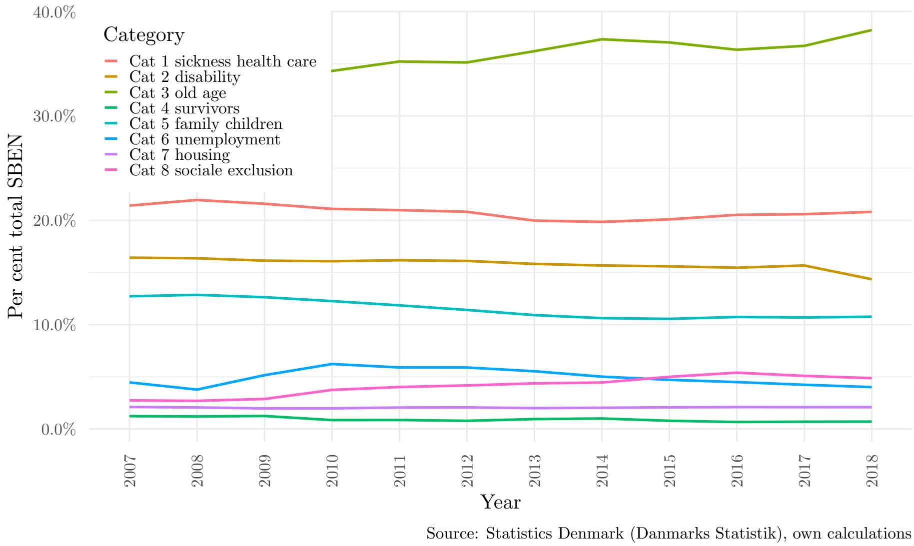


Figure 7.48: Social benefits by category

The old age category, as can be seen from Figure 7.49, is then dominated by tax funded pension payouts (app. 50% in 2017), old age accommodation and care (app. 15%) and civil (app. 11%) and other pension schemes (app. 12%), with the declining anticipated pension allocations (app. 5.2% in 2017) and growing labour market supplementary pension benefits (ATP[7.46]) (app. 5.8%) making up the balance. The full amount therefore could be considered as pension income, but since these pension benefits are funded predominantly by tax, rather than from assets, they are best kept separate from the capital income on pension assets described in Equation (7.51) above. This is perhaps with the exception of labour market supplementary pension benefits, which are payouts from a pooled investment portfolio.

[7.46] ATP is an anagram for *Arbejdsmarkedets Tillægspension*, which translates directly to *labour market supplementary pension*.

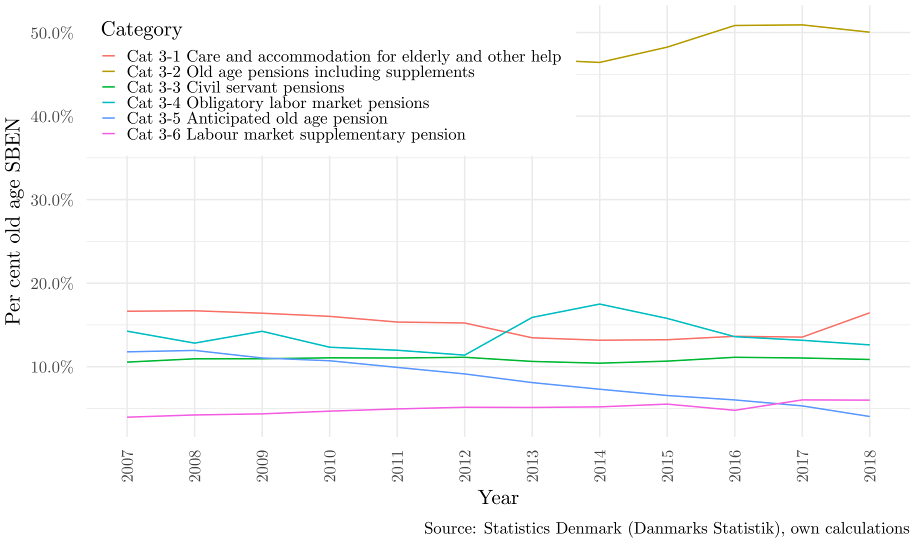


Figure 7.49: Old age social benefits

This is not merely a question of semantics, as the old age component is also an element of wage negotiations for the working population. A large part of social contributions ($SCON^H$) are also contributions towards the labour market pension fund.[7.47] $SBEN^H$ is, perhaps understandably, the second largest component of HH disposable income in Denmark. As can be seen in Figure 7.48, this can quickly be understood to be driven primarily by healthcare and pensions, but in a more general sense, by components of the strong Danish welfare system. Labour market pension payouts are expected to fall (rise), as are unemployment benefit payouts, as economic conditions improve (deteriorate). Unemployment, as an indicator of economic distress, appears to be a good

[7.47] The Danish pension system is beyond the scope of this discussion, but a brief summary may be useful here. As described by Andersen (2016, p. 2), the system is relatively complex three pillar system, with the most recent comprehensive reform taking place in 1964. The three pillars are: 1.) A state pension (with several minor schemes), 2.) Semi-mandatory occupational pensions (or labour market pensions), and 3.) Personal pension savings. The state pension and other peripheral benefits (such as old age accommodation support, heating support etc) is tax funded and essentially a flat rate benefit for all citizens, while the second and third pillars are savings based, and thus have been slower to mature. There have been a range of relatively minor adjustments to the state pension system over the past few decades, some of which are adjustments according to what other benefits or income the person has (partially means tested). The conditions of the occupational pension system, much like much of the labour market working conditions agreements, are determined via collective agreement. While there are no legislated wage or pension requirements - for example there is no minimum wage in Denmark - the coverage of collective bargaining agreements is almost universal. (Andersen, 2016) proxy for expected changes in benefit payouts relative to total HH disposable income. Equation (7.56) captures this effect, together with the effect of changes in the wage rate. The latter because unemployment benefits and several pension benefits are adjusted according to changes in industry wage rates, as noted by M R Byrialsen & Raza (2018) and (2019).

Real disposable income, as will be the case for several other variables in this model, can be calculated by dividing household disposable income by a consumption price index (P^c).

$$yd_t^H = \frac{YD_t^H}{P_t^c} \tag{7.57}$$

Consumption, like NFC investment, is estimated in real terms in a standard Keynesian form, and log-linearised for stationarity. Consumption is taken to be determined by a combination of real disposable income and household wealth of the preceding period. Although not explicitly modelled, current consumption thus is assumed to be based purely on expectations developed in the previous period.

$$ln(c_t) = \beta_0 + \beta_i ln(yd_{t-i}^H) + \beta_i ln(nw_{t-1}^H) \tag{7.58}$$

Nominal consumption can be calculated using the consumption price index to inflate the series.

$$C_t = c_t(P_t^c) \tag{7.59}$$

P^c, the consumption price index is endogenous to changes in the wage rate and the import price index from the previous period. In some way reflecting a delayed adjustment in (or, sticky) prices, and the importance of international prices for smaller open economies, such as Denmark.

$$ln(P_t^c) = \beta_0 + \beta_i ln(W_{t-i}) + \beta_i ln(P_{t-i}^m) \tag{7.60}$$

The following equations are related to household interactions with capital an investment markets.

In this model, households are only permitted to make productive investment in housing, which, in this model, is considered only as a primary market, following Zezza (2008), Fontana & Godin (2013) and Beckta (2015). The secondary market for houses is assumed to affect prices, but not the demand for additional housing investment. Demand for housing investment is determined by by a Tobin's-Q-like function, partially driven by changes in disposable income and previous period housing investment, and partially driven by a relative shift in sales price (P^H_{t-i}) and construction cost (P^i_{t-i}) indices.

Real investment in fixed assets (dwellings):

$$ln(i^H_t) = \beta_i + \beta_i ln(i^H_{t-i}) + \beta_i ln\left(\frac{P^H_{t-i}}{P^i_{t-i}}\right) + \beta_i ln(yd^H_{t-i}) \tag{7.61}$$

As noted by Byrialsen & Raza (2019, p. 20), "The intuition behind the above equation is straight forward, i.e., an increase in the house prices motivates the households to invest more in the construction of new houses, while an increase in the construction costs would lower housing investment."

A shift downwards in house prices would conversely reduce overall returns on houses relative to construction costs, and thus result in a decline in the demand for housing investment. This would result, all else equal, in an increase in savings and a consequent rise in the demand for alternative outlets. Limited below to the purchase of financial assets[7.48].

The nominal level can be calculated by inflating the real investment in housing series (i^H_t) by the investment price index (P^i_t):

[7.48] André (2016), in a recent OECD working paper argue that while there is an obvious connection between the availability of credit and house prices, the extent to which house prices are affected by changes in mortgage lending is affected by a wide range of factors, including sentiment, employment conditions, legislative changes, and a range of cyclical economic factors. Kohlscheen, Mehrotra, & Mihaljek (2018) also note the co-movement of residential property prices and credit as a prominent feature of models of financial cycles, although their focus is on commonalities in financial, demographic and real economy factors. Their (Kohlscheen et al., 2018, p. 2) findings suggest that the primary drivers are "real house prices, nominal interest rates, demographic factors, and the state of housing supply". The present model captures all but demographic factors in the determination of residential (HH) investment. They also find strong asymmetries in the effects of interest rates between boom and bust cycles, and with rising interest rates rather than falling. This is supported by Scanlon et al. (2008)'s findings that household mortgage lending is highly sensitive to short-term budget implications of interest and capital repayment costs.

$$I_t^H = i_t^H(P_t^i) \tag{7.62}$$

The nominal stock of housing (K^H), as with other assets to come, follows the simple process of previous stock, plus acquisition (in this case investment in new houses), less depreciation (or disposal) plus capital gains.

$$K_t^H = K_{t-1}^H + I_t^H - D_t^H + K_{CG_t}^H \tag{7.63}$$

Capital gains on houses, in turn, are calculated as:

$$KH_{CG} = \Delta P_t^H(K_{t-1}^H) \tag{7.64}$$

Which is simply the change in the price of houses applied to the level of stock at the end of the preceding period. The change in house prices leading into the current period is then by definition the same ratio proportion of capital gains to previous housing capital.

$$\Delta P_t^H = \frac{KH_{CG}}{K_{t-1}^H} \tag{7.65}$$

Nominal housing capital held by HH at the end of the current period can be expressed as the price adjusted stock at the end of the previous period, plus net investment and depreciation.

$$K_t^H = K_{t-1}^H(1 + \Delta P_t^H) + I_t^H - D_t^H \tag{7.66}$$

The deflated real capital index can then be found by dividing the series by the investment (housing) price index, as in Equation (7.65) above.

$$k_t^H = \frac{K_t^H}{P_t^i} \tag{7.67}$$

The level of savings is then calculated as a residual disposable income after consumption and net pension adjustments - the ESA 2010 (Statistical Office of the European Communities., 2013) definition of which is net of contributions, disbursements and returns of pension funds.

$$S_t^H = YD_t^H - C_t^H + CPEN_t^H \tag{7.68}$$

Net lending can then be calculated savings plus additional consideration for the net acquisition and disposal of fixed assets (NP) and capital transfers (KTR) less investment (assumed here to be solely in houses).

$$NL_t^H = S_t^H - I_t^H - NP_t^H + KTR_t^H \tag{7.69}$$

HH must also fund real activities and allocate any excess funds in the financial markets. As noted above, HH is the sector with most endogenous components in this model. It is also the sector, together with the financial corporate sector (FC) that has the most complex financial accounts. As noted by Byrialsen & Raza (2019), financial market changes in this model are driven primarily by the demand for credit and assets. As they explained, transmission is from flows to stocks. The behaviour is primarily modelled in transaction decisions, and stocks are then calculated as the sum of these together with capital gains.

The net effect of annual changes in the financial position of HH is captured by financial net lending. This is the sum of changes in financial assets less the sum of changes in financial liabilities:

$$FNL_t^H = FATR_t^H - FLTR_t^H \tag{7.70}$$

Household financial assets are held in interest bearing assets (IBA), equities[7.49] (EQA) and pensions ($PENA$). Transactions in each of these sum to make up the total transactions in financial assets.

$$FATR_t^H = IBATR_t^H + EQATR_t^H + PENATR_t^H \tag{7.71}$$

Transactions in equities are determined by a Tobin allocation matrix, thus enforcing a budget constraint on HH, where the investment decision of the

[7.49] The equity component in the balance sheets of the other sectors in this model is limited to a net equity position. It is assumed here that HH do not issue equities.

sector is determined at least in part by relative rates of return. One exception is pension allocations, where a fairly constant portion of HH income is allocated to pension investments, irrespective of the rate of return. This leaves equities and interest bearing assets.

Demand for equities is negatively affected by increases in the returns available on interest bearing assets in the previous period (β on $r^H_{A_{t-1}}$), positively related to returns on equities (χ), and positively related to increases in the extension of credit (β on $IBLTR^H$).

$$EQATR^H_t = \beta_i + \beta_i(\chi_t) + \beta_i(r^H_{A_{t-1}}) + \beta_i(IBLTR^H_t) \tag{7.72}$$

The link with IBL is associated with the investment incentive for more sophisticated investors, where low interest rate debt can be used to arbitrage higher returns on equities.

Pension transactions, in addition to the fixed proportion that is reflected as a constant in the equation below, are positively affected by returns on pensions (ψ) and the wage bill (WB). Pensions transactions can thus be affected directly by the wage rate, or the level of employment (and thus negatively by a rise in unemployment).

$$PENATR^H_t = \beta_i + \beta_i(\psi_t) + \beta_i WB^H_t \tag{7.73}$$

The demand for credit by households is where the current model differs most from Byrialsen & Raza (2019). The total demand for new credit is captured in the level of transactions ($IBLTR^H$). This is positively related to the level of demand for (new) housing (I^H), negatively to the level of debt in the previous period, positively to the total level of transactions in equities (for the same investment reason described above), and negatively related to the interest cost on loans ($r^H_{L_{t-1}}$) in the previous period.

$$IBLTR^H_t = \beta_i(I^H_{t-i}) + \beta_i(IBL^H_{t-i}) + \beta_i(FATR^H_t) + \beta_i(r^H_{L_{t-1}}) \tag{7.74}$$

The primary change to the model is the introduction of adjustable rate mortgage products in a fairly generic form, where the total level of outstanding IBL is split into fixed-interest (IBL_{FI}) and flexible-interest bearing liabilities (IBL_{FL}). The proportion of interest bearing assets held as IBL_{FI} is α.

$$IBL^H_{FI_t} = \alpha(IBL^H_t) \tag{7.75}$$

and thus,

$$IBL^H_{FL_t} = (1-\alpha)(IBL^H_t) \tag{7.76}$$

The level of α is taken from Statistics Denmark, and varies over time. The split is introduced in 2003, when the option was made available to HH. The composition of this debt is significantly more complex, as discussed in Section 7.3 above. This complexity can be simplified using a combination of interest rates and sensitivity or adjustment weights. At an aggregate level, the degree to which flexible rate mortgages adjust to changes in official rates can be estimated for each aggregate group of mortgage products. This is done for two broad groups in for this model, fixed[7.50] and flexible[7.51]. The effect is calculated as a percentage pass-through of official rate changes. Unfortunately it is not possible to compare rising and falling pass-through rates to existing mortgage holders prior to 2009. For the 2009 to 2017 period, however, fixed and flexible average interest rate payments, relative to outstanding nominal capital (cash) amounts, appears to have followed a very stable spread of approximately 2%. This is fairly easy to explain in a falling rates environment as borrowers take advantage of the option to refinance debt.

The composition of debt and the expected pass-through rate have a combined effect on the sensitivity of HH balance sheets and incomes to a shock to either interest rates or property prices. This simple modification is able to capture the two most dramatics innovations in the Danish mortgage debt system: the introduction of ARMs and of delayed amortization (or interest-only period, IO loans) loans.

The incentive to borrow for the purchase of a house, as in Equation (7.61) above, is partially driven by interest rates. The available interest rate is then adjusted according to the weighted average interest rate observed for each of the

[7.50] Group 1, called “fixed-interest” includes:
[7.51] Group 2, called “flexible-interest” includes:

two groups (flexible and fixed). The second is the introduction of interest-only periods, as explained in Section 7.2, the effect of which is to reduce the initial cost of borrowing. Thus as the amount paid on mortgages per family falls, the incentive to borrow rises.

An alternative is to calculate the interest rate as the total payments made by the household towards debt, inclusive of amortization payments, as a percentage of total debt remaining. This alternative is not employed here, but is planned for future research. Although this would not normally be captured in the interest rate, it is possible to artificially lower the rate of interest on the flexible rate group in order to capture this incentive. This is similar for debt with longer term structures, where monthly costs would reflect the reduced portion allocated to amortization.

Unfortunately, the additional risks factors related to products with full-term interest-only, or perpetual-interest-only loans would not be possible to capture in this framework.

The only interest bearing asset held by households in the model is deposits, which are calculated as the residual effect of transactions in the other assets. debt and net lending contributing positively, and outflows for equities or pension investment contributing negatively.

$$IBATR_t^H = NL^H + IBLTR_t^H - EQATR_t^H - PENATR_t^H \tag{7.77}$$

The current stock of each asset is then the sum of the stock from the preceding period, plus any transactions (positive or negative), plus any capital gains (or losses). The same is true for all assets and liabilities.

$$IBA_t^H = IBA_{t-1}^H + IBATR_t^H + IBA_{CG_t}^H \tag{7.78}$$

Equities:

$$EQA_t^H = EQA_{t-1}^H + EQATR_t^H + EQA_{CG_t}^H \tag{7.79}$$

Pensions:

$$PENA^H_t = PENA^H_{t-1} + PENATR^H_t + PENA^H_{CG_t} \tag{7.80}$$

Interest bearing liabilities:

$$IBL^H_t = IBL^H_{t-1} + IBLTR^H_t + IBL^H_{CG_t} \tag{7.81}$$

The sum of financial assess (liabilities) provides the total financial assets (liabilities).

$$FA^H_t = IBA^H_t + EQA^H_t + PENA^H_t \tag{7.82}$$

Since the only financial liability for households in this model interest bearing, it makes up the total.

$$FL^H = IBL^H_t \tag{7.83}$$

Net financial wealth is the difference between total assets and liabilities.

$$FNW^H_t = FA^H_t - FL^H_t \tag{7.84}$$

The inclusion of fixed assets provides the total net wealth for each sector, which both in this model and in reality are dominated by dwellings for the household sector.

$$NW^H_t = FNW^H_t + K^H_t \tag{7.85}$$

This can be deflated to provide wealth at constant prices, where real financial net wealth:

$$fnw^H_t = \frac{FNW^H_t}{P^c_t} \tag{7.86}$$

And, where real wealth, are the result of deflation by the consumption prices index P^c_t

$$nw_t^H = \frac{NW_t^H}{P_t^c} \tag{7.87}$$

7.10.3 Financial Corporate Sector

The financial sector acts as the provider, and thus counterpart of newly created credit in this model. The financial corporate sector (FC) is comprised of banks, insurance and pension companies, as well as several services related to the financial markets. Property income made up just below 75% of FC inflows, and approximately the same proportion of outflows in 1995, and falling to just above 50% in 2017 - with positive flows higher than negative flows, reflecting the rental income spread extracted by the sector.

Savings, according to the national accounts can be expressed as the sum of the net capital income, gross operating surplus ($B2_t^F$) (received), social transfers (STR^F) minus taxes paid to the government (T^F), and the changes in pension entitlements ($CPEN^F$) paid to the households.

This model adjusts the inflow to FC to take into account the split in debt in the household sector between flexible and fixed, where the average interest rate on each category is applied to the outstanding level of fixed or flexible debt respectively.

$$\begin{aligned}
S_t^F =& B2_t^F \\
&+ r_{A(FI)_{t-1}}^F (IBA_{A(FI)_{t-1}}^{F\sim H}) + r_{A(FL)_{t-1}}^F (IBA_{A(FL)_{t-1}}^{F\sim H}) \\
&- r_{L_{t-1}}^F (IBL_{L_{t-1}}^{F\sim H}) + r_{N_{t-1}} (NIB_{t-1}^F) \\
&+ \chi_t (NEQ_{t-1}^F) - \psi_t (PENL_{t-1}^F) - T_t^F + STR_t^F - CPEN_t^F + \epsilon^F
\end{aligned} \tag{7.88}$$

Where, $r_{A_{t-1}}^F$, and $r_{L_{t-1}}^F$ are average interest rates on assets and liabilities where the household sector is the counterpart, this is noted using the superscript on, for example, interest bearing assets, $IBA^{F\sim H}$, to indicate that these assets are held by FC and that the counterpart is HH. $r_{N_{t-1}}$ is a generic rate of return applied toall other interest bearing assets and liabilities in the form of a net interest bearing (NIB) position.

Fixed assets are again determined as the stock of the preceding period, less depreciation, plus additional investment and capital gains.

$$K_t^F = K_{t-1}^F + I_t^F - D_t^F + K_{CG_{t-1}}^F \tag{7.89}$$

Net lending can be then be expressed as the net savings after taking investment net sales and acquisitions of fixed property and any capital transfers into account.

$$NL_t^F = S_t^F - I_t^F - NP_t^F + KTR_t^F \tag{7.90}$$

The financial equivalent, financial net lending, takes into account any transactions in the financial assets and liabilities held by the sector. Again the superscript denotes the sector, and for IBA and IBL, the counterpart sector.

$$FNL_t^F = IBATR_t^{F\sim H} + NIBTR_t^F + NEQTR_t^F - IBLTR_t^{F\sim H} - PENLTR^F \tag{7.91}$$

In the cases of both $IBATR$ and $IBLTR$, the counterpart sector is HH, and the values for these flows are by definition equal

$$IBATR_t^{F\sim H} = IBLTR_t^H \tag{7.92}$$

$$IBLTR_t^{F\sim H} = IBATR_t^H \tag{7.93}$$

FC is thus passive to the demands and capacity of HH to borrow in each of these cases. All other interest bearing transactions are also determined passively from the transactions in other sectors - where again, the net positions determine the adjustment required by FC.

$$NIBTR_t^F = -(NIBTR_t^N + NIBTR_t^G + NIBTR_t^W) \tag{7.94}$$

Again the superscripts on each variable refer to the originating sector, where G

refers to government, N to NFC, W to ROW.

As in the household sector, financial stocks are determined as the closing value from the preceding period, plus net transactions, plus (less) any capital gains (losses). This is repeated for the other asset classes.

$$IBA_t^{F\sim H} = IBA_{t-1}^{F\sim H} + IBATR_t^{F\sim H} + IBA_{CG_t}^{F\sim H} \tag{7.95}$$

Although in this model $IBA^{F\sim H}$ is split into fixed $IBA_{FI}^{F\sim H}$ and flexible $IBA_{FL}^{F\sim H}$ rate products, the accumulation of stocks is calculated in advance of the split. This ensures stock-flow consistency in a simple fashion, and still allows the change in property income and expenditure to influence accumulation over time.

IBL on the other hand is simply the counterpart of the accumulation of deposits by households.

$$IBL_t^{F\sim H} = IBL_{t-1}^{F\sim H} + IBLTR_t^{F\sim H} + IBL_{CG_t}^{F\sim H} \tag{7.96}$$

The calculation of the stock at the end of the current period follows the simple standard structure.

$$NIB_t^F = NIB_{t-1}^F + NIBTR_t^F + NIB_{CG_t}^F \tag{7.97}$$

Pension assets include a domestic and relatively small and exogenous international component, which accumulates to offshore denominated assets.

$$PENLTR_t^F = PENATR_t^H + NPENTR^W \tag{7.98}$$

The equity asset transactions for FC are the residual flow, in that equity transactions are not modelled directly, but contributes positively or negatively depending on the relative sizes of NL^F, and the transactions in other assets. FC is fully passive in this regard as all other financial asset and liability components are equally passive to the behaviours generated in other sectors, as discussed above.

To explain the source of the changes in the value of net equity transactions in FC, we need to refer back to HH. Equation (7.99) is a repeat of Equation (7.77) in the HH section, and is shown here to identify the closure of the model.

$$IBATR_t^H = NL^H + IBLTR_t^H - EQATR_t^H - PENATR_t^H \tag{7.99}$$

$IBLTR_t^H$, $EQATR^H$ and $PENATR^H$ are all estimated directly, and NL^H is endogenous to the changes in HH income and expenditures. The only component that is not specified as for closure in any other sector is the level of $EQATR_t^H$

The full effect of $IBATR^H$ is also absorbed directly into FC via $IBLTR^{F\sim H}$, which is specified as equal to $IBATR^H$, which includes the value of $EQATR^H$, as captured by Equation (7.100).

$$IBLTR_t^{F\sim H} = IBATR_t^H \tag{7.100}$$

$IBLTR^H$, $PENATR^H$ and $IBATR^H$ are all directly offset in the FC via identities for $IBLTR$, $PENATR$ and $IBATR$, all of which are captured in Equation (7.101). The only financial transaction component that is unaccounted for in the equation is $EQATR_t^H$.

$$NEQTR_t^F = NL_t^F + IBLTR_t^{F\sim H} + PENLTR_t^F - IBATR_t^{F\sim H} - NIBTR_t^F \tag{7.101}$$

Since NL^F is equal to $NIBTR^F$, $NEQTR^F$ is necessarily equal to $EQATR^H$. This is the redundant equation, which, if specified, would cause the model to be over-specified.

Calculating the accumulation of net equity by FC, like NIB^F, follows the simple standard method.

$$NEQ_t^F = NEQ_{t-1}^F + NEQTR_t^F + NEQ_{CG_t}^F \tag{7.102}$$

Again, financial net wealth can be calculated as financial assets less liabilities.

$$FNW_t^F = NIB_t^F + NEQ_t^F + IBA_t^{F\sim H} - IBL_t^{F\sim H} - PENL_t^F \tag{7.103}$$

And total net wealth can again be calculated with the inclusion of fixed assets. FC fixed assets are minor relative to financial assets, with a total of 6% of GDP in 1995, and falling to 4% of GDP in 2017.

If desired, these can both be calculated in real terms using the consumption price index, but the repetition is excluded here for brevity.

$$NW_t^F = FNW_t^F + K^F \tag{7.104}$$

7.10.4 Government Sector

Denmark has a strong welfare system and as a result, a relatively large public sector (GOV. Government consumption, made up largely of wages to public sector employees, made up between 25% and 30% of GDP, and social transfers (made up largely of pension and medical expenditures) contributed a further 15% to 20% of GDP between 1995 and 2017. The total expenditure of GOV varied between 58% and 48% of GDP between 1995 and 2017, ending on 50.4%. Thus, roughly half of total GDP can be attributed to government expenditures.

The bulk of these expenditures are financed by taxation, although a relatively small of GOV income is generated from semi-private enterprises (between 2% and 3% of GDP, and roughly 5% of total positive GOV flows).

The taxes of all other sectors are combined to calculate total tax revenues.

$$T_t^G = T_t^N + T_t^H + T_t^F + T_t^W \tag{7.105}$$

Social transfers are also combined for all other sectors. The largest of which are to households via old age and medical categories. Old age transfers predominantly comprise tax funded pension payments, with the exception of ATP, a supplementary labour pension, funded by an investment portfolio.

$$STR_t^G = -(STR_t^H + STR_t^N + STR_t^F + STR_t^W) \tag{7.106}$$

Savings can then be calculated from government spending, which as in Byrialsen & Raza (2019), remains exogenous in this model, gross operating surplus, interest on net interest bearing stocks, taxes and social transfers.

$$S_t^G = B2_t^G + r_{N_{t-1}}(NIB_{t-1}^G) + T_t^G + STR_t^G - G_t + \epsilon^G \tag{7.107}$$

Government (or public) investment was between 2.6% and 3.5% of GDP between 1995 and 2017, and contributes to government capital stock in the same way as for the other sectors. The on-going stock of capital is then calculated as per the sections above.

$$K_t^G = K_{t-1}^G + I_t^G - D_t^G + K_{CG_t}^G \tag{7.108}$$

Net lending is also calculated in the same manner as previously.

$$NL_t^G = S_t^G - I_t^G - NP_t^G + KTR_t^G \tag{7.109}$$

All financial flows in GOV are passively balanced by transactions in the level of net interest bearing stocks. The assumption here is that any deficit or surplus will be reflected in a change in these stocks. A deficit will be financed by the issue of debt and a surplus will finance the redemption thereof. $NIBTR_t^G$ is thus the barometer of public sector finance effects of any shock.

$$FNL_t^G = NIBTR_t^G \tag{7.110}$$

The financing requirements of government are thus fully captured in $NIBTR_t^G$, the trigger for any need to finance a deficit or invest surplus funds is the net financing requirement generated in the real sector, net lending (NL).

$$NIBTR_t^G = NL_t^G \tag{7.111}$$

The change in the stock of NIB follows the same pattern as other financial assets in the previous sectors.

$$NIB_t^G = NIB_{t-1}^G + NIBTR_t^G + NIB_{CG_t} \tag{7.112}$$

This concludes the behavioural equations of GOV.

7.10.5 The rest of the world

The foreign sector, like GOV, remains unchanged from Byrialsen & Raza (2019). The model reflects that the Danish economy is small and open, and thus is exposed to relative price differentials with trading partners. In this model the gap in price differences is reduced to zero after the date at which the first shock is introduced - this is a marginal difference from Byrialsen & Raza (2019), but one worth noting.

Because it affects the levels of import and export growth relative to Byrialsen & Raza (2019)'s baseline model, there is also an impact on the speed of accumulation of foreign assets. This is artificially accelerated in their model in order to capture the growth of foreign sector assets. Although unrealistic in the long run, the mechanism acts as a buffer in that it eliminates the risk that a shock to interest rates will unnecessarily complicate relative prices, and that Denmark continues to maintain a positive trade balance (as appears to be realistic from data).

Imports are estimated in real terms in the log-linear form below.

$$ln(m_t) = \beta_i + \beta_i ln\left(\frac{P_{t-1}^y}{P_{t-1}^m}\right) + \beta_i ln(c_{t-1} + i_{t-1} + x_{t-1}) \tag{7.113}$$

As noted by Byrialsen & Raza (2019, p. 27), the "export function is based on the Armington (1969) model where the market share of the Danish exports is explained by relative prices."

This relation is captured below as annual Danish exports relative to a weighted index of all trading partners (m_t^W), which should be determined by domestic prices (the export price index, P_t^x) relative to foreign prices (the import price index, P_t^m), but moderated by price elasticity (β).

$$\frac{x_t}{m_t^W} = \left(\frac{P_t^x}{P_t^m}\right)^{\beta} \tag{7.114}$$

Some simple algebra allows this relation to be written in log linear form, with exports as the dependent component.

$$ln(x_t) = \beta_{35} + \beta_{36} ln\left(\frac{P_{t-1}^x}{P_{t-1}^m}\right) + \beta_{38} ln(m_t^W) \tag{7.115}$$

Both imports and exports can be inflated using their relevant price indices to for current prices.

$$M_t = m_t(P_t^m) \tag{7.116}$$

$$X_t = x_t(P_t^x) \tag{7.117}$$

In this model, actual prices of imports are expressed as the number one (1), and export prices are estimated as a function of import prices and unit labour costs. According to Byrialsen & Raza (2019), this is due to the fact that a large portion of imports to Denmark are intermediate goods. Kristoffersen & Spange (2016) investigated the effect of effective nominal exchange rate pass-through, and found that while domestic consumer prices were slow to adjust, the relationship between nominal exchange adjustments and import prices was stronger but weakening over time[7.52]. The influence on export prices depends more dramatically, however, on the composition of exports in terms of intermediate imports. Bo, Burman, Winther, & Jensen (2018) discuss the complexities in identifying the ultimate trading partners, and suggest the trade in value added (TiVA) method[7.53], but also point to the source of value added in

[7.52]They attribute the decline in pass-through of exchange movements to the growing relative importance of the Euro-zone, with which Denmark maintains a fixed exchange rate, together with increased invoicing in Euros and enhanced global adherence to inflation targeting monetary policy.

[7.53]They discuss the alternative interpretations of international trade in goods, balance of payments in goods, international trade in services, balance of payments in goods and services, balance of payments in direct exports and trade in value added by final destination. The relative importance of various trading partners shifts according to the choice of measure, but Germany, the USA, the UK, Sweden, China, Norway, France and the Netherlands comprise

Danish exports, where approximately 58% of export value is generated outside of the country[7.54]. As such, the model allows external price adjustments to inform part of export prices.

$$ln(P_t^x) = \beta_{39} + \beta_{40} ln(P_t^m) + \beta_{41} ln(ULC_{t-1}) \tag{7.118}$$

The savings of the foreign sector (rest of the world, ROW) are expressed from the perspective of ROW. Thus imports from the model are a revenue for ROW and exports an expenditure. Net pension flows are either positive or negative, depending on levels of contribution and disbursements. Interest on NIB and returns on NEQ depend on whether the net stock is positive or negative, wages and social transfers received are positive, and taxes paid are an expenditure.

$$\begin{aligned} S_t^W =& M_t - X_t + \chi_t(NEQ_{t-1}^W) + \psi_t(NPEN^W t - 1) + r_{N_{t-1}}(NIB_{t-1}^W) \\ &+ WB_t^W - T_t^W + STR_t^W + \epsilon^W \end{aligned} \tag{7.119}$$

The rates of return on equities (χ_t) and on pension assets (ψ_t) are assumed to be the same as for domestic assets. Danish pension funds invest a large proportion of assets outside of the country, largely as a result of the limited size of the Danish financial markets. As with the previous sectors, net lending can be calculated by taking net acquisitions and disposals of fixed assets, and capital transfers into account. The only difference here being that ROW is assumed not to make investment in Denmark.

$$NL_t^W = S_t^W - NP_t^W + KTR^W \tag{7.120}$$

Net lending is taken to reflect the current account balance for each period.

$$CAB_t = -NL_t^W \tag{7.121}$$

just over 50% off all export. Germany the largest share at 11.1%.

[7.54] Germany (11.1%), Norway (10.1%), US (9.5%), Russia (8.7%), the United Kingdom (7.9%), Sweden (6.4%) China (4.3%), and all others (42%)

The financial net lending account is again the sum of transactions in net financial stocks.

$$FNL_t^W = NIBTR_t^W + NEQTR_t^W + NPENTR_t^W \tag{7.122}$$

The present stock of each asset class is again determined by the simple method of preceding period stock, plus net transactions and capital gains (or less losses).

$$NIB_t^W = NIB_{t-1}^W + NIBTR_t^W + NIB_{CG_t}^W \tag{7.123}$$

$$NEQ_t^W = NEQ_{t-1}^W + NEQTR_t^W + NEQ_{CG_t}^W \tag{7.124}$$

$$NPEN_t^W = NPEN_{t-1}^W + NPENTR_t^W + NPEN_{CG_t}^W \tag{7.125}$$

The residual asset class for ROW is net interest bearing assets, largely because national liability positions are predominantly held as international debt.

$$NIBTR_t^W = NL_t^W - NEQTR_t^W - NPENTR_t^W \tag{7.126}$$

Net financial wealth can then be calculated as in the previous sectors, as the sum of net assets.

$$FNW_t^W = NIB_t^W + NEQ_t^W + NPEN^W \tag{7.127}$$

Since ROW does not own fixed assets, as per the system of national accounts, net wealth would be identical to financial net wealth, and is therefore excluded here.

7.10.6 The labour market

The final market that must clear in the model is the labour market. The size of the labour market is determined by the level of demand in the model, reflecting the Post Keynesian structure. GDP at factor costs (taken to be total labour costs plus gross operating surplus - profit - for the nation) is then used to calculate the adjusted wage share, from which the unit labour cost (ULC) is calculated.

$$Y_t^F = WB_t^N + B2_t \tag{7.128}$$

The adjusted wage share can then be calculated as the wage bill relative to Y_t^F.

$$WS_t = \frac{WB_t^N}{Y_t^F} \tag{7.129}$$

Finally, ULC is calculated as the ratio between the wage component and total factor costs.

$$ULC_t = \frac{WS_t(Y_t)}{Y_t^F} \tag{7.130}$$

Employment is then determined by the number of persons that are part of the labour force, but are not employed. Or, the difference between the total labour force (LF) and the number of persons that are employed (N).

$$UN_t = LF_t - N_t \tag{7.131}$$

UN as a proportion of LF provides the rate of unemployment.

$$UR_t = \frac{UN_t}{LF_t} \tag{7.132}$$

Employment (N) is estimated using actual population data and lagged real GDP.

$$ln(N_t) = \beta_i + \beta_i ln(y_{t-1}) + \beta_i ln(LF_t) \tag{7.133}$$

A combination of domestically and foreign employed persons provides the total level of employment (N_t^N)

$$N_t^N = N_t + N_t^W \tag{7.134}$$

Returning to the income of HH, wages (WB^H) for domestic employees are a product of locally employed persons and the local wage rate, which is in-turn estimated as a negative relation with the rate of unemployment.

$$WB_t^H = W_t(N_t) \tag{7.135}$$

$$W_t = \beta_0 + \beta_i UR_{t-i} \tag{7.136}$$

This reflects falling bargaining power in unions as unemployment rises, but also the relative over-supply of labour.

The number of foreign employed persons is then calculated as the average wage rate into the total foreign wage bill.

$$N_t^W = \frac{WB_t^W}{W_t} \tag{7.137}$$

7.10.7 Lists of variables from the model

Table 7.54: List of model variables from equations

variable	description
α	Ratio of fixed interest mortgage debt
β	Parameter
χ	Return on equity
ϵ	Property income adjustment term
ψ	Return on pension stocks
$B2$	Gross operating surplus
c	Consumption: Real prices
C	Consumption: Nominal prices
CAB	Current account balance
$CPEN$	Financial Liabilities: Change in pension entitlements
D	Depreciation of fixed capital
EQA_{CG}	Financial Assets: Equity assets: Capital gains
EQA	Financial Assets: Equity assets
$EQATR$	Financial Assets: Equity assets: Transactions
FA	Financial Assets
$FATR$	Financial Assets: Transactions

FL	Financial liabilities
$FLTR$	Financial liabilities: Transactions
FNL	Financial Net Lending (Balance)
FNW	Financial net wealth
G	Government expenditure
i	Gross fixed capital formation (Investment): Real prices
I	Gross fixed capital formation (Investment): Nominal prices
$IBA^{F\sim H}_{A(FI)}$	Financial Assets: Interest bearing assets: FC on HH: Fixed interest
$IBA^{F\sim H}_{A(FL)}$	Financial Assets: Interest bearing assets: FC on HH: Flexible interest
$IBA^{F\sim H}_{CG}$	Financial Assets: Interest bearing assets: FC on HH: Capital gains
$IBA^{F\sim H}$	Financial Assets: Interest bearing assets: FC on HH
IBA_{CG}	Financial Assets: Interest bearing assets: Capital gains
IBA	Financial Assets: Interest bearing assets
$IBATR^{F\sim H}$	Financial Assets: Interest bearing assets: FC on HH: Transactions
$IBATR$	Financial Assets: Interest bearing assets: Transactions
$IBL(FI)$	Financial Liabilities: Interest bearing liabilities: Fixed interest
$IBL(FL)$	Financial Liabilities: Interest bearing liabilities: Flexible interest
$IBL^{F\sim H}_{CG}$	Financial Assets: Interest bearing liabilities: FC to HH: Capital gains
$IBL^{F\sim H}_{L}$	Financial Assets: Interest bearing liabilities: FC to HH
$IBL^{F\sim H}$	Financial Assets: Interest bearing liabilities: FC to HH
IBL_{CG}	Financial Assets: Interest bearing liabilities: Capital gains
IBL_{FI}	Financial Liabilities: Interest bearing liabilities: Fixed interest
IBL_{FL}	Financial Liabilities: Interest bearing liabilities: Flexible interest
IBL	Financial Liabilities: Interest bearing liabilities
$IBLTR^{F\sim H}$	Financial Liabilities: Interest bearing liabilities: FC to HH: Transactions
$IBLTR$	Financial Liabilities: Interest bearing liabilities: Transactions
k	Stock of Capital: Real prices
K	Stock of Capital: Nominal prices
K_{CG}	Stock of Capital: Capital gains
KTR	Capital transfers
LF	Labour force: Total number of employable persons
m	Imports: Real prices
M	Imports: Nominal prices
N	Labour force: Denmark for workers in production

NEQ_{CG}	Net financial stock: Equity: Capital gains
NEQ	Net financial stock: Equity
$NEQTR$	Net financial stock: Equity: Transactions
NIB_{CG}	Net financial stock: Interest bearing
NIB	Net financial stock: Interest bearing
$NIBTR$	Net financial stock: Interest bearing: Transactions
NL	Sector net lending balance
NP	Net purchases of non-financial assets (NP)
$NPEN$	Net financial stock: Pension
$NPEN_{CG}$	Net financial stock: Pension: Capital gains
$NPENTR$	Net financial stock: Pension: Transactions
NW	Net Wealth
OTR	Other current transfers
P^c	Price deflator: Consumption
P^i	Price deflator: Investment (excluding dwellings)
P^m	Price deflator: Imports
P^x	Price deflator: Exports
P^y	Price deflator: GDP
$PENA_{CG}$	Financial Assets: Pension assets: Capital Gains
$PENA$	Financial Assets: Pension assets
$PENATR$	Financial Assets: Pension assets: Transactions
$PENL$	Financial Liabilities: Pension liabilities
$PENLTR$	Financial Liabilities: Pension liabilities: Transactions
r_N	Rate of return: Mean
$r_{A(FI)}$	Rate of interest: Interest bearing assets: Fixed interest
$r_{A(FL)}$	Rate of interest: Interest bearing assets: Flexible interest
r_L	Rate of interest: Interest bearing liabilities
r_A	Rate of interest: Interest bearing assets
$r_{L(FI)}$	Rate of interest: Interest bearing liabilities: Fixed interest
$r_{L(FL)}$	Rate of interest: Interest bearing liabilities: Flexible interest
S	Savings
$SBEN$	Social benefit transfers
$SCON$	Social benefit contributions
STR	Social transfers
T	Taxes on products
ULC	Labour force: Unit labour cost: Price index: Index for the price deflator with reference to 2010 (all other price deflator indices are referenced to 2010)
UN	Labour force: Unemployed persons
UR	Labour force: Unemployment rate

W	Wage rate
WB	Wage bill
WS	Wage share
x	Exports: Real prices
X	Exports: Nominal prices
Y	Total income: Nominal prices
y	Total income: Real prices
YD	Disposable income

8 Future research perspectives

Introductory remarks

This section is a compilation of further research possibilities that have arisen during the process of completing this thesis, and are primarily related to the SFC model presented in Article 5. It would be particularly interesting to further develop the empirical SFC model for the Danish economy to include a more complete pensions sector, and integrate this with the advances made to the mortgage market. The groundwork for these advances has been partially completed in the form of a core literature review of the Danish pension system, and some suggestions for how to apply the changes within the present framework. Two additional modifications are also considered: firstly, the integration of household refinancing; and secondly, the integration of credit risk, defaults and loan to value ratios. These additions intended to guide future macroeconomic research on the Danish economy, particularly within the Post Keynesian SFC framework. These insights may also prove useful to researchers from other paradigms that have an interest in understanding the intricacies of the Danish pension and mortgage credit markets.

Future research perspectives

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8.1 Introduction

This paper is a collection of potential further research possibilities, or rather further developments that could be applied to the SFC model presented in Article 5, forthwith referred to as “FlexFix”. Some have been developed to a more mature stage than others, but are not yet complete. The first proposal is the integration of household (HH) refinancing patterns in response to changes in interest rates. FlexFix currently does not include any reactionary behaviour by households, and so may over or understate the risks associated with the shocks applied in scenario testing. The second is the integration of credit risk, potentially through the introduction of supply side constraints. The motivation for this is that the financial corporate sector (FC) in FlexFix currently accommodates any level of demand for debt from HH. As will be discussed briefly, this is not reflective ofw the realities faced by HH and firms in the years following the global financial crisis (GFC), where credit was not available for many non-financial corporates (NFC) and HH that demanded it.

The third proposed change is to implement a circular flow of funds for HH. In summary, HH pay interest and fees through mortgage-debt products to FC, and many of those fees are then transferred from FC to pension funds. Those pension funds are in turn owned by HH, but the returns and assets held are only accessible at some point in the future. In a sense, the interest paid on any mortgage bonds held in this manner constitute inter-temporal substitution of consumption (or saving) made by HH. The motivation to pursue this addition to FlexFix is the relative size and importance of HH pension assets, which make up roughly 50% of all HH financial assets. The pension system is also an integral part of the Danish economy and contributes to the stabilisation of income and expenditure patters of Danish persons throughout the life-cycle. Each of these suggestions are discussed in some detail below, and for each, some details are provided about how the issue relates to the Danish economy.

8.2 Integration of household refinancing

The first possible addition is to integrate HH debt refinancing into FlexFix. The following brief section provides an introduction to refinancing (pre-purchase / buy-back) of Danish mortgage bonds, as well as a short explanation of why it is possible, and wy it is so relevant to consider. Particularly in relation to the borrowing conditions faced by Danish HH. Thereafter, some possible means of including this phenomenon in FlexFix are suggested.

Danish HHs actively monitor and adapt their debt in reaction to market changes. This can be observed in Article 5, in the migration from a 100% allocation in fixed-interest mortgage products in 2000 to an allocation of over 70% in adjustable-rate mortgage products by 2012. The vast majority of mortgage products are not held to maturity, and there are multiple incentives in the Danish mortgage finance system for borrowers to adjust their debt portfolio in relation to market changes.

In practice, refinancing is the act of settling an existing debt contract, and simultaneously entering a new contract under different terms of borrowing. In the data, refinancing can be identified from a material change in terms of the debt contract from one period to another, while property ownership records remain unchanged. Adjustments that are part of the original contract are excluded, for example, adjustments to the interest rate at previously agreed periods.

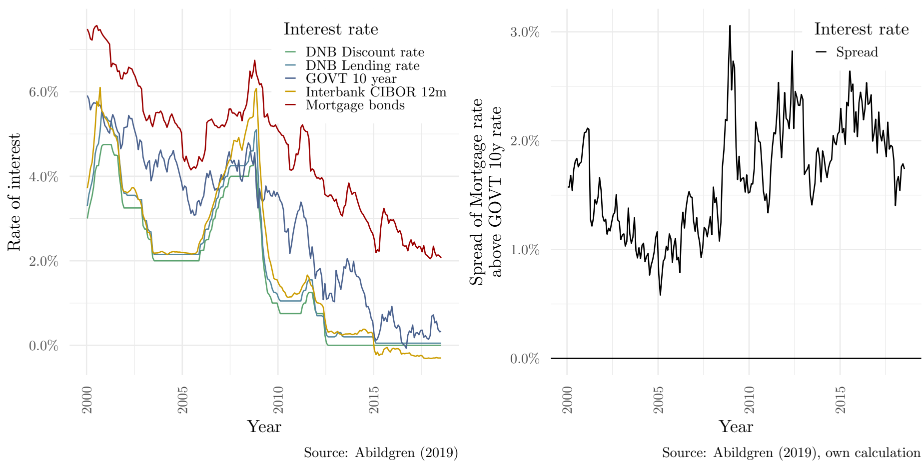
The reason that HHs are able to adapt to market changes is that they are endowed with the right to settle debt at par or to settle (buy-back)[8.2] an equivalent mortgage bond to the one issued in the borrowing process. These options are legislated rights of mortgage credit institute borrowers (Laustsen, 2009). The covered bond market in Denmark is both large and highly liquid, and covered bond interest rates track the yield on government 10 year bonds with a spread of around 2% points, as can be seen from panel (b) in Figure 8.1 below, although this spread has risen since 2010 - and especially so after the introduction of negative short-term interest rates. This spread should capture the market perceived risk premium that is priced into the spot price on long term mortgage bonds, over and above the risk on Danish sovereign 10 year issues. Some Danish covered bonds[8.3] and all government bonds are rated in the highest quality categories of the most prominent global ratings agencies,

[8.2]A callable bond is a security, sold by or on behalf of a borrower, where the borrower reserves the right to settle the debt at any time. The option is officially referred to as the "buy-back" option or delivery option, and applies to all mortgage bonds (whether callable or not) (Skinhøj et al., 2019). In Denmark, there are specific dates during the calendar year at which borrowers are able to call their bonds. For most of these bonds, notice must be given of cancellation of the bond two calendar months prior to the date of the next auction. The auction dates are 01 January, 02 April, 01 July, 01 October. The action taken by the borrower to buy a bond back prematurely is also referred to as pre-payment.

[8.3]This status is not applicable to all covered bond issuances, but as noted by Skinhøj et al. (2019) all major issuers in Denmark currently have AAA rated bonds available.

including Moody's, S&P and Fitch (Skinhøj et al., 2019). This is in part due to the Danish Government, which has maintained the highest quality rating since 2000 and onwards, even throughout the global financial crisis (GFC) of 2007-08 (Cailleteau & Lindow, 2008; Cailleteau, Lindow, & Mousavizadeh, 2005; Lindow & Oosterveld, 2011; Moody's Investor Services Ltd., 2000). The motivation for the strong rating was repeatedly noted as stable government finances and budget, stable and even income distribution and a commitment to the reduction of Danish national debt. These strong economic factors are also contributors to the stability of Danish HHs and their associated debt portfolios.

According to Skinhøj et al. (2019), the Danish covered bond market is also strategically important for the banking sector, as the government bond market is not large enough to provide the liquid assets needed by banks. This added emphasis on the market contributes to the ongoing liquidity and competitiveness in bond pricing, taken together with the balance-principle (or match-funding) this results in lower lending rates for borrowers.



(a) Nationalbank Rates

(b) Mortgage spread

Figure 8.1: Official interest rates in Denmark

As can be seen from panel (b) above, in the years preceding the GFC in 2007-08, the spread between the yield on government 10 year bonds and mortgage bonds compressed to less than 1% point. The crisis triggered a substantial increase in the risk premia attached to mortgage backed securities (MBS, or covered bonds), pushing the spread up to just over 3% points. The European debt crisis coincided with the 2011 and 2013 rise in the spread, and later in 2015, and 2016 concerns of potential rate hikes by the Federal reserve in the USA affected global debt markets. This may have played a roll in the spread during and up to 2017. Overall, however, HH face very favourable borrowing rates relative to "risk-free" government securities.

The opportunities available to HHs for prepayment are also dependent on several other factors. The first is the "balance principle" which ensures that all lending by mortgage credit institutes is funded directly by the sale of an equivalent bond in the open market, as discussed in Article 5. In order to ensure that borrowers have access to borrowing rates that are as low as possible, the market for covered bonds should be liquid, and the quality of the bonds should be high enough to minimise the risk premium paid by borrowers.

In Denmark risk premiums are kept low for the working population by substantial unemployment benefits, a flexible labour market, and strong support systems for skills development and re-entry into the labour market (commonly referred to as "flexicurity"[8.4], see M R Byrialsen & Raza (2018)). For the retired population, there are several pension and retirement systems in place, as will be discussed below. This stability of HH income reduces credit risk substantially and contributes to the quality of covered bonds.

As noted, and as illustrated in Figure 8.1 above, the liquidity of the covered bond market keeps rates low for borrowers. It also makes Danish covered bonds an attractive investment opportunity, as liquidity risk is relatively low. One concern with the market, however is that prepayment behaviour can dramatically change the nature and structure of a bond investment portfolio. Skinhøj et al. (2019, p. 19), in relation to a covered bond investment portfolio explained that "[t]he stochastic modelling of prepayment behaviour is a complex task and is outside the scope for most international investors." In a macroeconomic modelling scenario, however, this can be simplified significantly.

To incorporate this behaviour in FlexFix, due to the high level of aggregation, it is not neccessary to model the exact structure of each product, or the effect on each bond issue. One option would be to estimate an expected proportion of bond holders that would be likely to engage in prepayment for a given

[8.4]It should be noted, however, that, as noted by M R Byrialsen & Raza (2018), these supports have been eroded somewhat in recent decades.

shift in interest rates. Although a very rough measure, it would provide some information of the potential to shift borrowers from one product to another. In the dynamic environment of FlexFix, various scenarios and sequences of rate changes could be investigated. For example, if we were to first shift interest rates downwards, it might encourage a greater portion of borrowers to switch to fixed-interest rate products. This might result in a more stable HH sector, that could withstand greater upward shifts in interest rates later.

Models, such as FlexFix, that do not take this behaviour into account are at risk of overstating the impact of changes in interest rates on the net lending position of HH, and the associated incomes received by FC. If possible it should be included in future versions.

8.3 Integration of credit risk, defaults and loan to value ratios

The second possible addition to FlexFix is the possible inclusion of supply side constraints to the credit (debt) creation process. At present, all debt demand in FlexFix is accommodated in full by FC. The level of demand for additional debt, particularly for HH, is then only constrained by the level of demand for investment. The section that follows below notes that credit supply constrains were recognised as an issue by several Post Keynesian (PK) authors, and notes some evidence of constrianed credit in Denmark after the GFC. Credit limitations can have serious consequences for any economic participants that over extend their balance sheets. Where over-extension is endemic, it can cause systemic fragility.

It would be necessary to investigate the nature of contraints in Denmark further before including them in FlexFix, but some possibilities are suggested below. In contrast to HH refinancing, credit supply constraints have been investigated by a number of SFC studies, some of which are used to inform possible ammendments to FlexFix in the section to follow.

This is a factor that was raised in the Post Keynesian (PK) paradigm by authors that were concerned with the realities of structural and institutional limitations. Several authors disputed the reality of the PK argument that the money supply curve was horizontal (Goodhart, 1989; Palley, 1991, 1996), and argued that there were strong reasons to believe that there were limitations to the extent to which new lending could be accommodated. Lavoie (2006) presented a review of this discussion and several explanations of how the money supply curve could take many forms, depending on the length of time considered.

The concerns of the structuralists proved to be valid, even in Denmark where HH incomes are particularly stable. In the wake of the GFC, the availability of credit to borrowers dried up considerably, as noted by Sørensen (2015), although for firms rather than individuals, a credit survey by Statistics Denmark[8.5] showed that prior after the crisis, the rejection rate on credit applications for firms rose from just over 4% to over 20%. The degree to which applications were only partially fulfilled rose to over 20% from just over 7%, and the extent to which credit applications were approved fell from around 90% to around 55%. As he argued, the reasons for the reduction in availability of credit could have flowed through at least two channels - the bank lending channel or the balance sheet channel. The lack of availability for credit had the additional effect of discouraging many firms from applying. The balance sheet channel considers the credit worthiness of the borrower, while the bank lending channel considers agency costs involved in lending (partially captured by the finance premium), a more elaborate version of which is called the financial accelerator mechanism (For extended discussions see, Bernanke & Gertler, 1989, 1995; Bernanke, Gertler, & Gilchrist, 1994; Bernanke, 2007; Disyatat, 2011).

As noted in the literature review, several authors have constructed theoretical SFC models that capture credit side constraints. The extent to which these models capture the full extent of each of the balance sheet and bank lending channels differ considerably. Effah (2012), Beckta (2015), and Nikolaidi (2015) use non performing loans (based on a default rate) together with capital adequacy ratios in the banking sector.

Khalil (2011) on the other hand models non-performing loans (NPL) as an adjustable proportion of the total loans of each of the HH sectors in his multi-country model. He includes a capital adequacy ratio in the multi-country model, but it is unclear how this is used to moderate credit provision. The method used by Nikolaidi (2015) includes both the securitisation of debt and a number of supply side constraints, which may be useful for the addition considered in

[8.5] As he noted, firms were obliged to respond to the survey, which covered 2265 of the full population of 13990 firms. This data was supplemented with rating agency data covering each individual firm. Both datasets were subsequently

Section 8.4 below, and is therefore the version illustrated below. It is possible to separate the demand and supply of loans via the inclusion of a ceiling for loan satisfaction. As she noted, similar applications can be found in Heron & Mouakil (2008) and Dafermos (2012). The supply of credit restrictions could be applied as follows.

$$NLH = k_h NLH^D \tag{8.1}$$

New lending to HH (NLH) is the product of a proportion of lending satisfied (k_h, which she calls the degree of credit availability) and the total level of demand for new loans by HH (NLH^D). These figures are calculated in the Nikolaidi (2015) model for two separate HH classes, but is simplified here for explanatory purposes and to be better suited as an adaptation of FlexFix in Article 5.

$$k_H = k_{H0} - k_{H1}LEV_{W1-1} + k_{H2}(CAR_{t-1} - CAR^T) - k_{H3}BUR_{W1-1} - k_{H4}\phi \tag{8.2}$$

The degree of credity availability is a proportion between zero and one ($0 < k_h < 1$) and depends positively on the leverage ratio (LEV), and positively on gap between the lagged capital-adequacy ratio and the target capital-adequacy ratio of banks (which would be FC in FlexFix) ($CAR_{t-1} - CAR^T$). It then depends negatively on the lagged debt burden of HHs (BUR_{W1-1}) and the default rate (ϕ).

Finally the capital adequacy ratio is determined as the ratio between bank capital and the risk weighted assets of the sector.

$$CAR = \frac{K_B}{LH_{NS} + LC + LF} \tag{8.3}$$

In Nikolaidi (2015), as can be seen from Equation (8.3) above, the capital adequacy ratio (CAR) is determined as the ratio between bank capital (K_B) and the risk weighted assets of the sector, which include loans to worker HH (LH_{NS}, total HH debt in FlexFix) loans to capitalist HH (LC, which would not apply to FlexFix) and loans to firms (LF, NFC in FlexFix).

It may also be possible to use several of the conditional structures applied by Beckta (2015), which place some logical limitations on the manner in which loans and defaults can adapt under different conditions. For example, he used a fixed default rate component plus a conditional default component which adjusted upwards if, and only if, the (lagged) HH debt to income ratio exceeded a threshold level. This upward adjustment to default levels was fixed in his model, but could also be scaled. To apply this method to FlexFix, however, would require additional motivation of debt default thresholds. Alternatively it could be modified to be conditional on additional factors, for example, a significant decline in lagged GDP or investment levels. Other possibilities, within the current modelling framework could be to introduce a simple debt service ratio $\left(\frac{PIP^H}{Y_d^H}\right)$ conditional trigger, or possibly a (per-capita average debt service cost) / (per capita average disposable income) ratio.

One other possible trigger for changes in defaults or in credit rationing conditions could be a breach of threshold loan to value ratios (LTV). This mechanism would require a reasonably accurate (endogenous) property price estimation or determination in the model. This may be difficult to model at a macroeconomic level, as noted by Andersen & Duus (2014, p. 4), HH LTV ratios increased substantially after the decline in house prices after the GFC. Kuchler (2015) reviewed the distribution of LTV ratios amongst borrowers. He found that there was a tendency amongst HH for those with high LTV ratios were more likely to also have selected a product type with an interest only period and flexible interest rates. Essentially, those with the highest exposure levels were also likely to choose the riskiest products. The trouble is that the credit risk problems are likely to occur for a small selection of borrowers, and broad average measures might not provide clear guidelines as to the appropriate threshold levels.

It may be relevant to model the risk of default across multiple debt categories, as was done for the selection of fixed versus flexible interest rates in Article 5. This could also be accomplished without direct disruption to the demand for debt, and could be supplemented by analysis conducted on the administrative datasets.

Within the existing model framework, the inclusion of credit supply limitations could thus be achieved without disruption of the existing property market dynamics. Capital adequacy is unfortunately not presently possible to model directly, as bank capital is not modelled as a separate entity. It may however be possible to model some proxy for the capital levels held by banks. Elements of credit rationing could therefore be introduced on the basis of recent economic developments and, as in Equation (8.2) above, on an estimated combination of leverage (LEV), debt burden (BUR) and the default rate (ϕ). If a proxy for CAR can be established then it could also be included in the estimation. Some of the implications of these alterations are discussed in the concluding remarks below.

8.4 Circular integration of household and pension fund balance sheets

The third future research proposition for an alteration to FlexFix is to integrate the mortgage lending system with the pension system. A key feature of the Danish mortgage debt system is this circular integration of HH liabilities and assets. This is facilitated by the balance principle, discussed in more detail in Article 5. As noted therein, the principle ensures that all mortgage debt issued by mortgage lending companies is (near) perfectly hedged by a pre-sale of a covered bond. A large portion of these covered bonds are in-turn held by large pension funds, the beneficiaries of which are HHs, many of whom are the original borrowers. In a macroeconomic setting, the borrowers and asset owners would be of the same sector, and therefore indistinguishable from one another. To the extent that mortgage costs are accumulated in pension funds, and since pension funds are not accessible until retirement, this would essentially amount to an inter-temporal substitution of consumption.

This constellation of debt issuance, covered bond issuance and indirect ownership is not unique to Denmark. The process of origination, packaging and resale of debt is called securitisation in much of the academic literature. A key difference, however is the set of rules by which the participants must abide. The balance principle has been discussed in the sections above in relation to the behaviour of HHs, but has not yet been addressed in terms of how it connects the borrower to the ultimate beneficiaries. The ownership structure of the major lending institutions, and the tax and welfare-state structures within which the lending system sits are equally important.

At end of 2018, Stöcker & Costa (2019, p. 158) noted that Denmark was the largest issuer of covered bonds in Europe with € 405 991m[8.6]. As a relatively small economy this is reflective of a number of features already mentioned above. Firstly, it is a reflection of the volume of outstanding debt in the Danish economy, and secondly it reflects the large and liquid covered bond market that is supported by the Danish financial system (particularly the liquid asset needs of banks). These are also reflections of the capacity of the Danish property buyers to borrow; which, as noted above depends on income and economic stability. FlexFix already contains many of the features of the Danish welfare state that contribute to the stability of HH income, but presently lacks a detailed depiction of a feature that permits Danish HHs to maintain high standards of living throughout their lives, that is, the Danish pension system.

8.4.1 The Danish pension system

The Danish Pension System is a key aspect to understanding the Danish HH balance sheet position. As described by Andersen (2016, p. 2), the system is a relatively complex three pillar system, with the most recent comprehensive reform taking place in 1964. The three pillars are: 1. A state pension (with several minor schemes), 2. Semi-mandatory occupational pensions (or labour market pensions), and 3. Personal pension savings.

The state pension and other peripheral benefits (such as old age accommodation support, heating support etc) are tax funded and essentially are flat rate benefits for all citizens, while the second and third pillars are savings based, and thus have been slower to mature. There have been a range of relatively minor adjustments to the state pension system over the past few decades, some of which are adjustments according to what other benefits or income the person has (partially means tested).

The occupational pension system, much like labour market working conditions agreements, are determined via collective agreement. While there are no legislated minimum wage or pension requirements, the coverage of collective bargaining agreements is almost universal (Andersen, 2016).

8.4.1.1 Components of the Danish Pension System

The first tier, tax funded pension payments, is currently captured in FlexFix

[8.6] Denmark € 405 991m, Germany € 369 747m, France € 321 311m, Spain € 231 615m, Sweden € 217 979m Italy € 168 936m.

Table 8.1: Danish Pensions

Tiers	First Pillar	Second Pillar	Third Pillar
	State pensions and special arrangements for pensioners	Occupational pensions	Personal pensions
Third tier			Rent pension (lifetime)
(topping up)			Age pension (at once)
			Rate pension (10 years)
Second tier		Labour market pensions	
(income maintenance)		(Civil servants' pensions)	
		(Company pensions)	
First tier	ATP: State LM Pension (funded)		
(basic security)	People's pension: Basic Amount		
	People's pension: Pension supplement		
	Supplementary pensions benefits		
	Preferential housing benefits		
	Individual supplements (heating, health, personal)		

in the income received as social benefits ($SBEN^H$). It would be possible to separate the amount in the model, but for present purposes, this may not be worth while. As can be seen in Figure 10.30 from Section 10.5.1.2 in the descriptive appendix below, the proportion of social transfers to disposable income has remained fairly constant in Denmark since 1995. In addition, the proportion of that income that originates from old age related transfers has similarly remained almost constant, as can be seen from Figure 7.48, in Section 7.10.2. For the purpose of identification of actual income types for the sector, however, it is certainly relevant, as total tax funded social benefits ($SBEN^H$) are the second largest contribution to HH income at around 22%. Between 35 and 37% of which were old age related transfers.

Beier Sørensen & Dengsøe (2011) noted that once the second tier matures as a component of the pension system, the extent of income replacement for HHs with full labour market careers should be in the region of 65% to 100%, depending on the age joined and age of retirement. As explained by Andersen (2016), these pensions are semi-compulsory as a result of collective agreements, but are in fact private pension providers.

In terms of taxation, Beier Sørensen & Dengsøe (2011) noted that Danish pensions are taxed according to ETT (Exempt, Taxed, Taxed). This means that they are taxed at two out of three points of interaction with the individual. Each letter refers to the three components *contributions*, *returns* and *distributions*, and the E for exempt, and the T for taxed. Danish contributions to pensions are tax exempt (up to a limit), internal earnings are taxed at 15% and distributions to pensioners is again taxed at income tax rates, depending on the amount of the distribution.

From a flow of funds perspective this is beneficial for Denmark in several ways. HHs will by and large be able to maintain at least 60% of their pre-retirement consumption patterns after retirement. From a property and covered bond perspective, the high and stable income permits persons of retirement age to access mortgage lending. Even though there is presently a fairly large portion of pension payments linked to the tax funded scheme, greater portions of pension incomes will be received from investment based sources as the second and third tiers mature. The ETT structure of pensions then translates to larger contributions to the tax base by the retired portion of the population.

The sheer size of the Danish pension savings necessitate that a large portion thereof are invested internationally, and thus generate international asset holdings. This has a large positive impact on the balance of payments and foreign assets position of the country as a whole, as the net positive level of property income for the country grows. In its current form the system should also help to mitigate income inequality, since tax is applied on distributions (which are received as income), and income tax is progressive. A reflection of this can be seen in that Denmark also was tied for the fourth lowest income inequality in the retired population in the world[8.7].

8.4.1.2 Links to the covered bond market and mortgage bond fees

The typical home loan consists of at least three fee components. An interest payment made to a mortgage institute that will be passed on entirely to the covered bond holder (at market determined interest rates against a maximum of 80% of the market value of the property). A fee to the mortgage credit institute (currently somewhere between 0.73% and 1.5% p.a. of total debt, depending on the risk profile of the bond, in Danish called bidragsats). The third is a possible interest fee to a banking institution on any shortfall in the borrowed amount (for first-time buyers, this is often at the maximum of 15% of the market value of the property, as a minimum of 5% must be paid in cash).

In terms of the investment portfolios of pension funds in Denmark, Falch et al.

[8.7] According to OECD (2019), Denmark is also one of the countries in the world with the lowest income inequality in persons over the age of 65, measured in terms of the Gini coefficient. The lowest being the Czech Republic (0.185), the Slovak Republic (0.202), Belgium (0.222), Norway (0.225), Denmark (0.233), Finland (0.233) and the Netherlands (0.235). In contrast to the worst inequality, Mexico (0.500), Chile (0.441), Korea (0.419) and the United States (0.411).

(2017, p. 61) noted that the bulk of bond holdings in the life insurance and pension company sector is held in covered mortgage bonds - most likely due to currency risk considerations and the relatively small domestic government bond market. According to data from Forsikring og Pension (Foxman, 2018), on average, pension companies (excluding life insurance) held approximately 41% of their total assets in bonds[8.8]. Due to the need to deliver pension payments in Danish Krone, a large portion of Danish pension fund assets are Krone denominated. Essentially, this means that a large portion of mortgage bond interest payments are "re-captured" by HHs in the form of pension fund income.

Exactly what portion is difficult to say, since a large portion of bonds are held by mutual funds. If we consider the distribution of investors across the fill spectrum of bonds issued by Danish bond issuers, the Life Insurance and Pension companies held approximately 22.6%[8.9], and mutual funds and asset managers held an additional 18.8%. While the exact proportion is uncertain, it would not be unreasonable to estimate that approximately 40% of all interest paid by HHs is transferred almost directly into HH pension assets in the form of interest income.

In addition to the interest income, a portion of the fee paid to mortgage credit institutes is also returned to HHs in the form of profits. As noted by Skinhøj et al. (2019) Nykredit Totalkredit is the largest of the mortgage credit institute in Denmark (with approximately 41.3% market share of all mortgage lending[8.10]), of which roughly 17% is owned by a group of pension companies directly, and approximately 80% is owned by Forenet Kredit, which is an association of customers. According to the annual report from Forenet Kredit (Smith & Mogensen, 2019, p. 5), with over 80% ownership, the association has almost complete decision-making power over the proceeds of Nykredit Realkredit. In 2019, against total earnings of approximately DKK 11 billion, roughly DKK 8.3 billion was profit. It was determined to distribute roughly DKK 3.6 billion

[8.8] Based on data from Foxman (2018) and the author's own calculations, the asset holdings of non-life insurance pension companies were as follows: Bonds (41.96%), Investment in associated and connected businesses (24.58%), Capital portion (9.15%), Investment fund portion (5.88%), Investable shares and unit trust / mutual fund shares (4.44%), Investment properties (0.56%), Other securities (13.44%).

[8.9] According to Falch et al. (2017, p. 61), the investors in the Danish covered bonds at the end of September 2017 were comprised as follows: Life insurance/Pension funds 22.6%, Mutual funds and asset managers 18.8%, Financial institutions 27.9%, Foreigners 23.8%, Non-financial corporations 3.2%, General government 2.1%, and HHs 1.7%.

[8.10] Realkredit Danmark A/S of the Danske Bank group (28%), Nordea Kredit Realkreditaktieselskab (14.1%), Jyske Realkredit A/S (11.5%), and DLR Kredit A/S (5.3%).

in dividends, of which Forenet Kredit was the beneficiary of approximately DKK 2.85 billion. About half of this, around DKK 1.25 billion, was transferred back to borrowers via private and business customer rebate programmes. That is, just over 10% of all fees. Although this is not the case for all other major participants, a significant portion of equity and thus dividend income generated by each of the major groups would also flow to HH via pension fund asset holdings.

In addition to the above-mentioned return flows, an additional 30% of all interest payments can be deducted from personal income prior to the tax calculation. This is essentially an interest cost discount in the form of a tax deduction.

In summary, although HHs in Denmark have a significant outstanding level of debt, a very large portion of the costs related to holding debt are returned to the HH sector through a number of channels. The point at which the largest part of these benefits accumulate is the pension fund system.

8.4.1.3 Possible changes to the existing model

The primary focus of the changes described in the sections above is on HH, and therefore, only the equations that highlight key features for further use will be elaborated below.

HH income, following Danish protocols, is separated into three categories[8.11], capital income, personal income and taxable income. Capital income is taxed according to capital gains, dividend and interest income taxation laws, and is thus considered separately. Personal income includes all other taxable income sources, and total taxable income is the sum of the two (capital income and personal income).

In addition, HHs also receive income deductions and incomes in a number of non-taxable forms. Deductions include a universal flat rate tax deduction for each person and deductions for any contribution to pension funds or labour market organisations. In addition, as mentioned above, 30% of all interest cost can be deducted from personal income in the calculation of tax payments.

The relevance of these details for the model are as follows. Tax flows to government are affected by the level of interest payments on mortgages. HH

[8.11] Kapital indkomst, Personlig indkomst, Skattepligtig indkomst.

income is positively affected by interest expense deductions, but this positive "indirect" form of income is not taxable. Contributions to pension funds and labour market institutions equally reduce the level of income on which tax is calculated.

Prior to any deductions, a labour market contribution of 8% is paid. The pre-tax contributions to pension funds (pensionsbidrag) in Denmark are paid according to collective bargaining agreements. As a result there is a minimum of between 8% and 20% of personal wage income, of which the individual typically pays one third (depending on the agreement in place[8.12]). Although these contributions are largely tax free, there is a nominal cap on the level of contributions that can be deducted from taxable income. The portion of taxable income remaining is subject to high tax rates, roughly 38% of remaining income. The bulk of which flows to local municipalities (roughly 30 of the total 38 percentage points).

There are several important consequences of this arrangement for the model. The Danish level of disposable income is artificially lowered, making a comparison of ratios related to disposable income somewhat misleading when compared with other countries. A substantial portion of HH income is transferred to HH assets prior to the calculation of disposable income or tax. Thereafter, a substantial portion of the remaining income is paid in tax, resulting in a relatively small portion of total income to be called disposable income.

The steady flow of pension contributions also means that pension assets accumulate proportionately quickly. The primary innovation would be that while pension assets are important for future sustainability of HH income flows, they do not contribute directly to HH income in the short term.

In terms of HH income for each year, the return on pensions ($\psi_t(PENA^H_{t-1})$) remains a sector income, and is included in the taxable income of HHs. It will, however, be deducted from disposable income after tax.

[8.12] Called 'overenskomster' (plural) in Danish.

$$
\begin{aligned}
Y_t^H = & WB_t^H + B2_t^H + r_{A_{t-1}}^H (IBA_{t-1}^H) \\
& - r_{L_{FI_{t-1}}}^H \cdot (IBL_{FI_{t-1}}^H) \\
& - r_{L_{FL_{t-1}}}^H \cdot (IBL_{FL_{t-1}}^H) \\
& + \chi_t (EQA_{t-1}^H) + \psi_t (PENA_{t-1}^H) + STR_t^H + \epsilon^H
\end{aligned}
\tag{8.4}
$$

Equation (8.4) is HH gross income. Taxes then should not be calculated on the full income value, but income less deductions.

Pension distributions, which are also taxable are a stable nominal amount, based on retired population size and wages. Although these are not an income for the sector as a whole, since they originate from HH owned assets.

$$PENA_{dis} = \omega \cdot \nu \cdot WB_h \tag{8.5}$$

$$\omega = 65\% \tag{8.6}$$

$$\nu = 35\% \tag{8.7}$$

the retired income rate relative to the wage rate ω is set to 65% (0.65), and is based on the expected income replacement rate of Danish retirees (OECD, 2019). ν (0.35), is the retired population as a proportion of the working population. Both could be set exogenously, as above, or be adjusted according to expected cohort mortality rates.

Taxable income is equal to total income less any deductible incomes, here taken to include pension contributions and the total deductible level of interest[8.13]. Since contributions to pension funds are tax exempt, a reasonable proportion of pension contributions ($PENATR_t^H$) should then be deducted from the total value of taxable income, as in Equation (8.8) below.

$$T_t^H = \beta_i (Y_t^H - \kappa \cdot PENATR_t^H - R_{ded} + PENA_{dis}) \tag{8.8}$$

[8.13] HHs typically contribute up to the deductible pension limit, but not significantly above that level. It also includes the level of income drawn from pension assets, $PENA_{dis}$. Following the ETT taxation profile.

Where κ is the proportion of total of pension contributions that are tax deductible, and is arbitrarily selected to be 95% here for illustrative purposes. Pension contributions ($PENATR_t^H$) are then currently modelled as dependent on the wage bill (WB) and on the rate of return available on pension assets (ψ), and need not change.

$$PENATR_t^H = \beta_i + \beta_i(\psi_t) + \beta_i WB_t^H \tag{8.9}$$

The prominence of bonds in the pension portfolio, however, suggests that ψ should be closer to the rate available on bonds. The value of pension returns could thus be estimated, dependent on the average rate of interest available on mortgage bonds ($r^H_{IBL_t}$), or interest rates in general. For example:

$$\psi_t = \beta_i + \beta_i(r^H_{IBL_t})) \tag{8.10}$$

It should be noted, that the above changes do not introduce any direct changes to the flow structure of the previous model. Rather, they introduce some stabilisation mechanisms to the model via the moderation of tax flows.

In terms of the interest tax deduction, interest is initially paid in full by HH, thus all flows of interest should remain in place[8.14]. For the model, at an aggregate level, it would result in an upward adjustment of disposable income by the value of the interest deduction. This is captured as a reduction to total tax levels, as in Equation (8.8) above.

The total value of income deductible due to interest payments, R_{ded}, can be calculated as in Equation (8.8) below, where ϑ is equal to 30% (or 0.3) as per Danish legislation.

$$R_{ded} = \vartheta \cdot (r^H_{L_{FI_{t-1}}} \cdot (IBL^H_{FI_{t-1}}) + r^H_{L_{FL_{t-1}}} \cdot (IBL^H_{FL_{t-1}})) \tag{8.11}$$

As noted above, the net effect is to provide HHs with a marginally higher level

[8.14]HHs in Denmark then have the option to pre-adjust their tax and so receive the tax benefit spread throughout the year, or to receive the benefits of the interest rates deduction as a lump sum at the end of the year. Typically the tax authorities adjust expected taxes in consecutive years, and so we should be able to assume that the adjustment would affect disposable income of HHs throughout the year.

of disposable income. Thus, in the case of an interest rate increase, the effect will be partially offset by the positive impact on tax deductions.

Disposable income is then adjusted to include total income less total taxation, plus income from pension distributions ($PENA_{dis}$) and minus the exclusion of returns on pension assets ($\psi_t(PENA^H_{t-1})$). The alteration to the total tax value is automatically adjusted for GOVT, as GOVT receives T^H_t as income.

$$YD^H_t = Y^H_t - T^H_t - \psi_t(PENA^H_{t-1}) + PENA_{dis} \tag{8.12}$$

The total value of pension assets is then determined as total pension assets from the previous period, plus any capital gains, and plus the balance between pension contributions ($PENATR^H$), pension returns ($\psi_t(PENA^H_{t-1})$) and pension distributions ($PENA_{dis}$).

In FlexFix, HHs hold $PENA$ against FC. The main difference is that although HHs still make contribution decisions on the basis of rates of return, an increase in the returns on pension assets does not translate into an increase in HH disposable income. For HHs there is thus an obligatory reinvestment of capital.

$$PENA^H_t = PENA^H_{t-1} + PENATR^H_t + \psi_t(PENA^H_{t-1}) - PENA_{dis} + PENA^H_{CG_t} \tag{8.13}$$

The returns on pensions still flow to HH from FC, and the change in pension asset value will simply be an internal adjustment for HH.

$$FATR^H_t = IBATR^H_t + EQATR^H_t + PENATR^H_t - PENA_{dis} \tag{8.14}$$

These alterations would then have identical, but offsetting counterparts in FC. The existing model therefore provides an excellent platform for some additional relatively straight-forward adjustments. These adjustments and the underlying composition of HH income and balance sheets could be further investigated using the administrative micro datasets.

8.5 Concluding remarks

For each of the proposed changes to FlexFix, there are some expected implications. The inclusion of household refinancing behaviour is expected to alter the impacts of interest rate adjustments in FlexFix - possibly reducing the effect of the interest rate channel. Refinancing also has the potential to substantially change the debt-asset profile of HH. As noted above, the ordering of interest rate adjustment could also play a significant role in the ultimate balance sheet profile of each of the sectors. This may have significant consequences for future borrowing capacity (via the balance sheet channel).

The second suggestion incorporates the important economic concern of financial instability. The key concern addressed is the tendency for lenders to over-extend their balance sheets in times of optimism and strong economic growth. As noted by Disyatat (2011), it is not the result of a deliberate attempt to increase risk, but rather the accommodation of greater and greater number of loans at low interest rates (a reflection of possibly over-optimistic views on borrower credit risk) that slowly erodes the capital buffer of the sector.

One of the key criticisms of macroeconomic models prior to the GFC was an inability to predict or anticipate the risk that a crisis might emerge. These dynamics might be effectively captured by the inclusion of a combination of conditional behaviours, as implemented by Beckta (2015), together with credit supply constraints, as done by Nikolaidi (2015). In combination with the path dependency of the SFC framework, this may help to identify systemic risk in the economy at an earlier stage.

The final suggestion, to integrate the Danish pension system, would provide a more realistic idea of the risks associated with Danish household debt than FlexFix. HH debt has received significant attention in the literature and is often related to financial instability. The integration of HH with returns on the covered bond market via the pension sector helps to alleviate some of the long term risks associated with interest rate shocks, but it is not likely to mitigate short term volatility in HH disposable income. This is particularly the case where greater portions of debt are held in flexible rate products, as noted in Article 5.

In conclusion, the present state of FlexFix, and mortgage lending system therein, are incomplete, but there are several opportunities to refine it in order to capture the position of the Danish HH sector more realistically. As noted in the literature review, there is a trade off between simplicity and interpretable of the results of test on the model. It is presently uncertain whether these adjustments would contribute to a more stable baseline model, but it is certainly possible that they could.

9 Conclusion

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9.1 Conclusion

This thesis addresses the interaction between the sector balance sheets in Denmark, and thus contributes to understanding the impact and transmission of economic shocks and policies for the economy. This is particularly important in the context of rapid financial balance sheet expansion that preceded the Global Financial Crisis (GFC). The thesis is grounded in the Post Keynesian economic paradigm, and the Babylonian mode of thinking, where path dependency and a pluralist approach to method and methodology are encouraged.

As noted in the introduction, the period leading up to the GFC was characterised by broad-scale financial liberalisation, deregulation and privatisation. In the years prior to the crisis, it is argued that this led to the rapid expansion of the financial balance sheets of economic participants, and the institutional sectors to which they belong. In Denmark, it also led to the accumulation of the highest level of household debt to disposable income in the world. From a macroeconomic perspective, this expansion was driven by the interaction between the institutional sectors of the economy. These interactions are crucially important for the understanding of the transmission of economic shocks or policy measures throughout the economy.

A significant concern in the context of the Danish economy is that although Denmark maintains a sovereign currency, the Danish Krone is pegged to the Euro. In order to maintain the currency peg, and to avoid currency speculation, the Danish Nationalbank is thus compelled to keep Danish interest rates in line with those set by the European Central Bank. The consequence of which is that Danish interest rates are to a large extent, outside of the control of Danish authorities. In addition, a number of innovations in products and legislation occurred in the mortgage financing industry between 1996 and 2007, which resulted in a dramatic shift in the composition of HH debt from 100% that was previously borrowed as fixed-interest rate loans, to less than 30% by 2012. In general the innovations that were introduced resulted in a decline in the initial cost of borrowing. Although initial payments on new mortgage debt declined, this cost reduction carried with it the transfer of a variety of risks to the borrower. They also resulted in the rapid expansion of debt on the HH balance sheet to the highest level relative to sector disposable income in the world. The changes made to legislation and the interaction of HH with FC thus had significant effects on the composition of sector level balance sheets. It is further expected that any significant increase in interest rates would trigger cause some kind of property market response. If the increase in rates were sufficiently large, property prices in Denmark would be expected to fall. The two key risks identified were therefore an exogenously driven increase in interest rates, and a possible decline in property prices.

To achieve this understanding it is necessary to unpack these interactions progressively. To do so, the thesis thus addressed four key objectives: The first is to identify what the primary source of change in sector balance sheets is; the second is to empirically identify the connections and dependencies (interactions) between the three primary sectors - the private sector (PRI), the government sector (GOV) and the foreign sector (ROW); the third is to explore the implications of these interactions, and extends this analysis to include a disaggregated PRI - split into the household sector (HH), the non-financial corporate sector (NFC) and the financial corporate sector (FC); and, the fourth is to assimilate these interactions into a single macroeconomic framework - in order to examine the transmission of economic shocks or policy measures throughout the economy - and to use this framework to investigate the structure and implications of the unprecedented expansion of PRI debt relative to disposable income of Danish HH.

9.1.1 Findings

9.1.1.1 First objective: Sources of change

The first objective is addressed in Article 1[9.2] for financial balance sheets is argued to be money (debt) creation. The composition of the liability side of aggregate sector balance sheets is also recognised as an indicator of the initial use of funds, and from these it is possible to begin to identify motives. Growth in mortgage debt on the balance sheets of HH, for example, indicates an increase in demand and supply of mortgage credit. The economic drivers of the change in satisfied levels of mortgage credit can thereafter be investigated.

In terms of demand for new credit, a range of lagged correlation estimates relative to the output gap for Denmark, Sweden and Norway, in Article 2[9.3], in order to estimate the timing with which each sector net lends or net borrows relative to economic expansion. The results showed that PRI in all three

[9.2] *Money at first principles: A social value theory of money*, in Section 3.
[9.3] *Sectoral balance analysis: Evidence from Scandinavia*, in Section 4.

countries show growth in net borrowing as the output gap increased. Stated otherwise, PRI borrowing was shown to be pro-cyclical with the business cycle. The opposite was true for GOV, and the results were mixed for ROW. As expected for welfare states, GOV and PRI were also negatively correlated in all countries, reflecting automatic stabilising responses to changes in labour market conditions. This implies that as incomes rise PRI demand for credit is expected to rise with it.

From a supply point of view, the analysis in Article 5[9.4] suggests that increases in the availability of credit, or innovations that permit a greater number of borrowers to access credit, are likely to result in a higher level of credit satisfaction. This is particularly the case where the initial cost of borrowing is reduced, as was the case with the innovations in mortgage products, as such it would appear that borrowers do not fully appreciate the additional risks associated with such products.

In terms of implications, in so far as it is required for economic growth, Article 1 argues that it must also be assumed that additional debt must be held (accumulate) in the accounts either PRI or GOV. In a closed economy, the distribution of debt during and after a period of economic growth therefore depends on the extent to which PRI demanded credit, and or the level of borrowing undertaken by GOV (i.e. on the sources of the change). It is argued that the criteria for debt creation are also likely to exacerbate the problems of income and wealth inequality, which may lead to social and economic instability. The existence of large markets for potentially socially undesirable goods, such as tobacco or alcohol, further suggest that the ability to generate a profit through sales may not generate the most socially desirable allocation of capital (or resources in general). Beyond these largely normative (or political) issues, it is also argued that effective investment in the development of human and institutional capital will have important effects on the future pool of resources that might be employed through future money creation. To this extent, GOV has both the responsibility to provide public goods, and to limit behaviours (for example pollution) that result in negative externalities (climate change or loss of bio-diversity). It is thus suggested that there is some reasonable level of debt that should be held by GOV in a growing economy, and that there is a

[9.4] *Flexible rate mortgage loans: An SFC model of the impact of mortgage credit innovations on Danish balance sheet stability*, in Section 7.

significant roll for public investment in human and institutional capital.

The source of change to balance sheet positions can thus be distilled back to the initial demand for credit, against which a record of debt (liability) is created.

9.1.1.2 Second objective: Empirical observation

The first stage of empirical investigations into interactions between the macroeconomic balance sheets was to plot, in the thesis appendix[9.5], the progression of balance sheet composition of each sector over time. Thereafter, in order to understand the behaviours behind changes in the level of some of the more price volatile assets, the proportion of changes in equity and investment assets, were decomposed into price related, and transaction related changes. This acted as a guide to the source of changes in a large part of HH and NFC balance sheets. This was followed by charts of the positive and negative flow contributions to each of the sector net financing requirements, and to search for similarities across the sectors in terms of scale. The data presented and used for this analysis are sourced from national accounts data, the history and construction of which were crucial in making this research possible[9.6].

At the three sector level[9.7], the literature suggests generalised theories about the interactions, and support is provided to the Ricardian Equivalence hypothesis (REH) and Twin Deficit Hypotheses (TDH). The analysis in Article 2 followed existing literature, and estimated long-run correlation statistics between the sectors. It also included descriptive and historical analyses of the causes of major changes in the net interactions. These long run correlation results appeared at first glance to support both the REH and TDH, but it on closer inspection, this was for the wrong reasons. The negative correlation between PRI and GOV could be explained through automatic stabilisers, and the positive correlation between GOV and ROW in Norway was an artefact of international oil revenue flowing to GOV. The results also showed that the positive external balances (or trade balances) of each country, can best be explained by the history of investment and development in each. The use of net lending in conjunction with more traditional macroeconomic indicators, such as GDP or the level of

[9.5] *Appendix: Balance sheet descriptive analysis*, in Section 10.

[9.6] A brief history of the development of the system of national accounts in provided in the literature review, and a more detailed account of the developments in Denmark, Norway and Sweden is provided in Article 2.

[9.7] PRI, GOV and ROW.

unemployment, thus exposed new themes through the shifts in the flow of credit between the sectors. This analysis highlighted that the balances of each sector are interdependent, and it was argued that in the face of external deficits, it is mutually exclusive for each of PRI or GOVs to run an aggregate surplus. It also notes the importance of significant domestic investments and structural changes for the future foreign earning potential - and thus the balance with ROW.

To test the stability of the long-run relationships between sector net lending positions, correlation for rolling windows were examined in Article 3[9.8], and the analysis shows that long run patterns observed at the sector level do persist for extended periods of time, but that these patterns are also subject major adjustments. This does not preclude certain sensible relationships from persisting for long periods of time. The existence of certain economic institutions, for example, a strong welfare system, manifest in strong negative correlation between GOV and PRI for all three countries. Even this pattern, however, is inverted at certain points - particularly during the rapid expansion that occurred just prior to the GFC for Denmark and Norway. With reference to general economic indicators, it is argued that these deviations can be explained by specific economic incidents, which cause at least one sector to change behaviour for a certain period of time. These interpretations are supported by the historical analysis in Article 2. The leading causes of the dislocations are fundamental changes in the demand (expenditure) patterns of one of the sectors, and that the responses of the other sectors can be explained through standard Keynesian economic theory. In particular, the role of GOV in response to changes in PRI levels of NL at various stages of the business cycle. In this way, the rolling correlation analysis provides a simple way to identify structural beaks in broad sector patterns of behaviour.

9.1.1.3 Third objective: Implications

One of the motivations for the study was to evaluate the reliability of generalised theories about sector level interactions that have recently been used to motivate restrictive fiscal policy (austerity measures) in many debt burdened European countries after the financial crisis. SBA in Articles 2 and 3 provides a new lens through which to understand the limitations and implications of certain economic policies. The dependent nature of sector positions means that balanced-

[9.8] *Sectoral balance analysis: Short run deviations from long run patterns*, in Section 5.

budget public policy in the face of an external deficit will result in PRI debt accumulation. It is thus argued that GOV budget is not necessarily a reflection of GOV decision-making.

The analysis of the responses after the GFC in the Danish economy, in Article 4[9.9], show that the bulk of changes in the Danish public budget position in recent years have been reactionary (stabiliser) adaptations to changes in the levels of PRI income and social benefit claims. It is also noted that the driver of those changes was a decline in PRI demand - triggered by balance sheet and income pressures after the GFC. Both investment demand (in FC and NFC) and consumption demand (HH) fell, leading to a fall in employment levels, and hence the greater burden on public safety nets. Thus, while GOV is the one sector where decision making can (in theory) be centralised[9.10], it is also the sector that is designed to be most passive to the changes in another sector (PRI in particular). HH NL stabilised at almost perfectly balanced levels, but NFC and FC remain in significant surplus NL positions. This sector level saving behaviour indicates that the level of investment, and thus the creation of new credit in the NFC sector, has fallen - in spite of record low interest rates. Some of this is explained by credit supply restrictions faced by NFC after the crisis, but a substantial part is also explained by suppressed demand from the foreign sector.

In relation to austerity policies, the most important conclusion was that in the face of a negative trade balance, if PRI does not have the capacity to borrow, and GOV does not borrow, domestic revenues will fall and a decline in economic activity will be inevitable. The policy implication of this is that public borrowing and spending would be necessary to avoid a contraction - which is directly in contradiction with the requirements of austerity measures. An added consideration, however, is that this is only the case if the elasticity of imports to the GOV expenditure is smaller than the domestic spending multiplier. If import demand leads to excess expansion of external debt, the property income demands on the domestic economy may be unsustainable.

9.1.1.4 Fourth objective: Assimilation

[9.9] *Sektorbalancer i Danmark efter krisen*, in Section 6.

[9.10] Although in theory it might be possible to centralise public budgets, they are in practice determined in a highly de-centralised manner. Only a very small portion of the general GOV expenditures in Denmark are actively controlled by the central GOV, the bulk of public spending is managed at a regional and municipal level.

The final objective was to assimilate the sector interactions into a single macroeconomic framework, in order to examine the transmission of economic shocks or policy measures throughout the economy. A fully empirical stock flow consistent (SFC) model of the Danish economy, based on Byrialsen & Raza (2019), was used to investigate the paradox that the country with the highest HH debt-to-disposable income ratio in the world had what appear to be the lowest mortgage debt losses in the wake of the GFC. The model is constructed according to exactly the same principles that are applied to the SBA, however, the net balances are disaggregated into positive and negative flows. The empirical results of Articles 2, 3 and 4, thus inform several of the estimated equations used to model the interactions and behaviours of each of the sectors. The model was constructed with a focus on HH, with the aim to assess the sensitivity of HH responses to the two key risk factors described above. Unfortunately, the aggregate data available on HH debt does not provide sufficiently disaggregated detail regarding the relative importance of each of the innovations introduced during the period under study. A supplementary analysis was therefore conducted on Danish micro administrative datasets, and was used to develop more appropriate aggregates of HH debt.

Four scenarios were presented and analysed in the context of the model. i) The first reflected the interest rate risk faced by the Danish economy due to the fixed exchange rate regime, and was a two percentage point (2% point) increase in borrowing costs. ii) The second reflected a possible reaction of the property market as a result of interest rate changes, and was a permanent 20% decline in property prices. iii) The third scenario investigated the expected compound effect of an initial interest rate shock that later leads to a fall in property prices, and thus allowed the second shock to compound on the first in the model. iv) The fourth, explored the hypothetical situation where the proportion of HH mortgage debt in adjustable rate mortgage (ARM) products was substantially reduced, and involved a preliminary shift in the composition of debt, from an initial position of roughly 34% up to 80% allocated to fixed interest rate products.

The shock to interest rates has the most dramatic effect, as it drives HH income lower, together with investment. This triggers a reduction in income for NFC and a decline in import demand (an improvement in the current account balance), and ultimately a fall in employment. Within the limits of the model results, it is argued that HH responses to interest-rate shocks have become more sensitive as a result of the innovations in the mortgage financing sector. It is further argued that this increased sensitivity has significant consequences for each of the other sectors. In response to the property price shock, the structure of the property market in the model results in a decline in demand for property investment as a result of the fall in property prices. The decline in investment triggers successive declines in investment by HH, rather than disposable income directly. It also triggers a simultaneous decline in the demand for debt, and thus lower interest payments. The generally lower demand leads to job losses as NFC investment responds pro-cyclically to the decline in capacity utilisation. The net effect of which is a general economic contraction.

In terms of balance sheet effects, the property price decline provides a particularly interesting case. In scenario 3, The initial impact on HH savings from the increase in interest rates is negative, but after the property price collapse, it swings positive immediately. Initial interpretations of this might be positive, but the positive correction in HH NL was associated with a marked decline in investment - driven by the increased cost of borrowing. The ultimate impact on the HH sector of the combined shocks is significantly higher unemployment and a phase of rapid consolidation of debt[9.11]. This effects a contraction of the HH balance sheet; total financial assets contract by total of 2% three years after the interest rate shock (2023). In the scenario three, three years after the shock to property prices (2025), net HH wealth falls by 3.34%, but this understates the impact on the HH, since, as mentioned in the introduction, net measurements fail to take into account the impact on gross balances. In gross terms, stock of interest bearing liabilities falls by 10.6%, HH wealth in financial assets falls by 3.55% while stock of capital held in houses falls by 12.76%. The contraction in liabilities is substantially higher than the modest effect observed over the GFC where a similar 20% decline in property prices was observed. One major difference, however, is that HH benefited from global suppression of interest rates, which would be quite the opposite if interest rates were to rise.

In terms of financial sensitivity, and economic stability - defined narrowly here as the extent to which economic aggregates react to shocks to interest rates - the impact of the shocks are clearly smaller for scenario four (roughly half

[9.11] All affected variables and the size of effects relative to the baselines scenario be read in detail from the cross-section summary of affected variables in the appendix, in Section 7.9.4

as large in terms of unemployment effects) than for scenario three. This is particularly the case after the interest-rate shock, as HH disposable income is less responsive to the property price shock, which helps to maintain demand. On the basis of the analysis, it is argued that the change in composition of HH balance sheets has resulted in greater income and balance sheet sensitivity to economic shocks for HH, and indirectly for all other sectors.

In the introduction, the paradoxically low impact of the GFC on mortgage arrears payments and foreclosures was raised. Viewed in the context of the sector interactions of the Danish economy, particularly with reference to the strong welfare system, where HH enjoy income protection, a stable and well provisioned pension system and relatively equitable distribution of income, the Danish HH sector appears to be well insulated. This insulation indirectly provides greater stability to NFC and FC, both of which feed back into GOV and HH. As noted in the future research section[9.12], the financial markets in Denmark are tied together in quite a complex network. As a result, some risks of contagion effects across markets are identified (for example property prices, LTV ratios and the capital adequacy of credit institutions), but those interlinkages also provide HH and PRI in general with a number of protections - for example, the balance principle drastically reduces the risk exposure of mortgage lending for FC, and the pension system recaptures large parts of mortgage costs on behalf of HH. The robustness of Danish HH cannot be understood or explained by any of these factors in isolation, which brings into sharp relief the importance of sector level interactions for macroeconomic analysis.

9.1.2 Limitations and future research possibilities

There are a number of areas where the analyses in this thesis could be expanded, and there are equally, a number of important limitations related to the data, methods and finally to the model. These are addressed briefly below, together with some brief suggestions for future research.

In terms of data, the use of annual records to explain the behaviours of the real world is not ideal, but it is the only frequency of data that is available to the degree of disaggregation need for the analyses in this thesis. This is particularly the case for the micro data used in Article 5. Unfortunately, the micro-data

[9.12] *Future research perspectives*, in Section 8.

also does not contain any periods during which interest rates increased. The choice of data and methods for the correlation analysis is addressed below.

Correlation coefficients, as used in Articles 2 and 3 are simple tools, and many more sophisticated methods have been used to investigate generalised interaction between macroeconomic sectors. The aim of the analysis, however was primarily to identify sector dependencies that could be investigated through supplementary analysis. This was especially the case in Article 2, where the aim was to move beyond simple aggregates with a historical investigation into the causes of structural changes in each economy. A broad multi-country historical analysis was not feasible, and the existing literature provides a number of excellent econometric analyses, as were discussed in the article.

It is also acknowledged that each window in rolling correlation had very few observations (just four). This is also linked to the choice of data - more frequent data would introduce seasonality, which is undesirable due to timing of large structural flows, such as year-end taxation. Although short, the rolling windows cover a period of four years, while Abildgren (2006) estimated the average length of the Danish business cycle, since 1946, to be 5 years. Thus, while extending the window would increase the number of observations, this could also conceal changes in sector behaviour through a business cycle - and it is the short term deviations that were of interest.

In terms of the model presented in Article 5, the purpose of the analysis was to examine the impact of the change in composition of HH debt in relation to sector level interactions, within a path dependent macroeconomic model, with Post Keynesian theoretical foundations. There are a number of caveats raised in the article, however, none of these should have a material impact on the outcomes of the analysis. The concentrated focus on HH necessarily limited the details of other sector behaviours, but it is argued here that the behaviours included capture the broad patterns of behaviour expected by the other sectors. The one aspect that was of serious concern during simulations, was the exogeneity of asset prices and rates of return, but since the investigation was concerned with the *relative* impacts of negative shocks between a real and a hypothetical scenario, it was not necessary to generate specific projections of impacts.

The restriction of the shock to only one side of the HH balance sheet appears at first glance to be unrealistic, but a closer investigation of the HH balance sheet reveals that HH does not hold many interest bearing assets outside of pension funds. In a more realistic setting, the rise in interest rates would also affect HH incomes positively, but, as the model is mostly concerned with the shorter term responses, the scale of the effect is expected to be limited to only those assets from which the income is accessible immediately. The exogeneity of asset prices and rates of return are potential drawbacks, however, as noted in the article, it is not obvious that creating endogenous links between financial markets, assets and rates of return (i.e. a more integrated financial sector) would be an improvement on the current model structure, as it would obscure many of the current transmission channels that are of interest.

The model is by definition an abstraction, and therefore aggregates away many additional details about the Danish economy. Some of these details are addressed in the future research perspectives section. The empirical model from Article 5 is called "FlexFix" for brevity. The first proposal is the integration of household (HH) refinancing patterns in response to changes in interest rates. FlexFix currently does not include any reactionary behaviour by households, and so may over or understate the risks associated with the shocks applied in scenario testing. The second is the integration of credit risk, potentially through the introduction of supply side constraints. The motivation for this is that FC in FlexFix currently accommodates any level of demand for debt from HH. As was discussed in *Future research perspectives*, this was not reflective of the realities faced by HH and firms in the years following the global financial crisis (GFC), where credit was not available for many non-financial corporates (NFC) and HH that demanded it. The third proposed change is to implement a circular flow of funds for HH. In summary, HH pay interest and fees through mortgage-debt products to FC, and many of those fees are then transferred from FC to pension funds. Those pension funds are in turn owned by HH, but the returns and assets held are only accessible at some point in the future. In a sense, the interest paid on any mortgage bonds held in this manner constitute inter-temporal substitution of consumption (or saving) made by HH. The motivation to pursue this addition to FlexFix is the relative size and importance of HH pension assets, which make up roughly 50% of all HH financial assets. The pension system is also an integral part of the Danish economy and contributes to the stabilisation of income and expenditure patters of Danish persons throughout the life-cycle.

9.1.3 Contributions

The articles presented in this thesis contribute to the literature in several aspects. Article one revives moral and ethical concerns related to the creation of money, and promotes political discussion of public borrowing. Articles two, three and four all contribute to the relatively limited SBA literature, and Articles two and three introduce new applications of the SBA; firstly, for historical analysis and secondly, for the identification of behavioural structural breaks. The empirical model, and micro-data analysis in Article five contributes to the understanding of the impact of innovations in housing finance from a macroeconomic perspective, and adds to the limited set of fully empirical SFC models. Finally, the future research perspectives offer a fairly detailed road forward for additional contributions.

10 Appendix: Balance sheet descriptive analysis

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10.1 Introduction

This chapter provides a bird's-eye overview of economic developments in Denmark over the past decades. The first goal of this section is to illustrate the significant expansion of the volume of financial assets and liabilities relative to the productive activities of the economy. The second objective is to identify which asset and liability components have contributed most to each sector's position. The composition of gross, rather than net, positions provide some indication of the extent to which the sector positions are connected. For example, the bulk of the equity issued by the non-financial corporate sector is held by the household sector.

The final objective is to develop an understanding the nature of the budget constraint that each sector faces. Although the national accounts records are ex-post aggregations, and thus cannot inform decision-making for each sector, the budget constraint nonetheless illustrates certain financial limitations faced by each sector. For example, a surplus for the RoW sector (I.e. foreign trade deficit) must be balanced by a cumulative deficit position by the domestic sectors.

To be able to illustrate this, it is necessary to identify all flow components that contribute both positively and negatively to the budget of each sector. It also provides a simple visual overview of the changes in the composition of flows over time - a feature that is very useful for identifying similarities in patterns across sectors.

10.2 Descriptive data

The expansion of financial assets between 1995 and 2017 has been extensive in many countries, but Denmark stands out, with the highest household debt to disposable income ratio in the world. Aggregate levels of balance sheet expansion reveal a continuous extension of the degree of leverage in all sectors.

Following the conventions of the United Nations System of National Accounts (Inter-Secretariat Working Group of the European Communities, 1993), and the European System of National Accounts (Eurostat Euponean Commission, 2013), the expansion of financial assets can be investigated for each of the five main institutional sectors - the Household sector (Hh), the Financial Corporate Sector (FC), the Non-Financial Corporate Sector (NFC), the Government Sector

(Govt) and the Rest of the World Sector (RoW).

10.3 Stock composition

10.3.1 The total economy

Whether or not these developments have been or are problematic is a complex question to answer. A common approach is to present and analyse the net financial position of each sector, as in Figure 10.1. From the perspective of net financial assets (I.e. assets less liabilities), relative to GDP, the solvency of each sector is unremarkable. With the exceptions possibly of Hh with assets of approx. 174% of GDP, and RoW, with liabilities of 52% of Danish GDP at the end of 2017.

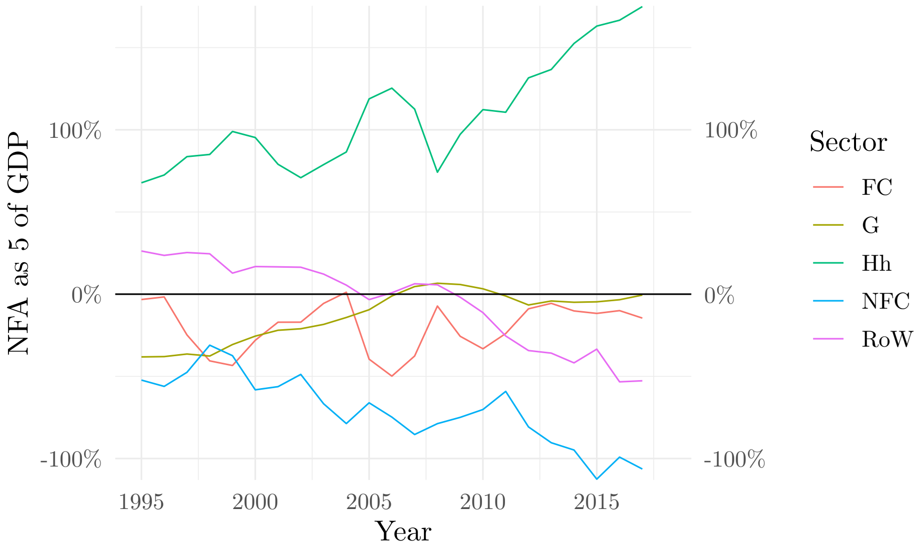

Figure 10.1: National net financial wealth

Net positions are somewhat misleading for several reasons. Firstly, net positions conceal the case where assets and liabilities expand simultaneously - I.e. gross changes in balance sheet magnitude. Secondly, it is not possible to observe changes in composition that occur within the asset and liability categories.

The following chart shows the gross magnitude financial balance sheets for the institutional sectors of Denmark relative to GDP. It includes separate asset and liability charts, together with underlying sectoral composition. Figure

10.2 is a combination of stacked bar chart and a line chart. In each year the lines represent the height of each stacked bar. In this way it is possible to see the proportional composition of both assets and liabilities (by the size of the bars), the sum of these proportions (the height of the stack), and to track the progression of each of the contributing factors (the lines). In this case the contributing components are the institutional sectors of the economy.

As can clearly be seen in Figure 10.2, the gross magnitude of the Danish financial balance sheet has expanded dramatically. In Figure 10.2, the contribution from each sector provides some insight into the relative magnitudes of their financial balance sheets. These magnitudes are as important as the relative change observed over time. The RoW and NFC sectors both started from relatively low base in terms of both assets and liabilities, but following their progress in Figure 10.2 reveals that RoW liabilities more than trebled to just over 300% of Danish GDP between 1995 and 2017, while asset holdings of the RoW in Denmark rose to just over 250%. Hence the negative net financial asset position of around -50% of GDP in Figure 10.1.

NFC had a similarly dramatic rise in liabilities, from around 170% of GDP to around 355% of GDP, while financial assets rose more modestly from just over 100% to around 245% - again reflected in Figure 10.1 by the negative net financial wealth position of the sector, at around -110% of GDP.

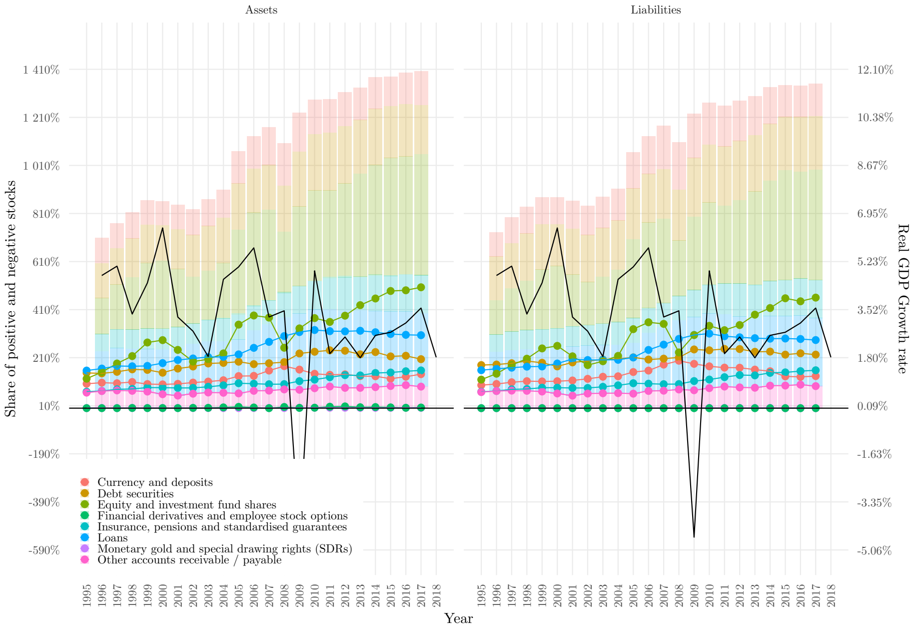

Figure 10.2: Total Economy: Financial Assets and Liabilities

While Figure 10.2 is interesting, the scale is rather compressed. This is as a result of the extreme rise in the size of the financial corporate sector (FC) balance sheet. It was expected in advance that FC, to a large degree, holds the counterpart assets of liabilities held by other sectors, and similarly holds counterpart liabilities for many of the financial assets of all other sectors (NFC equity and investment issues being an obvious exception)[10.2].

All charts are nominal values, normalised by taking them as a proportion of nominal GDP of the same year. A cursory look at the gross levels of assets and liabilities for all sectors shows an expansion for the general economy from roughly 750% of GDP to well over 1500%. The question that then arises as to what the outcome of such an expansion has been. In terms of literature in favour of capital market deepening (see for example, Apergis, Filippidis, & Economidou (2007)), it is expected that substantial improvements should be visible in some key economic indicators.

[10.2] The issuance of corporate debt is of marginal significance, as is shown in Figure 10.11 for NFC below. Hh are not expected to issue any securities directly, although they do participate indirectly in the (sale of) covered bonds market via mortgage borrowing.

A simplistic explanation is that financial expansion should be used to allocate resources effectively for the purpose of economic growth. An expansion of financial capital then might be reflected in an expansion of tangible capital. In order to investigate this, one could consider fixed assets relative to GDP. Unfortunately that does not provide much insight, since, although the fixed asset to GDP proportions have shifted marginally over time, Figure 10.3 illustrates that the levels of fixed capital stock relative to GDP have been almost perfectly static[10.3]. The dotted line in the chart illustrates real GDP growth through the period, as measured on the right-hand axis. The sharp decline in 2009, coinciding with the global financial crisis (GFC), can be seen to have some impact on the household sector[10.4].

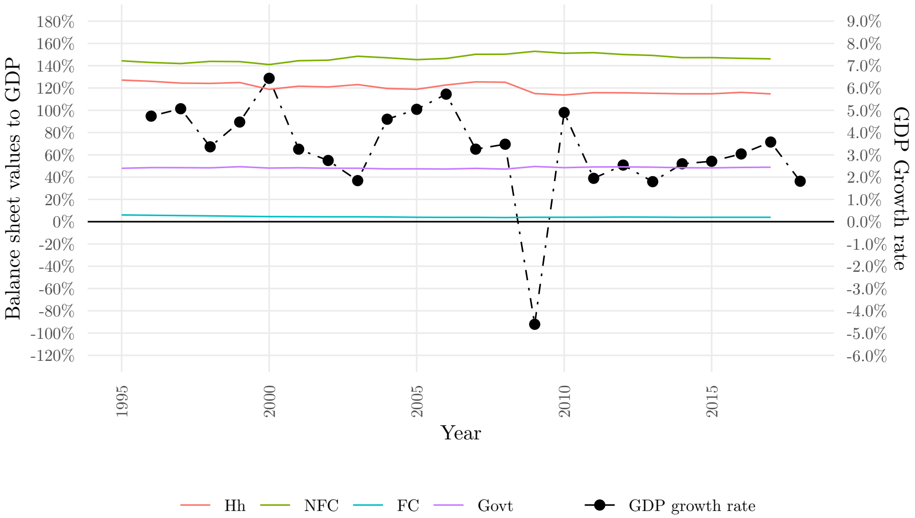

Figure 10.3: Total Economy: Fixed Assets

Another avenue or outlet for the growth in financial market debt and assets might have been to fund investment, or in terms of the SNA, gross fixed capital

[10.3] *N111N Dwellings (net)*, *N112N Other buildings and structures (net)* (Subcategories: N1121N Buildings other than dwellings (net), N1122N Other structures (net)), *N11MN Machinery and equipment and weapons systems (net)*, *N115N Cultivated biologicalresources (net)*, *N117N Intellectual property products (net)* (Subcategories: N1171N Research and development (net), N1172N Mineral exploration and evaluation (net), N1173N Computer software and databases (net), N1174N Entertainment, literary or artistic originals (net), N1179N Other intellectual property products (net))

[10.4] Household fixed assets showing the only notable decline around the 2009 crash, an issue largely related to the ownership structure of agricultural land, falling agricultural land prices, and property prices in general.

formation (GFCF, or I). A cursory look at the data, as shown in Figure 10.4, indicates that this might have been plausible.

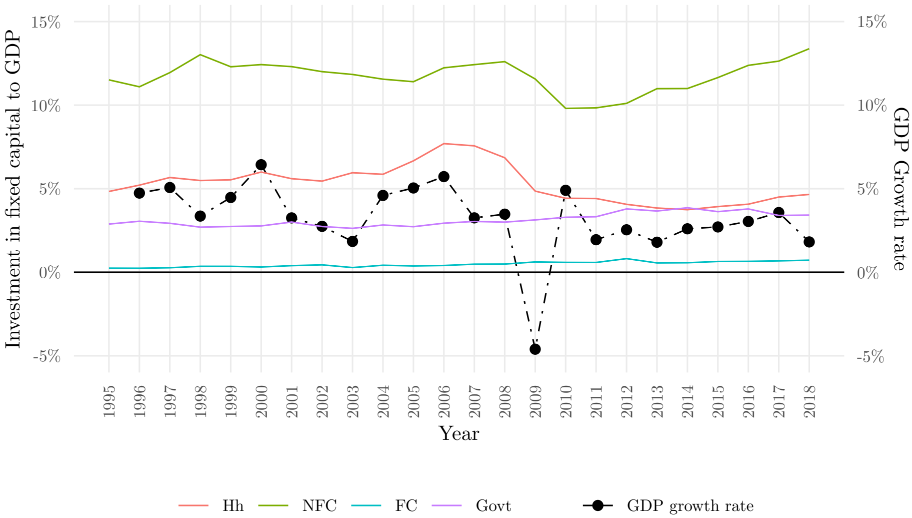

Figure 10.4: Total Economy: Gross fixed capital formation

In both Figure 10.4 and Figure 10.5, the level of GFCF illustrate nominal levels of investment (GFCF) as a proportion of GDP. The idea being that if financial capital was used to fund business investment, it should show up in real business capital formation. The unadjusted level of GFCF in Figure 10.4 appears to support this theory, with NFC GFCF at between 10% and 13%, between 3% and 4.5% for Govt, and Hh GFCF between 3.5% and 7.5%. At times, the sum total level of GFCF near to 25% of GDP. This, is however, only part of the full picture.

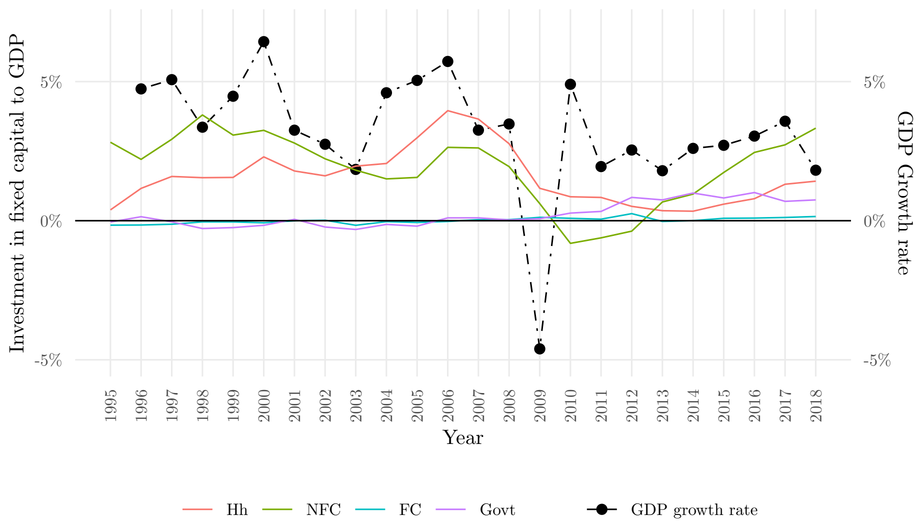

Figure 10.5: Total Economy: Gross fixed capital formation less depreciation

When one deducts depreciation (or consumption of fixed capital} from investment (GFCF), as shown in Figure 10.5, the actual additions to capital stocks reflect what is shown in Figure 10.3 - that fixed capital stocks have remained relatively unaffected. Replacement costs almost completely account for all investment after 2009. A better explanation of the drivers of the dramatic expansion of Danish financial balance sheets requires a further disaggregation of the data into specific asset classes.

It should be stated that so far, a stock, the financial balance sheet, has been compared with a flow, investment. This is potentially a misleading representation of what has occurred over the previous decade, however it does give some indication of the relative importance of each in comparison to nominal GDP. If GDP had expanded as a result of the financial balance sheet expansion, then it should be expected that the relative size of GDP would have in some way kept pace with the financial expansion. This appears not to have been the case.

Gross fixed capital formation, as a flow, is also measured relative to GDP. By contrast, GFCF has remained stable relative to GDP, as has the nominal level of fixed assets. While this is certainly an imperfect measure, it is sufficient to suggest that the bulk of the expansion of financial balance sheets has not translated into similar developments in fixed capital. In order to explore this further, the individual sector asset and liability compositions are presented below.

10.3.2 Household Assets and Liabilities

Household financial assets, as shown in Figure 10.6, as a proportion of GDP, doubled from around 155% to just over 300% of GDP. liabilities, by contrast rose from just under 100% of to a peak of around 250% of GDP in 2009 - in which a marked decline in GDP played a significant part. Debt levels have since declined steadily as the Hh sector has slowly de-leveraged.

The composition of the dramatic expansion of assets, as illustrated below in Figure 10.6 is dominated by a combination of pension assets and equities and investments.[10.5] The vast majority (over 75%) of Hh assets are presently held in a combination of equities, investments and pension funds. In considering the potential risk to household solvency, it is worth noting that pension assets are not immediately accessible.

The component called "Equity" in the chart, is in fact a combination of equity and mutual fund holdings or issuances by each sector[10.6]. The Hh of course do not issue either category and it thus does not feature on the liabilities side of the Hh balance sheet.

[10.5] This pattern is almost perfectly mirrored by the rise in equity liability figures for the NFC sector in Figure 10.11.

[10.6] The asset classes indicated follow the ESA 2010 classifications and are abbreviated in the chart for brevity. Monetary gold and special drawing rights (SDRs) are excluded from the analysis as the total value is negligible and is only held by FC. The full name of each asset class is as follows: F2.Currency and deposits; F3.Debt securities; F4.Loans; F5.Equity and investment fund shares; F6.Insurance, pensions and standardised guarantees; F7.Financial derivatives and employee stock options; F8.Other accounts receivable / payable.

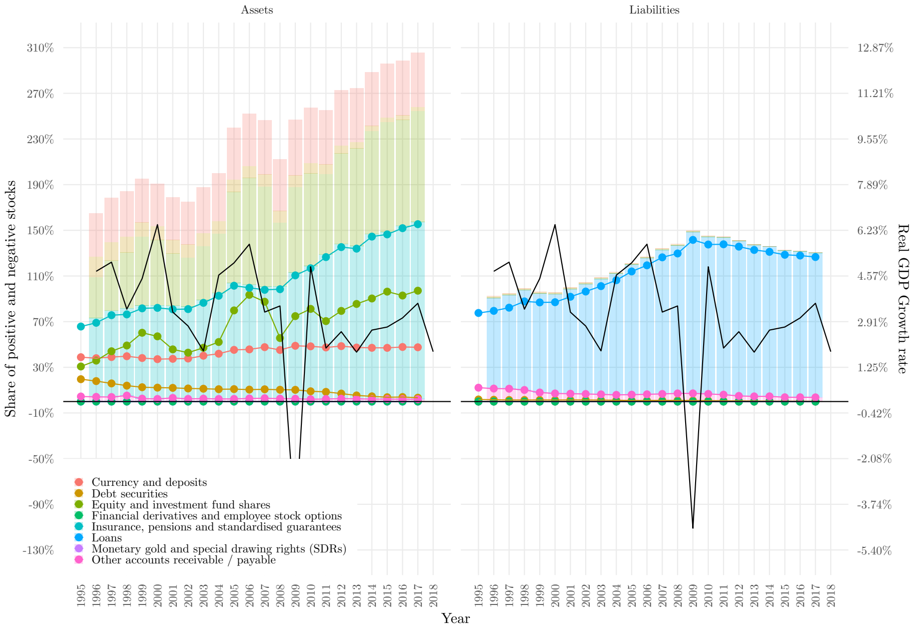

Figure 10.6: Hh: Financial Assets and Liabilities

These developments, and those for the sectors that follow below, should be read in the context of record low interest rates and financial capital markets that have absorbed enormous quantities of liquid capital through what was called unconventional monetary policy, or 'quantitative easing'. In Denmark, as in several other European economies, the effects on equity prices has been remarkable. Between 2010 and 2016, Danish equity prices more than doubled. In comparison with other European countries, as shown in Figure 10.7 below, at the end of 2016, Denmark had the greatest equity price growth out of all EU countries. These price developments suggest a possible explanation for where new financial capital has been directed.

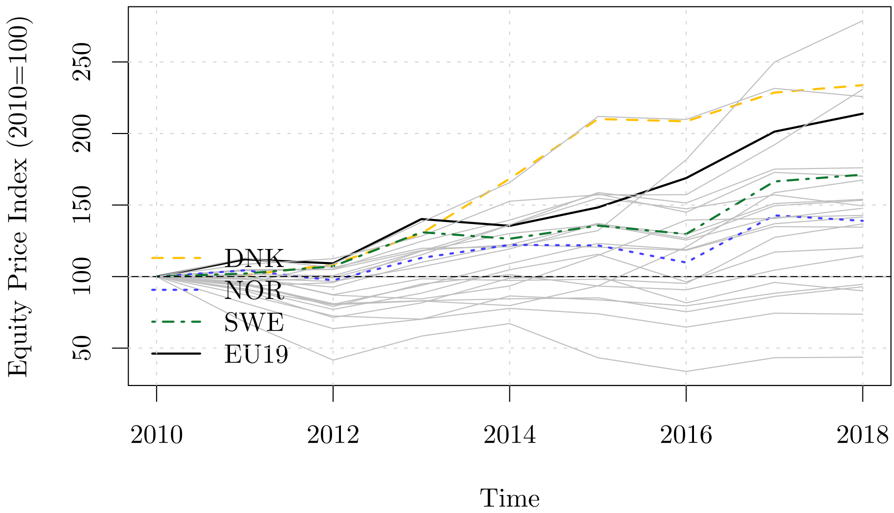

Figure 10.7: European equity price developments since 2010

With interest rates an a historic low, there really is no further scope decreases in the future. This poses a significant capital risk to household assets. The magnitude of potential capital losses being proportional to the relative proportional change in interest rates (rather than percentage point changes).

Fortunately, in Denmark, a large portion of the value Hh debt is linked to bond prices. Unfortunately, since 2003 the proportion of mortgage debt linked issued against flexible rate, or adjustable rate mortgages has increased dramatically - effectively stabilising the nominal value of household liabilities. In addition, Hh debt-to-disposable-income levels are the highest in the world, and peaked at just over 300% in 2009. This expansion of household debt and the potential risks it poses for the Danish economy will be a key focus in thesis. Certain innovations permitted individuals to borrow more freely for the purchase of housing after 2003, and as can be seen in Figure 10.8 this accelerated borrowing can also be associated with price increases in residential property of all types across Denmark. Figure 10.8 shows an index of property prices, taking 2006 (shortly before the peak of the Danish housing bubble) as the base year (index value = 100). It therefore shows relative price movements, for one-family houses, owner-occupied flats and weekend cottages (summer houses). The period from 2003 to 2006 in all cases resulted in around a 100% increase in property prices.

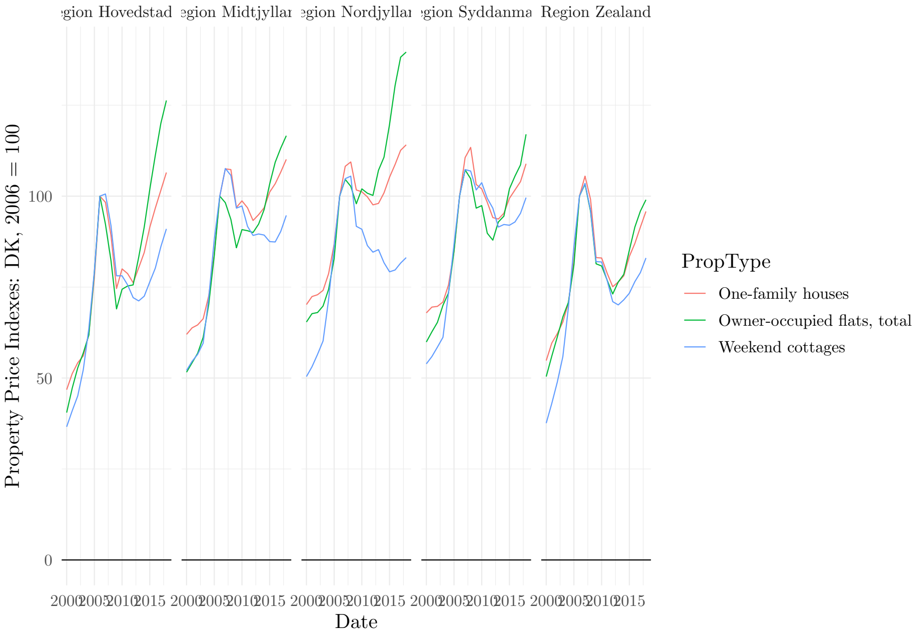

Figure 10.8: Regional Property Prices: Quarterly

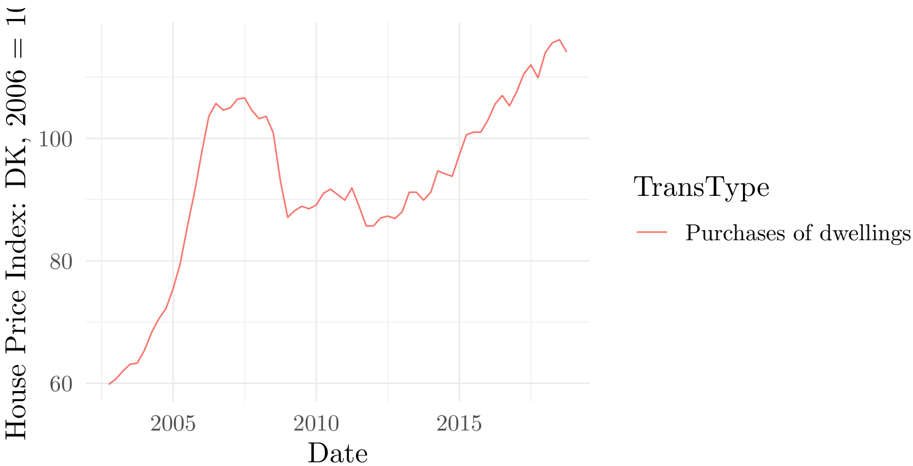

Figure 10.9: House Price Index (HPI): Quarterly

In terms of potential means of repayment, it can be seen in Figure 10.6 that liquid financial assets, such as money as deposits, have remained fairly stable, although rising marginally over the period. With the evidence presented thus far, it is by no means certain that the household sector is in any immediate danger, but it would appear that the financial position of the sector as a whole is substantially more fragile than it was in 1995. As can be seen from 10.8, even relatively stable house prices dropped between 5% and 25% for various categories of property across the regions.

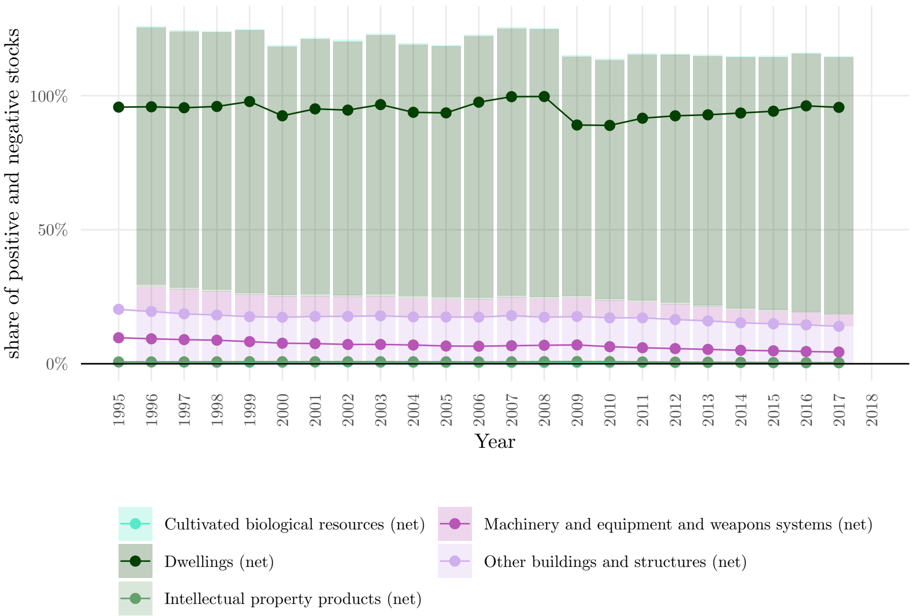

Figure 10.10: Hh: Fixed Assets

10.3.3 Non-Financial Corporate Financial Assets and Liabilities

The NFC sector is equally interesting, but for two different points. As can be seen in Figure 10.11, the first is the rapid acceleration of financial equity liabilities, from less than 60% of GDP in 1995 to well over 200% in 2017.

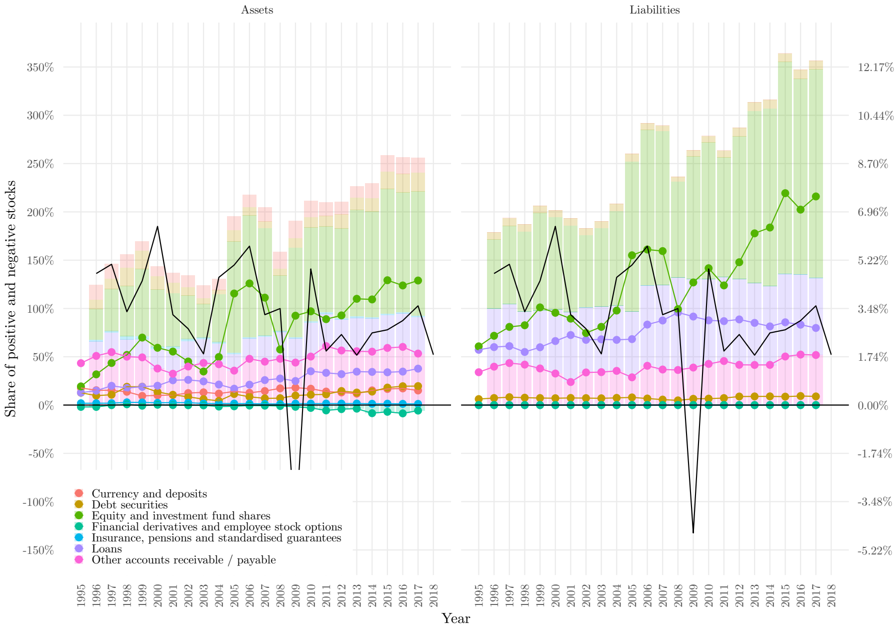

Figure 10.11: NFC: Financial Assets and Liabilities

The second is the dramatic increase in equity assets as a proportion of total financial assets, and the correlated rise in equity prices. This trend of NCF equity accumulation has several possible causes. The first, and least problematic is a simple expansion of the issuance of equity capital in Denmark to fund business growth. The second possible explanation, Barwell & Burrows (2011) presented as an explanation for similar occurrences in the UK through the late 1990s and early 2000s. They noted a rapid increase in the number of merger and acquisition (M&A) deals, and for the UK, such deals often involved the purchase of foreign companies and the issuance of equity in order to fund acquisitions. This created an accounting dilemma. The new equity issued stock and the existing stock of the purchased company would be counted together towards the equity liability of the holding company. Unfortunately it is not possible to separate these tiered holdings in the aggregate data.

The third is that NFCs have progressively become "financialised", by which it is meant that NFCs have progressively migrated from productive investment towards financial investment in order to secure returns. This is closely linked to the "financialisation" arguments that the *shareholder* view took over as a dominant form of corporate governance, as opposed to the purportedly usurped *stakeholder* view. The former focused purely on achieving returns to equity holders, and the latter on all stakeholders of the corporate enterprise - taken to include employees, up- and down-stream value chain participants and society in general.

The fourth, and most sinister possibility, management self-enrichment buy-backs, has been suggested by recent research conducted for the US. In this last category, NFC companies are reported to have issued corporate debt - presently at all time low interest rates (cost of borrowing) - with the intention of inflating equity prices around the times that option based remuneration packages become due to executive management. The US has seen a record rate of NFC debt accumulation over the previous decade.

In Denmark, however, it would appear that this trend of corporate buy-backs funded through credit channels has not developed, with gross corporate debt levels representing a negligible value, as shown by the red line under liabilities (L) in Figure 10.11.

Perhaps the simplest, and potentially most problematic, explanation is that the expansion of financial capital has been used primarily to inflate the prices of assets. Successive rounds of lending indirectly being used to support the progressive inflation of asset prices. One option to investigate this possibility would be to assess the degree to which the market capital changes over the past decade have come from new issuances or from revaluations.

Charts are presented in Section 10.4.1 below for all sectors, and will be discussed briefly there. A key take-away from Section 10.4.1 is that the NFC equities and mutual funds (both asset and liability components) are heavily affected by revaluations (as can be seen in Figures 10.21 and 10.22). Net issuances contribute only a small part of the annual change in both the *Equity and Mutual funds* and the *Equity only* categories.

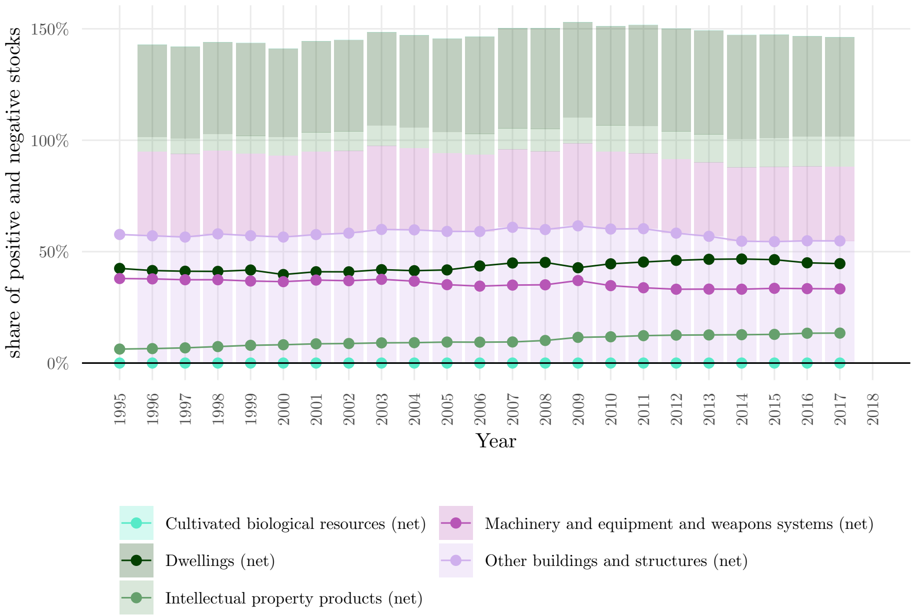

Figure 10.12: NFC: Fixed Assets

10.3.4 Financial Corporate Financial Assets and Liabilities

The financial corporate sector (FC) is more complex to decompose, largely as a result of the counterpart role that the sector plays in the financial markets. One remarkable change has been the shift in importance of equity as an asset. Figure 10.13 below illustrates this in the left hand panel as a green dotted line (or as the green bars). The only other time in the two decade history that equity prices have comprised such a large share of total FC financial assets was in 2000, shortly before the dot-com bubble collapse. A similar condition applies to equity liabilities, this may or may not be as a result of similar merger and acquisition behaviour to that described above for the NFCs of the UK.

For a comprehensive analysis, FC should really be separated into deposit issuing (taking) institutions and non-deposit issuing institutions, but for our present purposes, a more detailed explanation would provide an unnecessary distraction. While many studies and reports have dealt with the health of both types of institutions (see for example Danmarks Nationalbank (2016)), the focus of this research is on the financial stability of the household sector.

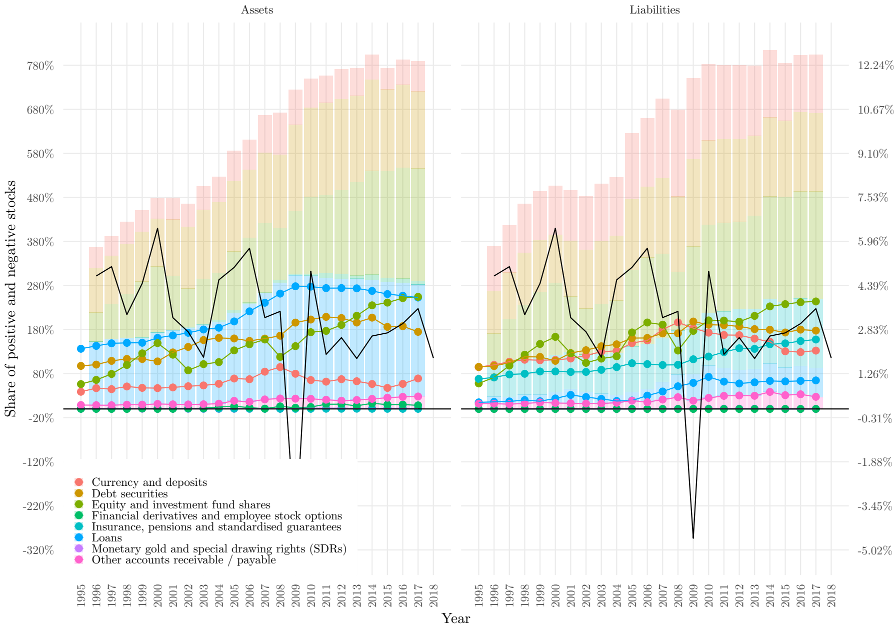

Figure 10.13: FC: Financial Assets and Liabilities

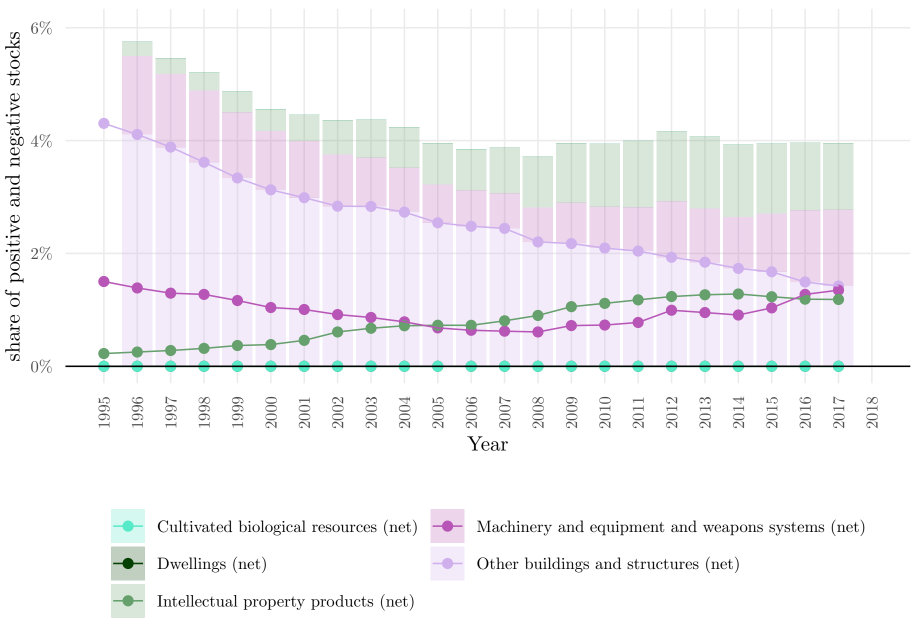

Figure 10.14: FC: Fixed Assets

10.3.5 Government Financial Assets and Liabilities

Government financial assets have been fairly stable for the past two decades, while financial liabilities have declined steadily. The trend in liabilities marks the latter part of a prolonged effort by government to reduce national debt, in particular, expensive international debts. As can be seen in Figure 10.15 below, those liabilities rose for a period over the financial crisis, presumably as automatic stabiliser mechanisms (in the form of public transfers) increased in response to labour market disruptions.

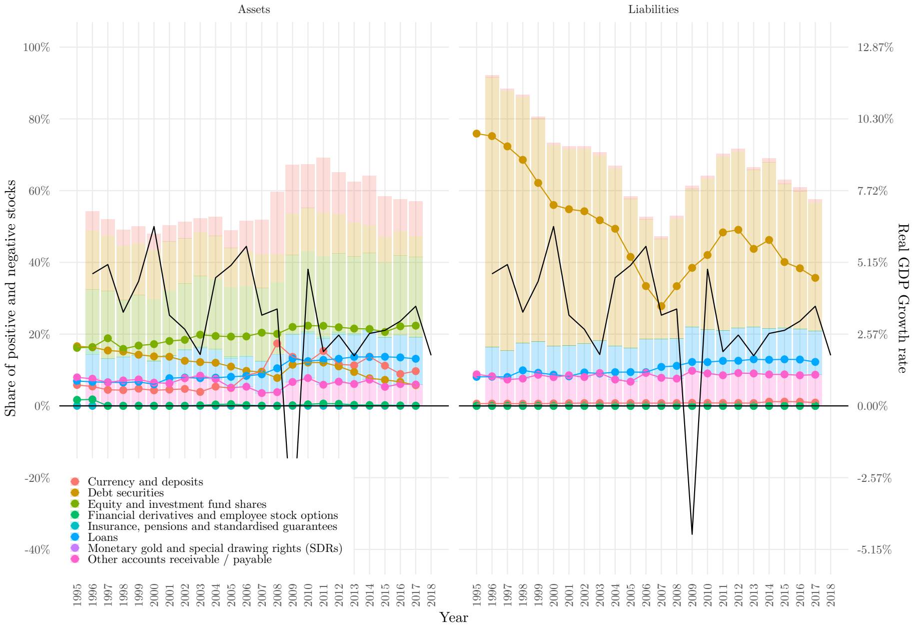

Figure 10.15: Govt: Financial Assets and Liabilities

The scale of Govt financial assets relative to the other sectors is also significantly lower, with neither assets nor liabilities ranging higher than 75% of GDP since the year 2000.

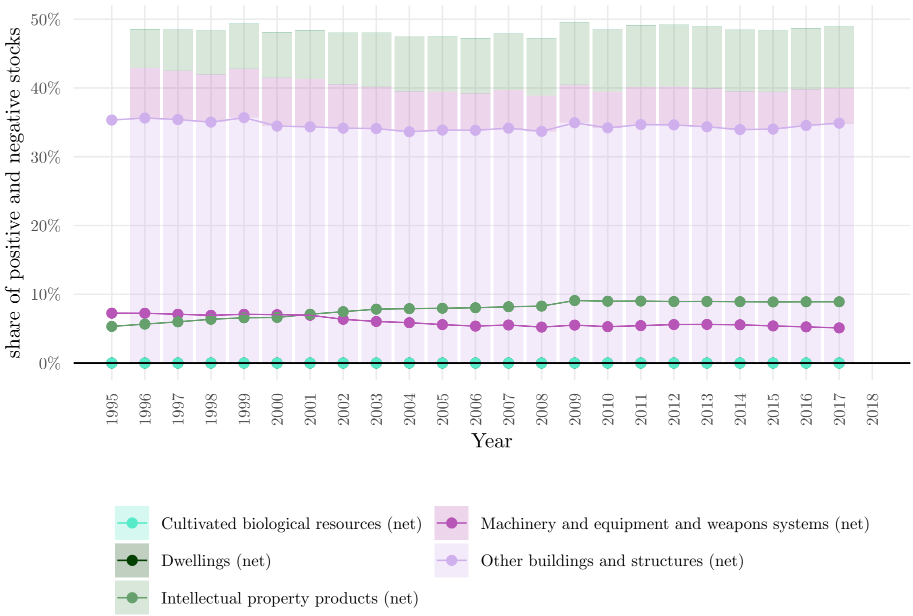

Figure 10.16: GOVT: Fixed Assets

10.3.6 Rest of the World Financial Assets and Liabilities

The Rest of the World (RoW) sector, viewed from the perspective of that sector, has progressively become more and more extensively integrated with the domestic economy. As can be seen in Figure 10.17 below, the scale of financial balance sheets linked to RoW has risen dramatically over the previous two decades. The liabilities component (that is, assets of RoW owned by Danish counterparts) has increased from approximately 75% of Danish GDP to over 300%.

In net terms RoW is a creditor to Denmark, but in gross terms, it is worth noting that RoW holdings of Danish financial assets exceed 250% of Danish GDP. The equity component once again making up the lions share of the growth in RoW liabilities to Denmark, and to a lesser degree the RoW assets in Denmark.

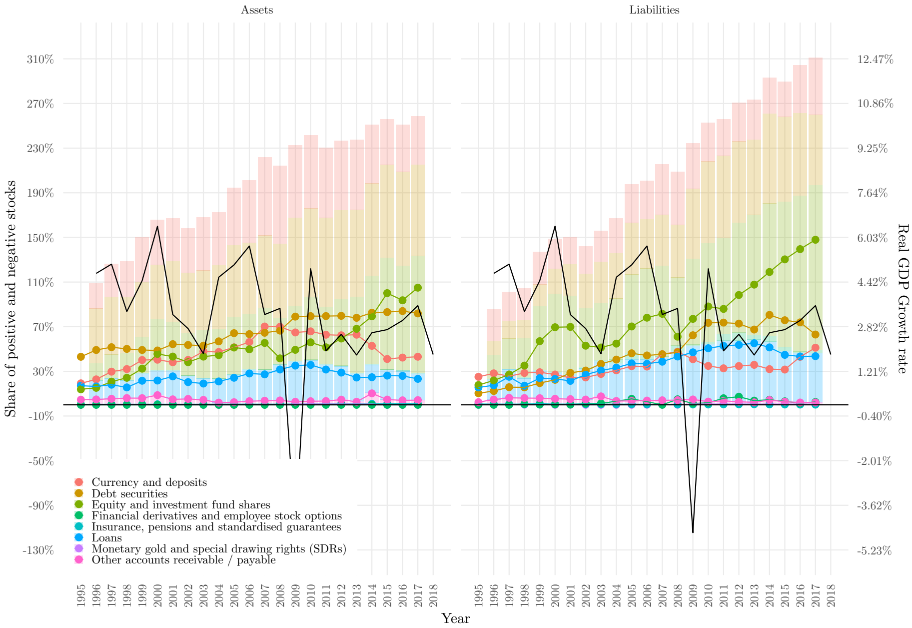

Figure 10.17: RoW: Financial Assets and Liabilities

The expansion of equity and investment fund shares as a proportion of total balance sheet values is a recurring theme in all sectors discussed above, and for RoW it is no different. This expansion, as discussed in Section 10.3.3 for NFC, the bulk of all changes to the total balance sheet values for equity and investment fund shares can be decomposed into two broad categories. Changes that arise from transactions, and changes that arise from revaluations.

Revaluation changes refer to changes in equity prices, and transactions refer to net changes in the volume of stocks held by each sector. Separating these components allows us to observe which of the two effects dominates the change in the balance sheet value from year to year.

10.4 Equity price changes: Revaluations and transactions

This section provides charts and some key observations for the change in total value of equity from year to year. Changes are separated into two parts. The revaluations component (which covers capital gains and losses) and the transactions component (which covers net purchase and sale of stocks).

The equity and investment fund shares component (Code F5 in the ESA) is presented first and a separate section is provided below that isolates the equity component (Code F51 in the ESA). Unfortunately, data is only available from 2004 for the latter, and there is one component, “other changes” that has been excluded from the charts, as in most cases the measure is not relevant and would only serve to confuse the charts.

The charts are provided in nominal values as the purpose is to illustrate composition. The sizes of the axes are scaled equally in order to provide a sense of scale for comparison between the sectors.

10.4.1 Equity and investment value changes and composition thereof

10.4.1.1 Hh: Equity and investment fund shares (F5)

Households do not issue equity or investment , and thus it is only the asset component that is relevant. As can be seen from Figure 10.18, almost all changes that have occurred over the previous two decades have been driven by prices changes. The exception being 2015 and 2016 which saw Hh make net acquisitions of Equity and investment fund shares.

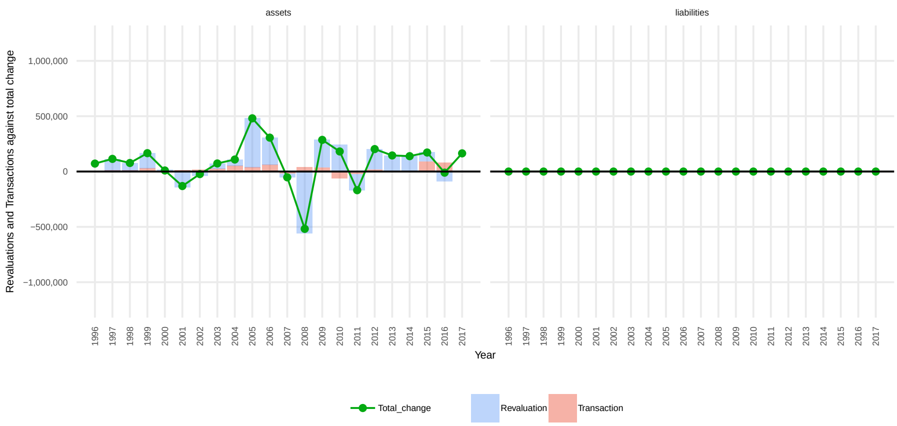

Figure 10.18: HH: Investment and Equity changes: composition

Due to the relative importance of insurance and pension fund assets to Danish Households, a similar chart is presented for Insurance, pensions and standardised guarantees (Code F6 in the ESA) for the households sector. The picture here is slightly different, in that there are consistent and significant ongoing acquisitions of insurance and pension assets by Hh. This is very likely as a result of mandatory pension investment flows.

10.4.1.1.1 Hh: Equity (F51)

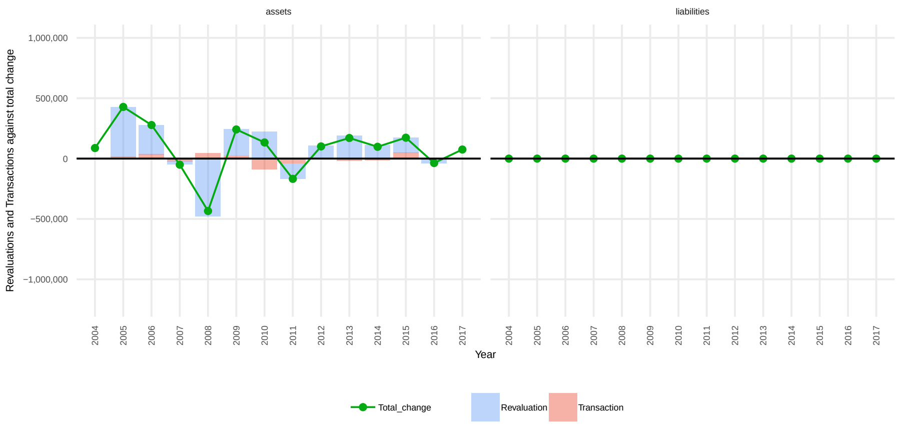

Figure 10.19: Hh: Equity changes: composition

10.4.1.1.2 Hh: Insurance, pensions and standardised guarantees (F6)

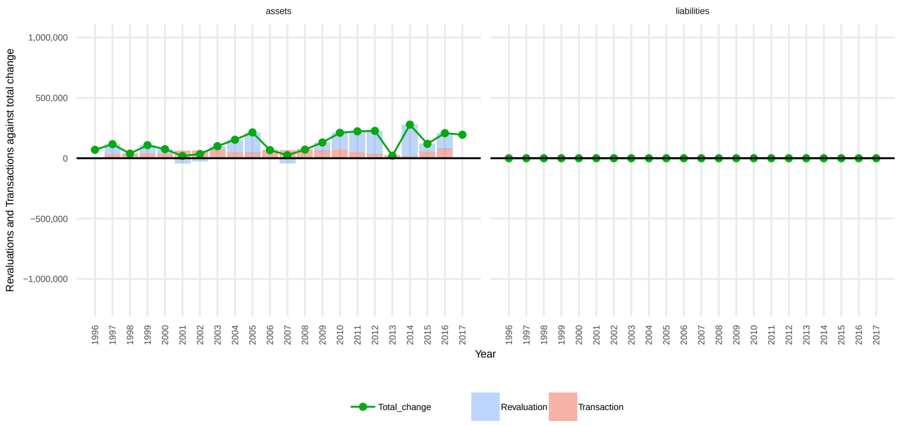

Figure 10.20: HH: Insurance, pensions and standardised guarantees: composition

Asset allocation of Danish pension funds in 2015, according to Danmarks Nationalbank (2016, p. 50), included approximately 25% in listed and private equity assets, with a strong bias towards higher yielding assets - particularly real estate investment companies. The bulk of the remaining assets were split between various bonds (64.5%) and land and buildings and derivatives (14.5%)[10.7].

Although these acquisitions are relatively small, the Danish equity and financial investment landscape is relatively limited. The constant flow of funds into the Danish market in the absence of significant issues of equity from NFC may have reinforced the extensive appreciation in equity and investment fund share prices.

10.4.1.2 NFC: Equity and investment fund shares (F5)

The effects of the pre-crisis boom and the post crisis collapse are clearly evident in the composition of NFC equity and investment fund shares, both in terms of assets and liabilities. The liability component can be interpreted as shares outstanding, and the dramatic contributions of revaluations to the outstanding value reflects changes in market prices. Interestingly, following four years of

[10.7] The asset allocation are based on a chart, are are estimated to have been as follows: land and buildings 6%, listed shares 14%, private equity 10.5%, government bonds 22.5%, mortgage bonds 27.5%, other bonds 14.5%, derivatives 8.5% and other 0.5.%.

dramatic price increases, NFC net issued significant quantities of new equities and simultaneously acquired the largest volume of listed equity and investment fund shares per year of all years observed.

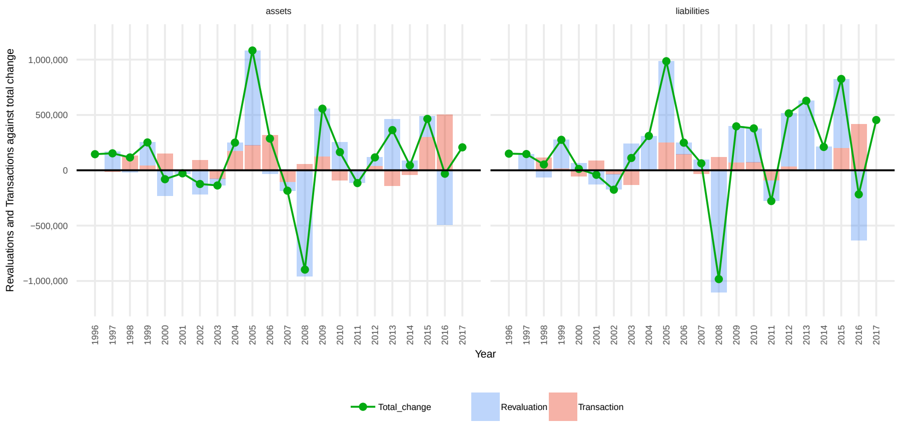

Figure 10.21: NFC: Investment and Equity changes: composition

10.4.1.2.1 NFC: Equity (F51)

The effects observed above are simply more pronounced for the equity only component of F5.

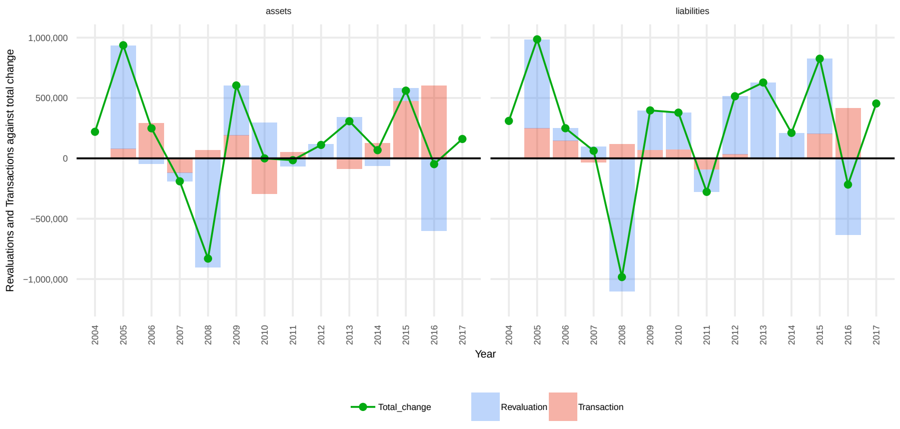

Figure 10.22: NFC: Equity changes: composition

10.4.1.3 FC: Equity and investment fund shares (F5)

In the financial corporate sector, stocks of both assets and liabilities accumulated at a more or less steady pace throughout the period. The total value of equity and investment fund shares fell dramatically at both the 2001 dot-com crisis and the 2007-8 financial crisis, but this reflects very little change due to transactions. The accumulation of assets, as noted earlier in Section 10.3.4, significantly outpaced the issue of liabilities. In 2011 and 2012, and again in 2015 and 2016 the outstanding value of equities issued by FC fell and stagnated respectively. Perhaps reflecting market responses to recent issues related to money laundering in the Danish banking system.

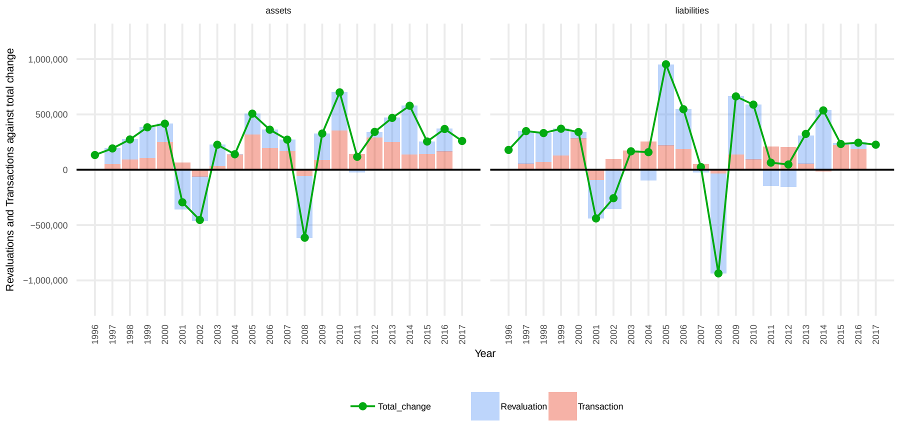

Figure 10.23: FC: Investment and Equity changes: composition

10.4.1.3.1 FC: Equity (F51)

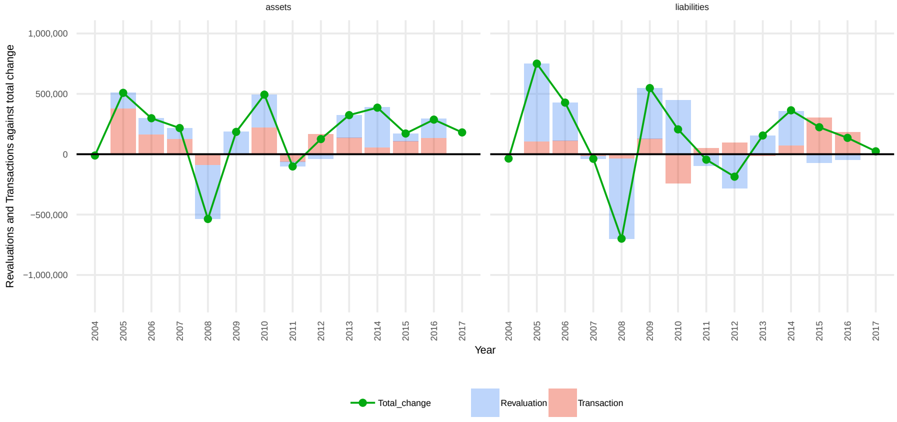

Figure 10.24: FC: Equity changes: composition

10.4.1.4 RoW: Equity and investment fund shares (F5)

For RoW, the accumulation of equity and investment fund shares and those of equities alone appears to be almost perfectly matched. This is true with the exception of a more dramatic revaluation effect in the latter during the 2007-08 crisis.

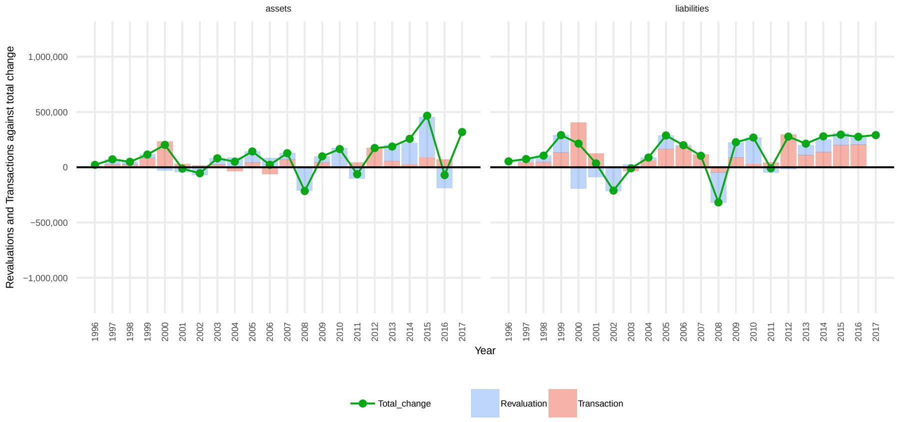

Figure 10.25: RoW: Investment and Equity changes: composition

10.4.1.4.1 RoW: Equity (F51)

Danish counterparts appear to have steadily acquired RoW assets in a majority of each of the previous twenty years. The recent rise in RoW assets appears by contrast to be almost entirely driven by revaluations. This is to be expected given the dramatic rise in Danish equity prices after 2010.

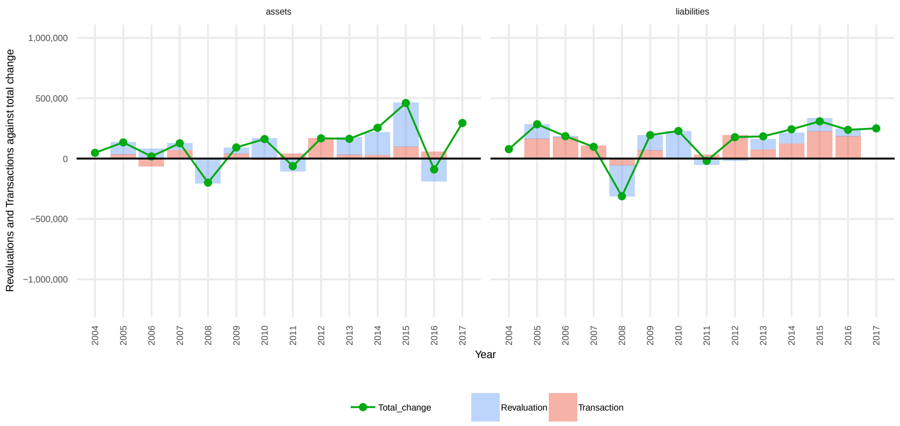

Figure 10.26: RoW: Equity changes: composition

10.4.1.5 Govt: Equity and investment fund shares (F5)

Government ownership of stocks, while important from an infrastructural point of view for Denmark, does not play a significant role in markets for equity and investment fund shares.

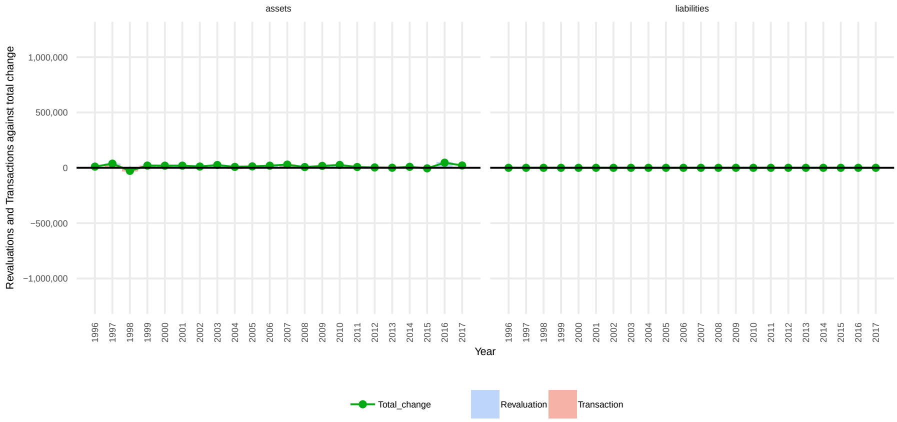

Figure 10.27: Govt: Investment and Equity changes: composition

10.4.1.5.1 Govt: Equity (F51)

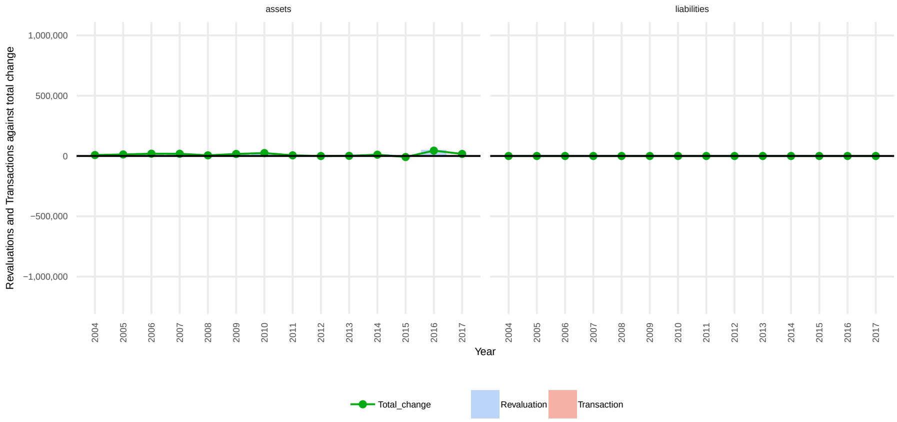

Figure 10.28: Govt: Equity changes: composition

10.5 Flows analysis

These plots cover a range of comparatives in order to properly understand the nature and evolution of the flows of each sector in Denmark. For each sector, the flows are presented first as a proportion of GDP, then as a proportional contribution to the total negative or positive flows for the sector respectively.

For most sectors, except the NFC sector, the variabels can be read as follows:

$$account[sector, received/paid]$$

The account is the income statement account that contirbutes to either the positive or negative side of the budget for each sector. R denotes an income, and P denotes an expense. For example:

$$C[h, P]$$

This is consumption expenditure, paid by the household sector. In the household section this is simple to identify as an expenditure.

A note of caution is that in the NFC section, this variable is recorded as an income for the NFC sector. This is done for consistency, as these flows are identical and offsetting.

10.5.1 Household flows

Hh flows have fallen from approximately 100% of GDP in 1995, as shown in Figure 10.29, to aproximately 90% of GDP in 2017. Figure 10.30 illustrates the proportional composition of these flows. All negative flows appear to be fairly constant, but with a significant decline in $r[h, P]$ (or, property income paid, made up mostly of interest payments) and a relative increase in tax payments, $T, c[h, P]$. Consumtion ($C[h, P]$) and tax ($T, c[h, P]$) are the largest contributors at aproximately 50% and 25% of all negative contributors.

The income side is fairly similar, with wages ($WB[h, R]$) at around 55% and Social benefits other than social transfers in kind ($STr, ob[h, R]$) at around 20% of GDP. Social transfer contributions paid by Hh ($STr, c[h, P]$) made up roughly half of transfers received up until around 2008. Both the Gross operating surplus ($F[h, R]$) and the level of property income received ($r[h, R]$) declined steadily both as a proportion of GDP and as a proportion of total positive flows between 1995 and 2017.

This decline, however, is a decline in realtive and in real, rather than nominal, terms, as can be seen in the Figure 10.31, which shows the nominal changes in flows. To clear up any confusion, the variable $PEN[h, R]$ represents *Adjustments* *for the change in pension entitlement* received by Hh, rather than pension incomes (which form part of social transfers received).

10.5.1.1 Household flows: As a proportion of domestic GDP

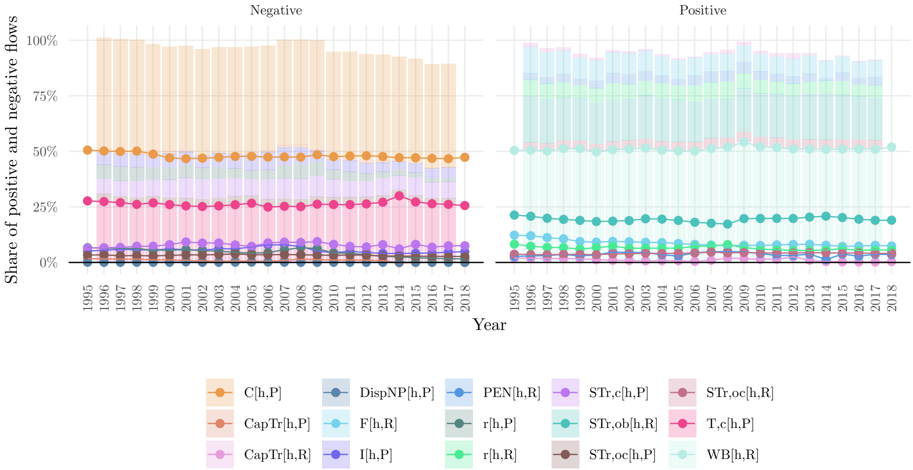

Figure 10.29: Hh: Composition of Flows: B9 Proportion of GDP

10.5.1.2 Household flows: As a proportion of positive and negative totals

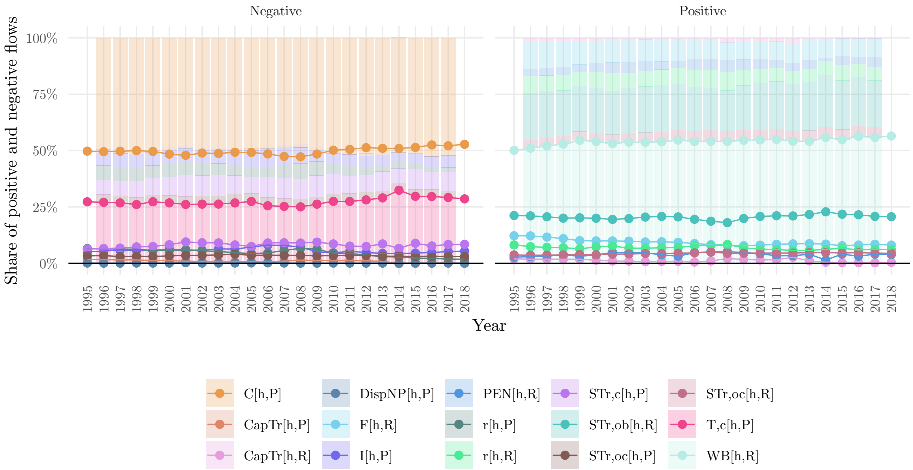

Figure 10.30: Hh: Composition of Flows: B9 proportion of (+) or (-) totals

10.5.1.3 Household flows: In level terms

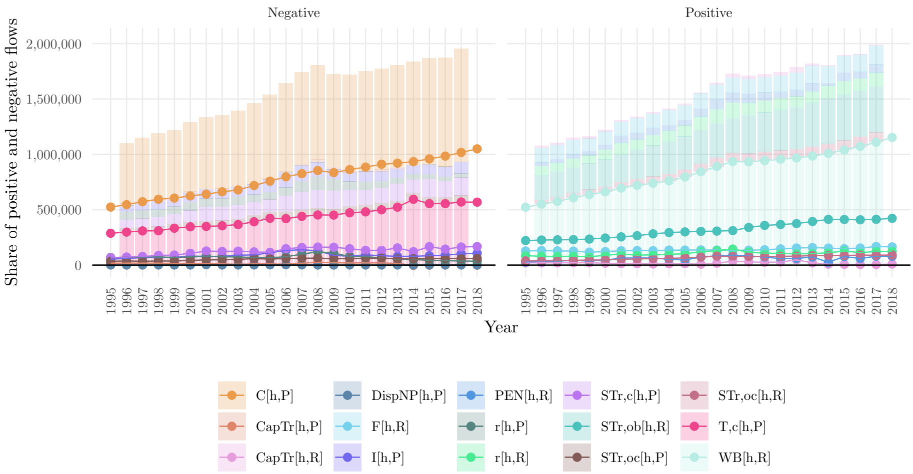

Figure 10.31: Hh: Composition of Flows: B9 in nominal levels

10.5.1.4 Household flows: As a proportion of Household disposable income

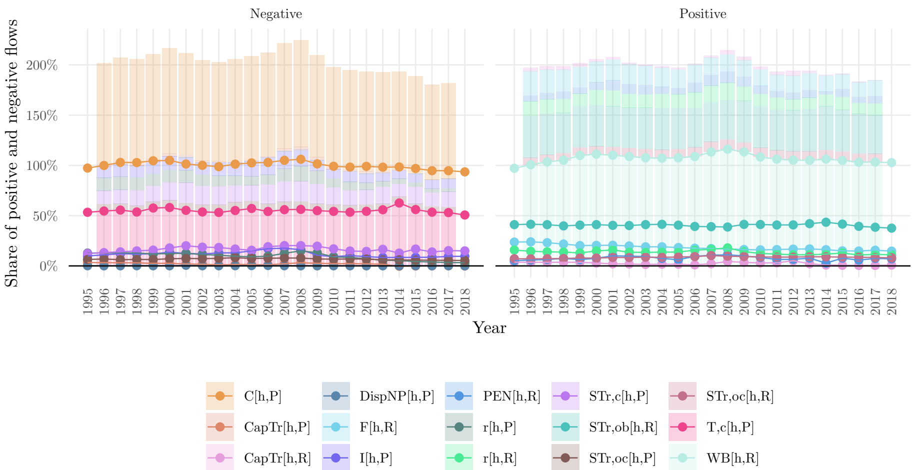

Figure 10.32: Hh: Composition of Flows: B9 Proportion of Yd

10.5.2 Non-Financial Corporate flows

Reading the NFC charts is more tedious than the household charts, as the incomes and expenditures are not as straight-forward.

In contrast to the Hh flows, NFC flows has progressively risen as a proportion of annual GDP rising from approximately 155% of GDP in 1995 to approximately 175% of GDP at the end of 2017. The positive rise was dominated by growth in exports ($EX[nf, R]$) throughout the period, while imports ($IM[nf, P]$) mirrored this rise at a lower level in the negative components. All other components appear to remain relatively constant relative to GDP throughout.

In terms of the share of positive and negative components, the absolute rise in exports and imports resulted in declining shares for all other variables. Most prominently illustrated on the revenue side by declining revenue from household consumption ($C[h, P]$).

10.5.2.1 Non-Financial Corporate flows: As a proportion of domestic GDP

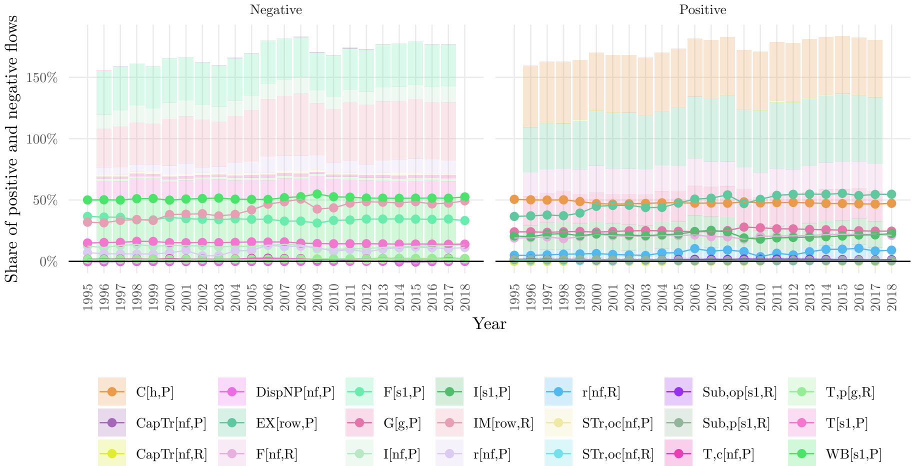

Figure 10.33: NFC: Composition of Flows: B9 Proportion of GDP

10.5.2.2 Non-Financial Corporate flows: As a proportion of positive and negative totals

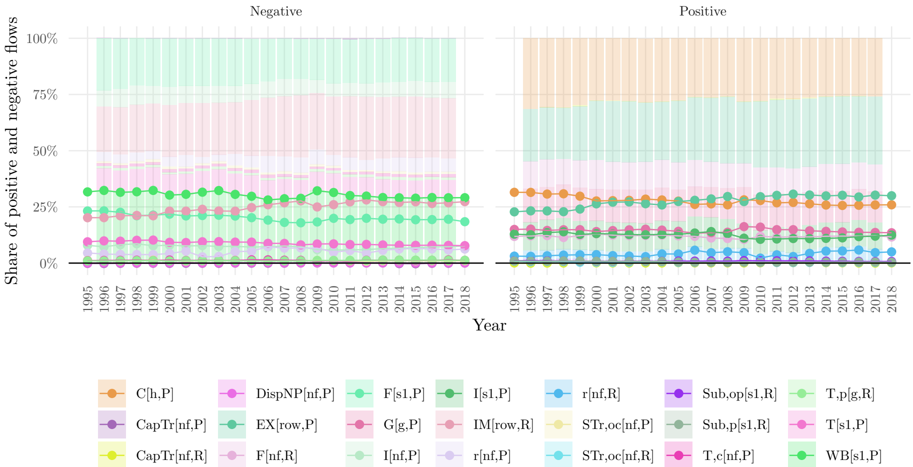

Figure 10.34: NFC: Composition of Flows: B9 proportion of (+) or (-) totals

10.5.2.3 Non-Financial Corporate flows: In level terms

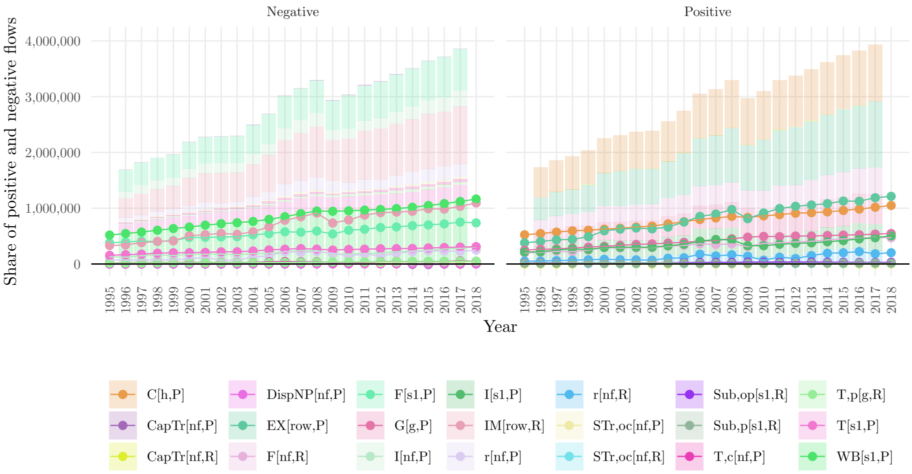

Figure 10.35: NFC: Composition of Flows: B9 in nominal levels

10.5.2.4 Non-Financial Corporate flows: As a proportion of Non-Financial Corporate disposable income

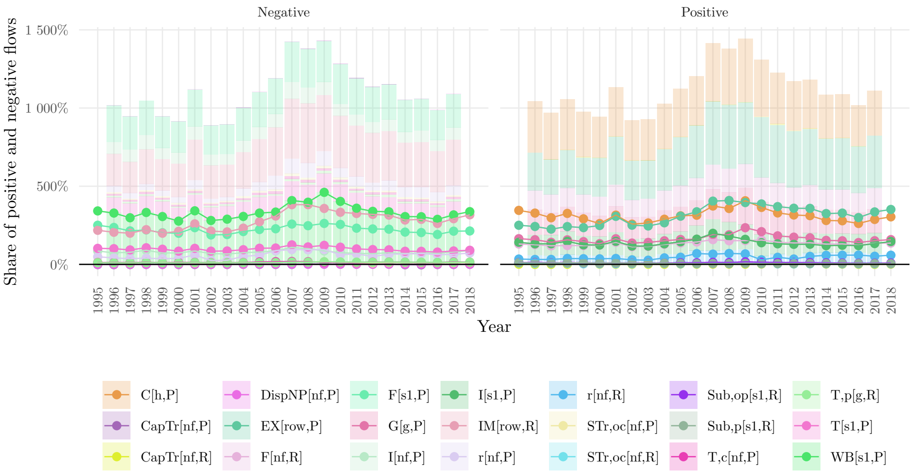

Figure 10.36: NFC: Composition of Flows: B9 Proportion of Yd

10.5.3 Financial Corporate flows

These plots cover a range of comparatives in order to properly understand the nature and evolution of the flows of each sector in Denmark.

10.5.3.1 Financial Corporate flows: As a proportion of domestic GDP

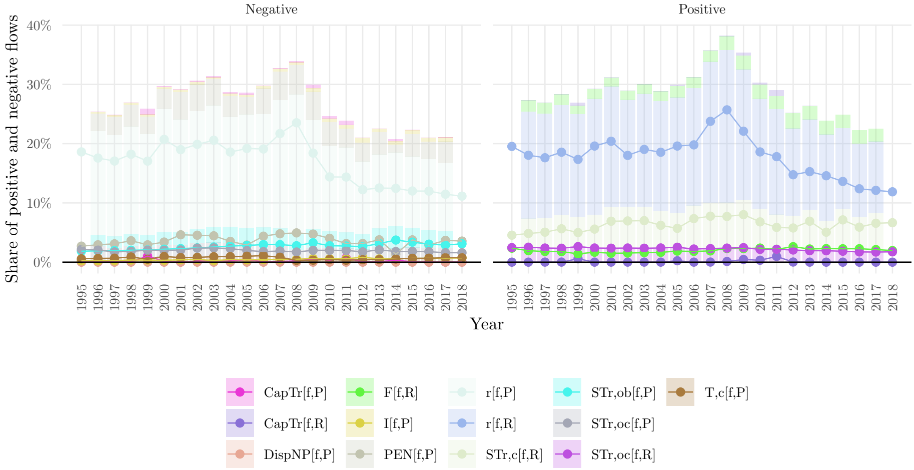

Figure 10.37: FC: Composition of Flows: B9 Proportion of GDP

10.5.3.2 Financial Corporate flows: As a proportion of positive and negative totals

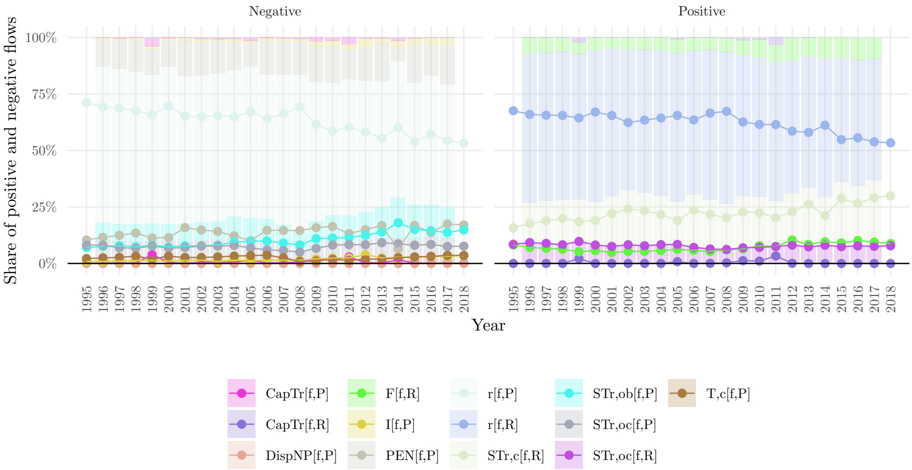

Figure 10.38: FC: Composition of Flows: B9 proportion of (+) or (-) totals

10.5.3.3 Financial Corporate flows: In level terms

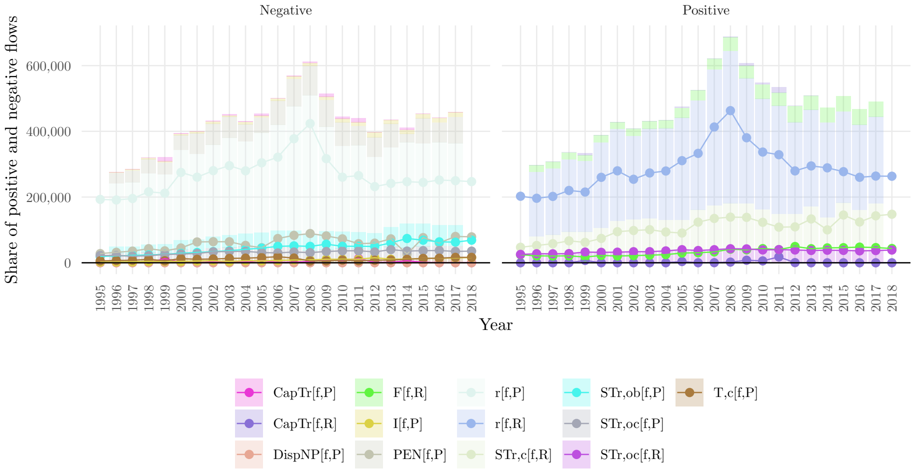

Figure 10.39: FC: Composition of Flows: B9 in nominal levels

10.5.3.4 Financial Corporate flows: As a proportion of Financial Corporate disposable income

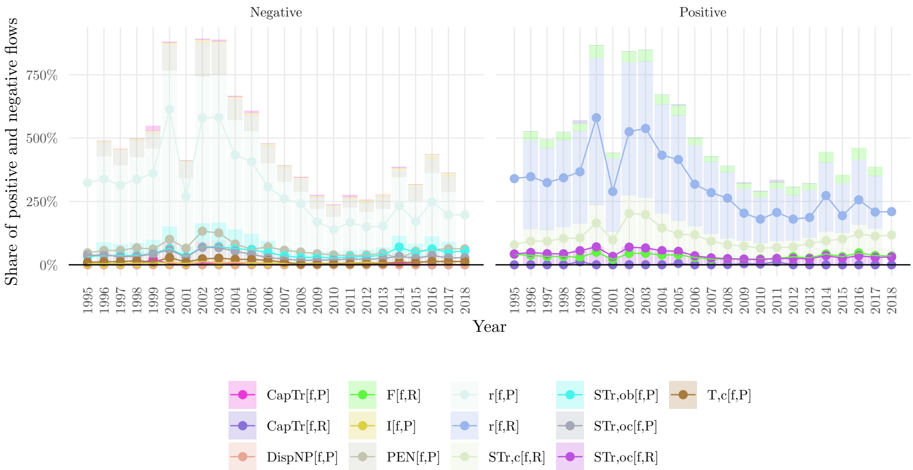

Figure 10.40: FC: Composition of Flows: B9 Proportion of Yd

10.5.4 Government flows

These plots cover a range of comparatives in order to properly understand the nature and evolution of the flows of each sector in Denmark.

10.5.4.1 Government flows: As a proportion of domestic GDP

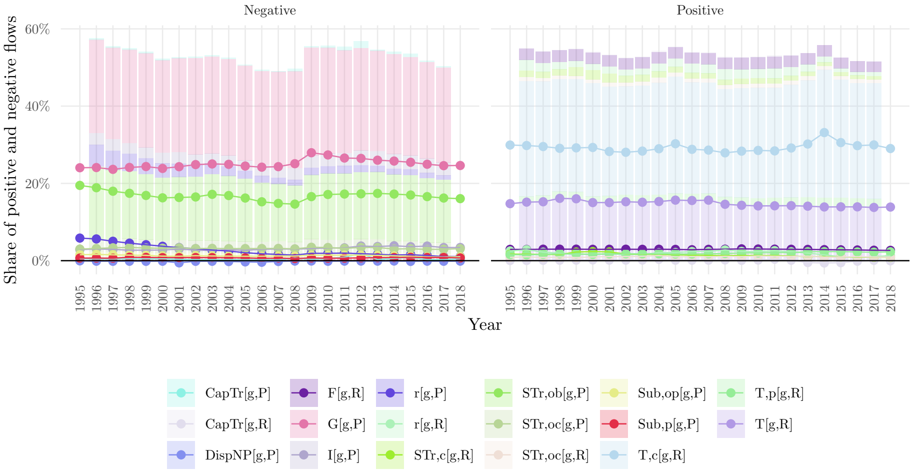

Figure 10.41: Govt: Composition of Flows: B9 Proportion of GDP

10.5.4.2 Government flows: As a proportion of positive and negative totals

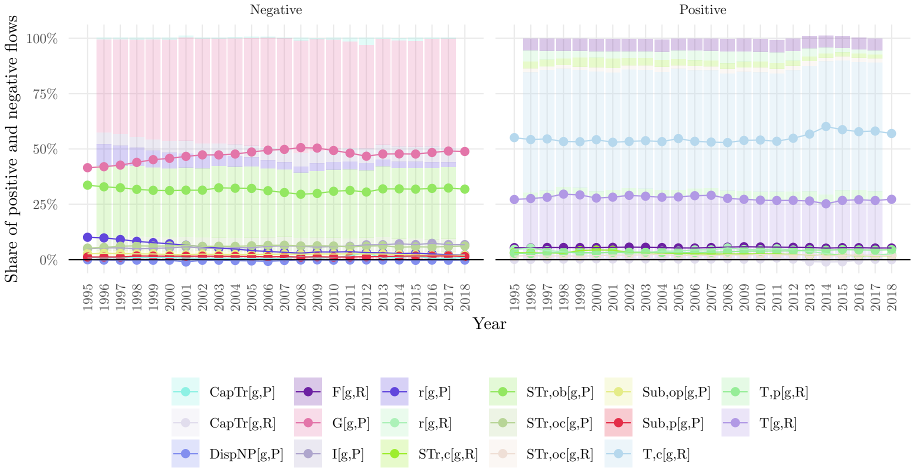

Figure 10.42: Govt: Composition of Flows: B9 proportion of (+) or (-) totals

10.5.4.3 Government flows: In level terms

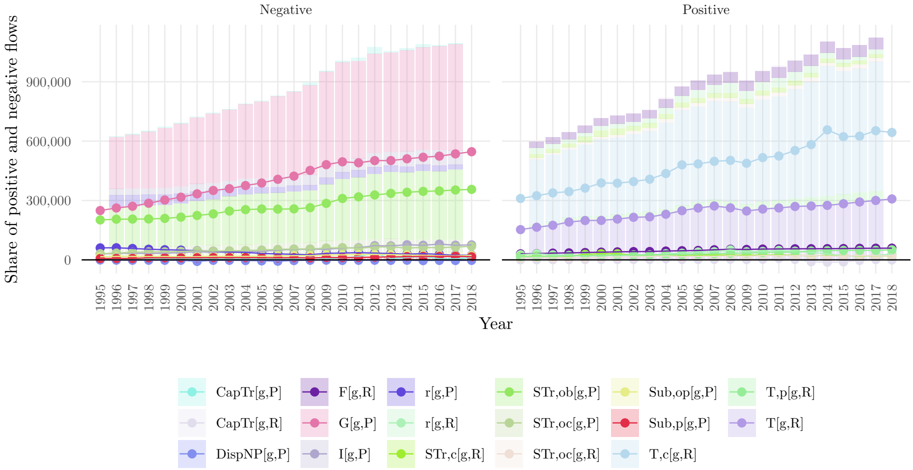

Figure 10.43: Govt: Composition of Flows: B9 in nominal levels

10.5.4.4 Government flows: As a proportion of Government disposable income

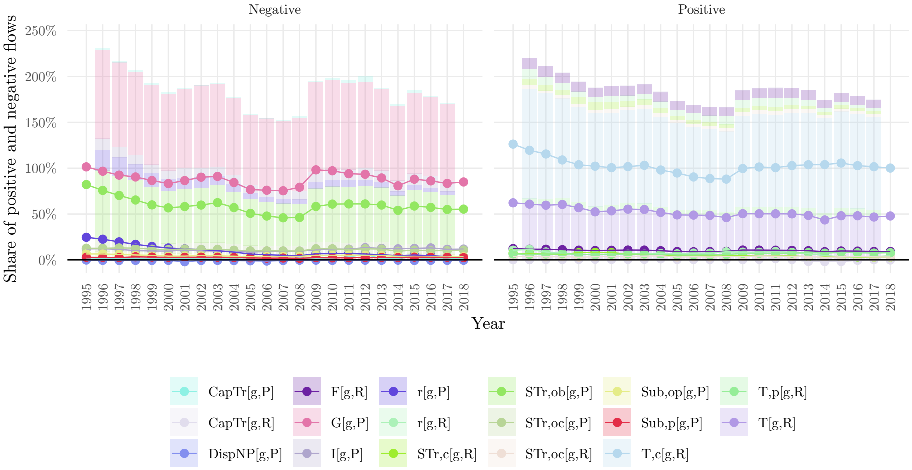

Figure 10.44: Govt: Composition of Flows: B9 Proportion of Yd

10.5.5 Rest of the World flows

These plots cover a range of comparatives in order to properly understand the nature and evolution of the flows of each sector in Denmark.

10.5.5.1 Rest of the World flows: As a proportion of domestic GDP

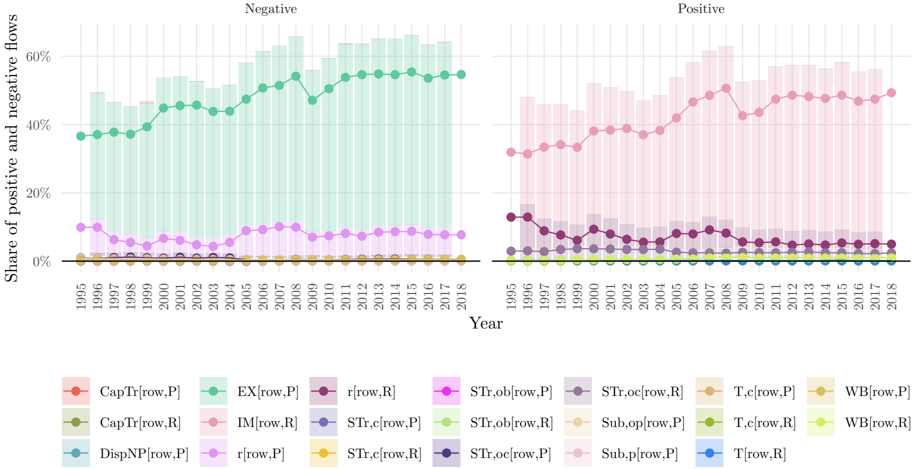

Figure 10.45: RoW: Composition of Flows: B9 Proportion of GDP

10.5.5.2 Rest of the World flows: As a proportion of positive and negative totals

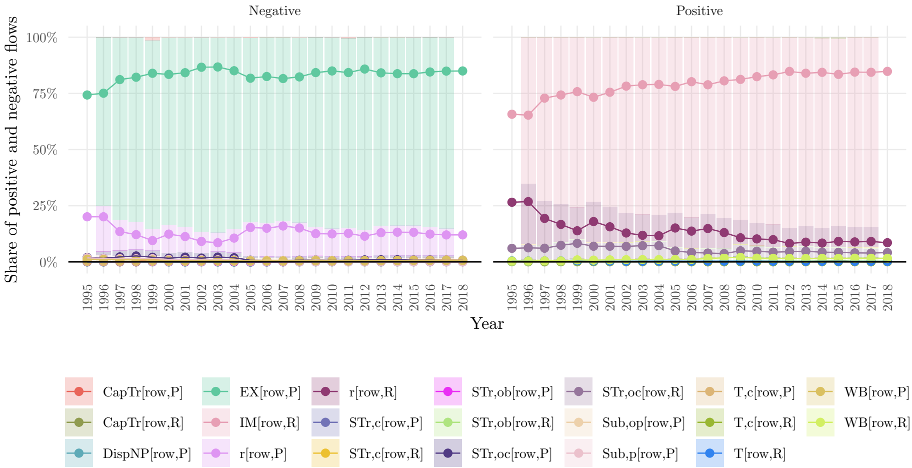

Figure 10.46: RoW: Composition of Flows: B9 proportion of (+) or (-) totals

10.5.5.3 Rest of the World flows: In level terms

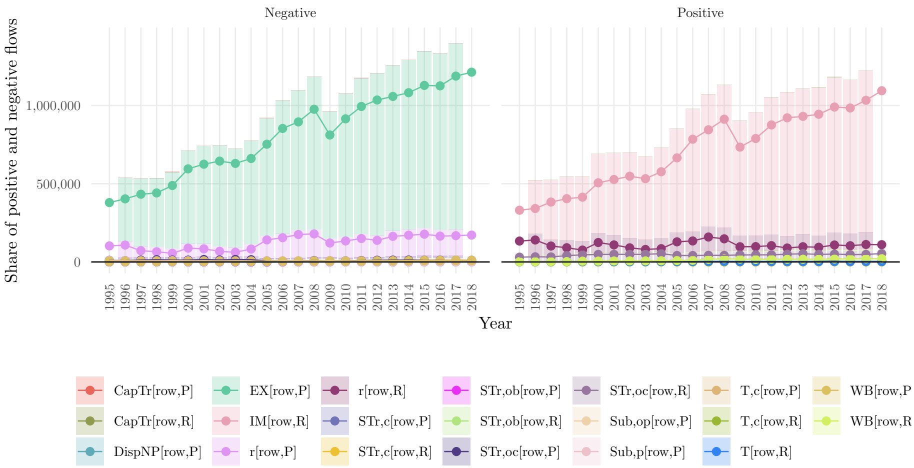

Figure 10.47: RoW: Composition of Flows: B9 in nominal levels

10.5.5.4 Rest of the World flows: As a proportion of domestic disposable income

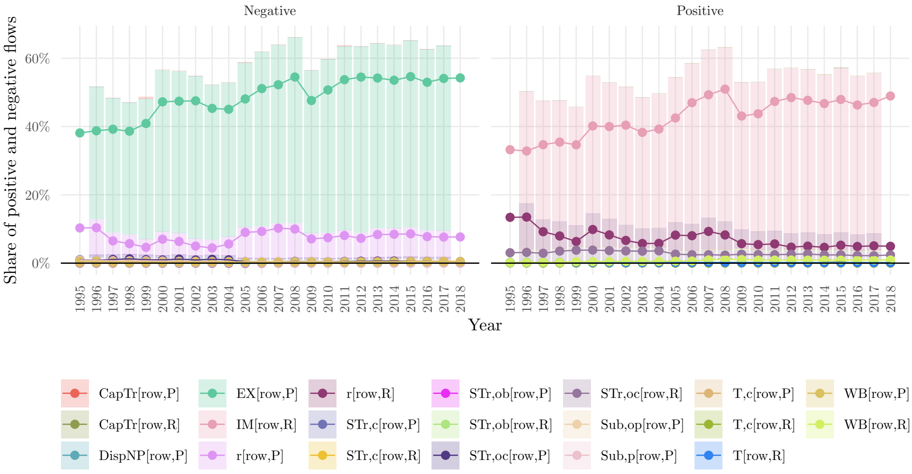

Figure 10.48: RoW: Composition of Flows: B9 Proportion of Yd

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SUMMARY

This thesis investigates the interaction between the sectoral balance sheets in Denmark, as they are crucial for understanding the impact and transmission of economic shocks and policies for the economy. This is particularly important in the context of rapid financial balance sheet expansion that preceded the Global Financial Crisis. The thesis thus addresses four key objectives: The first is to identify what the primary source of change in sector balance sheets is; the second is to empirically identify the connections and dependencies (interactions) between the three primary sectors - the private sector, the government sector and the foreign sector; the third is to explore the implications of these interactions, and extends this analysis to include a disaggregated private sector - split into the household sector, the non-financial corporate sector and the financial corporate sector; and, the fourth is to assimilate these interactions into a single macroeconomic framework - in order to examine the transmission of economic shocks or policy measures throughout the economy - and to use this framework to investigate the causes and implications of the unprecedented expansion of private debt relative to disposable income of Danish households. The thesis addresses these issues within the Post Keynesian economic paradigm and the Babylonian mode of thinking, where path dependency and a pluralist approach to method and methodology are encouraged. This is accomplished in the form of five independent, but progressive and related articles.

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