Political Perspectives on Economic Growth and Sustainability

from narratives to models

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POLITICAL PERSPECTIVES ON ECONOMIC GROWTH AND SUSTAINABILITY

- FROM NARRATIVES TO MODELS

BY
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Political Perspectives on Economic Growth and Sustainability

- from narratives to models

PhD thesis

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Preface

This PhD project was carried out by Emil Urhammer at the Department of Development & Planning, Aalborg University, Copenhagen. The scholarship was a part of the 'EcoMac' project funded by the Velux Foundations.

The project was conducted under the supervision of Professor (mso) Inge Røpke from May 2013 to August 2016. As part of the project, Emil Urhammer visited the University of Leeds, from January to June 2014, as a guest of the ecological economics group at the School of Earth and Environment, kindly hosted by Dan O'Neill.

This PhD is an article-based thesis consisting of six articles and a general introduction.

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Last, but not least, I wish to thank the Velux Foundations for funding my project, thus making it possible for me to engage with the interesting themes and topics of my thesis.

Abstract

We live in times of multiple, interconnected environmental, social, and economic crises, where climate change, financial crashes, inequality, recession, unemployment, ecosystem degradation and loss of biodiversity compete to be the greatest challenge of our time; a situation which has been made emphatically clear by the recent financial collapse in 2008 and the subsequent global economic recession and political upheavals. The present thesis delves into this monstrous planetary spectacle using macroeconomics as an entry point for discussing different political aspects of the above-mentioned complex of crises.

The main theme of the thesis is economic growth; an almost omnipresent economic policy object with significant gravity, able to determine and influence discussions and decisions about how to respond to the multiple environmental and social crises confronting societies today. As such, economic growth has become an almost unavoidable issue in economic sustainability research and policy; an entity which is difficult to avoid taking a stand on. Not surprisingly, this has made economic growth an object of strong antagonism between economic growth proponents and enthusiasts on one side, and growth opponents, sceptics, and agnostics on the other. The present thesis delves into this antagonism through several empirical entry points, the two most important of which are – economic policy proposals and macroeconomic models – for sustainability.

One of the main purposes of the thesis is to open and re-politicise the issue of economic growth and sustainability by presenting a series of alternative analytical takes and interpretations of this issue. In this spirit, the thesis does not propose many concrete economic policy solutions, but provides an opportunity to engage in and perhaps rethink the politics of economic growth and sustainability.

The thesis is organised around 3 research questions, which are addressed in a selection of articles. Question 1 regards policy proposals for solving the multiple environmental and economic crises of our age, and the narrative analysis of such proposals. Question 2 asks the ontological question of what economic growth is and how it has acquired its policy significance. Finally, Question 3 asks how macroeconomic modelling has been and still is involved in economic research and policy for sustainability in Denmark and internationally.

Altogether, the thesis consists of six articles, of which four have been published, one has been accepted with revisions, while one is an unpublished working paper. Five of the articles are devoted to answering the three overall research questions, while the sixth article does not directly concern any of these questions; instead it supplements the issues of macroeconomics, economic growth and sustainability by delving into the topic of values and value pluralism.

Resumé

Vi lever i en krisetid, hvor klimaforandringer, finansielle sammenbrud, ulighed, recession, arbejdsløshed, ødelæggelse af økosystemer, og tab af biodiversitet samtidigt er filtret ind i hinanden og konkurrerer om at være den mest uløselige samfundsmæssige udfordring. Denne afhandling adresserer dette planetariske kompleks af kriser og diskuterer forskellige makroøkonomiske aspekter af det.

Hovedtemaet for afhandlingen er økonomisk vækst; et næsten allestedsnærværende politikobjekt med betydelig indflydelse på den politiske debat og beslutninger om, hvordan vi skal reagere på de mange miljømæssige og sociale kriser vore samfund konfronteres med i dag. Således er økonomisk vækst et næsten uundgåelig emne i diskussioner om økonomisk politik og bæredygtighed; et emne man simpelthen er nødt til at tage stilling til. Ikke mindst siden det finansielle sammenbrud i 2008 er økonomisk vækst således blevet genstand for genopblusset kontrovers om økonomisk vækst. Denne afhandling adresserer denne kontrovers fra flere forskellige empiriske vinkler, de to vigtigste af hvilke er politikforslag og makroøkonomiske modeller.

Et af hovedformålene med afhandlingen er at åbne og re-politisere spørgsmålet om økonomisk vækst og bæredygtighed ved at præsentere en række alternative analyser og fortolkninger af dette tema. I overensstemmelse med denne tilgang advokerer afhandlingen ikke (i særlig udstrakt grad) for konkrete politiske løsninger, men forsøger snarere at skabe åbninger for nye forståelser af økonomisk vækst og bæredygtighed.

Afhandlingen er organiseret omkring 3 forskningsspørgsmål som behandles i et udvalg af artikler. Spørgsmål 1 omhandler politiske forslag til løsning af de mange miljømæssige og økonomiske kriser i vores tid og den narrative analyse af sådanne forslag. Spørgsmål 2 stiller det ontologiske spørgsmål om, hvad økonomisk vækst er, og hvordan denne størrelse har fået så stor politisk betydning. Endelig stiller Spørgsmål 3 skarpt på, hvordan makroøkonomiske modeller er og har været involveret i økonomisk forskning og politik for bæredygtighed i Danmark og internationalt.

Samlet består afhandlingen af seks artikler, hvoraf fire er blevet publiceret, en er accepteret med revisioner, mens en er et upubliceret arbejdspapir. Fem af artiklerne tager vare på besvarelsen af de tre overordnede forskningsspørgsmål, mens den sjette artikel ikke direkte vedrører disse spørgsmål; i stedet supplerer den diskussionerne af makroøkonomi, økonomisk vækst og bæredygtighed ved at behandle emnet værdipluralisme.

Articles

The main body of this thesis consists of the following six articles.

Article 1
Urhammer, E. & Røpke, I. 2013, "Macroeconomic narratives in a world of crises: An analysis of stories about solving the system crisis", Ecological Economics, vol. 96, pp. 62-70.

Article 2
Urhammer, E. 2015a, "Divine belief in Economics at the beginning of the 21st century", real-world economics review, vol. 15, no. 73, pp. 16-26.

Article 3
Urhammer, E. 2014, "Crisis in the habitat of the economic growth monster", On the Horizon, vol. 22, no. 14, pp. 308-317.

Article 4
Urhammer, E. forthcoming, Celestial bodies and satellites - energy issues, models, and imaginaries in Denmark since 1973, accepted with revisions for publication in Ecological Economics.

Article 5
Urhammer, E. in progress, To model or not to model - that is the question (but is it an epistemic one?), unpublished working paper.

Article 6
Pirgmaier, E. & Urhammer, E. 2015, "Value pluralism and incommensurability in ecological economics", The Green Economy, ed. A. Vatn, Norwegian University of Life Sciences, June 16 – 27, 2014, pp. 1-15.

Contents

Introduction

We are living in a time of planetary crises; climate change, ecosystem degradation and the eradication of species are taking place at this very moment, along with almost incomprehensible income and wealth inequality, social injustice and the unfair distribution of resources, while recent financial collapses and recessions are still affecting many national economies[1]. In response to this complex of crises, practitioners, activists, academics and even some politicians have taken an interest in sustainability and are proposing and investigating opportunities for a sustainable transition, a recurring theme of which is the economy.

Explaining the status of the economy as a key sustainability issues is a complicated affair. However, one way to approach this may be to emphasise a widespread perception of a well-functioning economy as a prerequisite for sustained prosperity and wellbeing. Adding to this, the emergence of global, human-induced environmental threats to prosperity and wellbeing have provided a new context for understanding the economy and economic activities and highlighted the paradoxical status of the economy as both a provider of prosperity and wellbeing and a major obstacle to the sustenance of these. This paradoxical status of the economy is closely linked to the *dilemma of growth*, which refers to the double-sided issue of economic growth as both a generic recipe for economic welfare and environmental havoc (Jackson 2009). In this thesis, the dilemma of growth provides the backdrop for addressing the multi-facetted issue of economic growth and sustainability.

Economic growth and sustainability

Given the complexity of the matter, it is not surprising that a clear-cut definition of sustainability does not exist. However, common to most sustainability conceptions is the idea of extending some prosperous and beneficial state of collective affairs into the future so that unborn generations have equal preconditions for prosperity and wellbeing to current generations (Pollitt et al. 2010). This implies that severe climate change, the destruction of vital life-supporting ecosystems, and the mass eradication of species contradict sustainability, and that a sustainable transition involves actions and changes to avoid or overcome such threats to prosperity and wellbeing.

In the sustainability literature, it is common to separate sustainability into three dimensions: *environmental*, *social and economic*, where sustainability ultimately depends on favourable conditions in all three dimensions (Pollitt et al. 2010). Even though this distinction is useful for multiple purposes, it is, however, not adopted in any strict sense in the present thesis. Rather, sustainability is seen as a more or less coherent ensemble of issues and solutions to problems such as climate change, inequality, loss of biodiversity, unemployment and ecosystem degradation, all of which are linked to economic activities in various ways. A key issue in this regard is the expansion of such activities – also labelled economic growth – the severe environmental consequences of which have been highlighted for decades and also

[1] Some might argue that the global economy is slowly recovering from the financial collapse of 2008; however, growth rates in the West have been declining for decades, unemployment in most Western countries is still high, and insufficiently regulated financial activities mean that the world is at constant risk of yet another financial collapse.

gradually documented (MEA 2005, Turner 2008, Krausmann et al. 2009, Rockström et al. 2009, Ewing et al. 2010, Wiedmann et al. 2015, Burton 2016).

Economic growth and GDP

By focusing on economic growth and sustainability, this thesis delves into contestations between various approaches to sustainability and sustainable transitions and investigates economic growth as a policy object of crucial importance to such transitions. In the following, I, therefore, briefly introduce some core issues in relation to economic growth and sustainability. To begin this, I wish to say a few words on the concept of gross domestic product (GDP); the current measure of economic growth.

The GDP measure

GDP is a measure of a country's total marketed production for a year (or a quarter of a year), which is calculated in terms of the flow of money during this period (Mankiw 1992). The flow of money is counted in two different ways: the *total income from production* and *the total expenditure on purchases* (Ibid.). These two aggregates are equal since "the expenditure of buyers on products is, by the rules of accounting, income to the sellers of these products" (Ibid.:17). Adding to this basic description, Mankiw explains how the flow of money can be divided into four overall components: consumption, investment, government purchases and net exports, where the sum of these components is considered equal to the total production of a country (Ibid.).

Using this formulation of GDP to define economic growth implies that it is the increase of monetary flows due to the production of goods and services from one year (or quarter of a year) to the next. Not surprisingly, economic decline is the opposite, and a decrease in the production of goods and services over two or more consecutive quarters of a year is called a recession (Investopedia 2016).

So far, I have merely presented basic accounting definitions of GDP, which are widely accepted and uncontested. However, controversy arises when economists argue that this measure of monetary flow is an appropriate measure of the wellbeing and prosperity of a nation as exemplified by the following: "Consumption is thus always rooted in production and income, and in so far as consumption is a good proxy for the economic wellbeing of people, annual GDP or income per person is a relevant measure of prosperity" (Sørensen & Whitta-Jacobsen 2010:29). The obvious consequence of this reasoning is that economic growth (as measured by GDP) is a vital source of prosperity and, therefore, also a key economic policy objective. This proposition is a central issue of contestation in this thesis and, in the following, I therefore briefly provide different perspectives on this issue, but first a short historical review.

A history of GDP and economic growth

Before I begin the review, I wish to stress that the history of GDP is part of the wider history of national accounting. In the following, however, I try to focus on GDP (to the extent that this is possible), while the wider concept of national accounts is further treated in the theory chapter of this thesis.

It has been asserted that the historical roots of the GDP measure stretches as far back as the seventeenth century, when the British Army commissioned a physician, named Petty, to draft a systematic survey of the wealth of Ireland for the purpose of taxation and the appropriation of wealth more generally (Fioramonti 2013). Petty's attempt to measure the wealth of Ireland was followed in the eighteenth century by French and British economists who tried to devise theoretical conceptions of the wealth of nations (Cobb et al. 1995), while further steps towards more elaborate national accounts were taken during the late nineteenth century (Coyle 2014). However, the development of a coherent system of national accounts, including GDP, began during the first half of the twentieth century as part of the efforts to overcome the upheavals caused by the Great Depression and later the Second World War (Cobb et al. 1995, Fioramonti 2013).

Haunted by the hardships of the Great Depression, the US government needed coherent economic statistics in order to get a comprehensive view of the current state of the economy, and to assess the effects of economic policy interventions (Cobb et al. 1995). All sorts of economic data and statistics were available, but no aggregate measure existed (Coyle 2015). This led the US government to hire Kuznets to propose a measure of the current state of the economy, and Kuznets responded by drafting a measure which aggregated all marketed economic production into a single number (Fioramonti 2013).

According to Coyle (2015), Kuznets intention was to draft a measure of economic welfare, which meant that he was concerned about identifying the elements of production that did actually contribute to welfare and those that ought to be excluded from the measurement since they did not. Along these lines, Kuznets also considered how the value of housework and home production could be included in his measure. Eventually, however, housework and home production were not included in the measure, while all marketed production was, regardless of whether it could be considered a contribution to economic welfare (Coyle 2015). One of the reasons for this decision was the difficulties of actually determining which elements of production should be excluded and how to impute reliable monetary values for housework and home production (Ibid.).

With the outbreak of the Second World War, the policy focus changed from economic welfare to the question of how to afford and expand an industrial war machine (Coyle 2014). In the UK, Keynes became involved in answering this question, and his involvement spurred an increasing interest in measuring economic activity instead of economic welfare (Ibid.). This change resonated with the circumstances of war, but also with Keynes's theoretical conceptions more generally, which the statistics of economic activity were eventually designed to fit. Among other things, this led to the inclusion of government spending (not least on the war) as a contribution to the measurement of overall economic performance. Before this, government spending was generally considered a drain on the economy.

The efforts of Kuznets, Keynes, and several others, including Clark, a British economic statistician, to respond to the economic hardships of the Great Depression

and the Second World War gradually led to the drafting of a coherent system of national accounts including a measure of economic performance which was first dubbed 'the gross national product' (GNP) and later, in 1991, GDP. This massive accounting enterprise paved the way for a new territory of governmental politics – macroeconomic policy – and was celebrated by the US Bureau of Economic Affairs in 2000 as "[o]ne of the Great Inventions of the 20th Century" (Tily 2015).

GDP as a measure of growth

Even though GDP is today used as a measure of economic growth, this was not the case at the time of its development. Thus, during the Great Depression and the Second World War, the measure was a means of supporting policy decisions regarding the reduction of unemployment and the allocation of resources for war purposes, which meant that the measure was used as an indicator of the current level of economic activity, not the rate of change of this activity over time (Coyle 2014). This approach changed, however, during the fifties, and in the early sixties, the Organisation for Economic Co-operation and Development (OECD) introduced GNP as a measure of economic growth (Coyle 2015), not least as a part of the competition with the Soviet Union, who commanded its own measure of national income and economic growth (Fioramonti 2013). This institutionalisation marked a turning point in policy attention and initiated the rule of economic growth, where GNP shifted from being a policy tool to being a policy end in its own right (Coyle 2015).

The gradual transformation of GNP to become an indicator of economic growth also included the incorporation of prosperity to the economic growth framework (Friman 2002). Kuznets had tried and failed to promote his measure as an appropriate measure of economic welfare, yet the adoption of economic growth as a central focus to policy-making (Tily 2015), meant that Kuznets's measure eventually gained a position as exactly such a measure. As emphasised by the earlier quote of Sørensen & Whitta-Jacobsen (2010), this status has strengthened the conception of consumption as a path to prosperity and has encouraged the promotion of economic growth by means of consumerist rhetoric and policies (Friman 2002, Fioramonti 2013).

The power of GDP

According to Fioramonti (2013), GDP has become the most powerful number in the world, a position rooted in the gradual institutionalisation of GDP as a measure of strength, success and failure of nation states and their governments, as a universal social cost metric, and as the arbiter over the affordability of public welfare expenditures (Ibid.). This institutionalisation took place over several decades and has now reached the point where economic growth is so ingrained in our collective perception of economic 'realities' that its power and influence seems to pass almost unnoticed.

Along these lines, Fioramonti (2013) also explains how the measurement of wealth has been used as an instrument of exploitation and domination to serve the interests of wealthy elites (Ibid.). In the seventeenth century, the measurement helped clear a path for the British appropriation of wealth in Ireland, while today, it helps framing the exploitation of poor countries' natural resources as a gain to their GDP (Ibid.). Finally, GDP also serves as a propaganda tool promoting the political status quo to

the benefit of the wealthy elite. An example of this is the narrative of trickle down economics, where economic growth is presented as a benefit to everybody in spite of the fact that most of this growth only benefits the top income bracket.

New upheavals

Even though the history of GDP is very much a story of an economic indicator conquering the world and achieving a hegemonic position, it is important to observe that this rise to supremacy was not without struggle or contestation (Fioramonti 2013). To exemplify this, the Soviet Union, various organisations and several academics have commanded and promoted alternative measures of economic scale, performance and prosperity. However, since the fall of the Soviet Union and the 'victory' of western capitalism, such alternatives have lived a relatively quiet life on the margin of mainstream economic discourse and policy-making.

Yet, as the global community once again finds itself in times of upheaval, with recent financial crashes and economic crises causing great concern, and climate change and ecological havoc advancing, GDP as a measure of economic growth and prosperity has become the subject of renewed contestation. This means that the question of whether we are, in fact, ruled by the wrong measure, and whether we should start developing and being concerned about entirely different accounts is receiving increased attention. Some of the questions in this regard concern whether a measure of economic performance ought to account for the activities of the financial sector more thoroughly, and whether it is appropriate to exclude stocks of natural capital from a measure of aggregate wealth. Acting on such critical issues, in 2008, the French government commissioned a group of renowned economists, headed by Stiglitz, to reinvestigate the issue of measuring economic performance and social progress (Stiglitz et al. 2009). In the following, I briefly summarise some of the issue raised in this and other similar investigations.

A new measure of economic welfare

In their report to the French government, the authors emphasise that "what we measure shapes what we collectively strive to pursue – and what we pursue determines what we measure" (Stiglitz et al. 2009:9). This underlines reciprocity between measurement and collective aspiration, a circular reinforcement, which, in the case of economic policy, has resulted in GDP growth becoming a core aspiration in its own right. However, this circular reinforcement appears to have reached a point, where the gap between what GDP measures and what probably ought to be our main collective concerns has grown to such proportions that it can no longer be ignored.

One way to understand Stiglitz and his co-authors' response to this problem is to see it as a return to the problems facing Kuznets, when he was trying to design a measure of economic welfare during the hardships of the Great Depression. Thus, Stiglitz et al. reopen the question of whether a measure of total market production is, in fact, a good proxy for societal wellbeing, and their conclusion is negative. Having said this, it is important to stress that the authors still consider it relevant to measure economic activity, not least because it determines the level of employment, yet it must be done appropriately and for the right set of purposes.

This understanding resonates with other recent fairly mainstream critiques of GDP, which emphasise the inadequacy of GDP to account for much of the value-added in present day economies (Coyle 2014, The Economist 2016a,b). Exemplifying this, The Economist explains how GDP is often unable to capture the value of innovations and services in the digital economy, and more generally, it is stated that much of what people hold dear is not captured by our "main yardstick of value" (The Economist 2016a). Putting this into an historical perspective, it is also stressed that the original purpose of GDP was to measure the productive capacity of the economy, while it is now used as a general compass for economic policy navigation in relation to taxation, unemployment and inflation (Ibid.). Finally, it is added that not only is GDP failing in terms of capturing the value-added of present day economies, using it as a measure of welfare is even more dubious (Ibid.).

Along this line of reasoning, Stiglitz et al. divide their investigation into three overall topics: *economic performance*, *wellbeing* and *sustainability*. Addressing the first theme, the authors emphasise how modern economies have changed significantly since GDP was invented, which presents new difficulties in accounting for economic output. To exemplify this, the authors highlight the massive expansion of the service economy (including finance), where the value added is difficult to capture, and to which the keyword is often quality rather than quantity; a distinction which GDP is not able to capture. Adding to this, the authors also stress that there is a need to redesign the measurement of government spending so that welfare contributions of public services, such as education, healthcare and housing, are appropriately accounted for (Stiglitz et al. 2009).

Turning to the question of wellbeing, the authors argue that there is a need to deploy multiple measures of wellbeing to complement the measurement of economic activity. As recognised by the authors, however, the list of welfare components not included in GDP is long: income and wealth distribution, health, education, political voice, social relationships, and equality of human conditions. In order to devise a reasonable welfare measure, all of these would have to somehow be taken into account. Furthermore, the authors distinguish between subjective and objective dimensions of wellbeing, dimensions which require very different methods of data collection and accounting. In conclusion, it could be argued that there are significant challenges to the project of designing a coherent set of measures for societal wellbeing.

Finally, the issue of sustainability is addressed as a question of how current levels of wellbeing can be sustained. To this end, the authors acknowledge the state of our environment as a key issue. Addressing this issue, the authors suggest the deployment of a well-defined dashboard of physical indicators to monitor the state of the environment. The basic logic in this regard is that "[c]hoices between promoting GDP and protecting the environment may be false choices, once environmental degradation is appropriately included in our measurement of economic performance" (Stiglitz et al. 2009:7).

Radical contestations

At this point, it should be noted that the Stiglitz report is only one of a long list of critical reviews of GDP, and in fact a rather mainstream example. Hence, I would now like to direct attention towards more radical growth contestations, for which I have chosen the publication of the Limits to Growth report in 1972 as a starting point.

In the early 1970s, a group of young academics was commissioned by the Club of Rome to make an assessment of the future predicaments of mankind (Meadows et al. 1972). This assessment was published in a report, which presented a series of scenarios for the future and concluded that economic growth was on a course of collapse, and would eventually meet its physical limits if nothing was done to change the course (Ibid.). The report immediately sparked heated debate, and the authors were met with harsh attacks from economists and politicians in several countries (Friman 2002, Cerasuolo 2012). What the authors hoped would be considered a reasonable warning and become a turning point in economic policy debate, was instead fiercely attacked and utterly rejected by mainstream economists and politicians (Cerasuolo 2012).

In spite of its very limited success in terms of changing mainstream economic policy objectives, the Limits to Growth report still had a significant impact on various academic communities and grassroots organisations, which adopted the Limits to Growth agenda and continued to promote and elaborate on the messages forwarded in the report. In this manner, the report became an important critique of economic growth, which was later followed by several attacks on the GDP measure for being a more or less irrelevant measure that combined costs and benefits and excluded all sorts of welfare components, such as housework and the stocks of natural resources, which help sustain our existence (Røpke 1997, van den Bergh 2011).

The critique of economic growth is closely connected to the development of the discipline of ecological economics, the founders of which expressed critical views on economic growth even before the Limits to Growth report. Thus, for decades, ecological economists have argued that the economy is a metabolic organism, the biophysical size of which cannot continue to grow indefinitely (Røpke 2004). In recognition of this biophysical limitation, some ecological economists argue that we should instead try to achieve a steady state economy with a stable or mildly fluctuating biophysical size, which does not exceed ecological limits (Daly 1991, CASSE 2016).

Such conceptions of the biophysical nature of the economy and the consequential impossibility of perpetual economic growth have existed for decades as a marginal economic discourse. More recently, however, in the wake of the financial crash in 2008 – which presented an opportunity to express a wide range of financial, economic and ecological crises as part of one unified crisis – the critique of economic growth has gained further support and gathered opposition under banners such as *prosperity without growth* (Jackson 2009), *degrowth* (Kallis et al. 2012), and *beyond GDP* (Seaford 2013).

Even though these labels stand for a very wide range of issues and proposals, it is, in my view, fair to claim that they all, in one way or another, concern what Jackson has coined the dilemma of growth. This dilemma articulates economic growth as a double-sided issue: on the one hand, economic growth provides societal stability, welfare and jobs, while on the other, it has detrimental environmental effects (Jackson 2009). This dilemma is central to the thesis and sets the scene of analysis by providing the core macroeconomic conundrum - *how to overcome the dilemma of growth?* - which presents entirely new challenges to economic thinking and has led to new modes of storytelling and macroeconomic modelling, which are further investigated in this thesis.

Three positions

In relation to the economic growth and sustainability controversies here described, three overall, overlapping (especially in the case of the latter two) economic growth positions ought to be mentioned: the *protagonist*, the *antagonist* and the *agnostic* position. The protagonist position can be further divided into two categories: the *super optimists* and the *decouplers*, where the former consider economic growth to be the solution to our environmental problems – as we get richer, we can afford to improve the environment – while the latter acknowledge that there is a need to determine how to decouple economic growth from environmental impact (OECD 2011).

Growth antagonists, on the other hand, are explicitly against the pursuit of further economic growth, and degrowth has become a well known label for this form of antagonism. However, degrowth is not merely an anti-growth movement, it also has positive content. Thus, Kallis explains that degrowth "is about imagining and enacting alternative visions to modern growth-based development" (Kallis 2015:0) and "an invitation to abandon economistic thinking and construct viable alternatives to capitalism (Kallis 2015:1). As such, degrowth is perhaps more than anything else a movement towards the re-politicisation of the economy and a move towards regaining democratic control over our economies by means of hard-fought institutional change (Kallis 2015:1). Adding to these considerations, however, Kallis also emphasises that degrowth involves the idea of "downscaling affluent economies and their material flows in a just and equitable manner" (Kallis 2015:1).

Finally, growth agnostics, who use labels such as *a-growth* and *post-growth*, question the status of GDP growth as the matter of most concern in this era of environmental and social crises. Instead, we should rather care about material flows, ecological impact, employment, equality, and justice and stop the quest for growth, whether it is measured by GDP, green GDP or any other fancy progress indicator. This approach reduces economic growth and GDP to less important residuals of other more important policy objectives (van den Bergh 2011). A part of the a-growth agenda is the suggestion to simply stop measuring GDP, which would free resources to do other more useful accounting and help us to direct our attention towards the more pressing issues of our time (van den Bergh 2011). Along these lines, it is also reasonable to ask whether progress in fact ought to be a core concern of our time. Another approach could be to say: let's stop worrying about further progress and

start to solve the calamitous problems we have caused on this planet during the last couple of centuries of progress.

Research questions

The individual articles of this thesis are all rooted in the controversies and issues presented in the preceding sections and, thus, economic growth and sustainability constitute a pivotal theme, which is addressed from several different angles throughout the thesis. In order to navigate the complex waters of this theme, my research was guided by three overall questions. In the following, I first present the questions and then explain how the individual articles respond to them.

The questions

1. *How can a comprehensive view of policy proposals for solving the multiple environmental and economic crises of our age be provided, and what can a narrative analysis of these proposals tell us about their political strength?*

2. *What is economic growth, and how did it become a policy objective with the ability to obstruct policy action in favour of a sustainable transition?*

3. *What is the role of macroeconomic modelling in policy and research for sustainability?*

Question 1 is primarily addressed in Article 1, where a collection of policy reports is investigated, a comprehensive mapping of policy proposals is presented, and a narrative analysis of the proposals is performed. The question of the political strength of the proposals is approached from a narrative policy analysis angle, which means that the proposals are analysed as stories expressing varying degrees of persuasive strength (Urhammer & Røpke 2013). This line of investigation is to some extent continued in Article 2, in which the question of characters, such as heroes, villains, gods and demi-gods, in policy narratives is briefly elaborated (Urhammer 2015a).

Question 2 is primarily addressed in Article 3, where this onto-political question is addressed by describing economic growth as a constructed monster that circulates, in various forms and appearances, through well established channels, between different sites such as statistical offices, ministries and news media (Urhammer 2014). The article takes a Latourian perspective on economic growth and uses notions such as *translation* and *circulation* to describe how the monster stays alive and maintains its position as arbiter of economic policy (Ibid.). In relation to the latter part of question 2, it is argued that the ability to obstruct policy actions in favour of a sustainable transition is rooted in the status of economic growth as the primary objective of economic policy and as a proxy for collective wellbeing, which entails that policies that can be framed as a threat to economic growth are implicitly also a threat to our common wealth and wellbeing (Ibid.).

The ontological status of economic growth is also a topic in Article 2, where economic growth is presented as the supreme god in a neoclassical system of belief, and the ability to obstruct policy actions in favour of a sustainable transition is

that can be framed as a threat to economic growth are implicitly also a threat to our common wealth and wellbeing (Ibid.).

The ontological status of economic growth is also a topic in Article 2, where economic growth is presented as the supreme god in a neoclassical system of belief, and the ability to obstruct policy actions in favour of a sustainable transition is explained by an alliance between a neoclassical system of belief and a wealthy elite interested in maintaining its favourable position (Urhammer 2015a).

Question 3 is addressed in Article 4 and 5; where macroeconomic modelling for sustainability is a key issue (Urhammer forthcoming, in progress). In order to acquire a clearer notion of the term macroeconomic modelling for sustainability, the reader will hopefully benefit from consulting the section about macroeconomics in the theory chapter of this introduction and in Article 5, where a more elaborate discussion of modelling for sustainability is presented (Urhammer in progress). However, a brief explanation of the term is that macroeconomic modelling for sustainability concerns the incorporation of environmental variables and concerns in various computational macroeconomic modelling frameworks.

Article 4 investigates the Danish history of a modelling discipline, which I have labelled macroeconomic energy modelling – a subset of the wider family of macroeconomic models for sustainability. As the story unfolds, it is explained how economic growth plays a key role in this development, and how the issue of energy was only the first in a series of sustainability concerns to get integrated in macroeconomic modelling (Urhammer forthcoming). As such, Article 4 provides an historical introduction to Article 5, which delves into a discussion of contemporary macroeconomic modelling for sustainability with the intention of contributing to ongoing discussions of ecological macroeconomics (Urhammer in progress).

Finally, it ought to be mentioned that Article 6 (Pirgmaier & Urhammer 2015) is a supplementary article, which does not respond to any of the three overall research questions. Rather it provides a background analysis of values and value pluralism, which is also a part of the antagonism of economic growth and sustainability.

As the reader of the thesis will probably observe, the research questions and their answers express some kind of an activist attitude, and they are in fact meant as contributions to an activist agenda in favour of a sustainable transition. In this regard, I do not consider the articles to be objective knowledge pieces, but rather interventions with the purpose of providing new perspectives on economic growth and sustainability as a key policy issue of our time. It is my hope that this will bring useful insights for further thinking and action in favour of a sustainable transition.

Thesis overview

Main theme	Economic Growth and Sustainability			
Research questions	Question 1	Question 2	Question 3	
Articles	Article 1 & 2	Article 2 & 3	Article 4 & 5	Article 6

Table 1. Overview of research questions and articles

Theory

In this chapter, I present an account of some theoretical aspects of the thesis. The chapter is divided into different topical sections: the first section consists of a few words about the interdisciplinary approach of the thesis. Following this comes an explanation of some different roles played by theory, which leads to a brief introduction to macroeconomics. This is followed by a section describing the theories used for analytical purposes, while the chapter ends with some words on the existence of an object named the economy.

Interdisciplinarity

This thesis relies on a multitude of theoretical perspectives, and *interdisciplinary* is probably the best adjective to describe it. What I mean by interdisciplinary in this regard is simply that it is more or less impossible to place the thesis in one specific disciplinary category since it draws upon and involves a wide range of disciplines. Thus, instead of choosing a specific discipline and its methods as the point of departure, the thesis puts an issue – economic growth and sustainability – in the centre of attention and addresses this issue from multiple theoretical angles.

A relevant critique of this approach is that it is very difficult for the interdisciplinary researcher to acquire an in-depth understanding of all the disciplines and theories at play in the research, and I am afraid that this critique applies in my case. However, I also find that there are advantages to this cross-cutting approach, which lie in the establishment of a wide range of entrances to addressing a multifaceted issue.

To grasp the interdisciplinary character of the thesis, one merely has to look at the two terms – economic growth and sustainability – and several disciplines are immediately called upon. To explain this, I initially wish to direct attention towards *economics* and *natural science*; economics in its capacity as the traditional discipline for dealing with economic growth, and natural science due to its role in investigating issues of sustainability such as climate change, ecosystem degradation and loss of biodiversity. Thus, the main theme of the thesis opens a door to an interdisciplinary territory; a territory which ecological economics has roamed for some decades now. Whether this thesis actually belongs to the field of ecological economics is not of great importance to me, but it is certainly fair to say that the thesis engages in issues which are core to ecological economics, especially to the sub-field of ecological economics labelled ecological macroeconomics.

Different roles of theory

Before I go on to describe some of the most important disciplines and theories at play in the thesis, I would like to suggest a distinction between three different roles of disciplines and theories in my thesis, which I have labelled: *background*, *object of research* and *tool of analysis*.

The role of the *background* discipline is played by various natural science disciplines, which provide a backdrop of concerns to the thesis in the form of alarming accounts of climate change, ecosystem degradation and loss of biodiversity (MEA 2005, Rockström et al. 2009, IPCC 2014), to name but a few. Each of these issues could be

the subject of social science research, and one could investigate their social constitution. However, this is not the aim of this thesis. Instead, climate change, ecosystem degradation and loss of biodiversity are simply treated as very troubling circumstances, which need to be addressed collectively and without any further hesitation.

Theory as object of research concerns the fact that certain academic disciplines and theories are important empirical sites of research to the thesis. Here I especially refer to macroeconomics and the accounting methods it depends on, the modelling practices it fosters, and the policy proposals which can be associated with it. Finally, theory as a tool of analysis includes discourse analysis, narratology and various science and technology studies (STS) perspectives, which have been deployed to answer the different research questions of the thesis.

In the following, I try to account for the most important disciplines and theories that play the latter two roles in my thesis and also, very briefly, relate the theories to various questions treated in the articles.

Theory as object of research

Even though this thesis does not rely on macroeconomics as a theoretical tool of analysis, macroeconomics still plays an important role in the thesis as an object of empirical research. In the following, I therefore give a short introduction to macroeconomics and some of its different schools.

Macroeconomics

No clear-cut definition of macroeconomics exists, yet I think few would object to the view that macroeconomics concerns the economy of nation states defined in terms of economic aggregates – *production*, *consumption*, *investments*, *inflation*, *unemployment*, *the balance of payments*, *public budgets* – and the causal relations between such aggregates (Jespersen 2009, Sørensen & Whitta-Jacobsen 2010).

Even though economists have theorised over such aggregates and relations before him, it is widely accepted that the British economist Keynes is the founder of modern macroeconomics, the literary beginning of which is marked by his seminal book *The General Theory of Employment, Interest and Money*, published in 1936 (Jespersen 2007). The General Theory was written as a response to the calamitous unemployment and the extreme economic, financial and political instability of the interwar period. These difficulties are reflected in Keynes's theoretical endeavours to provide sound policy advice for addressing and curbing the economic instabilities and the unemployment problem of his time (de Vroey & Malgrange 2011).

In this sense, Keynes's work had a significant normative and policy-oriented character, which has been a salient identity of macroeconomics ever since. To better understand this identity, it is useful to observe that, in spite of many deep methodological disagreements, different schools of macroeconomics share the idea that economic policy can make a difference, in the sense that it is possible to influence

macroeconomic mechanisms and developments by means of economic policy (Jespersen 2007).

Even though Keynes is widely recognised as the founder of modern macroeconomics, it must be stressed, however, that theorising on the wealth of nations and the economic affairs of countries predates Keynes by centuries. Both classical and neoclassical economists before Keynes addressed these issues, and Keynes was certainly aware of this theoretical heritage, to which he remained loyal during his early carrier until he finally rejected it by developing a radically different economic theory (Jespersen 2007). Thus, Keynes's early work can be seen as part of the neoclassical tradition, while his General Theory marked a radical break with this school of thought, a break which still divides modern macroeconomics into two fundamentally different methodological traditions: the *neoclassical* and the *Keynesian* (Ibid.).

Different schools of macroeconomics

In spite of the fact that there are fundamental differences between neoclassical and Keynesian economics, it is difficult to obtain a comprehensive view of the distinction between the two. This difficulty is rooted in theoretical developments, subsequent to Keynes's work, which include various attempts to integrate the two schools in various ways. Jespersen, however, offers a useful distinction by emphasising a fundamental divide between the two in terms of the neoclassical commitment to *general equilibrium* and Keynes's devotion to the concept of *fundamental uncertainty*. Adding to this, Jespersen also describes the divide as one between idealism and realism. In the following, I try to account for some of the features that characterise two fundamentally different schools of macroeconomic thinking.

Neoclassical macroeconomics

Neoclassical macroeconomics is rooted in the work of the neoclassical economists of the nineteenth century, who developed a highly mathematical economic discipline inspired by Newton's classical mechanics (Mirowski 1989). Neoclassical scholars conceptualised the economy as a deterministic ensemble of markets, for which the equilibrium between supply and demand on each individual market can be summed to a general equilibrium of all markets of the economy. In other words, this means that there always exists a vector of prices which clears all markets so that supply equals demand on all markets simultaneously (de Vroey & Malgrange 2011). The French economist, Walras, was the first to formalise this idea in a strict mathematical proof, while Arrow and Debreu further refined the mathematics of general equilibrium in the 1950s, thus strengthening the status of the general equilibrium axiom as the fundamental tenet of neoclassical macroeconomics (Jespersen 2007).

As an aggregate theory of supply and demand on particular markets, neoclassical macroeconomics can be seen as generalisation of so-called microeconomic theory resting on the existence of a representative economic agent, who optimises utility (households) and profits (firms). In order to do so, the agent needs to be rational and have perfect foresight, meaning that he has a clear ordering of preferences and always knows the outcome of his choices (Hodgson 1988). Adding to this, Jespersen stresses that perfect foresight, in the macroeconomic sense of the word, implies that the

economic agent always knows the vector of prices which clears all markets in general equilibrium (Jespersen 2007).

As a generalised theory of markets, neoclassical macroeconomics addresses fundamental problems, such as unemployment, inflation and the balance of payments, as questions of market equilibria that can be analysed independently due to the *ceteris paribus* – all other things being equal – assumption. In the case of unemployment, this means that solving the unemployment problem merely becomes a mater of finding the price (wage) which clears the labour market. According to this theory, involuntary unemployment only exists if wages are not flexible enough to clear the labour market.

Due to its very stylised description of the economy as an ensemble of perfectly functioning markets, Jespersen has characterised neoclassical macroeconomics as a theory concerned with how the economy ought to function ideally. This has prompted him to call neoclassical macroeconomics a form of idealism expressed in terms of axiomatic assumptions such as rationality, perfect foresight and general equilibrium (Jespersen 2007). Adding to this, it ought to be mentioned that neoclassical economics has also been described as a positivist science, meaning that it confesses to the idea that it is possible to arrive at true statements about the world if reason and logic (mathematics) is applied to empirical evidence in the proper way (Hodgson 1988).

Keynesian macroeconomics

According to Jespersen, Keynes's economic theory differs from neoclassical economics especially on two distinct points: *the economy as a whole* and *fundamental uncertainty* (Jespersen 2007). The idea of thinking about the economy as a whole was a rejection of the neoclassical conviction that the economy could be thought of in terms of separate markets, independently analysable according to the *ceteris paribus* assumption. Instead, Keynes's theory attempted to unify all the various macroeconomic aggregates into one causally connected system. One of the advantages of this approach is the avoidance of the *atomistic fallacy*, which, very broadly speaking, is the fallacy of explaining the development of the whole economy by means of the aggregated market behaviour of a single stylised economic agent (Ibid.). Adding to this, Keynes introduced the idea of fundamental uncertainty, which was a rejection of the neoclassical general equilibrium axiom, which rests upon the idea of the perfect foresight of economic agents. Instead, Keynes emphasised that there are multiple things economic agents are unaware of and that the future is highly uncertain – full of stuff about which "we simply don't know" (Jespersen 2007, citing Keynes) – which makes the general equilibrium axiom, dependent on the rational expectations and perfect foresight, useless. This new approach meant that especially the question of the distant future – the long term – became a question characterised by fundamental uncertainty instead of general equilibrium (Ibid.).

The uncertainty approach to economics opened a door to thinking about the economies of nation states in an entirely different way, which also included significant attention to institutional arrangements, such as public welfare and regulation, put in place to handle the fundamental uncertainty of the future. Finally,

Keynes's rejection of basic neoclassical tenets required attention to path dependencies connecting past, present and future by other means than perfect foresight and general equilibrium (Ibid.).

In relation to unemployment, Keynes realised that the persistent unemployment, which characterised the interwar period, could not be explained within the neoclassical general equilibrium framework. Instead, he suggested that insufficient aggregate demand was the cause of unemployment, and that this deficiency had its roots in insufficient investments (King 2002). Keynes concluded along these lines that full employment was only a special case of his more general theory of employment, and that governments needed to stimulate aggregate demand by means of public investments in order to bring down the high levels of unemployment (Ibid.). Furthermore, Keynes recognised an urgent need for a deeper understanding of the financial sector and for a reform of monetary theory and policy, which had proven inadequate for explaining or harnessing the financial dynamics behind the Great Crash in 1929 (Ibid.).

Unlike the neoclassical school, Jespersen argues, Keynesian economics is devoted not to how the economy should ideally function, but to how it actually functions. As such, Keynesian economics is devoted to realism and to studying the social ontology, characterised by fundamental uncertainty, which constitutes the mechanisms and development of the economy. This realist view also implies a distinction between theory and reality, where the job of the economist is to ensure the correspondence between the two (Jespersen 2007).

Different paths

Since the publication of Keynes's General Theory in 1936, macroeconomics has branched out in several directions, which has led to a number of slightly confusing labels of macroeconomic schools. Sticking to Jespersen's distinction (previously explained), it is possible, however, to separate these schools into two overall paths: the neoclassical and the Keynesian, where the *neoclassical synthesis*, the *new classicals*, and the *new Keynesians* belong to the former, while the *post-Keynesians* belong to the latter. In the following, I provide a very short account of these different schools of macroeconomics.

The neoclassical path

In the years following the publication of the General Theory, several attempts to further formalise Keynes's theory mathematically, such as Hicks's IS-LM model and Tinbergen's macroeconometric models, emerged (de Vroey & Malgrange 2011). However, as Jespersen observes, characteristic of these attempts was a devotion to neoclassical principles, which meant that these models can be seen as attempts at incorporating Keynes's theory of effective demand (as an explanations for the level of production and unemployment) in the general equilibrium framework. This theoretical integration can be seen as the first step in the direction of the so-called neoclassical synthesis, where a Keynesian analysis is only relevant in the short run, while the long run is characterised by general equilibrium (Jespersen 2007). In spite of this fundamental break with Keynes's approach, the proponents of the Neoclassical Synthesis still believed in the impact of fiscal policy on the adjustment of the

economy to the general equilibrium (Ibid.). The Neoclassical Synthesis came to dominate the three decades following the Second World War, and during the fifties it was further elaborated by Solow, who developed a highly influential economic growth model based on the framework (Ibid.). Thus, the neoclassical synthesis came to command two types of models: short term demand-driven macroeconometric models to explain business cycles, and long term economic growth models based on the general equilibrium assumption.

In the late sixties, strong voices critical of the Keynesian view and the neoclassical synthesis gained attention. The most prominent of these belonged to Friedman, who criticised the Keynesian reliance on a negative relation between inflation and unemployment, a critique which was strengthened in the early seventies by the simultaneous rise of inflation and unemployment (stagflation) (de Vroey & Malgrange 2011). Reinforcing Friedman's critique, Lucas used the stagflation phenomenon to initiate a fierce attack on the Keynesian framework and the neoclassical synthesis and, thus, took the lead in a movement which would eventually reinstall neoclassical economics as the mainstream of macroeconomic theory.

Lucas's uprising, dubbed *new classical macroeconomics*, contained several points of critique including the rejection of macroeconometric models and the lack of a micro-foundation of the Keynesian approach. The critique included the view that statistically estimated behavioural relations were not stable over longer periods of time, which implied that macroeconomic models should instead be based on the deeper, stable microeconomic behavioural relations, the existence of which Lucas did not venture into verifying empirically (Jespersen 2007). Thus, Lucas's critique led to an increased emphasis on the optimising behaviour of individual economic agents and the general equilibrium as the basis of macroeconomic analysis (de Vroey & Malgrange 2011).

In response to the new classical turn, leading proponents of the neoclassical synthesis accepted the demand for a consistent micro-foundation of macroeconomics and developed a school dubbed new Keynesian economics, where rational expectations and general equilibrium played centre stage, yet with a strong focus on understanding various rigidities in the adjustment to the general equilibrium (Jespersen 2007).

The post-Keynesian school

In order to account for the school of post-Keynesian economics, it is necessary to return to the 1930s, when opposing interpretations of Keynes's work led to different paths of development. As already described, one theoretical development consisted of integrating aspects of Keynes's ideas into the neoclassical general equilibrium framework, although this approach was not appreciated by all of Keynes's contemporaries and successors. This meant that several economists stayed loyal to Keynes's emphasis on fundamental uncertainty and the rejection of the general equilibrium axiom. Yet, several years passed before a common Keynesian front against the neoclassical synthesis emerged during the sixties, and a network of self-proclaimed post-Keynesians was establish in the seventies (King 2002).

When Keynes died, he left a wide range of questions unanswered, but the post-Keynesians adopted his principles and interests and engaged in theorising along his conceptual path to answer some of these question and new ones which had emerged (Jespersen 2007). Thus, post-Keynesians responded to an increased interest in understanding economic growth and developed a theoretical alternative to Solow's growth model based instead on Keynes's ideas of effective demand. Furthermore, post-Keynesians have proposed an understanding of money, which replaces the monetarist idea of exogenous money supply with a theory of endogenous money, and post-Keynesians have also taken a strong interest in distributional aspects, which cannot be treated properly within the market-based framework of neoclassical economics (Ibid.).

Since the 2008 financial crash, post-Keynesians have experienced an increased interest in their theoretical perspectives, not least due to the fact that members of the post-Keynesian economics community predicted the financial bust, more or less precisely, which mainstream economists and their models did not. These predictions were based on post-Keynesian approaches to financial accounting and monetary theory (Bezemer 2010).

Ecological macroeconomics

In its capacity as a discipline concerned with how to sustain the economic stability and prosperity of nation states, it can be argued that macroeconomics is in fact a sustainability discipline. However, the emergence of global, human-induced environmental problems and transboundary issues of inequality and resource appropriation have revealed the inadequacy of macroeconomics (regardless of theoretical inclination) to address wider environmental and social applications of sustainability.

Addressing this inadequacy, ecological economists have proposed the biophysical reconceptualisation of economics, which is founded on the view that economies are metabolic organisms that extract and transform energy and materials and emit pollutants (Røpke 2004). Using this perspective, environmental havoc, such as climate change, the destruction of ecosystems and the depletion of natural resources, can be explained as the result of economic metabolism. An obvious consequence of this biophysical ontology is the rejection of perpetual economic growth (metabolic growth) as a remedy for sustained prosperity (Jackson 2009).

This question also concerned the classical economists of the eighteenth century, some of whom argued that the amount of and access to land constitute physical limits to economic growth, a consideration which disappeared from economics, however, with the emergence of neoclassical economics in the nineteenth century (Friman 2002). Yet, during the late twentieth century, the question of limits re-emerged, not least due to the publication of the Limits to Growth report in 1972, and since the financial crash in 2008, this agenda has, once again, received increased attention (Røpke 2013).

The conglomerate of economic, environmental and social crises that appeared in concert after the crash in 2008 spurred several ecological economists to further consider what macroeconomics ought to be in the context of growing global

environmental challenges and inequity. This has led to a collective effort to define ecological macroeconomics for the twenty first century. In the following, I sketch some headlines of this (very ambitious) theoretical endeavour.

The biophysical ontology of ecological economics provides a backdrop for ecological macroeconomics by putting an emphasis on the scale of the economy and the distribution of resources. The limited planetary space for expansion leads to a concern for the material size of our economies, while the limited amount of natural resources makes it necessary to consider how these are distributed justly. One of the consequences of this focus is the call to abandon the objective of continued GDP growth, which makes the dilemma of growth a key challenge to ecological macroeconomics. The dilemma of growth refers to the problem that economic growth is our main recipe for economic stability and prosperity, while at the same time it is undermining the biophysical preconditions for stability and prosperity (Jackson, 2009). Recognising this dilemma, Jackson et al. state that "there is a need to develop a fully consistent ecological macroeconomics in which it is possible to maintain financial stability, ensure high levels of employment, improve the distribution of income and wealth and yet remain within the ecological constraints and resource limits of a finite planet" (Jackson et al. 2015: 6). This view highlights how ecological macroeconomics concerns the integration of the traditional macroeconomic heritage and the concerns of ecological economists.

Evaluating the problems confronting ecological macroeconomics, Røpke highlights a series of challenges and requirements attached to this theoretical project, which includes the inability of the traditional macroeconomic focus on nation states to capture the global character of the problems facing economics today. This means that the term macro must be expanded to incorporate a planetary perspective on the pursuit of 'the common good' (Røpke 2013). Adding to this, Røpke also emphasises how macroeconomics is not suited to handling the problem of transformation, which is most likely to involve radical institutional change and international security issues in times of possible upheaval and instability (Ibid.).

To address some of these challenges, Røpke suggests a list of requirements for ecological macroeconomics, which includes: the development of an elaborate consumption perspective to complement the mainstream production perspective, abandoning GDP as a key economic policy measure, accounting directly for natural material flows, handling radical institutional change, and incorporating the concept of socio-technical systems (Ibid.). Obviously, this is an immense task, and not surprisingly it involves the engagement of several different disciplines. Thus, ecological macroeconomics can be seen as a joint effort to integrate various schools of heterodox economics, especially post-Keynesian and ecological economics (Ibid.).

There are probably many answers to why these two schools of economics have ventured into collaboration, yet it is perhaps not so surprising that two marginalised schools of economics have joined forces in order to gain influence, not least since these two schools seem to supplement each other very well. Thus, ecological economics brings an elaborate ecological perspective to the table, while post-Keynesian economics offers a solid methodological apparatus for analysing money,

finance and economic crises, which have been insufficiently treated by mainstream macroeconomics.

Finally, it should be mentioned that efforts to incorporate the community of sustainable transition research into the ecological macroeconomics agenda is also taking place. This means that, among other things, the view on the economy as a set of sectors, connected by means of production and consumption can be supplemented by a perspective which interprets economic processes as an interplay between socio-technical systems (Ibid.).

Accounting

According to Coyle, three main factors of macroeconomics motivated economic policies in the post-war period: theory, statistics, and modelling (Coyle 2014). In my view, these factors are still key to the interface between macroeconomics and policy-making and to the existence of a policy object named 'the economy'. In the preceding, I have given a brief account of macroeconomic theory, and in the following, I try to do the same for the other two factors.

When talking about macroeconomic statistics, Coyle refers to national accounting, which concerns the account of aggregates such as *gross domestic product*, *unemployment*, *inflation*, *interest rate*, *exchange rate*, *balance of payments*, and *the public budget* (Jespersen 2007). These are statistical measures of key macroeconomic variables, and as such, national accounting provides an indispensable statistical foundation for macroeconomics, which establishes a close connection between the two. To better understand this connection, it is useful to observe that modern macroeconomics and national accounting both emerged as parts of a conjoint effort to overcome the economic difficulties of first the Great Depression and later the Second World War. As such, national accounting was developed in order for politicians and economists to get a general view of the state of national economies, and macroeconomics depended on such accounts for theorising, policy assessment and the provision of advice (Tily 2009, Coyle 2014).

As mentioned in an earlier section, Keynes's ambition was to view the economy as a whole, and national accounting provided the statistical foundation for doing so. However, as Coyle observes, economic statistics are not objective measures, they are interpretations that also change realities (Coyle 2015). Bearing this in mind, it is noteworthy that the development and design of national accounts was, in fact, influenced by the worldviews and theoretical requirements of Keynes's macroeconomics (Tily 2009). This reveals how national accounting is not merely an objective measure of real entities, but also a measurement drafted to provide an empirical body for theoretical entities.

Adding yet a dimension to the understanding of accounts, Miller & Rose argue that accounting is a constituent element in creating governable objects (Miller & Rose 1990). In the case of national accounting, the economy is the object which has been rendered governable, at least to the extent that there now exists a widespread perception of the economy as something which can be governed by means of policy and state regulation. In this capacity, national accounting has become an instrument

for augmenting the influence of nation states, making national accounting a technology of power just as much as it is a source of information (Miller 1986). Along these lines, Miller sees national accounting as part of a wider political modernisation project, which has introduced political rationalities, such as economic growth and progress, as key governmental objectives (Miller 1986).

To end this section, I wish to highlight that the emergence of pressing environmental problems has led to the need for and development of entirely different sets of accounts, which ecological economists, along with others, are trying to promote and incorporate in the framework of macroeconomics. Such accounts include environmental accounts that are drafted to inform us about the state of ecosystems, the stocks of natural resources, the amount of materials we use, and the general environmental impacts of economic activities. Using Miller & Rose's perspectives, this means that the environment is also undergoing a process of statistic objectification, which strengthens the perception of environmental processes as governable by means of policy-making. When this perspective is incorporated into the macroeconomic perspective, it can be seen as an attempt to reinterpret and re-objectify the economy in biophysical terms.

Modelling

Models and modelling play an important role in macroeconomics, where they are employed for several purposes including *conceptualisation*, *theorising*, and *empirical application*. By conceptualisation I mean a figurative description which articulates a basic ontological vision. Exemplifying this, Daly speaks of the pre-analytical vision of ecological economics, picturing the economy as a subset of the biosphere (Røpke 2005), thus providing a new context for the mainstream vision of the economy as a circular flow of money, goods and services between households and firms (Mankiw 1992).

A macroeconomic model for theorising is an equation or a set of equations that can be solved analytically for the purpose of explaining causal relations between economic aggregates. Examples of theoretical models could be the Cobb-Douglas production function or the Arrow-Debreu general equilibrium model. Finally, empirical application (computational models) involves larger sets of equations, often fitted to country-specific data, solved on computers for the purpose of providing policy advice, forecasts or assessments of policy proposals, and testing theoretical propositions (den Butter & Morgan 2000, Jackson & Victor 2015).

The boundaries between these categories are ambiguous, and the different types of modelling overlap and interact. Thus, basic ontological visions of the economy set the scene for theoretical modelling, while theoretical models are incorporated into applied models, and applied models, in turn, can help strengthen or destabilise conceptual models. To exemplify this interaction, one could claim that the three basic ontological visions of the economy mentioned earlier – a deterministic ensemble of markets (neoclassical), a causally connected system of diverse aggregates (Keynesian), and a metabolic organism (ecological economic) – set different scenes for the theoretical models. The first allows for *ceteris paribus* general equilibrium models, the second rules out this type of modelling, while the latter demands the

incorporation of environmental accounts and causalities. This makes macroeconomic modelling a complex affair with multiple theoretical and political implications.

One of these implications is the basic question: what are macroeconomic models? Having tried to figure this out for the entire time span of writing this thesis, I have to admit that my best answer is: well, it depends. Some macroeconomists share the realist (or critical realist) view that the economy exists as an objective reality, and that macroeconomic models are (or ought to be) epistemic tools which try to represent this reality and provide the best possible correspondence between theory and reality (Jespersen 2007). Somewhat in opposition to this view, neoclassical economists, such as Friedman, have emphasised that economic theories and models should not be judged by the truth of their assumptions, but by their ability to predict (Friedman 1953), which makes macroeconomic models crystal globes of soothsaying.

Finally, proponents of the *performativity* approach (which is further explained in a following section) hold that the question of economic theory and modelling is not an epistemic question of true or false, but a question of successful or unsuccessful (Callon 2007). Thus, the important question is not whether the model makes true statements of the world, but whether it is able to make a difference or not. As such, macroeconomic models are political creatures highly sensitive to the wishes and worldviews of their operators and the demands of the operators' employers.

Theory as a tool of analysis

Having now introduced the discipline of macroeconomics, I wish to turn to some of the theoretical perspectives that have been deployed for analytical purposes in the thesis.

Discourse analysis

Several of the articles in this thesis use documents of various kinds as empirical material. Even though it is not imperative, one approach to such material is to see it as discursive material, the interpretation of which can benefit from discourse analysis. Such an approach has been taken in Article 1, where macroeconomic policy proposals for solving the global system crisis are seen as belonging to either one or both of two opposing policy discourses labelled *pro-growth* and *no-growth* (Urhammer & Røpke 2013). In doing so, the article uses discourse as an overall framework to set the scene of analysis.

The range of discourse analysis approaches is vast and includes contributions from multiple scholars, and as a interdisciplinary researcher, I have only scratched the surface of the field. Hence, in the article, we rely, for a large part, on literature which summarises discourse analysis (Jørgensen & Phillips 1999), thereby acquiring just enough insight to use it analytically. In Article 1, a brief introduction to discourse analysis is provided (Urhammer & Røpke 2013), and I see no reason to repeat it here. Instead, I try to account for some features of discourse analysis not presented in the article. In doing so, I focus on Foucault (1972), who is rightfully considered an influential scholar to the field of discourse analysis. Furthermore, the account is aimed at pointing out connections between Foucault's discourse approach and other theoretical perspectives deployed in the thesis.

Going straight to the connections, I wish to emphasise Foucault's strong attention to the role of discourse in the creation of *knowledge objects* (Foucault 1972). This attention is epitomised by the following question, which defines the purpose of discourse analysis "what is this specific existence that emerges from what is said and nowhere else?" (Ibid.:31). Some of Foucault's examples of such existences are *madness* and *sexuality*, which he argues have become knowledge objects due to discursive practices of psychiatric and medical expertise (Ibid.). Of special interest to my thesis in relation to expertise is Foucault's treatment of the role of economics in governmental practices (Foucault 2008). Here, Foucault emphasises how economic expertise has constituted a certain truth regime, which determines what is true and false (and right and wrong to do) in relation to 'the economy' as an object of *governmentality* (Ibid.), where governmentality can be understood as a certain dispersed regulatory mentality towards social life (Miller & Rose 1990).

The focus on objects and knowledge objects is a recurring theme in several of the theoretical perspectives of my thesis, especially the STS perspectives, which are presented in a following section. However, amongst STS scholars, I have observed an emphasis on the importance of materiality (tangible things), which at least indirectly questions Foucault's strong focus on discourse as the constituter of knowledge objects. Yet, it is in fact possible to find in Foucault's work, a recognition of the existence of something external to discourse, or, as Foucault puts it, the existence of 'prediscursive' experiences freed from the tyranny of texts (Foucault 2008:47). In my view, this establishes a point of reconciliation between Foucauldian discourse analysis and STS, and suggests that the difference between the two is, at least to some extent, a question of empirical focus, where discourse analysis has a more narrow focus on symbols and written and spoken language, while STS is often characterised by ethnographic research that attempts to take a wider ensemble of empirical inputs into account.

Continuing along the line of pointing out similarities between discourse analysis and STS perspectives, I would like to direct attention to Foucault's emphasis on discourses as networks of relations between signs and statements, relations that determine the space of possible utterances of a given discourse. Perhaps a bit laboured, this is somewhat akin to STS approaches, such as actor-network theory (ANT), which also concerns networks of relations between things. However, in the case of ANT, relations extend far beyond signs and statements and involve the association of material things, statements and technologies in networks connecting multiple human and non-human actors (Callon 1986a, Callon 1986b, Latour 2005). Finally, Foucault repeatedly stresses that discourse is practice and observes how objects emerge from discursive practices. This attention to practices (yet more widely considered) also characterises various STS approaches to the construction of objects (Latour 1993, Mol 1999).

To end this section, I would like to say a few words to relate the Foucauldian view on discourse to Article 1 (which also draws upon several other approaches to discourse analysis) of this thesis (Urhammer & Røpke 2013). The most important heritage from Foucault in the article is probably the view that knowledge objects are discursively constituted (Ibid.). From this point of departure, the article delves into an analysis of

a controversy regarding economic growth and sustainability as it materialises in a collection of policy reports. In doing so, the article uncovers a certain form of antagonism, where two more or less opposing discourses struggle to settle and stabilise the meaning of economic growth in relation to sustainability (Ibid.).

Narratology

In Article 1, the antagonism between the discourses is described as a war of stories, which means that the policy proposals presented in the article are analysed as narratives (Urhammer & Røpke 2013). Hence, the discipline of *narratology* plays an important role in the article. As was also the case for discourse analysis, narratology is briefly introduced in the article, yet, to supplement this description, I here try to provide some additional insights.

Narratology is concerned with the analysis of *narratives* – stories and storytelling – and the priniciples of narratology are fairly simple: "[o]nce characters and a plot are in place, a story has been constructed" (Czarniawska 2010:64). Rooted in this understanding, narratology comprises a set of theories of plots (sequences of events) and characters, where the former can be seen as a structural dimension and the latter as a dimension of agency. In this sense, narratology somehow echoes a modern distinction within many social sciences between structure and individuals, yet in a very unorthodox manner, where structure and agency are impossible to separate, and where the conception of character stretches far beyond human agency. Along these lines, Czarniawska stresses how narratology "[…] does not search for laws, but for patterns and regularities, which do not reveal a deep structure – either of the world or of the mind […]" (Ibid.:60). Thus, narratology is not about finding fundamental laws of the social or the psyche, and as such, it resembles understandings forwarded in the STS literature, especially by Latour, who has in fact been profoundly inspired by Greimas, one of the founding fathers of narratology (Latour 2013). One important influence of Greimas on Latour was the attention to non-human agency (Ibid.), which is evident in folktale, where all sorts of non-human characters, such as magic rings, dragons and gnomes, play important roles and are able to drive sequences of events (plots).

An aspect of narratology of special interest to the present thesis is the view that narratives are the main bearers of knowledge in contemporary societies (Lyotard cited in Czarniawska 2010:59). According to this understanding, attention is directed towards a non-modernist perspective on knowledge practices as forms of collective storytelling, where humans and non-humans interact and produce sequences of cause and effect, reasoning, explanation and interpretation (Ibid.). This understanding connects to the production of historical knowledge (also of great interest to Foucault), which in a narratology perspective is not the discovery of an objective, universal history, but the emplotment of events into something which becomes history (Ibid.). This view formed my approach in Article 4, which is an historical article about macroeconomic energy modelling in Denmark (Urhammer forthcoming). Here, I emphasise that it is 'my' story not objective history, though I certainly hope and believe that my informants agree with me on the most basic patterns and regularities.

STS perspectives

STS and especially the studies carried out by Latour have played an important role in my understanding of the issues investigated in this thesis. Yet, Latour's perspectives do not play a very explicit role in the thesis, except in Article 3, which is fully committed to a Latourian worldview (Urhammer 2014). Unfortunately, when writing the article, time and length were too limited to allow a fair account of Latour's many literary contributions. Hence, to make up for some of the most critical omissions in this regard, in this section, I attempt to explain some aspects of Latour's and other kindred STS scholars' work, which is of special interest to the thesis.

Empirical philosophy

In Article 3, I use the term *empirical philosophy* as a general term to describe Latour's mode of inquiry (Urhammer 2014). This, however, is perhaps too much of a simplification since Latour has been involved in the development of a variety of theoretical movements carrying several different labels. The theory which Latour is probably most often associated with is ANT, which was developed by scholars such as Callon, Law and Latour (Muniesa 2015). However, recognising that Latour has a somewhat ambivalent attitude towards the term ANT, both recalling it and still embracing aspects of it (Latour 1999), I searched for another term to describe his perspectives, and found empirical philosophy, which Latour has used himself to describe his approach more recently (Latour 2013b). To me, empirical philosophy is a very suitable term for Latour's approach since it emphasises that he is in fact a philosopher (by training) who is deeply interested in philosophical questions and engaged in a crusade against a line of philosophical thought that dates all the way back to Plato. This line of philosophical thought, Latour argues, has led to a modernist mode of interpretation, which dominates common perceptions of the world today (Latour 1993).

Thus, one could say that Latour's crusade concerns the rejection of modernity and a modernist mode of interpretation, which, according to Latour, has resulted in speculative separations and dichotomies such as *nature* and *culture*, *subject* and *object*, and *reality* and *representation*. To accentuate the prevalence of such separations in present day conceptions of our common world, Latour has proposed that our age is ruled by the *modern constitution*, the perceptions and interpretations of which dominate institutions such as science and politics (Latour 1993, Latour 2004, Blok & Jensen 2011).

In his attempt to overthrow the modern constitution, Latour points out that "we have never been modern" and that modernist interpretive categories are constantly obliterated by human-non-human relations, which reveal that our common world – the world that humans and non-humans share and construct together – is hybrid and constituted by associations across modernist boundaries (Latour 1993, Blok & Jensen 2011). This understanding has prompted Latour to propose the replacement of the modern constitution by a *non-modern* or *a-modern* constitution, the key operation of which is *ecologization* – a mode of operation which involves the obliteration of modernist categories and the recognition and inclusion of non-humans as legitimate and constituent members of our common world (Latour 2013b). As such, Latour sees the new constitution as an on-going composition of a common world, an activity

which he has dubbed *cosmopolitics* (more about this later). The cosmopolitical programme reveals Latour's strong emphasis on non-human agency, which is inspired by Greimas, and means that materials, animals, plants and technology are considered legitimate members of our collective, where collective is Latour's term to replace the modernist term society (Latour 2013a,b).

Methodologically, Latour's mobilisation against the modern constitution consists of a call for philosophy to leave its speculative grounds and engage in empirical inquiry, which means that he imagines empirical philosophy to be a crossing of the anthropological approach and the philosophical tradition, where the devotion to inquiry and fieldwork is taken from the former and mixed with the interest in metaphysics and ontology of the latter. Equipped with this mix of traditions and disciplines, Latour imagines how the non-modern ethnographer is able to engage with multiple modes of existence and participate in the composition of a common world (Latour 2013b).

In the turn towards inquiry and fieldwork, Latour's take on philosophy resembles other STS scholars' approaches. Exemplifying this, Mol explains how she is engaged in a philosophical mode of investigation which is not "interested in the preconditions for acquiring true knowledge" or in *"how to find the truth?"* (Mol 2002:5, original emphasis). Rather, Mol's philosophical mode is characterised by an interest in knowledge practices and how objects are handled in practice (Mol 2002). This invokes a conception of politics, not unlike Latour's, as a matter of objects and ontology (more about this later).

A sociology of translations

When writing about ANT, Callon and Latour have sometimes referred to it as a *sociology of translations* (Callon 1986b) or *sociology of associations* (Latour 2005:173). The latter term is not used very often, even though it emphasises the basic tenet of Latour's philosophy – *the relation* – which implies that existence is a matter of relations, and that nothing exists in itself, since every thing exists through relations with other things. This is Latour's basic take on metaphysics, which rejects ideas of a universal substance or *a priori* categories[2]; the coming into being, existence and disappearance of things is always a matter of relations with other things: *being-as-other* instead of *being-as-being* (Latour 2013b). Here, it is appropriate to mention that Latour is certainly not the first to base his philosophy on relations, and he has not tried to hide the fact that he is inspired by the works of 'mentors' such as Serres and Dewey, who have also taken relations or associations as a philosophical point of departure (Serres 1995, Dewey 2012). This means that Latour can be considered part of and a contributor to a wider philosophical tradition based on relations or associations.

Now turning to the other term for ANT – sociology of translations – which can also be considered part of the relations-tradition, yet now with an emphasis on acts of translation. Latour describes translation as displacement, movement, and

[2]The typical and unavoidable philosophical question in this regard is, of course, whether 'The relation' is an *a priori* category or not.

transformation of the current state of an entity (Latour 2005), and Callon adds that "[t]ranslation builds actor-worlds from entities. It attaches characteristics to them and establishes more or less stable relationships between them" (Callon 1986b:25-26). In this sense, translation can also be seen as a means for world making, where actors are deliberately associated to achieve a specific reality that serves the interest of the world maker (Callon 1986b). In relation to this view, however, it is important to observe that world making is difficult and unpredictable since actors might resist, have entirely different agendas or try to construct the world in a different manner. This means that translation involves resistance and alliances between actors and that no translation is possible without work (Latour 2005). As such, the sociology of translation is a sociology which can be applied widely to explain multiple aspects of societal life and add new interpretive dimensions to the concept of power.

The theory of translation has been used by Callon and Latour to show how objects of science (scientific facts) come into being as chains of translations (networks), which are stabilised by the work and agency of multiple human and non-human actors (Latour 2005). Adding to this, Latour points to the importance of circulation as a means for objects to maintain existence and for facts to remain 'true' (Latour 1992). Thus, the circulation of objects or facts by means of different vehicles is vital to the stabilisation and existence of knowledge objects and scientific facts (Blok & Jensen 2011).

In Article 3, the terms translation and circulation are used, to articulate economic growth as a chain of translations (a monster), which stays alive as a constant signal circulating in a stabilised circuit (ecology of circulation) (Urhammer 2014). However, due to the fact that the special issue in which the article was published was about language and economics, I succumbed to the temptation to bend the notion of translation towards the common understanding of translation as an act of translating words between languages (Ibid.). Prior to publication, I was not very satisfied with this bending until I became aware that translation, as used by Latour and Callon, is in fact inspired by Serres' theory of information and transformation of signals, in which translation is seen as a mediation which transmits and distorts a signal (Blok & Jensen 2011). This is, at least in my view, not so far from the process of translation of words between languages, and in this sense, the translation of words can be seen as a certain mode of translation, which is part of the far larger repertoire of translations.

Conceptions of politics

As the title of this thesis indicates, there is something political[3] about economic growth, something which most readers will probably not deny, at least in the sense that economic growth certainly is a salient trope in mainstream policy discourse. However, I hope that the articles in this thesis will convince the reader that there is more to the issue. Hence, in order to accommodate this persuasion, I make a theoretical account of the different conceptions of politics at play in the thesis.

[3] In the following, political is an adjective meaning "something which has to do with politics" or "is of politics".

Politics has occupied the minds of scholars for ages, and an entire academic discipline – *political science* – is devoted to studying this topic. In the political science tradition, various forms of government, especially government as practiced by states and state institutions, have been the main focus of attention (Boyer 1990). More recently, however, attempts at expanding the conception of politics and what can rightfully be labelled political have emerged not least within the field of STS.

One major achievement of STS is a convincing description of the social workings of science and technology, which has led to a strong rejection of the modern perception of science and politics as two separate domains, with science dealing with facts, while politics takes care of values (Latour 1993). In contrast, STS has shown that politics occurs in all sorts of places, science is an important site of politics, and that facts and values do not belong to each separate domain (Jasanoff 1990, Latour 1993, Mol 1999). In a recent article, Brown reviews the STS literature (and beyond) on science and politics and presents a series of interesting conceptions of politics (Brown 2015). In the following, I briefly account for some of these conceptions which are of special relevance to my thesis.

To set the scene, Brown (2015) initially identifies two very general conceptions of politics: a *spatial-* and an *activity-conception.* The spatial-conception articulates politics as belonging to and taking place in a specific domain or sphere – 'the political domain' or 'the sphere of politics' (Ibid.). Even though this conception is abstract and metaphorical, it is often associated with the state and its institutions (Ibid.), an association which Rose & Miller have made an effort to challenge, yet still somehow maintaining a spatial-conception of politics. This is exemplified by the following sentence: "The domain of politics is thus simultaneously distinguished from other spheres of rule, and inextricably bound into them" (Rose & Miller 2010:279). In a similar vain, Article 1 of the present thesis expresses a spatial-conception of politics and articulates distinguishable domains of politics and science (Urhammer & Røpke 2013).

In contrast, the activity-conception describes politics not as a feature of a specific domain, but as a certain type of activity, which involves deliberation, negotiation, persuasion and contestation between all sorts of actors (Brown 2015). Obviously, this conception does not rule out entities such as the state and its institutions as the sites of politics, but it rejects the existence of one single, stable domain of politics and the idea of the state and its institutions as the site of politics par excellence. Instead, the activity-conception allows for practically any place to become (and stop being for that matter) a site of politics, depending on what actors do at these places at specific times under specific circumstances. In its many different forms, the activity-conception is, in my view, the conception of politics which is favoured by most STS scholars.

As indicated, science plays an important role in STS conceptions of politics, which rebel against so-called 'scientism', which expresses science as objective, value free and essentially non-political[4] (Brown 2015). This rebellion has been carried out by showing that the production of scientific facts is full of deliberation, negotiation,

[4] Neoclassical economics is, by the way, a good example of scientism.

persuasion and compromise between human and non-human actors, and that facts and values are closely intertwined (Latour & Woolgar 1979, Latour 1993, Jasanoff 1990). Within the boundaries of this more or less general agreement, STS scholars have, however, developed different conceptions of science and politics, where some have remained closer to more traditional conceptions of science and politics and focused on science-politics interactions in terms of science advice and science policy (Brown 2015, Jasanoff 1990). In this approach, traditional agencies of politics, such as politicians, civil servants and state organisations, remain in focus, while the practices of science and scientific advice are added (Jasanoff 1990). Furthermore, socio-technical controversies and imaginaries are important sites of research in this approach, where such sites are investigated with special attention to so-called *co-production* involving the interaction between discourses, technology, institutions and various epistemic practices (Jasanoff 2004, Blok 2005).

Continuing his search for conceptions of politics, Brown identifies a conception, which he has dubbed *world making* (Brown 2015). This conception is comprised of concepts, such as *ontological* politics (Mol 1999), *object oriented* politics (Marres 2007), and cosmopolitics (Stengers 2005, Latour 2007), and is closely related to the understanding of the construction of knowledge objects, presented in the previous section, although now with an emphasis on the politics of such objects.

In Mol's approach, ontological politics involves "[…] the way in which 'the real' is implicated in the 'political' and *vice versa*" (Mol 1999:74, original emphasis), where 'the real' is performed by different ontologies and 'the political' entails the struggle (and sometimes reconciliation) between ontologies (Mol 1999). In this conception, 'the real' sets the possibility conditions for collective action, while the contestation of realities makes it possible to influence and change such conditions by means of ontology. In relation to my thesis, ontological politics concerns how various macroeconomic schools, narratives and models struggle to define macroeconomic realities and, thus, determine the possibility space for collective action in relation to these realities. In Article 4, this form of politics is illustrated by the establishment of a macroeconomic reality – economic growth – performed by practices of modelling and forecasting in state organisations and research institutes. The main argument in the article is that this reality is influential in determining the possibility space for the future development of the Danish energy system (Urhammer forthcoming).

The object (or issue) oriented take on politics is concerned with how contested objects, such as roads and epidemics, become sites of politics, and how such objects or issues spark public involvement (Marres 2007, Brown 2015). In her formulation of this understanding, Marres is inspired by Dewey, who argued that publics come into being as a result of social mobilisation due to the consequences of conjoint action[5]. Marres adds to this perspective by focussing on the articulation of such consequences as issues, and on how this articulation becomes political since different articulations struggle to define issues (Marres 2007). In accordance with Dewey, the issue

[5] For a more thorough account of this view, see the theory section of Article 4 (Urhammer forthcoming).

oriented conception of politics is closely connected to perceptions of democracy and can, thus, be seen as one of many paths laid out in an on-going pursuit of democracy.

Somewhat linked to this pursuit, Latour promotes cosmopolitics - the collective composition of a common world – as a replacement of the ruling modernist concept of politics (Latour 2004, Latour 2007, Brown 2015). How exactly the composition of a common world can be seen as a form of politics is not easy to understand and even harder to explain. However, it might be helpful to see it as an on-going ontological enterprise involving efforts to determine what our common world is and how to deal with the hybrid entities inhabiting it. To Latour, this is a political project, which requires a non-modern constitution – *the parliament of things* – a new set of institutions to replace the modern constitution, in which humans and non-humans can come together and somehow settle who and how many we are, and how we can live together (Latour 2004, Blok & Jensen 2011).

Trying to relate Latour's vision of a new constitution to the topics of my thesis, it could be argued that Latour's grand tale of cosmopolitics and the parliament of things resembles the grand sustainability tales discussed in Article 1, where some form of utopia (green growth or a steady-state economy for instance) is reached by means of *sustainable transition* (Urhammer & Røpke 2013). Parallel to this, Latour's grand tale concerns the utopia of a new a-modern constitution, which is reached by means of ecologization (Latour 2013b). Furthermore, Latour's attention to the composition of a common world is also closely connected to discussions of political ecological and environmental conflict (Blok & Jensen 2011), which can be interpreted as concerning those entities and life forms that are excluded from taking part in the composition of a common world. Here, I especially think of non-human life, indigenous peoples and marginalised social groups more generally as excluded from constitutional politics. In a cosmopolitical utopia, these groups would somehow have to be included and allowed to participate in decisions about the world they inhabit.

Adding a final aspect to the world making conception of politics, I wish to stress that controversies and acts of politicisation which challenge established practices, institutions, and objects and transform them into sites of controversy, must also be considered core to politics (Brown 2015, Latour 2005). Exemplifying this, Latour has emphasised that controversies are important sites for understanding sociality and politics, and he is participating in the on-going development of an elaborate methodological framework for mapping controversies (MACOSPOL 2016). Even though I have not used these methods of controversy mapping, the controversy perspective still plays an important role in my thesis, where antagonism and contestation between opposing approaches to economic growth and sustainability are analysed from different empirical angles.

Theoretical controversies

Continuing along the lines of controversy, I wish to highlight the fact that my thesis is, in fact, characterised by multiple theoretical and methodological controversies and tensions including fundamental disagreement regarding economic growth, general equilibrium, and the ontological status of the economy, to mention but a few. I myself am not external to these controversies and participate in them in multiple ways.

Thus, in relation to economic growth, I would call myself a moderate agnostic, who certainly thinks we should devote less collective energy to the worshipping of the economic growth god, while still acknowledging that the measurement of economic activity actually makes sense for various macroeconomic policy purposes. When it comes to general equilibrium and neoclassical economics in general, I am very far from being a fan and much more in favour of Keynes's concept of fundamental uncertainty. Yet, in the case of the ontological status of the economy, I am in opposition to most post-Keynesians and ecological economists, many of whom tend, more or less explicitly, to take a realist or critical realist perspective on the economy and the world we live in more generally. Exemplifying this, the teachers of a methodology course in ecological economics, which I attended for ethnographic purposes, at the University of Leeds, emphasised several times that a model is a representation of reality, thus making a conceptual distinction between reality and model. In opposition to this approach, I am more in favour of the STS tradition, in which it is common to consider the strange thing called reality to be partly constituted by theory and method (Law 2004).

To end this chapter and continuing along the lines of the preceding statements, I would like to devote a few words to discussing how various theoretical perspectives, some of which have been introduced in the preceding, can be used to understand the thing called the economy.

The economy

In spite of several differences, discourse analysis, narratology and various STS perspectives all share an interest in the construction of knowledge objects and describe such objects as emerging from various practices. In Foucault's view, this emergence is rooted in discursive practices (Foucault 1972), to narratology, knowledge objects emerge from stories and storytelling (Czarniawska 2010), while to branches of STS, such objects are described as emerging from practices of associating multiple human and non-human entities in sequences of translations (Callon 1986, Latour 2005).

Various versions of the 'knowledge object'-perspective have also been deployed to describe 'the economy', for instance by Schabas, who states that " '[t]he economy' emerged as an object of reference for economists circa 1820 and endures to the present as an epistemic object" (Schabas 2008). Thus, in Schabas's view, there is a 'before the economy', when economists did not use this expression (and if they did, it meant something entirely different from today), while the classical economists discursively created 'the economy' as part of their endeavours to carve out a specific epistemic domain of economics, separated from nature and fully explicable in terms of human behaviour and market mechanics (Schabas 2005). Adding to this, Schabas explains that the economy gradually became part of everyday speech in a similar vain as the concept of temperature (Schabas 2008). Taking a 'knowledge object"-perspective on the economy, thus, allows for the description of the economy as an epistemic object, which has emerged from discursive practices of neoclassical economists and later spread to become part of everyday language.

This description, however, calls for a few considerations regarding the metaphysical applications of such a perspective. Hence, firstly, it should be mentioned that this perspective is in opposition to a realist view, which tends to consider the economy as an objective reality, existing independently of human description. Instead, Schabas's view can be seen as *social constructivist*, meaning that she explains the economy as a linguistic construct which is created by economists. As an alternative to the realist and social constructivist positions, however, it is also possible to take a *constructivist* perspective, which offers a third view on the emergence of knowledge objects.

The constructivist perspective has been proposed by Latour in order to bypass the dichotomous deadlock between realism and social constructivism and consists of seeing the emergence of scientific facts and objects as a process which obliterates the boundaries between what is real and what is socially constructed. In this view, knowledge objects come into being as a result of description meeting indeterminate material conditions (often in various laboratory settings), a process which, in some cases, gradually allows for stabilisation and the coming into being of well-defined facts or objects (Latour 1992).

Steps in the direction of understanding the economy in a somewhat constructivist manner have been taken by scholars such as Callon and Mackenzie, who promote a *performativity* approach to economics (MacKenzie 2006, Callon 2007). The basic proposition of this approach is that markets are constructed in interactions between statements and calculative devices of economics, and various socio-material settings (Callon 2007). This is a rejection of a positivist view, typical of neoclassical economics, of markets being objective realities governed by universal economic laws, which can be understood by means of rigorous mathematical description. Instead, the performativity approach sees economic theory as a participant in the creation of market realities (MacKenzie 2006, Callon 2007).

The use of the term performativity is inspired by Austin's theory of speech acts, where a *performative* is a sentence which, instead of describing or asserting something as being true or false, is part of an action. Hence, a performative is not true or false, it is successful or unsuccessful (Austin 1962). A famous example of a performative is the 'yes' uttered at a wedding, which concludes the performance of a marriage. In Austin's theory, the context in which the performative is uttered is vital to its success: in order for the 'yes' to be performative, the institutional setting of a marriage needs to be in place (Ibid.).

The STS version of performativity elaborates on the relationship between statements and their worlds. Thus, according to Callon, words and worlds should not be viewed separately, but in complete entanglement, where the statement and the object are constituent elements of each other (Callon 2007). As a consequence, material conditions determine the possibility conditions of statements, while statements are able to change material conditions. From this view, Callon derives the idea of economic theory as a participant in the creation of markets. Extending this view to my thesis, one could say that I have tried, in Article 4, to illustrate how macroeconomic statements provided by models were part of determining what could be thought and done in relation to the Danish energy system, a determination which

also influenced decisions regarding transformations of this system (Urhammer forthcoming).

An important aspect of the performativity approach to economics is the significance of calculation and calculative devices, where calculation is considered a practice of "[i]solating objects from their context, grouping them in the same frame, establishing original relations between them, classifying them and summing them up [...]" (Callon & Muniesa 2005:1232). In addition, economic calculation involves the formatting of values by means of a monetary metric in order to establish institutions of economic transactions (markets) and calculation.

One of the main lessons from this understanding is that economic calculations are interventions in socio-material conditions, which change such conditions. Exemplifying this, Callon & Muniesa describe markets as calculative devices, where a multiplicity of material and social conditions are transformed into the monetary exchange of goods and services (Callon & Muniesa 2005). In a somewhat similar vain, Miller & Rose (1990) emphasise how accounting (one of the aspects of calculation) can be used to transform multiple socio-material conditions into objects of governance.

Even though Callon and Muniesa do not engage in analyses of macroeconomics and 'the economy as a whole', their view also applies to macroeconomics and macroeconomic models that can be considered good examples of economic calculation and calculative devices, participating in the construction and governance of an object named the economy. During the course of writing the thesis, I struggled with my ambition to present a more elaborate constructivist take on the economy. This project, however, did not come to a conclusion and has not been included in the thesis. Yet, I would like to note that such a project, at least in my view, consists of determining how elements such as – national accounting, theorising, modelling, storytelling, translation, and circulation – connect to each other and establish the economy as an object which is almost omnipresent in state institutions and processes of policy-making.

To relate such a constructivist perspective on the economy to the previously described conceptions of politics, one could say that there is, in a sense, something highly non-political about the economy, meaning that its existence and qualities are hardly ever contested in mainstream policy discourse. Along these lines, Latour describes the Economy (with a capital E indicating objectivity and singularity) as a frozen continent meticulously constructed by a modernist "economization project whose aim it is to put an end to politics and construct an infrastructure about which is said "hands off" " (Latour 2016). What Latour expresses here is how the calculative practices of economics have constructed an object step by step, a thing called the Economy, the existence and characteristics of which are almost as irrefutable as hard facts produced in science laboratories (Latour 2013b). The consequence of this appearance is a de-politisation of collective concerns of great importance: what ought to be open to political struggles and moral considerations has become a matter of economic 'facts' better left to the economists. In this thesis, I attempt to reopen and re-politicise the economy, in particular the almost uncontested objective of economic

growth, in order to participate in struggles to find solutions to the massive economic and ecological difficulties of our time.

Materials and methods

Given that the themes of my thesis – economic growth, sustainability, macroeconomics, modelling – are transboundary and cut across analytical categories such as the global, national and local, it is not easy to confine the analysis to one specific locality or a well-defined set of data. This means that neither a traditional ethnographic study of occurrences at a specific site, nor an analysis based purely on documents seemed appropriate to serve my purposes. Instead, I have tried to combine various data sources and methods of analysis to create a patchwork, where a variety of data and methodological approaches have been deployed in combination. Having said this, it should be stressed that the thesis exhibits an empirical inclination towards economic issues of Western countries and in some cases more specifically Denmark and Danish historical developments. Furthermore, I ought to mention that the main empirical basis of the thesis is in fact documents and audio recorded interviews, so most of the articles mainly rely on this type of material.

In the following, I first provide a few general reflections on documents, interviews, search methods and coding. Thereafter, I present the empirical material of the thesis, while I conclude the chapter with some considerations regarding multi-sited ethnography and my role as a researcher with an urge to make a difference.

Documents and interviews

According to Lynggaard, documents are language fixed in text and time, where text is commonly perceived as written, but also includes photography, graphs, and other visual objects (Lynggaard 2010). The documents analysed in my thesis were mainly journal articles, books, and policy reports. One of the intriguing features of this type of material, however, is that it is carefully drafted with a purpose of persuasion. Thus, Latour emphasises how scientific articles are pieces of rhetoric, conveying an impression of objective discovery, where the entire ethnographic 'backstage', characterised by negotiation, compromise and doubt, of the article is omitted (Latour 1987). This observation applies, in Latour's case, to scientific texts produced by science labs. However, McCloskey has argued in a similar vain in relation to economics and elaborately explained how economics is also a discipline of rhetoric (McCloskey 1998).

Acknowledging this feature, I have chosen two different methodological approaches. The first was to embrace the rhetorical dimension of journal articles and policy reports and analyse such documents as instances of storytelling and persuasion to get a sense of the persuasive strength of different macroeconomic policy proposals. Secondly, I have tried to find ways to 'get behind the scene' and learn about the machinery of drafting macroeconomic journal articles and policy reports, especially to determine the role of modelling in this enterprise. However, doing this thoroughly would require elaborate ethnographic fieldwork at specific locations, such as ministries or economic councils, which was never the intention of my project. So instead, I have sought to find what could be labelled a middle course between pure document analysis and ethnographic fieldwork, which ended up being interviews. Thus, interviews with economists and model builders at universities and state organisations, such as the Ministries of finance and the Danish Economic Council,

became my opportunity to take a peek inside the macroeconomic 'laboratories' of various universities and the Danish state apparatus.

According to Kvale, an interview is a conversation with the purpose of acquiring an insight into the life-world of an interviewee (Kvale 1996). I find this description appropriate, but would perhaps rather say that an interview is a conversation with one or multiple purposes. In my case, the purposes counted: getting to know practices of macroeconomic modelling, acquiring a better understanding of macroeconomics, piecing together historical sequences, retrieving information which could not be found in articles and reports, and acquiring a comprehensive view of macroeconomic modelling for sustainability. My approach to achieving these purposes was the well-known formula of a semi-structured interview, where the interviewer has a check-list of prepared questions, yet is open to and interested in the exploration of unprepared questions and themes (Berg 2007).

Given the multiple different purposes of my interviews, my informants also came to play different roles. Thus, during one interview, an interviewee could switch between being an expert conveying expert knowledge of her specific field, an artisan telling anecdotes about modelling practices, and a historian providing information on long past events. Audio recordings of the interviews later allowed me to turn the interviews into written text and divide statements into various categories reflecting the different roles that my informants came to play during the interviews.

Searching

In relation to the creation and gathering of data, questions of search strategies obviously emerge, and in present day academic practices, academic writers are especially expected to account for how text is identified and collected. In my thesis, articles and other documents were located by methods such as: using search engines and combinations of search terms on the Internet, paying attention to references and going through bibliographies, and recommendations given to me by peers and interviewees. Other than that, I have not followed any strict strategy of data gathering, but I have rather tried to acquire sets of data, which seemed adequate for my research purposes and which were within my reach given the constraints of time and personal resources.

Coding

An academic researcher is generally expected to be able to account for the process of engaging with data and the production of analyses. Yet, I must admit that this process is, at least in my view, too subtle for me to claim full awareness of since it involves many elements that I have not consciously controlled. For instance, I would sometimes go to bed confused about how to approach my material and then wake up the next morning with a useful and very tangible idea of how to proceed. Thus, sleeping was in fact a vital part of my research method, even though I have no idea what went on during my sleep. Having said this, there were luckily also methodological techniques which were within my conscious control, and coding was one of them.

Emphasising that coding is a rather multifaceted and complex affair, Coffey & Atkinson (1996) note that categorisation and systematisation is, in fact, a good point of departure for the coding of given data material. This may sound quite obvious, and it probably is, but I have to acknowledge that the systematisation and categorisation of documents in various thematic folders on my computer was in fact one of the most important parts of my coding process, and it helped me get an overview of my material and develop conceptual ideas. As people interested in philosophy will probably certify, categorisation is certainly not an innocent business and my category choices where highly idiosyncratic in a way which shaped the final results and sometimes led to undesirable constraints and dead ends.

As another aspect of coding, Coffey & Atkinson (1996) highlight how the identification and marking of chunks of text can separate data into various thematic categories. This activity is sometimes referred to as segmentation, which can be followed be recontextualisation, where chunks of text are reinserted in new textual contexts and perhaps surrounded by similar thematic chunks from other interviews or by statements written by the researcher (Ibid.). Such processes of marking, segmentation and recontextualisation were also applied during the drafting of my thesis, where documents (including transcribed interviews) were marked in various ways, and where chunks of text were copied and inserted into new textual contexts. In some cases, such coding concerned the identification of discursive categories and narrative structures (Urhammer & Røpke 2014), while in other cases, coding consisted of recognising and linking historical patterns and events across interviews and documents (Urhammer forthcoming).

More generally, Coffey & Atkinson (1996) highlight how coding establishes a link between data and theoretical concepts, where the categorisation and systematisation of data are merely elements in a wider multifaceted interpretive process. As such, coding is a heterogeneous discipline, which is not confined to activities of organising material in various thematic categories or highlighting sentences using different colours, however useful such activities may be. Thus, Coffey & Atkinson (1996) emphasise that coding is just as much a process of reflection as it is a question of a precise procedure, which means that coding requires interaction with data, goes beyond data, and adds new layers of interpretation to the research process.

In my case, this view spurred me on to achieve some kind of awareness of coding as a hybrid and rather creative process and embrace the role of active interpreter and creator of new interpretive layers to the data material. Along these lines, I have also tried to be aware of how my personal theoretical inclinations influenced the understanding of the data material, but also how the available data material constrained the theoretical ambitions. Exemplifying this, discourse and narrative analysis suited my choice of using documents as empirical material, while my theoretical interest in STS provided me with a partly unsatisfied urge to go further than text and discover practices and material conditions. In the case of document analysis, the afore-mentioned element of rhetoric and persuasion, which characterises the documents I have engaged with, prompted me to embrace this rhetorical dimension and analyse certain documents as if they were collections of narratives and storytelling. In this case, the coding of the material consisted of adding an

interpretive layer by configuring the text material into a selection of well-defined narratives.

Data material

During the course of writing this thesis, a wide range of data was gathered and processed in various ways. All together, the collected data material for the entire thesis includes approximately: 33 hours of audio recorded interviews of 21 professionals, 11 hours of audio recorded seminars, 45 reports, 88 journal articles, 8 books, 18 websites and a few field observations (for a comprehensive overview of the data material see appendix 1). Even though each individual article draws upon a specific set of data, it is appropriate to talk about a collective set of data for the entire thesis, not least since some articles share data and rely on data material from other articles as background material. In the following, I describe the data material and how it was processed for the purposes of the individual articles. Finally, I discuss the concept of multi-sited ethnography, which has, at least to some extent, inspired my research.

Interviews and seminars

In the span of writing the thesis, I carried out a series of interviews and audio recorded a number of seminars of special empirical interest. Some of the interviews could be labelled expert interviews, which provided insights into macroeconomic modelling, while other interviews rather served as explorative conversations about a wide range of issues related to macroeconomics and modelling. However, all the interviews could reasonably be labelled semi-structured.

In Article 4, 15 Danish model builders (expert practitioners), economists and civil servants, many of whom were part of the Danish macroeconomic modelling community, were interviewed about macroeconomic modelling and energy in Denmark (Urhammer forthcoming). All the interviews were transcribed and coded in order to identify: important events, a common chronology and significant models and modelling features. While working on the article, I also recorded a Danish seminar about multi-sector models and energy. This recording became a useful source of information about the most recent of the three models described in the article.

In Article 5, some of the above-mentioned interviews along with similar interviews of model builders, who I arranged to meet during my stay in Leeds (more about this later), served as material for approaching the interface between macroeconomic modelling and policy-making (Urhammer in progress).

Reports

The reports and documentations used in this thesis were published by organisational actors, such as the OECD, the Danish Energy Agency, the New Economics Foundation and the Worldwatch Institute, and spanned a wide range of issues from green growth policy programmes to energy plans and documents on macroeconomic models.

In Article 1, 19 reports were analysed for the purpose of investigating economic policy proposals for solving the so-called system crisis (Urhammer & Røpke 2013). The reports were located using the Google search-engine and search words, such as 'green growth', 'green economy' and 'degrowth', by exploring organisational websites, and by going through lists of references. During the process of reading the reports, a gradual categorisation of the reports into two overall discursive categories took place using folders on my laptop. Parallel to this, excel spread sheets were used to group policy proposal into two overall policy categories and a number of sub-categories. Parallel to this work, an analytical layer was gradually developed by articulating two grand stories and a series of archetypical narratives for each discursive category.

In Article 4, 16 reports were analysed for the purpose of telling the story of macroeconomic energy modelling in Denmark (Urhammer forthcoming). The collection of reports comprised a series of energy policy plans and documents of different Danish macroeconomic energy models. In many cases, interviewees made me aware of the existence of specific reports. The energy plans were used as a supplement to interviews and provided a means for tracing the subtle connection between modelling activities and policy-proposals. In the pursuit of this connection, the energy plans were coded in order to identify coinciding themes between interviews and reports. Furthermore, the plans were part of establishing the overall chronology of the story. The technical model documents primarily served as a supplement to the interviews and provided a valuable source for understanding and describing the technicalities of the models.

Finally, Article 5 used 7 reports about different macroeconomic approaches to environmental modelling as a supplement to a selection of journal articles (Urhammer in progress). Article 3 used 1 report about beyond growth indicators to better understand the circulation of economic growth (Urhammer 2014), while nine reports from various Danish State organisations, mainly about modelling and national accounts, served as the background for understanding the core themes of the thesis.

Journal articles

Journal articles also served as empirical material for a number of the articles. This was especially the case for Articles 1, 5 and 6 (Urammer & Røpke 2013, Urhammer in progress, Pirgmaier & Urhammer 2015). In Article 1, 10 journal articles were used to supplement the organisational reports (Urhammer & Røpke 2013). Even though academic articles are most often organised differently than reports, the categorisation of the articles and their policy proposal followed the same procedure as for the reports.

In Article 5, 38 journal articles were surveyed (Urhammer in progress). The articles were located using Science Direct, Scopus and Google Scholar and search words, such as 'macroeconomic', 'modelling' and 'sustainability', by going through lists of references, and finally, by asking peers and model builders for useful references. The articles were categorised using laptop folders into several methodological categories, some of which were again subdivided into sub-themes. Parallel to this, excel spread

sheets were used to help organise the content of the articles in sheets divided into categories such as *research questions*, *theory and worldview* and *tools and technicalities*.

In Article 6, 35 journal articles were reviewed in order to account for a series of axiological positions and to analyse the use of the term 'value pluralism' in a series of articles published in the journal Ecological Economics (Pirgmaier & Urhammer 2015). The search process, categorisation and analysis resembled the one performed in Article 5 (Urhammer in progress). Finally, the articles analysed in Article 5 also served as a background for writing about neoclassical economics as a system of belief in Article 2 (Urhammer 2015a).

Books

Also various books have served as data material in this thesis. This is the case for Article 4, 5, and 6. Yet, the most important use of a book as empirical material is in Article 2, which depends heavily on Sørensen & Steinsland's book about the Norse poem *Völuspa* (Sørensen & Steinsland 2001).

Websites

Even though the data material of this thesis does not contain many websites, Article 3 draws on statements and information from 17 websites (Urhammer 2014). The websites were located using Google-searches combining words such as 'the economy' and 'economic growth' with words such as "healthy", "sick", and "strong", in order to find linguistic instances of the objectification and personification of these entities. The searches were not carried out to gather exhaustive data material, but to acquire telling examples to support conceptual propositions. Furthermore, Article 4 used one website in order to help get an overview of the history of Danish energy policy from the point of view of the Danish Energy Agency (Urhammer forthcoming).

Field observations

Parts of this thesis are inspired by disciplines committed to ethnographic fieldwork, and even though fieldwork did not play a prominent role in writing the thesis, it is still fair to claim that field observations did serve as a supplement to the rest of the data material. As such, the fieldwork of the thesis did not follow an elaborate plan, instead it simply happened along the way, or, as I write in Article 3, "in the stream of my life" (Urhammer 2014:311). In the following, I will try to describe some of the fieldwork carried out in the course of writing the thesis.

In the first year of the project, I spent six month at the School of Earth and Environment at the University of Leeds. Here I became part of a community of ecological economists and participated in meetings, events and followed a graduate course in quantitative ecological economics methods. The University of Leeds turned out to be a very relevant ethnographic site since it housed a strong group of ecological economists and a group of Post-Keynesian economists. While I was there, these two groups participated in planning the biannual conference of the European Society for Ecological Economics, and I got the chance to be present at sites of cross fertilisation between these two communities, where the ecological community encouraged the incorporation of ecological aspects to the post-Keynesian framework,

while the post-Keynesians inspired the ecological framework not least with its rigorous understanding of the financial dimension of economics.

At the end of my stay in Leeds, I got the chance to participate in an international exergy economics seminar, which gathered the world's leading researchers within this field. The seminar was workshop-based and focussed strongly on opportunities for collaboration and how to push the research programme of exergy economics forward. I participated as a note-taker and thus had the chance to be an almost anonymous observer. Some of the recurring themes at the seminar were: the creation of and access to data and databases, the struggle against and opportunities for collaboration with mainstream economists, and the opportunities for enrolling other research programmes, such as life-cycle assessment and complexity theory, in the exergy agenda.

Back in Denmark, I got to know central members of the Danish macroeconomic modelling community and learned about the Danish history of macroeconomic energy modelling through a series of interviews, which brought me to sites such as The Danish Ministry of Finance, Statistics Denmark and the Niels Bohr Institute for Theoretical Physics. In Denmark, I also participated in several seminars about macroeconomic modelling, through which I acquired further knowledge about mainstream modelling methods and how they are practiced in governmental organisations.

When it comes to using fieldwork as a direct source of information, Article 3 does so most elaborately (Urhammer 2014). In this article, I draw upon conversations and meetings which took place during my stay in Leeds. The most fruitful of these were two conversations with former civil servants of the UK Treasury and the Mexican Ministry of Finance, and a meeting with a programme manager from the New Economics Foundation in London. The civil servants provided me with insights into the epistemic practices of ministries of finance, with knowledge about the tight entanglement of macroeconomic modelling and processes of policy-making, and put me on the track of the circulation of numbers and graphs between statistical offices and ministries of finance, while the programme manager shared his experiences of economic growth as a strong cultural idiom in many of the UK ministries he had visited.

Concluding the fieldwork, it was mainly a source of background information helping me interpret and find connections between the topics of my thesis, although it also served as a more direct source of information which helped me to develop the conceptual framework for Article 3 (Urhammer 2014).

Some elements of a multi-sited ethnography

In Article 3, I claim to have performed a multi-sited ethnographic study (Urhammer 2014). This claim, however, is not explicitly justified in the article. Hence, I would like to devote a few words to elaborate a bit on this methodological topic as it has been articulated by Marcus (1998). According to Marcus, multi-sited ethnography emerged during the 1980s from inter/anti-disciplinary research, which challenged

the distinction between local life-world perspectives and world-system perspectives as two separable levels of investigation, the former studied by ethnographers, the latter by macro-theorists (Ibid.).

In opposition to this distinction, multi-sited ethnography approaches world-systems as objects that emerge from connected life-worlds through the circulation of macro-theoretical concepts and narratives between specific sites and localities. In this view, world systems are objects which must be studied from site to site through multiple contexts, and hence, the objects of multi-sited research can neither "be accounted for ethnographically by remaining focused on a single site of intensive investigation" nor by pretending a view "from above or 'nowhere' " (Ibid.:80 and 97). Along these lines, multi-sited ethnography tries to avoid assumptions about the existence of systems prior to analysis. Instead it "[…] allows the sense of system to emerge ethnographically and speculatively by following paths of circulation" (Ibid.:92).

Even though my work is very far from a carefully crafted multi-sited ethnographic study as Marcus envisioned it, my approach to economic growth and macroeconomics somehow still resonates with some of Marcus's ideas. Especially, I have been encouraged by Marcus and several STS scholars to follow things through different sites and data material. Which things to follow obviously depends on the research question, yet, Marcus emphasises, among other things, *controversies*, *stories* and *metaphors* as suitable objects of a multi-sited ethnography (Ibid.). Thus, in the absence of a reliable holistic model of macro-processes, following the parties to a specific controversy can open useful terrain, and when dealing with discourses and modes of thought, following plots, symbols and metaphors can lead the way to new discoveries (Ibid.).

In line with these recommendations, I have tried to follow controversies regarding economic growth through various sorts of data material along a blurry line of separation between different epistemic approaches to macroeconomics and economic growth. This has led to a description of economic growth as a multidimensional object with many appearances: in Article 2, it is a god in a mythological system of belief (Urhammer 2015a), in Article 4, it is a key factor in crafting energy policy imaginaries (Urhammer forthcoming), in Article 3, it is a constructed, circulating monster (Urhammer 2014), and throughout the thesis, it acts as a separator between discourses, publics, models, and policy proposals.

The ethnographer activist

To end this methodological account, I wish to mention one more aspect of Marcus's multi-sited approach which has served as an inspiration to my work: *the ethnographer activist* – a translator and storyteller, who participates in processes of circulation, articulation and renegotiation of world-system objects (Marcus 1998). At least to some extent, I see myself as an ethnographer activist who has tried to make my project a contribution to a struggle to change our current mode of economic thinking and policy-making. This intention has, among other things, prompted me to install an element of flexibility in my project, which has allowed me to react to calls from various academic journals in order to communicate transformative perspectives to

audiences expected to be more or less unfamiliar with such views (Urhammer 2014, 2015).

Finally, it could be argued that the themes of the thesis were also more or less determined by my activist agenda, which is reflected in the fact that the main emphasis of the thesis was originally supposed to be macroeconomic modelling for sustainability. However, the aforementioned activist flexibility and the constant discovery of economic growth as a monster political obstruction to economic policy transformation made me reconsider the focus and allow economic growth to somehow take centre stage. As such, the process of writing the thesis can be described as that of an ethnographer activist gradually discovering, and not trying to avoid, the gravity of economic growth, not least due to recognition of the enormous influence of economic growth on macroeconomics and modelling in relation to issues of sustainability.

Presentation of articles

In this chapter, I present the articles of the thesis. Since the articles are different and have been written under different circumstances, I do not present them in the same way. Instead, I highlight a few relevant features and link the articles to the research questions they intend to answer. Hence, before I proceed to the presentation of the articles, I first present the research questions again.

Question 1

> *How can a comprehensive view of policy proposals for solving the multiple environmental and economic crises of our age be provided, and what can a narrative analysis of these proposals tell us about their political strength?*

Question 2

> *What is economic growth, and how did it become a policy object with the ability to obstruct policy action in favour of sustainable transition?*

Question 3

> *What is the role of macroeconomic modelling in policy and research for sustainability?*

Article 1[6] (Urhammer & Røpke 2013)

Article 1 addresses Question 1 of the thesis and sets the scene for the rest of the articles by introducing the system crisis perspective and by mapping a wide range of policy proposals for solving the system crisis (Ibid.). In doing so, the article establishes economic growth as a controversial issue, which serves as a pivotal point of contestation throughout the thesis.

The article presents a combined discourse and narratology approach to analysing a selection of policy reports and academic articles, by means of which it contributes to two different literary discussions. Firstly, it adds nuances to the study of contestations between growth protagonists and antagonists by pointing out that growth protagonist and antagonist discourses share a selection of policy narratives. Secondly, it adds a dimension to the concept of narrative policy analysis by suggesting a strong connection between narrative dynamics and structure. In Roe's approach to narrative policy analysis, attention is directed towards the structure of narratives in the sense that the shape of the plot is considered to be the determining factor to the persuasive strength of a story (Roe 1994). In Article 1, it is argued that the internal dynamics of a narrative – the cast of characters and what this cast does to create the structure – also plays a role in determining the persuasive strength of a narrative (Urhammer & Røpke 2014). If a story has too many villains and no heroes, for instance, it is likely to lead to chaos and a less engaging plot.

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[6] It ought to be mentioned that this article elaborates on work initiated in my master thesis (Urhammer 2012).

As mentioned in the introduction to the thesis, the thesis has an activist attitude, which is also detectable in Article 1, the purpose of which, among other things, is to direct attention towards narratives and storytelling as important factors in policy-making for a sustainable transition. The normative hope thus expressed in the article is that stronger attention to policy stories told, shared and circulated among a wide range of actors will strengthen the movement towards a sustainable transition (Ibid.).

Article 2 (Urhammer 2015a,b)

Article 2 was written on request from the Danish literature journal 'Kritik' for a special issue on crises (Urhammer 2015b). In my capacity of (wannabe) ethnographer activist, I saw the writing and publication of this article as a chance to communicate the issues of my thesis to a wider audience. As there was no restriction on the form of the article, I took this as an opportunity to play with genre, which resulted in the article being a mix of futuristic fiction and academic article.

In Article 2, Questions 1 and 2 of the thesis are addressed with an emphasis on question 2, which means that the article presents economic growth, along with other entities of economic theory, as a god in a system of belief. In addition to this, the article also elaborates on the discussion of heroes and villains in economic policy narratives, which was initiated in Article 1. This is achieved by introducing gods and demi-gods to the discussion. With this extension, Article 1 and 2 collectively command a vocabulary to rearticulate aspects of economic policy in terms of gods, demi-gods, heroes, and villains (Urhammer & Røpke 2013, Urhammer 2015a).

The purpose of the article is strongly normative and consists of an attempt to challenge the objectivity ethos of neoclassical economics and to illustrate how policy objects, such as economic growth and competition, possess traits and features similar to those of mythological gods and, therefore, perhaps should rather be considered as such. In this regard, the article can be seen as a proposal to embrace economics and economic policy rather as a matter of mythology than a matter of economic 'facts'.

Continuing along the normative path, the article also tries to establish a connection between neoclassical mythology and the interests of 'the elite'. The main argument in this regard is that the theoretical tenets of neoclassical economics almost too conveniently fit the interests of the rich and corporations so that the neoclassical gods, such as growth and competition, can be used to confront policies, such as corporate taxation and environmental regulation, with reference to how such interventions will threaten the gods of the neoclassical system of belief (Urhammer 2015a).

Finally, I would like to mention how Article 2 connects to discussions of the opposing worldviews of neoclassical and ecological economics. Thus, to describe the former, I have chosen to speak of the deterministic, linear, neoclassical cosmology, while the Norse poem *Völuspa* represents the crisis awareness and attention to downfall, which is characteristic of ecological economics. Along these lines, the *Völuspa* also represents the attention to complexity, chaos and uncertainty which

characterises the systems thinking of climate science and other environmental sciences.

Article 3 (Urhammer 2014)

Article 3 is the main article for addressing Question 2 of the thesis, which means that the article investigates the ontological status of economic growth. Amongst economists, this status is mainly a question of representation, where economic growth is described as an objective phenomena measured by GDP. In Article 3, this perception is challenged, and a perspective, which considers data collection and processing and the translation and circulation of numbers and graphs to be constitutional elements of economic growth as a policy object, is presented.

As was also the case for Article 2 (Urhammer 2015a), Article 3 came into being as part of my activist agenda, which means that the article can be seen as an intervention with the purpose of disseminating unconventional perspectives on economic growth and sustainability. More concretely, the article was a response to a call for a special issue on language and economics, and I saw this call as an opportunity to draw attention to the major environmental crises of our age and their relation to economic growth both as a biophysical phenomenon and a policy object. Since I had to react fairly quickly to the call, I had no time to establish a solid empirical base for the article, which means that it became a conceptual paper, sketching a certain perspective rather than thoroughly investigating clearly defined empirical material. Along these lines, my sense of relevant literature was also limited at the time of writing. This is most likely still the case, but I have at least tried briefly to make up for this shortcoming in the theory chapter and the introduction to this thesis.

In its capacity of conceptual paper, several themes and propositions of the article are merely touched upon and deserve further elaboration. In this regard, one theme especially calls for further explanation (perhaps even retreat), and that is the question of how a new inclusive language of decision-making can offer a path for Latourian ecologisation?[7] (Urhammer 2014). The reason for considering a retreat in this regard is the fact that I have to admit that my plea for a new inclusive language is mostly wishful thinking, which I do not have any clear idea of how to operationalise. Having admitted this, I could try to excuse myself by saying that Latour's notion of ecologisation is equally vague (which I am inclined to think it is), yet it seems more interesting to direct attention towards work which does in fact try to investigate the role of language in processes for which ecologisation might be an appropriate label. In this regard, I would like to mention de la Cadena, who has studied indigenous interventions in state politics of Latin American countries, and who describes such interventions as sites for connecting different language situations (de la Cadena 2010). Along these lines, de la Cadena's and other scholarly work, might serve as an entrance to engage with the problem of how to develop a new inclusive language for the purpose of ecologisation.

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[7] For a slightly more detailed description of ecologisation see the section labelled "empirical philosophy" in the theory chapter.

Article 4 (Urhammer forthcoming)

In Article 4, the focus is switched to addressing Question 3 of the thesis, which means that macroeconomic modelling takes centre stage. One of the purposes of Question 3 is to provide useful insights for current discussions of macroeconomic modelling, sustainability and economic policy. The article attempts to do so by describing specific historical modelling developments in Denmark, and by situating these developments in a context of politics and policy-making (Ibid.). In relation to the latter, the intention of the article is to get 'behind the scenes' of Danish energy policy-making and to provide insights into models and modelling practices involved in this type of policy.

While writing the article, I struggled with the ambition to empirically cover links between model building, policy plans, and actual policy decisions, which turned out, however, to be overly ambitious. Instead, I ended up focussing on model building and merely indicating how such practices connect to policy plans and decision-making. My approach in this regard was to argue that macroeconomic models can be seen as effective instruments for articulating the economic realities of energy policy not least due to their capacity to draft energy policy imaginaries – visions of energy system futures (Ibid.).

A key, yet only mildly surprising, discovery of the article is the fundamental role of economic growth and economic growth projections in Danish macroeconomic energy modelling, a role which consists of constraining the imaginary policy space by requiring the energy system to be able to deliver the energy demands of a growing economy (Ibid.). Along these lines, economic growth projections can be seen as a constant pulse of information, which emanates from the ministry of finance and is incorporated in modelling projects and reports covering issues of the energy system and the wider economy in Denmark.

The version of Article 4 appearing in the thesis is a revised version which has recently been resubmitted to Ecological Economics. The article has, thus, undergone the first round of peer review and is currently awaiting the editor's decision.

Article 5 (Urhammer in progress)

Article 5, which is in fact not an article but a working paper, continues along the lines of Article 4 and addresses Question 3 of the thesis. The work on this article was initiated in the first months of writing the thesis. Article 5 is thus the article which I have spent most time trying to write, and yet I have not been able to conclude the work in the form of a journal article. My original intention was to provide a very wide survey of macroeconomic modelling for sustainability, which turned out to be far too ambitious due to the huge variety of methodological approaches and vast amount of literature on the issue. Hence, along the way, the aim of the article became instead to identify a range of key topics for macroeconomic modelling for sustainability and to see how the treatment of these issues could provide insights into the development of ecological macroeconomics, especially in relation to modelling and policy-making.

As mentioned, the article is a working paper, which means that it is not organised as a traditional journal article, instead it is a collection of thematic chapters treating various aspects of macroeconomic modelling for sustainability in an ecological economic policy perspective.

Article 6 (Pirgmaier & Urhammer 2015)

Even though Article 6 is thematically different from the rest of the articles – it neither concerns economic growth nor macroeconomics – it is still closely related to the overall themes of the thesis. Thus, it discusses values, value pluralism and value incommensurability, which, at least in my view, are key separations between neoclassical economics and ecological economics, where the former can be labelled value monist, while at least a segment of the ecological economics community adhere to value pluralism.

Putting this in relation to economic growth, GDP can be seen as a value monist measure, which can only account for value if it is articulated in terms of a single monetary value metric. In opposition to this, the aforementioned ecological economists and other like-minded scholars, hold that it does not make sense to count all value by the same metric and aggregate it into one single number. Instead, we should acknowledge the fact that some values are incommensurable in that they cannot be accounted for by the same metric. In the case of certain values, it might even be utterly absurd to try and account for them at all. In this sense, values and value pluralism also relate to the discussion of macroeconomic modelling, which – especially in the case of neoclassical methods – is totally dependent on the assumption that one value metric suffices. Yet, if this assumption does not hold, how should we then do macroeconomic modelling, and is this type of modelling meaningful at all?

Summary

To end this chapter, I briefly summarise the conclusions of the articles in relation to the three overall research questions of the thesis.

Conclusion 1

The main conclusion in relation to Question 1 is that a comprehensive view of policy proposals for solving the multiple environmental and economic crises of our age can be provided by means of a mapping of narratives consisting of an overall distinction between two discourses (pro-growth and no-growth), six so-called macro narratives, and a series of economic means (Urhammer & Røpke 2013:65). Regarding the political strength of policy narratives, it is concluded that Roe's (1994) emphasis on the plot structure as an indicator of political strength can be supplemented by highlighting the importance of actants who enable certain structures. Thus, Article 1 puts emphasis on the cast of characters and the presence of heroes and villains. The strong cast of heroes in the pro-growth narratives facilitates a well-structured green growth policy plot, while the lack of heroes and the excess of villains in the no-growth narratives complicates the telling of a coherent and engaging story (Urhammer & Røpke 2113). Finally, Article 2 adds to the conclusion by introducing

the gods of economics to the cast of characters (Urhammer 2015a). If a policy narrative incorporates the authority of institutionalised gods, such as growth, market and competition, it inherits some of the strength of these gods.

Conclusion 2

Conclusion 2 responds to Question 2 by proposing that economic growth is a circulating monster composed of multiple translations, including the formatting of scattered data into a single number, the visual presentation of this number in graphs, and stories about this number (Urhammer 2014). The strength of the monster is explained by "an entanglement of institutions, state instruments and discourse that facilitates easy circulation and makes economic growth a nearly omnipresent concern in certain collectives" (Ibid.:315). The ability of the monster to obstruct policy action in favour of a sustainable transition is explained by the status of economic growth as a concern which trumps environmental concerns. Article 2 'concludes' that economic growth is a god in a system of belief; a god which possesses the power to reject policies that appear to be a threat to its existence (Urhammer 2015a).

Conclusion 3

The final conclusion concerns the role of macroeconomic modelling in economic policy and research for sustainability. The answering of this question is divided between two articles. Article 4 concludes that macroeconomic modelling was included in Danish energy policy as an instrument of inquiry into emergent energy issues of core concern to the Danish government. Furthermore, it is argued that these modelling practices became a means of incorporating an overall concern for economic growth into energy policy imaginaries (Urhammer forthcoming).

In Article 5, the preliminary conclusion is that macroeconomic modelling in economic policy and research for sustainability has multiple roles. Sometimes it is a means of establishing consistency in relation to theory or accounting principles; sometimes it is a means of serving the interests of an incumbent government, and sometimes it can be used to debunk various theoretical propositions (Urhammer in progress). Thus, given this multiplicity, a further conclusion is that the usefulness of macroeconomic models depends on how they are designed and used to fit their purposes. This means that model builders, who wish to use models as weapons in battles for a sustainable transition, might benefit from reconsidering whether the models they build do, in fact, serve the purpose of the policy changes they are aiming for.

General conclusion

In this thesis, I approach the issue of economic growth and sustainability from a range of different empirical angles and theoretical perspectives, the overall purpose being to re-politicise the issue of economic growth and sustainability by illustrating a variety of political dimensions of this issue. This quest for re-politicisation is spurred by deep frustration over what appears to me to be the widespread and seldom disputed (at least in mainstream media and politics) 'truth' of economic growth as the most important economic policy objective and a universal societal good, the pursuit of which trumps concerns for issues such as climate change, inequality, ecosystem degradation and loss of biodiversity.

In order to re-politicise the issue of economic growth and sustainability, I have particularly embraced three recurring and entangled modes of politics: *controversy*, *world making* and *policy-making*. Controversy is core to the thesis, which treats economic growth antagonism in relation to sustainability by delving into a series of pro-growth and post-growth battles and disputes. Thus, Question1 of the thesis sets the scene for investigating the economic growth/sustainability controversy as a battle of storytelling, where macroeconomic policy proposals for sustainability are presented as narratives exhibiting various degrees of persuasive strength (Urhammer & Røpke 2013), while Question 3 provides an opportunity to approach the same controversy from a different angle; namely macroeconomic models and modelling (Urhammer forthcoming, in progress). Together, these two research questions make it possible to investigate this controversy by focussing on two different weapons of battle: stories and models. Furthermore, in Article 4, the controversy perspective is approached using Dewey's notion of a public, which facilitates the investigation of the controversy in terms of confrontations between two opposing publics; the *traditionalists* and the *environmentalists* (Urhammer forthcoming).

As has been elaborately illustrated by mappers of controversies, controversies are complicated and messy (Venturini 2010), and I must admit that some of the richness, complexity and messiness of the controversy in focus has been lost in my configuration of it by means of a fairly rigid distinction between economic growth protagonism and antagonism. Yet, I have made an effort to show some of the nuances of the controversy, not least by emphasising that protagonists and antagonists do, in fact, share stories and modelling methodologies, and that different publics, organised around this issue, intermingle and are not that easily separated (Urhammer & Røpke 2013, Urhammer forthcoming, in progress).

Politics as world making consists of articulating the formatting and configuration of material circumstances as a form of politics. From this perspective, all three research questions of the thesis are invitations to think of theory, accounting, modelling and storytelling as world making. In this sense, Question 1 allows for a conception of narratives as creators of macroeconomic realities (Urhammer & Røpke 2013). Question 2 opens a space for describing economic growth as a constructed world, a monster, and a god (Urhammer 2014, 2015), and Question 3 sets the scene for presenting macroeconomic models as participators in the making of economic and environmental realities not least by being constituent elements in the construction of imaginaries of the future (Urhammer forthcoming, in progress).

Finally, the question of policy and policy-making is salient throughout the thesis. This salience is rooted in the understanding that a sustainable transition of the scale which is required to address the massive environmental and social crises of our time is probably only achievable if governments around the world support it whole-heartedly instead of obstructing it in the name of growth, which often seems to be the case today. In Article 1, the issue of policy is addressed by focussing on policy proposals and the analysis of the persuasive strength of such proposals (Urhammer & Røpke 2013). Article 2 addresses policy by presenting macroeconomic entities such as economic growth, the market and competition as gods in a religious belief system, which is heavily involved in economic policy (Urhammer 2015a). The policy perspective in Article 3 concerns how economic growth has infiltrated public policy-making institutions and shaped them in such a way that they have become dependent on this monster (Urhammer 2014). Finally, Article 4 and 5 delve into descriptions of how macroeconomic models and modelling is involved in processes of policy-making. This is done by showing how models are able to set the scene for policy processes by producing policy assessments and imaginaries of the future and by providing the language and epistemic tools for engaging in questions of economy and sustainability (Urhammer forthcoming, in progress).

Due to the predominant focus on macroeconomics, this thesis does not venture into analyses of the interphase between macroeconomic calculation and special interests in policy-making. Sometimes I get the impression that economic growth is very much a policy trope serving the interest of elites, corporations and industry. For instance, if a policy proposal in favour of a sustainable transition threatens the interests of corporations and industries, one effective way to undermine it is to let some macroeconomic model calculate how many billions the policy will cost society in terms of GDP. This indicates to me that there is a connection between macroeconomic calculations and special interests, which I have not had the chance to investigate in any depth. Along these lines, it is important to emphasise that this question obviously also includes the special interests of environmental NGOs and communities in favour of post-growth transitions, which means that a stronger awareness from this side of how to use macroeconomic calculations to serve their interests might be helpful to the quest for a post-growth transition. The interphase between and entanglement of macroeconomic calculation and special interests is, thus, in my view, an issue of great importance to communities working for radical policy change, and I therefore encourage anybody with an interest in this question to explore it further.

Other than this encouragement, I must admit that this thesis does not present many concrete recommendations. Nonetheless, having investigated policy proposals such as green growth and neoclassical impact assessment models, I tend to think that they are expressions of some sort of collective madness; a worshipping of a brute god in a weird mechanical world, and the sooner we leave this religious practice the better. Hence, my main recommendation consists in repeating the plea for economic growth agnosticism, which others have proposed before me (van den Bergh 2011). Thus, I insist that economic growth is simply not the most important policy issue of our time. Instead of being so concerned with the ups and downs of GDP, we should

direct far more collective energy towards climate change, the wild west of finance, ecosystem degradation, loss of biodiversity, inequality and social injustices. One way to begin this, probably and unfortunately, long goodbye could be to invest fewer resources in the measurement of GDP, and not succumb to the temptation to invent new silly economic welfare measures to replace it. Rather, we should devote more collective energy to accounting for and taking care of tangible things such as the materials and energy we use, the waste and pollution we produce, and the habitats we destroy.

To end this general introduction, I would like to state that in the acknowledgment of the importance of policies for sustainable transition, this thesis tries to reopen the understanding of economic growth and sustainability and present alternative policy stories, models and perspectives, which can hopefully serve as a contribution to the re-politicisation of the frozen economic growth continent.

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Appendix 1: articles

Article 1

Urhammer, E. & Røpke, I. 2013, "Macroeconomic narratives in a world of crises: An analysis of stories about solving the system crisis", Ecological Economics, vol. 96, pp. 62-70.

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Analysis

Macroeconomic narratives in a world of crises: An analysis of stories about solving the system crisis

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ABSTRACT

Since the financial crisis in 2008, a series of publications on macroeconomic responses to the compound crises of the economy and the environment have emerged. Under labels such as *green new deal*, *green growth* and *the great transition*, attempts at offering coherent responses to the crises have been made. These responses have in common that they all present a large number of policy proposals for ways in which to solve the current crises and achieve a sustainable economy. This article provides a mapping of a selection of such responses and an analysis of their content. The analysis combines discourse theory and narrative analysis and investigates discourses by studying the narratives they produce. The study thus contributes to the long line of analyses on discourses on sustainable economy: empirically, by investigating and analysing a number of macroeconomic proposals for solving the system crisis, and theoretically, by elaborating on the concept of narrative dynamics in relation to persuasive strength in political decision-making.

1. Introduction

The world is facing a multitude of environmental, economic and social crises which are threatening the wellbeing of present and future generations. Climate change, ecosystem degradation and pollution are destroying the environment (MEA, 2005; Rockström et al., 2009). Financial meltdowns, recessions and debt are affecting the economy, and unemployment, inequality and social unrest are threatening the stability of many societies, also in Western countries, which are the focus of this paper (Asici and Bünül, 2012; Lipietz, 2013). The political responses to these crises differ. Many actors tend to give priority to the economic crisis and focus on getting the economy back on the growth track before they are prepared to direct more attention towards environmental issues (Geels, 2013; Tienhaara, 2010). Others are aware that a return to business as usual is not an option, because economic, social and environmental problems are interconnected and call for coherent solutions which address the problems simultaneously (Jackson, 2009; NEF, 2010b; OECD, 2011c; UNEP, 2011b). The strategies for addressing the problems in a coherent way differ widely with regard to their radicality. Some stay close to the traditional economic framework and aim at returning to the growth path, only in a modified form of green growth (OECD, 2011c; UNEP, 2011a), whereas others consider the different crises as aspects of a deeper system crisis that calls for more radical solutions and will involve a halt to economic growth in the affluent countries (Jackson, 2009; NEF, 2010b).

This divide points to the existence of two different discourses which provide different stories of how to solve the system crises. The main purpose of this article is to analyse and compare the persuasive power of these different stories. The study is based on the application of discourse and narrative analysis (Czarniawska, 2010b; Dryzek, 1997; Fairclough, 1992; Greimas, 1966; Hajer, 1995, 1996; Roe, 1994) and provides a mapping of a broad selection of macroeconomic proposals, adding to a couple of survey papers in this field (Asici and Bünül, 2012; Bina and La Camera, 2011) by applying a different approach for systemisation.

Economic growth is at the core of these proposals. It is a nodal term which holds the key to understanding the system crisis and the opposing views on how to solve it. Central to this understanding is *the dilemma of growth* (Jackson, 2009), which refers to the problem that economic growth is at the same time the main provider of wealth and social stability and the instigator of environmental disaster (Jackson, 2009). There seems to be two main approaches to confronting this dilemma. The first is to decouple economic growth from environmental impact by the use of technologies which secure high resource and energy efficiency (OECD, 2011c; UNEP, 2011a), and the second is to establish an economy based on a stable throughput of materials and energy within global carrying capacity (Daly, 2008; Jackson, 2009; O'Neill et al., 2010). The first approach suggests what we see as a reconfiguration of the current global economy, while the latter implies a total transformation of the global economic system. The feasibility of decoupling is strongly

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challenged by the proponents of the latter approach (Jackson, 2009), and we suggest that these two opposing conceptions have led to the emergence of two different discourses as regards the dilemma of growth; here, we characterise these as a pro-growth and a no-growth discourse, respectively.

The latter approach fits in with the basic ideas of ecological economics, but until recently, ecological economists have contributed relatively little to macroeconomic research and policy development. The field has a long tradition of research focusing on how to operationalise the concept of scale of the economy in relation to the biosphere, and discussions on the environmental impact of economic growth, relative and absolute decoupling, and Herman Daly's steady state propositions also have a long history (Røpke, 2005). But it was not until the outbreak of the economic crisis in 2008 that more detailed discussions on macroeconomic issues and policies appeared high on the agenda, and the strong criticism of mainstream positions on growth was supplemented by an increased focus on constructive policy proposals. Recent years have thus seen a growing number of contributions to the development of an ecological macroeconomics (Daly, 2008; Harris, 2009, 2013; Jackson, 2009; Kallis et al., 2012; Lawn, 2010; Røpke, 2013; Schor, 2010; Victor, 2008; Victor and Rosenbluth, 2007), but the theoretical foundations and policy proposals of an ecological macroeconomics still need to be elaborated in more detail.

In addition to this elaboration effort, there is a need to consider how the perspective of ecological macroeconomics can impact policy-making in a wider and more effective way. An important precondition for political impact is that the perspective offers a strong narrative with considerable persuasive power (Roe, 1994). Analyses and debates on political impact, narratives and discourses all play a rather modest role in ecological economics, so we have found inspiration in a number of contributions both from within and outside of the boundaries of ecological economics. Fred Luks was the first to suggest that ecological economists should include the discourse on rhetoric into the self-awareness of ecological economics, because rhetoric is important for the political impact of this field (Luks, 1998). For instance, he emphasises the importance of metaphors in communication with a wider audience. Closer to the topic of the present paper are two more recent contributions. Berg and Hukkinen (2011) provide a narrative policy analysis of the sustainable consumption and production debate taking place in Finland and make the interesting observation that growth critique may strengthen the dominant growth stories because the critique adds to the complexity and uncertainty in the policy field. The second paper was written by Lehtonen, who has conducted a critical discourse analysis of internal discourses in OECD, highlighting the organisation as a site for discursive battles (Lehtonen, 2009).

Outside of the boundaries of ecological economics, authors such as Hajer (1995, 1996) and Dryzek (1997) have made interesting contributions to the field of policy analysis regarding the issues of the environment and economy, Hajer by developing a rigorous discursive framework for analysing subjects such as acid rain and ecological modernisation (Hajer, 1995, 1996) and Dryzek by delivering a broad analysis of four different environmental discourses (Dryzek, 1997). By drawing on this literature, we connect the tradition of discursive policy analysis of environment and economy to similar contributions within ecological economics.

Previous studies on the environment and economy using a discourse approach have focused on environmental discourses (Dryzek, 1997), on single subjects such as acid rain (Hajer, 1995), concepts such as ecological modernisation[1] (Hajer, 1996), and studies on a national (Berg and Hukkinen, 2011), organisational (Lehtonen, 2009) or local level (Åkerman and Peltola, 2012). In this study we expand the domain of analysis by investigating a series of macroeconomic responses addressing economic, social and environmental problems.

In Section 2, we describe our empirical material and provide an introduction to the theoretical understandings applied in the article. Section 3 presents and structures the content of the research material and identifies nuances and incoherences in the discourses. This is followed by a narrative analysis of the content in Section 4. Section 5 elaborates on the finding of shared narratives, while the conclusion in Section 6 puts the study into perspective.

2. Materials and Methods

The basic ontology of this study is that issues are discursively constituted, implying that the investigation of issues benefits from focussing on the discursive practices through which they materialise. These practices include storytelling, which connects a myriad of entities from different social domains (Hajer, 1995). The methodology of this article is thus to investigate the issue of the system crisis and its possible solutions by delving into the rich world of narratives in a series of publications containing macroeconomic solutions to this crisis. By using visual mapping, we sketch some outlines of the order of discourse which constitutes the issue of the system crisis and its possible solutions. Furthermore, an analysis of the narratives through which this order of discourse materialises provides an idea of how the dynamics of narratives adds to the concept of narrative persuasive strength.

When focusing on the scientific impact on policymaking, we find it relevant to analyse narratives from a realm between the scientific and the political domains. Thus, the primary focus of this study is official reports from organisations that are neither political parties nor universities but still closely connected to both the scientific and the political domains. Another reason for focussing on such reports is that this type of communication is well suited for the narrative analysis of our study, since it tends to gather a large number of concrete policy proposals in a more clear-cut fashion than is often the case in scientific articles.

We have analysed reports from the following organisations: Organisation for Economic Co-operation and Development: OECD (OECD, 2009, 2011b,c,d,e), United Nations Environment Programme: UNEP (UNEP, 2009a,b, 2011a,b,c), United Nations Department of Economic and Social Affairs: UN DESA (UN DESA, 2009), New Economics Foundation: NEF (NEF, 2008, 2009, 2010a,b, 2011), Sustainable Development Commission: SDC (Jackson, 2009), Centre for the Advancement of the Steady State Economy: CASSE (O'Neill et al., 2010) and The Worldwatch Institute: WI (Assadourian, 2012). Altogether, we have analysed 19 reports spanning the period between 2008 and 2013. Eleven of these reports we label pro-growth and 8 of them no-growth. Since the more radical positions are less institutionalised than the mainstream strategies, we have supplemented this selection with a number of scientific articles covering these perspectives (Bonaiuti, 2012; Kallis, 2011; Kallis et al., 2012; Kerschner, 2010; Lorek and Fuchs, 2013; Martinez-Alier, 2009; Martinez-Alier et al., 2010; Schneider et al., 2010; Smith, 2010a,b).

We are aware that the data material of this study does not fully cover the issue at hand and that there is a bias in favour of Anglo-American perspectives. This bias presents a challenge as regards the inclusion of alternative and less institutionalised perspectives such as degrowth, sometimes published in languages other than English. We have tried to overcome this challenge by supplementing the data material with a number of scientific articles that present these perspectives and draw on a wider base of non Anglo-American literature. With this addition, we find our data material sufficient to provide a basis for our methodological approach and conclusions.

The theoretical starting point of this article is that our writing and way of talking about issues form the perception of and lead the actions

[1] Ecological modernisation is a concept rather similar to the concept of green growth studied in this article. Green growth can be understood as a further development of ecological modernisation.

we take regarding these issues. This is clearly not a new idea, and many scholars within social sciences have contributed to it. Common to these contributions is the notion of discourse which has been developed by, among others, Foucault (1972, 1973), Fairclough (1992, 1995) and Laclau and Mouffe (1985). Within the field of policy analysis, the so called interpretive turn has led to an understanding of policy processes according to which the idea of discourse is influential (Yanow, 2000), and regarding the issues of environment and economy, discourse approaches have been applied by authors such as Hajer (1995) and Dryzek (1997). All of these authors add to the notion of discourse, and place emphasis on different aspects of it, but the general idea is that discourses are particular ways of speaking about and assigning meaning to certain parts of reality, and that discursive activities are considered to be key forces that shape social structures and processes (Jørgensen and Phillips, 1999). Thus, discourses matter in politics (Dryzek, 1997), and therefore it is worthwhile to investigate the discourses constituting the issue of the system crisis and its possible solutions.

Complex issues often attract a large variety of interpretations and suggestions (Dryzek, 1997), and the issue of the system crisis and its possible solutions is no exception. Thus, this issue can be perceived as constituted by different discourses struggling to assign certain meanings to it. Such a complex configuration of competing discourses covering the same social domain can be conceptualised as an order of discourse (Fairclough, 1992). This article attempts to give a rough sketch of the order of discourse constituting the issue of the system crisis and its possible solutions by investigating a relatively large set of written narratives.

A narrative can be understood as the linguistic ordering of events and phenomena in structures establishing more or less coherent accounts of these events and phenomena (Czarniawska, 2010a,b; Roe, 1994). Such accounts are often referred to as stories. Even though some authors distinguish between narratives and stories (Czarniawska, 2010b; Roe, 1994; Yanow, 2000), we do not apply a sharp distinction between these two. Instead, we find it worthwhile to distinguish between the notion of discourse and narrative. In this regard, we consider narratives to be phenomena embedded in discourses. Discourses are wide ensembles of ideas, concepts and categorisations (Hajer, 1995), while narratives are the result of discursive practices which organise elements of these ensembles into comprehensible plots. Thus, narratives can be understood as a certain type of materialisation of discourses.

Narrative analysis has been applied within policy analysis, for example by Emery Roe, who focuses on the plot structure of narratives in relation to political decision-making. Roe discovers how certain narratives enable politicians to act on issues, while others do not. The explanation for this is to be found in the plots of the narratives (Roe, 1994). The plot is the essential structure of the narrative — a sense-making way of organising narrative content (Czarniawska, 2010a,b). Narratives with a simple tripartite structure of beginning, middle and end are suitable for political action, while for example the scattered plots of critique do not offer a clear direction for political decisions (Roe, 1994). We find this view important, but suggest that there are also other dimensions of narrative strength in relation to policymaking, such as the institutional setting in which the narratives are told and the internal dynamics of narratives. This relates to Hajer, who emphasises two important aspects of discourses: the institutional context in which they are embedded and the content of the discourses (Hajer, 1995). Even though we agree with Hajer on the importance of both of these aspects, this study mainly focuses on the content of narratives and not so much on the institutional setting in which they are told.

The analysis of narratives often has a strong focus on the structure of narratives. But the analysis can also focus on the dynamics embedded in and shaping these structures. Todorov, for example, describes the development of a simple tripartite plot as caused by forces and actions (Todorov, 1971).[2] In this view, the dynamics of narratives lies in the presence of actants. This perception can be further elaborated by the use of the actant model developed by Greimas, in which generic pairs of actants create the basic dynamics (Greimas, 1966; Petersen, 1998). Some of these actants are: the subject and the object, and the sender and the receiver. The subject is the active part reaching for or doing something to the object, while the sender communicates or brings something to the receiver (Petersen, 1998). Often, the actants can be termed heroes, villains or victims (Petersen, 1998). We believe that this dynamic understanding of narratives can add something to the perception of narrative persuasive strength.

3. Macroeconomic Narratives

In this study, we refer to responses to the system crisis such as *green growth*, *green new deal* and *the great transition* as macro narratives. This word has a double meaning: first, it refers to these responses as macroeconomic, and second, as aggregates of smaller narratives. These smaller narratives are policy proposals — means for achieving certain goals. In order to visualise the macro narratives, we have constructed a mapping which connects a series of means to a series of these narratives by the use of black, white and grey colouring, illustrating their composition of different smaller narratives.

For the sake of clarity, we have carried out a crude separation of macro narratives into two wide discursive categories: pro-growth and no-growth. The pro-growth macro narratives promote continued economic growth in a green version, while the macro narratives of no-growth consider this impossible and therefore recommend the development of different versions of a no-growth economy. In our study, the pro-growth narrators are OECD, UNEP and UN DESA, while the no-growth narrators are NEF, CASSE, SDC, WI and a number of scholars from the field of ecological economics.

The pro-growth narrators are international and highly institutionalised organisations, and their main audience is governments and government officials from around the world. Thus, they are empowered by the advantage of directly addressing an international audience involved in policymaking at several levels. The no-growth narrators are smaller and far less institutionalised in comparison with those of pro-growth, and it seems fair to assume that their audience is further away from actual policymaking.[3] Although few of the no-growth narrators are empowered by the same privilege of speaking directly to political decision makers from around the world, they exert an indirect influence, for instance through public media and educational institutions.

Each of these narrators tells a specific macro narrative. OECD tells the story of *green growth* (GG), UNEP calls their story *green economy* (GE), NEF unfolds *the great transition*[4] (GT), SDC speaks of *prosperity without growth* (PWG), CASSE provides a story about *steady state economy* (SSE) and finally, WI and a series of scholars are telling the story of *degrowth* (DG). In our mapping, macro narratives are often syntheses of more than one publication. This means, for example, that the green-growth column contains proposals from all the selected publications from OECD, and the great-transition column does the same regarding the selected publications from NEF. Finally, it is important to observe that the degrowth column is qualitatively different from the other columns, since the information it carries is provided by a mix of both reports and scientific articles. In most cases, the reports include lists of

[2] "*An 'ideal' narrative begins with a stable situation, which is disturbed by some power or force. There results a state of disequilibrium; by the action of a force directed in the opposite direction, the equilibrium is re-established; the second equilibrium is similar to the first, but the two are never identical*" (as cited in Czarniawska, 2010b).

[3] As an exception, it should be mentioned that SDC was actually set up politically to update politicians on subjects regarding sustainability.

[4] NEF uses this title for a specific report, while we have used it to designate a wider selection of NEF reports.

concrete proposals supported by the authors, while this is rarely the case for the scientific papers. The authors of the latter tend to be more nuanced and to demonstrate a more dialectic approach, which may sometimes make it less obvious whether or not the author supports a certain proposal. Thus, the degrowth column could be claimed to be associated with a higher level of uncertainty.

Before the narratives are presented, the next two sub-sections are dedicated to a few background observations.

3.1. Green New Deal

The narrative of *green new deal* (GND) is a special case, since it is used by both pro-growth and no-growth narrators. Regardless of the narrator, green new deal is a story about immediate crisis management, which signals a strong sense of urgency and suggests large-scale initiatives such as government stimuli in the form of large investments in sustainable infrastructure, leading to the creation of new jobs. When told by pro-growth narrators, green new deal (UN DESA, 2009; UNEP, 2009a) is a more narrow and earlier version of the wider narrative of green economy, while the NEF version (NEF, 2008) holds a unique position in between pro-growth and no-growth. On the one hand, it resembles the pro-growth versions of green new deal, but unlike all of the pro-growth versions, it takes a strong critical stance against the financial sector and makes radical suggestions regarding stronger regulation of this. On the other hand, it shares the general understanding of the crisis with the no-growth narrators, but unlike no-growth narrative promoters, it remains silent about economic growth. In Tables 1 and 2, UNEP's and UN DESA's versions of green new deal have been merged with the remaining reports on green economy, while NEF's version of green new deal has been merged with the remaining NEF-reports in the macro narrative 'the great transition'.

3.2. Green Growth and Green Economy

Even though green growth and green economy are very similar, they are also significantly disparate. One example concerns their different emphasis on economic growth. This difference is apparent already in their respective titles and definitions, where the word *growth* appears both in the title and in the definition of green growth,[5] while this is not the case for green economy.[6]

A closer look at their respective definitions reveals that green growth emphasises the necessity of the conservation of natural goods and services for *our* wellbeing, while GE also takes future generations into account. Considering that OECD is an organisation of wealthy nations, this emphasis on *our* wellbeing adds a special flavour and indicates an approach less loyal to the entire global community than the approach of UNEP, according to which the interests of future generations require the involvement of significant time horizons, all countries and more environmental caution in decision-making.

It is also possible to track the two organisations' heritage in their respective definitions of concepts. OECD remains faithful to its main objective of development, which has so far been reached through growth, while UNEP seems to be inspired by the UN system's own definition of sustainable development, which contains the element of present wellbeing without compromising that of future generations.

Table 1
Governing supply and demand.

Macroeconomic means	Macro narratives					
	GG	GE	GT	PWG	SSE	DG
Price-based instruments:						
Ecological tax reform						
Carbon tax						
Cap and trade						
Border tax adjustments						
Picking the winner:						
Technology policies						
Stopping perverse subsidies						
Green subsidies						
Governing demand:						
Green stimulus						
Education and re-education						
Mainstreaming						
Increasing the demand for resource-extensive services						
Redirecting financial flows (green investments):						
Pension fund investments in green infrastructure						
Eco-tax revenues invested in green transition						
Financial transactions tax financing green transition						
Advertisement tax revenue invested ingreen transition						

Table 1: *Governing supply and demand.*

Legend	
	Agitates for
	Discusses or mentions
	Does not speak about

Table 2
Change of socio-economic structures.

Macroeconomic means	Macro narratives					
	GG	GE	GT	PWG	SSE	DG
Means for localisation:						
Local currencies						
Strengthening the informal economy						
Enhancing local production and services						
New redistribution and labour marketpolicies:						
Maximum and minimum income						
Citizen's income						
Worksharing						
Employer of last resort						
Harnessing the financial sector:						
Division between investment and retail banking						
Forced demergers of financial actors too big to fail						
Tax on financial transactions						
Ban of obscure instruments						
Capital control						
Limit on bonuses						
Fight tax havens						
State-monopoly on money creation						
Regulation of and creation of new businesses:						
Limit to size (and right-size profits)						
Cooperative ownership						
New business models						
Regulation of international trade						
New measures for economic progress						

Table 2: *Change of socio-economic structures*

Legend	
	Agitates for
	Discusses or mentions
	Does not speak about

3.3. Diverging Problem Analyses

The following presentation and comparison of the different macro narratives focuses mainly on macroeconomic means, but obviously these means are related to the narrators' understanding of the crises — the key problems they identify, and the goals they

[5] *"Green growth means fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies"* (OECD, 2011d).

[6] *"For UNEP, a 'green economy' can be defined as a system of economic activities related to the production, distribution and consumption of goods and services that result in improved human well-being over the long term, while not exposing future generations to significant environmental risks or ecological scarcities"* (UNEP, 2009b).

are urging politicians to achieve. Therefore, in this section we briefly introduce the similarities and differences between pro-growth and no-growth approaches with regard to their problem analyses, and, in the following section, with regard to goals.

In general, the pro-growth reports devote much less effort to basic problem analyses than do the no-growth reports, and in some cases, the problem analyses have to be deduced from the implicit rationales behind the macroeconomic proposals. Three key problem areas are considered here: the connections between the economy and the environment, between the economy and social stability, and between the financial sector and the real economy.

The pro- and no-growth accounts agree on the need to face serious environmental problems, but the framing of the problems differs. While the pro-growth analysis conceives of the problems in terms of externalities and allocation, the no-growth analysis focuses on the scale issue, planetary boundaries (Rockström et al., 2009) and the need for sharing limited resources. In the pro-growth account, environmental problems are not considered to be a hindrance for economic growth, because the internalisation of externalities can correct the misallocation of capital and make it flow in desirable directions (UNEP, 2011b), while in the no-growth account, the limits imply that the rich countries should stop growing their economies in order to leave more biophysical capacity for the poor countries to grow and develop (O'Neill et al., 2010).

Regarding social stability, the two accounts agree that economic growth is the main recipe for maintaining this stability in the current economic system, since growth provides jobs and income. But the approaches draw opposite conclusions on how the economy should deliver social stability in the future. While the pro-growth account focuses on the challenge of how to decouple growth from environmental impact, the key issue for the no-growth account is to determine how an economy without growth can provide social stability in the form of jobs and prosperity.

In the problem analyses of the no-growth account, the relationship between the financial sector and real economy plays an important role. Two related problems are considered. First, the deregulation of the financial sector led to the dissociation of the financial sector from the real economy and to a debt-fuelled race for profit in which the size of the sector and its actors reached a level which threatened the stability of the entire economic system (NEF, 2009; Skarstein, 2011). Second, this development constituted part of the background for increasing inequality in wealth and income in many affluent countries (Jackson, 2009). Stagnant incomes for the middle class tend to reduce overall demand, but in countries such as the US and the UK, this effect was postponed by a steep increase in credit, not least in the real estate market (Skarstein, 2011). When the bubble burst, the impact on the real economy thus proved to be significant. In this analysis, it becomes a key challenge to re-regulate the financial sector radically and transform it into a servant of the real economy (NEF, 2008).

While the issues of financial deregulation and increasing inequality figure prominently in the problem analyses of the no-growth accounts, they play a negligible role in the pro-growth accounts. An obvious explanation is that organisations like OECD and UNEP are publishing vast amounts of reports on a large variety of subjects and treating topics such as financial regulation and inequality in other publications (e.g. OECD, 2011a). However, it is an important observation that these issues are not considered central to green macroeconomics, and that the strategies developed to reconcile environmental and economic goals do not take them into account.

3.4. Macroeconomic Goals

All the narrators share some overall macroeconomic goals that should be combined with environmental improvements: employment, social stability, prosperity and wellbeing, but they disagree on the relationship between these goals and growth. From a pro-growth perspective, employment, social stability, prosperity and wellbeing are more or less synonymous with economic growth, and must be obtained by growth. Thus it is not necessary for pro-growth narrators to provide a deeper analysis of these terms, since they are already embodied in the word growth. In this view, the entire economic problem seems to have been solved once economic growth has been decoupled from environmental pressure. No-growth narrators oppose this view and search for new ways of achieving social stability and new definitions of prosperity and wellbeing independent of economic growth (Jackson, 2009). In this view, wellbeing is far less dependent on material consumption, and is instead based on good social relations, strong local communities and meaningful societal participation.

3.5. Macroeconomic Means

It is common to the macro narratives of this study that they present a series of means for achieving their goals. For further categorisation and organisation of these means, they have been divided into two broad categories: means for *governing supply and demand* (Table 1) and means for *changing socio-economic structures* (Table 2). The first category contains means for directing production, consumption and innovation towards a green transformation by the rules of the current economic system, while the second contains means for the reconstruction of the system. This conceptual division reflects the basic division between the pro-growth and the no-growth discourses, in which pro-growth is proposing system modification, while no-growth is advocating a system change. This difference is visible in their different preferences of means. However, the narrators of the two discourses actually agree on quite a few means, particularly as regards those in the category of governing supply and demand, which include means such as: *price based instruments*, *picking the winner*, *governing demand* and *redirecting financial flows*.

Price-based instruments are intended to signal what we want more of and what we want less of, while leaving it to the market to decide which technologies and actors will be successful. Ecological tax reform is a version of this narrative particularly favoured by many. In this story, the workers and green innovative firms are the heroes, while polluting and resource intensive firms are the villains. To favour the heroes and restrict the villains, taxes on income must be lowered, while taxes on resource consumption and pollution should be raised.

Picking the winner refers to more direct government influence on sector developments such as subsidies to green industries. It is the story of the government as a subject intervening in the market game in favour of the environment. The heroes in this narrative are new sustainable industries, while the villains are the sunset industries, e.g. the fossil fuel industry. Both pro-growth and no-growth proponents are in favour of picking the winner, and it is noteworthy that the pro-growth interest in this strategy reveals a more diverse approach than a pure neoliberal strategy strictly focusing on market-based and technology-neutral instruments.

Governing demand is mainly based on instruments for greening the public sector demand. It comprises public investments in: green infrastructure, ecosystem restoration, green education and re-education and the mainstreaming of green considerations in all sectors and public institutions, e.g. by means of green public procurement. This is a tale of the government as a provider of sustainable transformation and jobs through strategic investments and new institutional configurations. The pro-growth preference of such measures again demonstrates that pro-growth is not a pure neo-liberal agenda, since the idea of governing demand is clearly inspired by a Keynesian approach to macroeconomics.

Redirecting financial flows means increasing the flow of financial capital into green investments. There is agreement between pro-growth and no-growth regarding this redirection. However, from a

pro-growth perspective, this is an exercise of redirecting financial flows within the channels of the existing system, while the no-growth approach is to redirect through radical changes in the financial institutions.

The category *change of socio-economic structures* includes measures such as: *means for localisation*, *new redistribution and labour market policies*, *harnessing the financial sector*, *regulation of businesses and the creation of new business models*, *the regulation of international trade* and *new measures for economic progress*.

The basic rationale behind the *means for localisation* is that humankind is inherently living unsustainably, and that globalisation exacerbates this tendency drastically. There are various reasons for this, but essential to this mechanism is that globalisation enables countries to live far beyond their own biophysical carrying capacity, because they are able to draw on the output of ecosystems across the planet (Rees, 2006). Furthermore, globalisation also makes it difficult to establish closed circulation of nutrients. Localisation is therefore a story about the ways in which local communities can seize control over their economies, disconnect from the globalised economy and create modes of living within the local carrying capacity (Schor, 2010). If this endeavour were accomplished in all the local communities of the world, this would imply global sustainability (Rees, 2006). This narrative definitely belongs to the no-growth narrators. Except for a few pro-growth remarks on the subject (UNEP, 2011a), the idea of localisation is only promoted in the no-growth narratives, with different emphasis on different means (see Table 2).

New redistribution and labour market policies contain: maximum and minimum income, citizen's income, worksharing and employer of last resort.[7] Central to this narrative is society as a subject troubled by inequality, unemployment and social unrest, and nature as the victim of devastation from the economic activities of society. By sharing income and work between citizens, society can address important social problems and at the same time decrease further environmental pressure by removing some of the strongest incentives for further growth. It is imperative that restraint with regard to consumption for large social groups is not transformed into increased profits and affluence for the few, which presupposes radical changes of the power balance. These ideas are only expressed by the no-growth narrators. However, differences still exist within no-growth regarding the emphasis on and preferences for these means (see Table 2).

Harnessing the financial sector is a story in which the financial sector is a furious bull that must be bridled. Each of the means in this story (see Table 2) is a shackle forged to control the beast, so as to make it a servant, not a master of the economy. Again, this is a story not told by the pro-growth narrators. In the no-growth camp, it is a popular story in many versions. The most elaborate version of this story is told by NEF, which has so far devoted two full reports to the subject (NEF, 2009, 2011).

The regulation of businesses and the creation of new business models contain: a limit to size, cooperative ownership and new business models. This category has protagonists from both discourses, but pro-growth focuses only on new business models, not on business regulation. The pro-growth suggestions for new business models count ideas like product-service systems and public-private partnerships, while the no-growth proponents also suggest various forms of cooperative ownership and more locally and ethically grounded business concepts. The regulation of business in this category is mainly focused on actors in the financial sector (NEF, 2010a, 2011).

The regulation of international trade addresses the problems of globalisation and is therefore closely connected to the localisation narrative. Globalisation has provided the rich countries with enhanced opportunities to export their environmental impacts and exploit resources such as minerals, fish and cheap non-union labour. Deregulation has made it possible to move all categories of capital across borders throughout the world, and has nourished tax havens and multinational exploitation of local resources. Globalised international trade is thus seen to be in favour of the rich countries, the multinationals and the capital owners, while it exploits the poor countries, undermines the positions of workers in both rich and poor countries, and threaten the interests of local communities. The regulation of international trade is meant to address these problems. Even though these issues are central no-growth concerns, it is interesting to observe how few actual proposals regarding this are to be found in the reports. The most concrete ideas for this can be found in the story of harnessing the financial sector (see Table 2).

Redefining the measure of progress is a story about challenging the autocratic rule of GDP over the meaning of prosperity. In this narrative, new indicators, designed to count in the environment and social circumstances, challenge the position of GDP.

4. Narrative Analysis

A basic understanding in narrative policy analysis is that "[*s*]*tories commonly used in describing and analysing policy issues are a force in themselves, and must be considered explicitly in assessing policy options*" (Roe, 1994). The structure of stories is the main dimension in this consideration, and here the tripartite plot consisting of beginning, middle and end is a sign of narrative persuasive strength (Roe, 1994). Berg and Hukkinen (2011) refer to this finding in their study of the Finnish debate on sustainable consumption and production, in that they consider the unstructured plot of growth-critique to be weak and only instrumental in strengthening the incumbent story of growth. Drawing on the perception introduced earlier that the structures of plots possess and are shaped by internal dynamics, the idea of narrative persuasive strength can be reformulated in terms of these dynamics: a story possesses strength not only because it has a certain structure, but also because it is characterised by certain dynamics. In the following, we will try to elaborate this idea.

4.1. The Grand Story

It might be argued that humanity is currently a party to the making of a grand story, the full plot of which is yet unclear. For decades, the rich kingdom of the west was prosperous and relatively stable. The growth economy was the provider of this wealth and stability. Now serious environmental disaster, social unrest and economic crises have joined forces and become a monster crisis threatening to push the kingdom and the rest of civilisation out of equilibrium towards the unknown. If we look at this dynamics, it is possible to imagine how this will lead to a story of beginning, middle and end. However, since we seem to be somewhere in the transition between the beginning and the middle stages, it is unclear what forces will dominate and create the dynamics that will shape the rest of the story. One possible continuation is that the monster crisis takes over and creates chaos and takes civilisation to a new equilibrium of poverty and distress. Another is that rescuing heroes march in to change the dynamics and establish a happy ending in the form of a sustainable society. And finally there is the possibility of something in between. In the following, we will analyse two different approaches to telling this grand story.

4.2. Pro-growth

Based on the pro-growth reports, it is possible to construct the following archetypical pro-growth plot consisting of beginning, middle and end:

business as usual → system modification → green growth economy

[7] Employer of last resort means that the government provides public employment for the unemployed at a minimum wage (Lawn, 2010).

This story revolves around the growth metaphor, which in the pro-growth discourse is synonymous with employment, social stability, prosperity and wellbeing. This narrative possesses strength because it provides politicians with a clear direction (Roe, 1994) and does not question growth as the basic driver of the economy (Berg and Hukkinen, 2011). It begins by describing the environmental failures of the current economic configuration called *business as usual*. These failures make the economy a subject that has to pursue the object of green. By modifying its operations, it reaches its goal of becoming green without fundamentally changing its own identity as the sender of wealth to society. This means that not only does this narrative have a simple structure; it also possesses a simple and understandable dynamics maintaining growth as the sender and society as the receiver of prosperity and wellbeing after a process of modification in which the economy reaches out for and achieves its new green identity.

The modification stage of the plot is composed of a number of narratives which can be synthesised into three interconnected stories: *government intervention*, *technological revolution* and *market salvation*. In the first story, the government is the sender of new instructions to the economy. By regulating, investing in and reforming economic institutions such as the tax system, new economic frameworks and dynamics are provided to secure the desirable allocation of capital. The second story has technology as its subject. When the government sets the right framework, technological innovation will blossom, and new efficient technologies will replace the old polluting technologies. Finally, the last story is the story of how the market subject serves green modification by providing the optimal allocation of capital. As soon as the market has received the framework for getting the prices right, the market will work ceaselessly in favour of greening the economy.

If a story is to have a happy ending, the presence of heroes is useful. The hero creates hope and overcomes the insurmountable by defeating the villains and helping the victims. Thus, the cast of heroes, villains and victims creates important dynamics. In the pro-growth story, there are many heroes and few villains, which makes it a story bound for a happy ending.[8] The main heroes of pro-growth are: the market, the government, the investor, the technology, the innovator, and the entrepreneur. In the interaction on market terms, these characters create the modification of the economy and actualise the new green growth economy. These heroes are identical with those which drive business as usual, and they represent the dynamics of business as usual, but by inspiring and constraining these heroes to act green, they are capable of turning the entire economy green. The victims that will be saved are ecosystems, resources, poor countries and poor people, while old polluting industries are the most obvious villains in these growth-celebrating narratives.

Within narrative analysis, the idea of leaving something untold plays an important role. In order to tell a good story a whole world of elements must be left out. This reduction of elements is called synecdoche (Czarniawska, 2010a,b). The most interesting synecdoche of the pro-growth narrative is perhaps the total omission of the financial system, which indicates a lack of interest in the connection between the current crisis and the financial system. This synecdoche shows the pro-growth propensity to status quo and to modification rather than radical solutions to the present crisis.

4.3. No-growth

The main problem for the grand story of no-growth is that it contains too much critique and proposes utopia. Roe emphasises how criticism is a weak narrative in politics because it has no simple structure but organises as scattered arguments (Roe, 1994). As suggested earlier, this understanding can be reformulated by also looking at the dynamics embedded in this unorganised structure. Critique can be viewed as emphasising negative forces that are pushing things in the wrong direction, without providing counter forces to push things in a more favourable direction. If we take critique of globalisation as an example, the dynamics of this narrative is driven by the furious beast of globalisation draining the earth and its people — multinational villains rule in an unrestricted race to the bottom, victimising the local communities and leaving no space for heroes. We suggest that it is possible to rediscover the persuasive weakness of the unstructured plot of critique (Roe, 1994) in the dynamics of this narrative. The narrative remains powerless since it is not able to provide sufficient counter dynamics to the dynamics it criticises, it provides too many victims and villains and not enough heroes. This can be exemplified by the relatively small amount of ideas for how to regulate and contain international trade (see Section 3.5). There is no global agency that can act as a hero in this story. Local communities are the most possible heroes, but they are at the same time victims of the villains of the globalised economy.

However, when we study the details of no-growth more closely, serious attempts at establishing counter dynamics appear. To exemplify this, we have selected three significant no-growth stories, which could be entitled: *harnessing the beast*, *sharing* and *localisation*. Harnessing the beast comes in different varieties. In one variety, the beast is the economy, a wild creature destroying the planet. By imposing serious restrictions on its metabolism, it is possible to harness this beast and teach it to live in harmony with its surroundings. Another variety has the financial sector as the beast, and in a third variety, economic globalisation plays this role. In all its versions, this story emphasises the need for constraining the malfunctioning global economic system.

The story of sharing suggests moderation to the competitive mode of the growth economy. If those who have more share some of their abundance with those who have less, the incentives for growing the economy can be reduced: the growth economy fights poverty by growing, the no-growth economy fights poverty by sharing. The concept of sharing is especially focused on income and work. By sharing these, we obtain a more equal distribution of wealth, reduce the drive for further growth and render no-growth more acceptable. In this narrative, altruistic individuals and societies are heroes establishing a counter-dynamics to that of the furious globalised growth economy.

In some respects, localisation is a version of harnessing the beast, because one way to harness globalisation is to create local economies out of its reach. Thus, localisation is about creating relatively more closed local economies which enhance local production and consumption. Means for supporting such a development are local currencies and cooperative ownership. By localising, it is easier for local communities to consume and produce in accordance with environmental values and to reduce the impact of transportation and packaging. In this context, local communities are heroes establishing valuable counter-dynamics.

To end this section, we venture to sketch the grand no-growth plot as a simple tripartite structure.

system crisis → system transformation → no-growth economy

The big challenge for the narrators of this story is to account for the feasibility of the two last stages of the plot. Hopefully, the three stories mentioned above provide some inspiration for this task.

5. Shared Stories

If we are to find possible routes to actual changes of policy measures in favour of a sustainable transition of the economy, one approach could be to look for stories shared across the discursive boundary of pro-growth and no-growth.

[8] It is important to stress that we only mean 'happy ending' within the narrative analysis. Whether the pro-growth approach will lead to a happy ending in factual terms is an entirely different story.

Our mapping of narratives (see Section 3.5 and Tables 1 and 2) reveals that the two discourses pro-growth and no-growth agree upon telling a number of stories. The most significant are: *ecological tax-reform*, *green investments* and *redefining the measure of progress*. The advantage of these narratives is that they are shared by narrators across the discursive boundary, and that they have already been on the political agenda in many countries. Massive investments in green infrastructure were strongly emphasised in many green new deal proposals, and in the years following closely after the financial crisis, many countries actually added a green flavour to their stimulus packages (Geels, 2013; Tienhaara, 2010). The story of an ecological tax reform is widely told across the order of discourse and has also been drawing political attention (Beuermann and Santarius, 2006). The story of new measures for economic progress is not a pure no-growth story, actually OECD and UNEP stress that GDP "*provides a distorted lens for economic performance*" (UNEP, 2011b:4) and that "*GDP generally overlooks the contribution of natural assets to well-being*" (OECD, 2011d:21). Thus, the willingness to discuss and change the way in which we measure progress is already present on both sides of the discursive boundary.

The existence of these shared stories suggests what Hajer has termed a discourse-coalition (Hajer, 1995). A discourse-coalition is constituted by a set of stories,[9] a group of narrators uttering these and the practices through which these stories materialise (Hajer, 1995). It is important to note that "[*Discourse*] *coalitions are not necessarily based on shared interests, let alone shared goals, but much more on shared concepts and terms*" (Hajer, 1996: 247). Thus, from an ecological economics perspective this discourse-coalition might provide a strategic opportunity for disseminating macroeconomic narratives in favour of a sustainable transition of the economy, without undermining the critical view on pro-growth. However, there are some serious challenges to this idea, and perhaps it presents some interesting questions for further research.

The shared stories are there, but how to use them? Luks suggested a distinction between internal and external rhetoric of ecological economics (Luks, 1998). Is it possible to elaborate this idea by the use of these shared stories? Are there events where these stories should be emphasised and other stories should remain untold? Is it dangerous to emphasise this coalition with pro-growth at the expense of the deep criticism of the pro-growth approach? Will the participation in this coalition turn ecological economists into useful idiots?

6. Conclusion

The macro narratives under scrutiny in this study flourished in the years following immediately after the financial crisis in 2008. First, the different versions of green new deal appeared with the intentions of ensuring a quick recovery by using win–win logic. Later followed broader narratives such as green growth and the great transition, treating a large number of problems and presenting a major catalogue of means. Common to all these narratives is the tendency to see the financial meltdown in 2008 as a golden opportunity for solving a wide range of economic, environmental and social problems. However, these narratives now seem to have lost momentum, probably due to a strong focus on business as usual, economic recovery and austerity policies, especially in Europe (Geels, 2013). But it is worth noting that even if the rich world were to recover from the current economic and financial crises, the system crisis persists, and so does the need for coherent answers to it. Thus, we claim that the stories constituting the discourse coalition between pro-growth and no-growth are persistent, highly relevant and likely to gain new momentum under the same or new labels, simply because they are kept alive by the urgent and undeniable need for sustainable transition of the global economy. We therefore suggest that the discourse coalition based on these narratives possesses useful discursive power in the on-going battle of sustainable transformation of the economy.

Even though it might lead to some useful insight to draw a sharp boundary between pro-growth and no-growth and describe them as two distinct opposites (Bina and La Camera, 2011), we believe that important insight can be gained by perceiving them as overlapping and interacting in the practice of storytelling. It seems clear that neither pro-growth nor no-growth has the power to govern the economy. Mainstream economics is the main ruler, and thus both pro-growth and no-growth can be considered alternative discourses trying to change the reproduction of meaning exercised in business as usual. For this purpose, strong new narratives are required. Roe emphasised that a simple plot is an important factor in narrative persuasive strength (Roe, 1994). We expand this notion to also concern the internal dynamics of narratives. It might thus be useful for alternative economic perspectives not only to establish simple structured plots, but also to think about how actants such a heroes, villains and victims create certain dynamics within the narratives.

Many forces govern the economy, but one of the most important of these is policy making — political decisions influence the rules of the game, and these decisions are under the influence of discourses and guided by certain narratives. By the deliberate use of narratives, the balance in the discursive power struggle of changing the rules of the game might be altered, leading to actual policy changes in favour of a transition to a more sustainable economy.

[9] Hajer uses the word story-line, but the three stories we have highlighted all meet Hajer's definition of story-line.

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Article 2

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Divine belief in Economics at the beginning of the 21st century[1]

Emil Urhammer [Aalborg University, Denmark]

> Drinking the strength of life
> from men doomed to die,
> spitting the crimson blood
> on all the lands of gods;
> black becomes the sun
> in summers to follow,
> weather spells disaster –
> Need you know more?

With this stanza, I begin my story of the divine belief in Economics at the beginning of the 21st century, when this faith was practised and reached the height of its glory. The stanza originates from the Norse poem *Völuspá,*[2] meaning prophecy of the Völva, which tells the tale of ancient gods, who at the beginning of the 21st century had long since perished. The verses were originally written in the Norse language approximately eighteen hundred years ago, while the present translation is from the beginning of the 21st century and thus about eight hundred years old. Despite the large gap in time between the first writing of these verses and the translation, it is still as if the stanza prophetically heralds the coming of events, which began in the days when the translation was made.

The Völva speaking in the poem is a mysterious entity with the ability to speak prophetically about distant pasts and futures. In this manner, one might understand the Völva as an entity located outside of time, telling us of things to come and things long since passed.[3] In her prophecy, the Völva predicts the end of the Norse gods in the violent calamities of Ragnarök, but the prophecy can also be considered as mirroring the crises, which increased throughout the 21st century. For this purpose, in particular the final lines in the stanza above, show prophetic clarity. The disastrous climate changes that truly came into effect in the second half of the 21st century are mirrored here, and we are sarcastically reminded that extensive knowledge did not serve as sufficient motivation to take the actions necessary to avert subsequent disasters.

Thus many centuries later, it is not easy to give an in-depth explanation as to why countries and governments did so little to avert these self-inflicted disasters, whose nature was known with some certainty and whose arrival was doubted by few. However, there can be no doubt that the divine belief in Economics with its strong anchoring in central authorities and close alliance with society's elite was of great importance to maintaining the status quo, thus preventing the necessary transitions. Based on this relationship, I find it relevant to direct my

[1] Published in Danish in the Journal, *Kritik*, Volume 48, Issue 214, August 2015
[2] Sørensen & Steinsland. "Vølvens Spådom". Høst og Søn 2001. Translated to English, for the purpose of this article, by Daniel Olesen.
[3] This interpretation comes from Sørensen & Steinsland 2001.

searchlight at the divine belief in Economics in the 21st century to highlight certain characteristics of this faith. Hopefully, such an investigation can improve our understanding of the tragic downfall of a civilisation.

It has now been about seven hundred years since the gods of Economics were supplanted by other systems of belief and cosmologies. Just as the Norse faith was combatting and gradually supplanted by the cosmology of the Christian faith around year 1000, the second half of the 21st century was also an era of old and new cosmologies battling for the right to preach the common faith. Belief in the gods of Economics was until this age very strong and held the foremost position in the national administrations and political thinking. State administrations were flooded by *economists*, a form of priests, skalds and sages, considered to possess unique powers related to interpreting the past, understanding the present, and foretelling the future. The policies of the nations were shaped according to their directions. Unfortunately, these directions were characterised by whims lacking a deeper understanding of the real issues of the age.

Due to extensive wars and calamitous natural phenomena, which increased in occurrence in the second half of the 21st century and presumably is the reason for the loss of many important sources in understanding divine belief in Economics, the following is a mosaic with many gaps; the number of missing pieces is most likely much greater than the number of sources I do possess. Despite the loss of many sources related to the divine belief in Economics, there is still a quite significant amount of material informing us of this system of beliefs. Based on this material, the divine belief in Economics appears to be a highly advanced, diverse complex of myths, and it is thus beyond the scope of the present work to describe the entirety of this complex. Instead, I will attempt to make selective incisions and highlight certain aspects that appear to be of particular importance in relation to understanding the gods of Economics and the times during which they were worshipped.

First, it should be noted that what we today refer to collectively as economic mythology in fact covers a number of different denominations, of which the most important are: *classical, Marxist, institutional, Keynesian, neoclassical,* and *ecological Economics*. Central to my investigations is the neoclassical denomination,[4] which around the year 2000 held the greatest dominance; in part thanks to a political doctrine known as neoliberalism, derived from this denomination.

Whether every denomination mentioned here can truly be called a religious denomination is doubtful, however, since the status of religion is highly dependent on being anchored in institutions as well as proclamation practices. The reason why the neoclassical denomination had the status of religion must be found in an extensive proclamation practice, anchored in academic environments, partisan circles, central authorities, media, and general speech combined with a strong affinity for worshipping the divine. Thanks to this, economic sages were able to conjure up strong, religious “truths” despite the extremely underdeveloped epistemological apparatus of neoclassical Economics.

Regardless of the clear epistemological weaknesses contained in the economic mythology, this denomination was widespread throughout the world and was practised alongside the great monotheistic world religions. In some ways, it can be maintained that divine belief in Economics was the most widespread of the world religions around the year 2000. It was

[4] In the following, divine belief in Economics is synonymous with neoclassical divine belief.

widely practised by nearly every public administration across the world, regardless of other religions also practised in the various countries.

However, the worldview presented by the natural sciences also held a strong position around the year 2000, and this epistemology had conquered many spheres of influence formerly belonging to religion. Economic mythology deftly took advantage of this by choosing a form of proclamation that was in the guise of the natural sciences. Economic mythology was thus based on an extensive, mathematical foundation. This gave the mythology strong powers of persuasion equal to those of the natural sciences, and its computational models often held status as Völvas with the same powers of prediction as the natural sciences[5]. In the twilight years of the mythology, however, it became more and more obvious that its acolytes made use of dubious, mathematical descriptions lacking durable theorems.[6]

Historical observations

Desiring brevity, I have in this presentation chosen to keep my scope limited to the region that still to this day encompasses the Nordic countries. I will therefore initially outline latent tensions between environmental realities and economic myths characterising the societies of this region eight hundred years ago.

Around the year 2000, the Nordic region was still highly affluent and well organised. Compared to many other regions, the Nordic countries were also characterised by relatively high levels of equality, trust and welfare, although all of the above was in decline, in part due to financial crises and the neoliberal doctrine. Related to this, it is worth mentioning that the Nordic region was among those that resisted neoliberalism the longest, along with the increasing inequality, distrust, and instability caused in part by the divine belief in Economics. This resistance was due to a particular Nordic tradition of distributing the wealth of society, though it eventually fell to the neoliberal dismantling of the welfare state.

Coinciding with how the divine belief in Economics strengthened its position of power, there was a rise in the number of increasingly alarming reports on the environmental state of the planet, originating from the natural sciences. Climate changes were deservedly the most often mentioned threat, but it was merely one out of a growing number of crises. Similarly, the swift expansion of humanity, increasing streams of refugees, the systematic eradication of other species, and ever-reducing amounts of clean water were all well documented issues. It was characteristic of many of these crises that one way or another, they were the by-product of the economic activities of human societies. The ways in which people produced, traded, consumed, transported, and built across the globe were thus on a swift collision course with the environmental boundaries of the planet. It is therefore not controversial to claim that with the knowledge possessed then as well as now, there were strong arguments in favour of radically transforming the economic activities of these societies to respect the environmental boundaries of the planet.[7]

[5] It is interesting to note that these models often had names with religious undertones, such as ADAM (Judaism), HEIMDALL (Norse mythology), and HERMES (Greek mythology).
[6] Among the first to make this point was the Finnish econometrist Juselius, who assisted in uncovering fundamental issues in the neoclassic models. For examples, see “Using Econometrics for Assessing Economic Models”, *Economics* 2009.
[7] The idea of planetary boundaries was probably first proposed by Rockström et al. in "A safe operating space for humanity", *Nature* 2009.

There is a number of reasons why this did not happen to a sufficient degree, of which the influence of the divine belief in Economics is merely one. However, it is useful to highlight how this religion helped reinforce certain positions of power resistant to change; how its occult faith in Growth demanded a resistance against radical, environmental efforts and democratic control of multinational corporations, who in turn possessed the necessary resources to buy influence in parliamentarian democracy.

Unfortunately, it was not evident to the general public at the time that the multinational corporations were able to drain the nations of social, environmental, and economic resources at such an extensive scale. The populations were greatly manipulated by neoliberal sermons that the multinational corporations were in service to Growth, creating jobs, and that all had to bring sacrifices to the altars of Growth and Market; the dispossessed needed to be further dispossessed, minimum wage needed further lowering, everyone had to work longer hours, democracies had to relinquish their autonomy, and the environment had to be sacrificed. This way, religious belief was used as a tool for political propaganda.[8]

It is a lesson well known from studying the downfall of civilisations that priesthoods and affluent elites often join forces to protect the status quo of society[9]. There are several historical examples of this, which mirror trends that one could observe in the Nordic welfare societies around the year 2000, displaying an elite that completely ignored and underestimated the warning signs heralding the end of society. Additionally, the hypothesis concerning the close, temporal proximity between the heyday and the fall of a civilisation should also be mentioned; in many ways, this hypothesis is confirmed by the history of the Nordic welfare societies post year 2000.

Proclamation and divine belief

What we today acknowledge to be irrefutable fact was still unclear and controversial at the start of the 21st century, while matters that today are shrouded in doubt and mystery were then considered unquestionably true. By the former, I mean the multitude of environmental and social crises, which at the time had yet to manifest themselves fully; by the latter, I mean the mythical characters of the divine belief in Economics. However difficult it may be for us, we must try to understand that the society of that age truly believed in *Market* and *Growth* as eternal gods. In connection to this, it is worth mentioning that gods have a habit of losing their power over time. Around the year 2000, the Norse gods had long since passed into legend and become harmless. The same fate has fallen upon the gods of economic mythology, and we can only speculate, which of the gods of our era will be considered a mere fancy in a thousand years.

If you wish to try to understand how the gods of Economics became real, imagine yourself as a Viking and envision the journey across the sea during a thunderstorm with lightning and thunder tearing the sky apart. It is not difficult to imagine that for the Viking, having so often made sacrifices to Thor and heard tales of him, the god of thunder suddenly becomes real. Similarly, imagine the stockbroker a thousand years later being seized by the belief in Market

[8] A phenomenon also known from the societies of the Viking Age according to Sørensen & Steinsland.
[9] For examples, see Diamond, “Collapse. How Societies Choose to Fail or Succeed”. Viking Penguin 2005.

when key numbers suddenly rocketed towards the sky or plummeted towards the ground, showering the few in wealth and the many in misery.

Looking at documents from that age, we find that in particular the economic priesthood, partisan factions, and certain news media preached the divine belief in Economics and constantly referred to the blessings of Growth and the all-knowing providence of Market. These preachings had a great effect on the language and perception of reality as related to everyday life. Thus, you could often hear politicians speak of how Growth would soon return and bring its blessings to all, or that it was best to leave responsibility for the Economy in the hands of Market.

Around the year 2000, the divine belief in Economics was still conquering new lands. This was done by the skalds, politicians, and multinational corporations, who expanded their sphere of influence by constantly letting the gods Market and Price subjugate new territories. In this manner, rivers, forests, mountains, animals, plants, and people were given a price denoting their market value, through which they could be subject to the market mechanism, the ever-valid 'natural law' of Economics.

Mirror images

The purpose of this investigation is to examine the beginning of this millennium, now in its twilight years, in order to interpret the economic belief and missionary practices prevalent at the time. In aid of this, I have chosen an older system of faith, the Norse one, practised in the Nordic region during the Viking Age. Neither Norse nor economic beliefs are today living organisms of faith, but remnants of their many phenomenological appearances can be found in various works of writing. My primary source for the Norse mythology is the poem *Völuspá*, which we have preserved in various translations[10]. Due to its charismatic gods and strong themes of downfall, this mythology is a bountiful parallel to the divine belief in Economics as well as the era in which this belief was practised.

It is generally acknowledged that the *Völuspá* is based on oral traditions and it was not put into writing (in different versions) until around the year 1000. We should therefore view the surviving, written versions of the *Völuspá* as crystallisations of oral storytelling traditions, believed to have been kept alive by the skalds of that age. The written versions originate from an era where the Norse culture was receding and the Christian world religion was advancing. There have thus been many speculations as to how much the written versions of the poem are affected by and adapted to a Christian worldview. The intent of this investigation is not to contribute further to these speculations, however. Instead, focus is directed at how the poem, as we have it in its written form, can be used as an analytical mirror held up against the cosmological understanding belonging to economic mythology as we know it.

[10] For transparency's sake, it should be noted that the following description of *Völuspá* is widely based on the translation and interpretation made by Sørensen & Steinsland, published in 2001.

Völuspá

The *Völuspá* is a grandiose cosmology, stretching from the earliest distant times of genesis until the last days of the gods during Ragnarök.[11] The storyteller is the Völva, able to gaze deeper into both past and present than even the all-father Odin, *the ancient one*. Using a classic device from narratology,[12] the prophecy can be divided into three phases[13]: chaos, order, and downfall. However, it is important to note that the phases overlap and that a phase of decline before the downfall and clear indications of resurrection following the downfall can be added to the model for the sake of further precision.

The Völva tells us that the world is born out of the void, Ginnungagap, a potential of chaotic, primordial forces. Different creatures emerge from Ginnungagap. Ymir the Jötunn is the first, and then follow the gods Odin and his brothers, who create order in chaos and shape the world known as Midgard. The gods also name all things and summon time by counting the years as they pass.

Already in the earliest phase of this creation the seed of destruction is planted. Odin and Ymir each sire a race, the Æsir and the Jötnar, who are constantly engaged in conflicts. Simplified, one might say that the original, primordial chaos is manifest in the Jötnar, while the Æsir is the opposing force, attempting to maintain order and stability. Among the Jötnar are counted the Midgard Serpent and the wolf Fenrir, who during Ragnarök assist in the downfall of the gods, but in turn succumb to the power of the gods in this all-consuming battle.

A central element in the creation of the gods is the world tree Yggdrasil, which represents stability and life force. Below the roots of the ash Yggdrasil flows a sacred source, nourishing the world tree. The three Norns live by this source, participating in the act of creation by weaving the fates of gods and mankind. The three Norns represent the three manifestations of time: past, present, and future. During the golden age of the gods, Yggdrasil is strong and green, but it is later discovered that the tree suffers more than what is known to humanity. Several creatures are sapping its strength, and the tree is rotting,[14] which forewarns the impending destruction of the world.

When Ragnarök approaches, many bad omens appear. Forces of chaos, long kept in chains, break loose. Yggdrasil quakes, and moral decline becomes rampant throughout the world of Men. Finally, war can no longer be avoided, and the wild hordes of the Jötnar, including the wolf Fenrir and the Midgard Serpent, charge forward; from the East they are led by Loki, Odin's treacherous foster brother, and from the South by Surt, a Jötunn from the realm of fire. In this final battle, all the gods perish alongside their powerful enemies among the Jötnar. The wolf Fenrir kills Odin but is slain in turn by Vidar; Thor kills the Midgard Serpent but dies from the wounds inflicted by the worm upon him. As Æsir and Jötnar die, the world ends. The sun turns black and sinks into the sea while Midgard burns. Thus, Ragnarök ends in moral collapse, natural disasters, and war.

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[11] According to Sørensen & Steinsland, Ragnarök means “the fate of higher powers” or “the downfall of higher powers”.
[12] Narratology is among others shaped by writers such as Greimas and Todorov.
[13] This device is not from Sørensen & Steinsland, but my own attempt towards an analytical model. Whether this device has been used before in sources unknown to me, I cannot say.
[14] This description comes from the poem “Grímnismál” in Lembek & Stavnem's translation and interpretation of Snorri Sturluson's “Edda”. Gyldendal 2013.

After Ragnarök, however, the world is resurrected and restored to vitality while freed from the disorder and chaos of the Jötnar. Many of the old gods, though Odin and Thor are not among them, are also resurrected; similarly, humanity is also restored to life in this new world. One of Odin's sons chooses the new world tree, and the "new" gods take up residence upon Odin's former grounds. The continued line of the gods shall live in the wide halls of the windy sky, while Men will live in peace and harmony at Gimlé, which offers shelter against the fire.

With these words and short of breath I conclude my presentation of the *Völuspá* to make room for a reflective description of economic mythology.

Gods and people of economic mythology

As a system of collective beliefs, economic mythology is polytheistic akin to its Norse counterpart, meaning it is populated with several gods. Unlike its Norse counterpart, however, economic mythology does not contain a central story that clearly progresses into several phases. Therefore, I will not begin with a narrative mirroring but instead begin by describing some of the most important gods of the economic mythology.

The first god I wish to discuss is *Market.* Market is the god eternally creating structure, keeping the primordial forces *Supply* and *Demand* in check. This way, Market resembles the gods creating order in the Norse world. However, Market cannot control the market forces without a helper. This is where the god *Price* becomes important. Practically speaking, Price maintains the balance between Supply and Demand, thereby ensuring the equilibrium of the *Economy*. Through the market mechanism, which describes an eternal interaction between Supply and Demand, Market can be considered the creator of the Economy, the legendary world of the economic gods.

There is also a number of other important gods in the economic mythology besides Market and Price. Without a doubt, the god *Growth* is chief among these. Growth is the deity overseeing wealth, happiness and prosperity. The more sacrifices upon the altar of Growth, the greater wealth and happiness shall flow into the society of mankind.

In particular, natural resources, time, and democratic rights were sacrificed to Growth around the year 2000. Goods such as clean drinking water, biodiversity, and picturesque landscapes were all sacrificed on the altar of Growth. Similarly, people had to contribute an ever-increasing amount of work hours to Market, and the various countries had to yield certain democratic rights to make room for multinational corporations with the capacity to be of service to Growth.

Same as with Market, Growth also has its helpers: *Productivity* and *Competition.* Productivity is a kind of fertility god, who is able to constantly create bigger yields with less effort, while Competition is the god of war, strengthening the countries in their economic wars against each other.

But no mythology is without forces of darkness, and in economic mythology, these are called Recession and Unemployment, representing disorder, chaos, and impoverishment. One might be tempted to consider these as the counterparts of the wolf Fenrir and the Midgard Serpent in economic mythology. Recession is the archenemy of Growth, while Unemployment is the eternal woe plaguing Market. Unlike Norse mythology, there is no tale in economic mythology of how these opposing forces will confront each other and perish in Ragnarök. It is

implied that Growth and Market will be victorious as long as we remember to make our sacrifices.

It is not certain who the supreme deity among the economic gods was. This was often dependent on the specific context in which this faith was practised. In state administrations, Growth reigned undisputed while for some political parties and independent temples, Market was most likely the supreme divine authority. If one takes a more general look at the era, however, there is a clear tendency for Growth to be considered standing tallest. Nearly every economic sage, politician, businessman, and journalist bowed before Growth in service to its every whim, regardless of how strong or weak their faith in Market.

As in Norse mythology, there is a human being in the economic mythology. This person is called *Homo Economicus* and is an important element in the market mechanisms. Unlike the Norse example, the economic man is omniscient, yet has but one thing in sight, the god Price, and one objective, to optimise his own utility.

Circles and lines

Whereas Norse mythology contains a progressive story, economic mythology is completely devoid of history. In every case, it is the same story of Price creating and maintaining the balance of the market, which is repeated ad infinitum. In spite of this, the two mythologies share certain dynamics. For instance, both can be viewed from a linear and a circular perspective. If you view *Völuspá* as a series of events from creation to Ragnarök, you will find a linear story. If you choose to incorporate the part concerning resurrection, you find the possibility of a cyclical cosmology, where the *Völuspá* merely describes one rotation in the eternal circle of birth and death[15].

This circular theme can also be found in economic mythology, where a constant cyclical exchange between households and businesses results in steady growth, continuing indefinitely and only disrupted by temporary business cycles surrounding a steadily increasing growth trend. These upwards and downwards economic trends can be seen as cyclical and understood as the rotation inherent in economic mythology between crises and affluence, birth and death[16]. Thus we find in both Norse and economic mythology an interesting reciprocity between linear progress and cyclical repetition, where it becomes nearly impossible to imagine linear progression without cyclical repetition and reverse.

Besides these basic dynamics, Norse and economic mythology have a deterministic understanding of the world in common. However, while Norse determinism is characterised by dream-like visions, economic mythology presents a kind of hyper-determinism, where the market forces are always forced into balance. This way, there is never an actual confrontation between the primordial forces and Market. Market is always superior and brooks no resistance. This is clearly the opposite of Norse mythology, escatological in nature, meaning it moves towards an end of days where forces of order and chaos eradicate each other. In this

[15] Finally, you can also view the different phases of the prophecy as concurrently existing aspects of human life and life in society. I will not pursue this interpretation further here, however, since it has no obvious counterpart in economic mythology.
[16] This theme is also found in Schumpeter's hypothesis regarding creative destruction.

manner, economic mythology is a myth of eternity, always suppressing chaos, disorder, and unpredictability.[17]

Times of upheaval

As mentioned, the times surrounding the year 2000 were times of upheaval; human destruction of the planet's vital systems and the threat of future climate change became widely acknowledged. This is also reflected in economic mythology, which during this age became forked into new, conflicting directions. A contradiction arose inside the mythology where certain higher deities were considered forces of darkness by a smaller group of heretic skalds and their supporters. This was the case in particular with the god Growth, who was portrayed as a false idol to be rejected. Growth became a decisive point of contention, making heretic skalds denounce their fealty to this god.[18]

Due to the schism between those who worshipped and those who denounced Growth, two new myths arose: *Green Growth* and *Degrowth.*[19] Both arose in response to the emerging environmental and social crises of that age. Green Growth was the myth presented by the ruling priesthood on how the economic growth engine could continue in a greened version with the gods Growth and Market as supreme authorities, while Degrowth was proposed by the heretic skalds and included an extensive, radical transformation of the economic cosmology.

A central point of opposition between these two myths is that the same gods and worlds appear as good and evil forces, respectively. Here, I am in particular referring to Growth but also to the very world of the mythology, the Economy. In Green Growth, these are both benign while Degrowth portray the former as evil and the latter as an organism out of balance with its surroundings, which requires it to be transformed and limited.

Both Green Growth and Degrowth are myths of transformation, in which the Economy is transformed. In Green Growth, transformation happens due to the intervention of heroes. The most important heroes in connection to this are: *the Government,*[20] *the Investor, the Entrepreneur* and *the Innovator*. The government acts by helping Price send the right market signals to make environmentally damaging behaviour costly while environmentally friendly behaviour is rewarded. The investor acts by sending financial capital to the greenest areas of the Economy, while the entrepreneur and the innovator create new green products, which are surrendered to Market and thereby supplying Growth with vitality.

An important demigod, who has a central role in the traditional divine belief in Economics, also appears in Green Growth. This demigod is *Technology*; a demigod because it has its origin in mankind, but possesses divine powers. Technology is generally believed to be able

[17] It is important to highlight that this is primarily in reference to neoclassical mythology, which unlike e.g. Keynesianism did not acknowledge unpredictability.
[18] It is important to note that many of these heretic skalds still considered Market to be a central and important deity.
[19] The following interpretation of these two myths is the continued development of ideas proposed by Urhammer & Røpke in "Macroeconomic narratives in a world of crises: an analysis of stories about solving the system crisis", *Ecological Economics* 2014.
[20] The fact that the government is shown as one of the heroes indicates that Green Growth is not a purely neoliberal myth. According to neoliberalism, it was irrefutably damaging if the state interfered in the affairs of the market.

to solve all unsolved problems in the future. In this manner, technology has a reassuring presence and ensures that people need not be worried about the future.

Whether Degrowth can be considered a coherent myth is doubtful; it is simply too complicated and lacking in structure. Yet it is still useful to consider it a form of collective myth with many mythological elements, however, characterised in part by its lack of heroes. On the other hand, it has many villains and dark forces that in time proved to be as dangerous as predicted by the myth. Here, I am particularly thinking of the multinational villains, the financial shadow lands, and gods such as Growth and Competition.

While Degrowth largely defines itself as a myth in opposition to the reigning economic mythology, it also contains a wealth of constructive, political proposals; these are difficult to gather into a simple, coherent myth, however. Examples of such proposals are localisation as a response to deregulation and globalisation, fewer work hours, and a guaranteed basic income to prevent poverty, inequality, and stress, and finally certain measures to wrest control over wealth and happiness from Growth by measuring these as circumstances determined by a larger range of social and environmental conditions.

Akin to the Norse vision of Gimlé, the golden land where mankind shall live in peace after Ragnarök, Degrowth also contains the vision of a harmonious life after growth, where humanity has reached a balance between itself and the habitats of all living things. The path to this harmonious existence is through enacting a large number of political proposals, of which the aforementioned are merely a few.

Lastly, it should also be noted that a form of agnosticism towards Growth found a foothold in the economic mythology around the year 2000. Its primary belief was that Growth was a deity of no importance and whose fate was of no concern. Instead, people should devote themselves to questions concerning righteous life in society and the state of nature, letting Growth perish from a lack of attention; this was based on the belief that a god or false idol no longer being worshipped or denounced would cease to be either a god or false idol.

Final thoughts

Over the years, much has been written about the 21st century and its climate changes, social crises, and devastating wars. These works have tried to explain the conditions of society, which were the reason why highly developed societies did not react and adapt in time. Some of these works have also included the divine belief in Economics as part of their explanations. However, as far as I am aware, nobody has made a comparison between the divine belief in Economics and Norse mythology. This has been my attempt, and an important insight of this effort is the difference between the fundamental acceptance of the downfall in Norse mythology and the complete lack of this in economic mythology. In this manner, the *Völuspá* can be used as a commentary on a younger faith's lacking ability to understand its own age and the terrible calamities approaching.

If one lets the Völva be a voice whose prophecy apply to the future of the world more generally, her predictions are not merely relevant to the men and gods of the Norse world, but also to the societies and divine worship of future ages. From this perspective, the Völva has the power to explain the terrible crises of the 21st century along with the demise of the gods of Economics.

That the gods of Economics were gradually swallowed up by twilight is because they, similarly to the Norse gods, lost their connection to the surrounding world, which was swiftly changing. Blinded by their withdrawal from the world, the worshippers of Economics overlooked the actual problems of society and devoted themselves to worshipping dying gods. The economic preachers, the ruling political parties, and the elite of society were thus guilty of ignoring the advancing moral, social, and natural disasters, which might have been avoided by paying attention to the prophecy of the Völva.

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Crisis in the habitat of the economic growth monster

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Abstract

Purpose – *The purpose of the paper is to offer a new view on economic growth and use this view to add to the explanation of economic growth as a powerful agent that determines policies regarding urgent issues such as climate change, loss of biodiversity and pollution.*

Design/methodology/approach – *The study is based on analysis of scholarship and media, interviews and observations in a multi-sited ethnography of economic growth.*

Findings – *The article argues that the circulation of economic growth has contributed to a shaping of institutions and language to an extent where environmental policy proposals framed as harmful to economic growth can easily be rejected. Furthermore, the article offers an operationalisation of the term* ecologisation *by promoting a new inclusive language in decision-making.*

Originality/value – *The paper fills a gap in literature by offering an empirical philosophical take on economic growth and by offering a suggestion for the operationalisation of the term* ecologisation.

Keywords *Economic growth, Translation, Circulation,* Ecologisation*, Monster*

Paper type *Conceptual paper*

Introduction

The Earth is changing: a growing ecological crisis comprising overwhelming problems, such as climate change, the loss of biodiversity and pollution, heralds the age of the Anthropocene (Crutzen, 2005; Rockström *et al.*, 2009). At the same time, many countries still face economic difficulties in the aftermath of the 2008 financial crisis. This situation places economic growth at the centre of a controversy. On one hand, mainstream economists and politicians prescribe further economic growth to restore struggling economies. On the other hand, a growing chorus of voices argue that economic growth is in a process of transgressing fundamental ecological limits and that we must free the Earth from economic growth before it is too late (Jackson, 2009; Simms and Johnson, 2010; Dietz and O'Neill, 2013).

At the centre of the controversy stands the gross domestic product (GDP), the calculative technology that quantifies economic growth. According to Fioramonti (2013), GDP is the world's most powerful number due to its ability to determine the success of governments and the progress and the international status of nation-states. However, economic growth is not merely a number that aggregates economic transactions, it assumes multiple shapes and appears in many places. Thus, economic growth appears in the literature as a production process (Mankiw, 1992), on the Internet as an entity with human virtues such as health and strength (Kumar, 2013) and in political discourse as a powerful propaganda tool (Fioramonti, 2013).

The multi-shaped and multi-sited existence of economic growth appeals to the use of Latour's (1992) notion of *monster*: an entity that circulates in collectives and shapes them by its presence. Hence, in this article, economic growth is conceptualised as a monster, whose existence depends on circulation; the purpose of the article being to identify

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facilitators of circulation and to highlight indicative examples of how this circulation shapes our common world and political decisions.

To interpret economic growth as a monster, the terms *collective* and *translation* are essential. In Latour's (2013) work, the term collective replaces the concept of Society, a human domain that is distinguishable from Nature. Instead, a collective is a messy ecology that comprises both humans and non-humans (Blok and Elgaard, 2011). In this sense, a collective is an assemblage of diverse elements, such as humans, technologies, plants, symbols, animals and scientific disciplines. This makes our common world a multiplicity of collectives that is inhabited by humans and non-humans (Latour, 2013). It is also in these habitats that we find the economic growth monster.

When a monster is circulating in a collective, it means that the monster is constantly passed on from one agent to the next in various forms (Blok and Elgaard, 2011; Latour, 2013). At one instant, economic growth is a number in a spreadsheet; later, this number becomes a dot in a graph, and later again, is verbally uttered in a news broadcast. Often, circulation changes the appearance of that which is circulated. This change happens when a multitude of economic transactions is transformed into a single number, when a column of numbers is turned into a graph and when this graph is later interpreted in a sentence such as "the economy is growing". This transformation of appearance can be termed translation and is central to the existence of a monster.

This mode of existence can be compared to the emergence of a viral hit, a YouTube video, for instance. At first, the video is merely a video, but as soon as Internet users begin to pass it on to each other, and it goes viral, it changes from a video into a hit. Suddenly, it does not only exist in its YouTube habitat: it crosses borders to new sites and changes appearances. At one instant, it is a verbal account in a conversation; at another instant, it is a story in a newspaper that later becomes the subject of a heated discussion. As I will argue in the following, economic growth maintains its status as a monster "hit", not least due to a similar type of circulation.

In relation to the rising ecological crisis, economic growth is, at least, a threefold problem. First, evidence clearly indicates that global economic growth is closely correlated to increased global resource use, carbon emissions and pollution (Wackernagel and Rees, 1996; Krausmann *et al.*, 2009; Ewing *et al.*, 2010). Second, the imperative for continued economic growth is often used as the main argument for not addressing these issues[1]. Third, the pursuit of economic growth fosters the legitimisation of continued environmentally harmful activities such as oil drilling, land grabbing and the expansion of infrastructure for cars. The motivation for this study is thus to generate a better understanding of how economic growth has become the ultimate trump that can reject proposals for addressing ecological issues of extreme urgency.

Empirical philosophy

It is not expedient to try to frame Latour's (1992) work in a singular fashion, and his approach has several different labels. However, for practical reasons, I refer to it here as *empirical philosophy*, a term Latour himself has used to describe his methodology. In empirical philosophy, monsters can be studied by tracing their circulation in sequences of translations, where translation can be defined simplistically as the process by which an entity transforms from one appearance into another (Callon, 1996; Blok and Elgaard, 2011). Thus, translation, as used in this approach, bears many similarities with linguistic translation, where words are translated between languages. Within linguistics, the issue of the conservation of meaning during the act of translation is important (Chandler, 1994). However, to empirical philosophy, this issue is not as important because translation does not concern how to change from one representation of meaning to another; each translation creates a new entity with a life of its own. Thus, the GDP is not a mere representation of an objective reality, but is a being in its own right. This beingness is also evident in the graph

that can be constructed based on a series of measurements of the GDP or the statement "the economy is growing". These three entities are closely associated, but they should not be considered merely as representations of the same objective phenomenon. However, the interconnectedness and the circulation of these entities perform, collaboratively, the economic growth monster.

Despite the dissimilarity between empirical philosophy and linguistics, the empirical philosophical notion of translation is related to the concept of language. Although an empirical philosophical translation does not entail transporting a specific meaning from one domain of representation to another, translation can often be regarded as a transformation from one semiotic form to another. A row of numbers has a different semiotic quality than does a graph composed of dots; the statement "the economy is growing" assumes yet a third mode of appearance. In this manner, the notion of discourse also figures into this analysis because numerous translations of economic growth are discursive and occur in inscriptions and verbal utterances.

Finally, I would like to emphasise that ecology is a core issue for empirical philosophy. This is evident in the articulation of *ecologisation* as the solution to the ecological crisis of our age. According to Latour (1992, 2013), this crisis arises from the modern division of the world into domains, such as Nature, Society and Economy. Interpreting Latour, these domains are harmful because they misrepresent the messy world in which we live and conceal the fact that humans and non-humans constantly connect in multiple indivisible ecologies. This misrepresentation hinders recognition of the consequences of our current mode of living, in which legitimate members of our collectives[2] are systematically excluded from participation in democratic processes and are thus effectively silenced. This leads to exploitation and destruction of that which is considered external to Society and Economy. Empirical philosophy can therefore be considered to be a quest for ecologisation, where ecologisation means the constitution of human–non-human ecologies and the recognition of multiple excluded or silenced members of our collectives (Latour, 2013).

Economics

Exploring economics using empirical philosophy implies that we must reject the objective existence of the economy as a phenomenon that economists observe and measure and that exists regardless of measurement and description. However, adopting an empirical philosophical approach also means that we must dispense with the idea of the economy as a purely human construction that only exists in the vocabulary of economists. Instead, the economy is a collective construction that is created by means of an interplay of multiple human and non-human agents.

This interpretation is closely related to similar approaches that emphasise the performative aspects of economics (MacKenzie, 2006; Callon, 2007). The performative understanding of economics is exemplified by Callon's statement, "no economy without economics" (Callon, 1998), which implies that the economy is not a phenomenon that economists merely observe and try to represent; rather, it is an assemblage of diverse elements that create a totality in which theories and statements about this totality are fully absorbed (Callon, 2007). However, the performativity approach to economics has thus far been primarily concerned with the construction of markets, not with macroeconomic constructs such as economic growth. Thus, this article intends to contribute to the performativity literature by analysing economic growth and more generally, to economics literature, by introducing an empirical philosophical perspective on the issue.

Empirical approach

The empirical approach of this article combines analysis of scholarship and media, interviews and informal conversations and observations at events such as seminars and conversations. Rather than analysing a clearly bounded set of data, I have examined many

interrelated sources. In this respect, my approach could be called a multi-sited ethnographic study conducted in the stream of my life. I do not refer to a specific country, but to tendencies observable simultaneously in rich and less rich countries. However, the main focus of the article is Western industrialised countries, though the growth monster roams well beyond their borders.

Ecology of circulation

As my work on this article has progressed, I have gradually become able to sketch the contours of an ecology of circulation, namely, the activities and technologies of a series of agencies. The first such agency I would like to mention is national statistical offices, which possess the necessary infrastructure to collect data and the technological procedures to calculate the GDP. When data are processed, and the latest GDP figure is inscribed into spreadsheets and other transportable formats, the GDP figure is easily passed on to other agencies. Some of the first agencies to take notice of the latest economic growth number are departments in the treasury and other ministries. At these sites, civil servants are continuously updating databases with the most recent numbers from the national statistical office, GDP being the most prominent number. In these departments, the numbers are used for different purposes and are passed on to other agencies either in translated form or as they were received. Some of the new receivers count instead ministers, presidents and other parliamentary politicians. Again, the GDP number is used for new purposes, for instance, to support an argument at a negotiation table or make a statement at a press conference.

The latest growth figure soon appears in various news media stories and can be found all over the ecology of circulation, translated into many different appearances, such as statements from business leaders, blog posts or debates on public radio. Because this process constantly recurs, the economic growth monster is kept present and alive. The main observation in this case is that there are well-designed procedures that cut across such agencies as national statistical offices, ministries and media and facilitate the circulation of the economic growth monster. However, despite the incomplete and relatively linear description provided here, it is important that circulation not be understood as a process with a specific beginning or end. Circulation is messy and impossible to map in an orderly fashion. National statistical offices are, nonetheless, a good place to start the description because they repeatedly create the most recent GDP figure.

Shaping of collectives

Having now indicated some elements of an ecology of circulation, it is necessary to address another important aspect of the economic growth monster: its ability to shape the collectives within which it circulates. To clarify this ability, it is helpful to recall that economic growth has not always been integrated into public administration; it was institutionalised[3] by the help of factors such as the GDP and the promotion of national accounting by organisations such as the UN (Miller, 1986; Fioramonti, 2013). Thus, the calculation and the circulation of economic growth have gradually become integrated into the activities of state agencies to an extent that they rely entirely on it to assess their own success and for decision-making (Fioramonti, 2013). In this way, economic growth has become integral to governmental decision-making: a compass that governments use for navigation. To maintain this compass function, economic growth must constantly be circulated. This dependency even extends into the future in the sense that not only is the present growth figure circulated, but future economic growth, as it is forecasted by multiple agencies, is also circulated in numerous versions (Reichmann, 2013).

This dependency on navigation based on economic growth and the wider economic discourse that promotes it has further necessitated the presence of economic expertise in public administration (Cobb *et al.*, 1995). Economists spawned the monster, so who better to consult regarding its well-being? In this respect, the circulation of economic growth has

shaped public administration by increasing the dependency on economic expertise, in turn necessitating continued circulation due to a maintained concern about economic growth in many departments of the administration. However, not only does public administration navigate its actions and policies according to present and future economic growth, but the decisions of businesses and private investors are also influenced by future growth expectations. Thus, again, the integration of economic growth in decision-making makes continued circulation necessary. The basic observation of this section is that shaping and circulation are closely connected. Circulation shapes the collective, and this shaping necessitates further circulation.

Language and discourse

Yet, shaping does not end here. According to Cobb *et al.* (1995), economic growth as measured by the GDP has become the very language of America's economic reportage and debate. Along these lines, it makes sense to say that economic growth has influenced our language and made new metaphors possible. When listening to a debate or reading an article about economic growth, metaphorical skills are required to comprehend that a sentence such as "brighter times are ahead of us" means "we expect economic growth in the future" and that "the economy is healthy and getting stronger " means "the economy is growing". These examples indicate a widespread propensity to associate economic growth with terms that are generally perceived as positive, while decline is associated with terms that are perceived as negative. This tendency is also evident in descriptions of economic growth that use words such as health and strength, while decline is often described in terms of sickness and weakness (Calmes and Appelbaum, 2011; Goodman, 2011; Kumar, 2013). This shaping of language necessitates continued measurement of GDP, for how else would we know whether the economy is sick or healthy, or whether brighter or darker times lie ahead?

Economic growth is also present in semiotic discourse[4]. A researcher from a think tank reported, based on his observation of governmental departments that he had seen banners on the walls promoting economic growth and, according to him, economic growth is engrained in these departments to such an extent that it extends beyond theoretical equations to a general discourse promoting economic growth as an ultimate good and the solution to all our problems. Additionally, Seaford observes "[. . .] that in practice GDP does tend to be treated rather like a single welfare function" (Seaford, 2013, p. 27), an observation also supported by Fioramonti, who confirms the widespread use of economic growth as a proxy for well-being (Fioramonti, 2013). Thus, the economic growth discourse has shaped the ability to imagine what well-being is by reducing it to a monetary phenomenon. To use Fioramonti's formulation, this shaping is a form of domination, or discursive power (Haugaard, 2003), which can also be detected in the ability to determine what wealth and valuable contributions to society entail, namely, increased GDP, as well as that which contributes to this increase, regardless of social and environmental consequences (Fioramonti, 2013).

Measurement

According to Fioramonti, measurement is fundamental to our way of understanding the world. Hence, a multitude of measurements have been institutionalised in our daily activities (Fioramonti and Bell, 2014). This institutionalisation is also the case for the measurement of economic growth, which is now so fundamentally built into agencies of public administration that abandoning it would be equivalent to a captain throwing the GPS overboard in high seas.

GDP has become the ultimate measure of progress, which means that "no government or society is really able to think of progress outside of GDP" (Fioramonti and Bell, 2014). Thus, GDP immensely influences parliamentary politics and affects the outcome of referendums. The magnitude of these influences implies the ability of measurement to determine our

decisions, and in the case of GDP, the ability to reduce humans and non-humans to instruments and commodities serving its own maximisation (Fioramonti, 2013).

State instruments

Another important mechanism necessitating circulation is the connectedness of GDP to other accounting entities and state instruments, such as the national budget and taxation. As Cobb *et al.* (1995) explain, this connectedness is centuries old and is rooted in attempts to measure economic growth to facilitate tax collection. In our present epoch, this technological dependency is so precisely manufactured that if GDP declines, then tax revenues rapidly decrease, consequently pressurising the budget. Thus, GDP influences governments' economic latitude and makes GDP a top priority for public administration. This influence necessitates circulation and explains why economic growth forecasts are integrated into public budgeting (Larch and Salto, 2005), as well as why administrators are eager to be kept informed of the most recent GDP prognoses.

Having attempted to describe some dynamics of circulation and the shaping of collectives and language, I will spend the next section discussing the issue of contestation.

Contestation

Although economic growth and its proponents seem to occupy a nearly hegemonic position, there exists a well-established but scattered choir of voices expressing the devastating effects of further economic growth. Compared to the army of growth protagonists, this ensemble of voices seems small, yet it is sufficiently substantial to make economic growth a controversial issue.

An important dimension of contestation is the GDP's inappropriateness, which can be incompletely summarised as the exclusion and the neutralisation of data. The exclusion of data implies, among other things, that the state of ecosystems, the condition of natural resource stocks and the value of unpaid work are not part of the GDP calculations. The neutralisation of data refers to the lack of distinction between positive and negative contributions to the GDP (Cobb *et al.*, 1995; Røpke, 1997). This shortcoming allows harmful events, such as oil spills, murders and accidents, to contribute positively to the GDP because spill clean-up, murder investigations and rescue work generate income that is considered a positive contribution.

Criticism of the GDP is just one of many areas of economic growth contestation. According to Friman (2002), limits to growth have been an area of contestation since the classical economists; after the advent of neoclassical economics, these limits were rarely expressed. However, since the middle of the twentieth century, limits to growth have again become an issue, not least due to mounting evidence of environmental havoc, which many scholars explain as the result of economic expansion (Friman, 2002).

The main observation here is that economic growth is not a monster without a habitat: it inhabits a human–non-human ecology, while numerous entities in this habitat come together to protest and impose limits. Thus, endangered species, ecosystems and the climate form ranks with new indicators, models and activists to constrain the monster. This limits-to-growth assemblage is not maintained by a single organisation, programme or strategy, but various spokespersons have expressed what could be termed core points of contestation. For the sake of simplicity, these can be divided into three main points. The first regards the economy as a biophysical process, the growth of which requires increasing energy use and materials and begets increasing waste outputs (Dietz and O'Neill, 2013). Economic growth thus has severe consequences for the Earth's ecology and is in a process of transgressing vital boundaries securing the living conditions on Earth (Rockström *et al.*, 2009). The second point states that economic growth is actually not the panacea that provides wealth and well-being to all. Despite economic growth, poverty remains pervasive; inequality is growing; and beyond a certain, relatively low, level of GDP

per capita, there appears to be no correlation between an increased GDP and well-being (Jackson, 2009; Dietz and O'Neill, 2013). The third point argues that the growth rates of Western economies have been steadily declining for decades and that, due to falling productivity, it is questionable whether the high growth rates of the past will return (Chancel *et al.*, 2013). In sum, these points offer sufficient reason for choosing another path and starting to compose stable economies independent of economic growth as soon as possible (Jackson, 2009; Dietz and O'Neill, 2013).

Nonetheless, it is important to emphasise that these contestations do not slow the circulation; in fact, they encourage it by producing new translations. Hence, even though these translations make the monster far less lovable, they expand its existence. Attempts to surmount this problem by making something else circulate can be found in the so-called *Beyond GDP* indicators, which are alternative progress indicators intended to replace the GDP (Seaford, 2013). These indicators have not, so far, been successful in doing so. In the quest for finding an answer, Seaford has sought boundaries for the institutionalisation of the Beyond GDP indicators. Reviewing Seaford's results reveals that these indicators basically lack a well-constructed ecology for circulation. Among many examples of lack, Seaford describes how data for calculating these indicators are often insufficient or lacking, how there is no popular narrative to support them and how they are disconnected from the work that is performed in ministries, organisations and businesses. Furthermore, Seaford observes that these alternative measures do not fit a widely accepted economic model, that there is no widespread expertise capable of handling the indicators and that there is no clear idea about which Beyond GDP indicators to pursue (Seaford, 2013). This collective uncertainty regarding the viability and the use of Beyond GDP indicators explains the lack of circulation of these indicators and also deepens the understanding of the economic growth monster, for which all of these facilitators are in place. The main task for the promoters of Beyond GDP indicators is thus to determine how to change the ecology of circulation in favour of indicators that consider ecosystems, well-being and natural resources when calculating the progress of nation-states. How this consideration could be accomplished in greater detail is beyond the scope of this article, but in the next section, I will elaborate a bit more on approaches to fighting the economic growth monster.

Ecologisation

An important aim of this article is to explain how economic growth has become a pervasive policy objective able to trump ecological concerns. Examples of this ability are numerous and can be found in the rejection of proposals such as higher taxes on pollution, stricter environmental regulation and regulation of international trade and in the necessitation of so-called development, such as new highways, free trade and oil fields. The first proposals are rejected by the argument that they would harm economic growth, while the latter are recommended to secure it. In my view, the ability of economic growth to influence decisions regarding these issues lies in an entanglement of institutions[5], state instruments and a widespread economic growth discourse. A range of public institutions, the tax system and the national budget have all become dependent on economic growth, and this dependency is constantly reinforced by the discursive reproduction of economic growth as an ultimate necessity. Therefore, as long as economic growth remains the ultimate political objective, anything that is framed as a threat to that objective will be rejected. This makes it nearly impossible to imagine proper solutions to the ecological crisis by means of conventional policymaking. Thus, if one believes in conventional policymaking as an important agency for solving the ecological crisis, it is necessary to determine how to reduce the power of the economic growth monster and the discourse promoting it.

The economic growth discourse can be considered to be part of an activity, which Latour (2013) has termed *economisation*. An important element of economisation is a discursive practice that claims to capture values using the language of economics. The use of this language implies that only that which can be given a price and exchanged in a market has

value and can be taken into account. Everything else is external and must be internalised, i.e. given a price, before it can be taken into consideration. This discourse conceptualises Economy and Nature as two separate domains, and entities belonging to Nature can only be acknowledged if they are internalised and thus become part of the economic domain. In empirical philosophy, this type of reasoning can be seen to be a part of a greater misconception of the world in which we live, a misconception that provides the basis for the current ecological crisis, the solution to which is a move towards ecologisation (Latour, 2013).

In the context of the present article, a move towards ecologisation could be the promotion of a language that allows the presence of multiple voices and the expression of values that are currently excluded or oppressed by the economic growth monster. In its role as excluder and oppressor, this monster becomes a passage point for values and voices. If a certain concern or value can be phrased in the economising language of economic growth, it can be part of the discussion. If not, it is excluded. This means that value articulations that are compatible with economic growth can enter the discourse of decision-making, while those that are not are silenced. According to Medina (2004), the solution to this type of problem is a linguistic transformation that requires a multitude of radical changes. One way to start such a cascade of changes could be the explicit dismissal of the economising framing of political issues and an insistence on speaking an inclusive language that articulates the beauty of landscapes, the rights of non-human beings and justice for marginalised people without the use of monetary valuation (Monbiot, 2014). Second, the discipline of economics and its calculative technologies, such as GDP, that dominate vital ecologies of circulation should continually be challenged and replaced by other disciplines and measures that are more open to multiple values and voices. Third, it is necessary to facilitate the collection and circulation of data that speak on behalf of excluded or misrepresented members of our collectives or, if possible, to invite these members to speak on their own behalf. Finally, the new inclusive language, the alternative measures and the multitude of voices and values must be incorporated into the institutions of public decision-making. If all these changes are made successfully, there is hope that they would lead to a weakening of the economic growth monster and to the empowerment of excluded voices and values to address the rising ecological crisis of our age.

Conclusion

This article is inspired by empirical philosophy and offers a new perspective on economic growth to extend the explanation of how this monster has become so powerful. My explanation builds on an entanglement of institutions, state instruments and discourse that facilitates easy circulation and makes economic growth a nearly omnipresent concern in certain collectives. I also try to exemplify how this monster has shaped institutions, instruments and language and thereby has necessitated its own presence.

I am aware that economic growth is not the only obstacle to solving the multiple crises today. Nonetheless, it epitomises the current mode of economisation and constantly appears as the main argument for overruling ecological concerns. As such, economic growth has become a main trope in a technocratic language that suppresses other languages and rejects all values that are not monetary. In this way, economic growth has become a monster necessary to attack.

An important feature of economisation is the tendency to separate ecology and economy into two separate realms, such that ecology is reduced to a realm of control and exploitation. This divide is, according to Latour (2013), the fundamental source of the rising ecological crisis of our age, and until we understand that there is no economy–ecology divide and that humans and non-humans inhabit the same ecology, there is bleak hope that we will overcome the overwhelming problems of our age. In the context of the present article, an answer to these problems is the promotion of a new inclusive language that empowers the voices and values of silenced members of our collectives.

Notes

1. Here, I refer to the rejection of such proposals as eco-taxes and environmental regulation, using the argument that such measures will make businesses less competitive and, in turn, harm economic growth.

2. The term "members of our collectives" must be understood in the widest possible sense and includes entities such as landscapes, non-human species and homeless people.

3. By institutionalisation I mean the incorporation of certain norms or rules in various practices.

4. The term semiotic discourse is used to emphasise that discourse is more than verbal and textual, it also comprises a large range of signs, such as images, sounds and postures.

5. By institution I mean a set of norms or rules enacted through various practices.

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Article 4

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Celestial bodies and satellites

– energy issues, models, and imaginaries in Denmark since 1973

Abstract

This article uses the history of macroeconomic energy modelling in Denmark as a case for presenting a theoretical framework which describes *issues*, *publics* and *imaginaries* as an important nexus for energy policy. The story evolves around the actions, tensions, and entanglement of two publics – the traditionalist and the environmentalist – and presents macroeconomic modelling as an instrument for *issue articulation* and the construction of *energy policy imaginaries*. The article concludes that macroeconomic modelling is an effective instrument for articulating the economic realities of energy policy, and that economic growth plays a key role in these articulations by determining the basic preconditions for collective imaginaries of energy system futures.

Keywords: macroeconomic modelling, energy issues, publics, imaginaries, economic growth

1. Introduction

The world is on the verge of climate disaster. Human-induced temperature increase is threatening societies across the planet, and global energy system transformations are urgently needed[1] (IPCC 2014). At the same time, governments all over the world are staring fixedly at the economic growth indicator in the hope of upward-sloping tendencies, which are synonymous with better times ahead in their view. This situation is well captured by Jackson's term *the dilemma of growth* (Jackson 2009), which means that modern societies have become heavily dependent on economic growth in order to secure social stability, employment and welfare institutions, despite mounting research which suggests that economic growth has undesirable effects on the planet (Wackernagel et al. 2002, Weinzettel et al. 2013, Wiedmann et al. 2015). Thus, the dilemma of growth encompasses two thus far conflicting concerns: continued economic growth and global environmental havoc. The first can justly be termed as being top priority for states and governments, whereas the latter takes up a less prominent spot further down the list of government priorities and is often represented by publics less connected to the core operations of the state and its government.

Since the early seventies, it has become increasingly apparent that energy is a vital component of economic growth, societal order and stability. However, the use of energy, especially fossil fuels, for this purpose comes with severe environmental disadvantages such as carbon emissions and climate change (IPCC 2014). Hence, the issue of energy encompasses the same concerns as the dilemma of growth, in relation to which the state and its government historically has been mostly interested in energy as a means for securing economic growth and stability, while those concerned

[1] In fact, much more is needed; however, due to the limited scope of this article, I mainly focus on energy system issues.

with environmental issues have focused on the adverse effects of energy consumption.

In this respect, energy has, since the emergence of the first oil crisis in 1973, become an increasingly important political issue and the subject of perpetual policy-making and dispute (van Dalen et al. 2002). This increased political interest has also led to inquiry into the energy issue, which began to make use of *computational*[2] macroeconomic modelling already in the early seventies. The treatment of energy by this type of modelling is a key theme of the present article. By tracing the joint enterprises behind such modelling activities, this article provides insight to the apparatus behind the creation of *energy policy imaginaries*. This is achieved by addressing the following research question: *how has macroeconomic energy modelling been developed as an instrument for energy policy in Denmark since 1973, and what can be learned from this story about the role of macroeconomic modelling in Danish energy policy?*

The treatment of this question reveals a tension between the aforementioned concerns regarding economic growth, but also between different epistemic traditions, where mainstream macroeconomics is a tradition in favour of continued economic growth, while thermodynamics and system dynamics have been favoured by academics who are growth-antagonists (Georgescu-Roegen 1971, Meadows et al. 1972). Mainstream macroeconomics conceptualises energy as a market good and a substitutable factor of production (Andersen et al. 2010), while the antagonistic perspective emphasises the systemic and entropic aspects of energy. The former perspective explains economic growth by enhanced factor productivity as a result of technological progress (Solow 1956), whereas the latter holds that energy - or more precisely *exergy*[3] - is the key term in understanding economic growth (Ayres & Warr 2005). Furthermore, the latter perspective points to the entropic consequences of economic growth, which means that maintaining low entropic societal order and stability (especially by means of fossil fuels) comes at the price of high entropic environmental degradation (Georgescu-Roegen 1971).

The epistemic divide between mainstream economics and growth antagonistic perspectives is also key to understanding the title of the present article, which is inspired by macroeconomic modelling language. In this language, it is common to speak of an appendix model to a macroeconomic[4] model as a *satellite*. Hence, the macroeconomic model can be seen as a *celestial body* around which various satellites, such as energy models, orbit and whose gravity they have to obey. Taking an exergy view on this metaphor, however, requires a radically different explanation in which

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[2] Computational, as opposed to theoretical, means that the model consists of a set of equations, which is solved by a computer, thus providing a numerical result. Since all the models treated in this article are computational, this will not be stated explicitly.

[3] Ayres & Warr define exergy as 'available' or 'useful' energy, which means the potential for physical work contained in a given quantity of energy (Ayres & Warr 2005). The high exergy content of fossil fuels is, thus, key to understanding the rapid economic growth, which has taken place since the Second World War.

[4] To be more precise, satellites are developed for so called macro-econometric models, which are a special type of macroeconomic model.

the role of celestial body is played by exergy, while the economy is a satellite under its command.

The analyses of this article are a combination of sociology of science and policy analysis with an inclination towards the former. This means that the article does not attempt to trace the influence of modelling on concrete policy-making, but rather investigates the historical development of a specific type of modelling as a certain mode of inquiry with the ability to produce energy policy imaginaries. Even though the article relates to several strands of literature, one of its main purposes is to contribute to on-going discussions of politics as a matter of *issues*, *publics* and *imaginaries* (Dewey 2012 (1927), Marres 2005, 2007, Brown 2009, 2015, Jasanoff 2009, 2013). Epitomising these strands of analysis, Marres has emphasised the significance of issues and publics to politics and democracy (Marres 2005, 2007, Brown 2015), while Jasanoff & Kim (2009, 2013) have highlighted the important role of sociotechnical imaginaries in policy-making. However, these two perspectives have, to my knowledge, not yet been merged together, which is what I do in the following.

Also of interest to this article are two different literary strands covering two different kinds of modelling: *macroeconomic* and *energy/environmental* modelling. The former investigates the role of macroeconomic modelling in various contexts of political decision-making (Andersen & Madsen 1995, Evans 1997, den Butter & Morgan 2000, Henriksen 2013, Reichmann 2013), while the latter does the same for energy/environmental modelling (Midttun & Baumgartner 1986, Baumgartner & Midttun 1987, Hogan 2002, van Daalen et al. 2002, Nilsson et al. 2011, Upham et al. 2015). Even though they discuss two different types of modelling, these two strands are closely connected since discussing one makes it hard to ignore the issues and concerns which motivate the other. Thus, energy has become part of macroeconomic modelling and macroeconomics has become part of energy modelling. For the purpose of elaborating on this relationship, this article puts the connection between macroeconomic and energy modelling at the centre of attention and investigates activities of developing a discipline which I have labelled *macroeconomic energy modelling* (MEM). Denmark – one of the leading renewable energy nations of the world – was chosen as the case for this historical investigation. Due to its compelling history of energy system transformations, Denmark provides an interesting case of entangled grassroots mobilisation and governmental policy intervention (Jørgensen & Karnøe 1995, Karnøe in progress). This article focuses primarily on the governmental policy side of the matter and investigates how macroeconomic modelling has been mobilised as a tool for articulating energy policy imaginaries in Denmark.

The story focuses on three characteristic MEM collections from three different decades: the 1970s, the 1990s and the 2010s. Each of these decades saw events and were characterised by themes of special interest to MEM and, therefore, provide a good background for telling the story. The models of the seventies are called the

IFIAS[5] models, EMMA[6] is the model of the nineties, while a model collection named IntERACT[7] represents the current decade.

The rest of the article is organised as follows: in section 2, a brief account of the empirical material is given, while, in section 3, some of the limitations of the research are considered. The theoretical framework is presented in section 4, and section 5 discusses macroeconomic modelling and national accounting. Section 6 unfolds the story; section 7 discusses some aspects of the story, while a conclusion is provided in Section 8.

2. Empirical material

The empirical material of this article consists of fifteen semi-structured, audio recorded and transcribed interviews, and one audio recording from a seminar on multi-sector models[8] (see appendix 1 for a list of interviewees and their institutional affiliation). This material conveys the worldviews and stories of key actors including economists, civil servants and energy system researchers involved in the story of MEM in Denmark. Since all the interviews were performed in Danish, I have translated direct quotes from the interviews to English. The interviews and the seminar are referred to in square brackets. To supplement the audio recorded material, I rely on academic articles and book chapters and a body of reports and documents from central agencies such as the Danish Energy Agency, Statistics Denmark[9] and the Danish Ministry of Finance.

3. Limitations

The following story naturally has several limitations, two of which are the missing treatment of the impact of computer technology on macroeconomic modelling, and the fragmentary ethnographic detail concerning the linkages between policy change and modelling. It is widely recognised that the evolution of digital computers had a tremendous impact on computational modelling, and I am convinced that this influence also provides an opportunity for interesting investigations in relation to macroeconomic models. Yet, due to the focus on issues, publics and imaginaries, this part of the story has been omitted, leaving a gap for further research. Regarding the linkages between policy change and modelling, it is not easy to acquire the desired ethnographic detail since these linkages require access to rather closed and secretive environments such as the Danish Ministry of Finance. Several times during the research, I realised that access to such sites was quite limited and often beyond my reach.

4. Theoretical framework

In order to analyse the case at hand, a selection of different, yet kindred theoretical perspectives have been weaved together, the purpose being to highlight the relation

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[5] The International Federation of Institutes for Advanced Study.

[6] Energy and eMissions Models for ADAM (Annual Danish Aggregate Model).

[7] INTegrated Economic eneRgy Applied Computational Tool.

[8] All together comprising approximately 24 hours of audio recordings.

[9] The Danish National Bureau of Statistics.

between issues, publics, and imaginaries as an important nexus for energy policy, in which macroeconomic modelling plays a significant role. Thus, one of the main observations of the article is that macroeconomic modelling cuts across this nexus by being commissioned and commanded by certain publics, by participating in the articulation of issues, and by being used in the drafting of energy policy imaginaries. In the following, a more elaborate description of the theoretical perspectives deployed to develop this argument is provided.

The first thread in the patchwork is the concept of *issue articulation*, which according to Marres, is a constituent element of politics and democracy (Marres 2007). Roughly speaking, issue articulation concerns the construction of objects by means of associating material circumstances through activities such as data collection, measurement, and calculation. In this sense, issues, such as the oil crisis in 1973, can be seen as objects which enter our common world through socio-material associations and acquire specific traits and qualities depending on how they are measured, calculated, and by other means expressed. As the following story hopefully reveals, macroeconomic models are able to participate in such socio-material articulations, and, hence, they can be understood as effective instruments of issue articulation.

The next perspective in the patchwork is Dewey's idea of the public as a pivotal notion in understanding democracy, societal change and the transformation of the state. In order to explain the public, Dewey takes indirect consequences of conjoint human actions as his point of departure: "The public consists of all those who are affected by the indirect consequences of transactions to such an extent that it is deemed necessary to have those consequences systematically cared for" (Dewey 2012:48). Thus, a public is a social group which emerges as people who are affected by the consequences of conjoint actions engage in systematically caring for and dealing with these consequences.

In her contemporary reading of Dewey, Marres translates the indirect consequences of conjoint actions into *issues* and suggests that, "issues spark a public into being" (Marres 2005:title). Using this phrasing, Dewey's theory of societal change becomes a theory of how specific social groupings named publics are called into being by emerging issues and how these organise and act in order to respond to these issues. Along these lines, it is important to emphasise that Dewey considered the state and its government to be a public (Dewey 2012); a public in which multiple modes of organisation have turned into stable institutions and regimes of regulation in order to care for and handle a multitude of issues. In this perspective, societal change is highly dependent on how the state reacts to emergent issues and on interactions between the state and new publics called into being by these issues.

In the following, tensions between two publics dubbed the *traditionalist* and the *environmentalist* public (or simply the *traditionalists* and the *environmentalists*) constitute a fulcrum for telling the story of MEM in Denmark. The traditionalist public is anchored in core ministries of the Danish state, such as the Ministries of State, Finance and Commerce, whose main economic concerns are strongly tied to national accounting, whereas the environmentalist public is constituted by research

groups, NGOs, and grassroots movements called into being by the environmental consequences of economic growth.

The question of how the state and new publics react to emergent issues leads to Dewey's notion of inquiry, which is a certain instrumental mode of knowledge production that regards the clarification of indeterminate situations, instances of ambiguity and confusion (Brown 2009). As such, inquiry plays an important role as articulator of emergent issues and devisor of 'appropriate' responses (Marres 2007). As Brown explains, "[i]nquiry begins with the desire to respond to [a] disturbed and troubled situation, followed by the transformation of the indeterminate situation into a "problematic situation", and then into a specific "problem" to be solved" (Brown 2009:153). By virtue of this ability to transform a troubled situation into a specific problem, inquiry is core to determining what can be thought of, planned and chosen (Dewey 2012). In the story which follows, macroeconomic models are investigated as instruments of inquiry, which help to transform troubled situations into solvable problems by providing frameworks for articulating energy issues and drafting energy policy imaginaries.

Continuing along these lines, the final theoretical thread I wish to add to the patchwork is an emphasis on the imaginary; in this case visions of the future Danish energy system. For this purpose, I draw inspiration from Jasanoff and Kim, who use the term *sociotechnical imaginaries* to describe "collectively imagined forms of social life and social order reflected in the design and fulfilment of nation-specific scientific and/or technological projects" (Jasanoff & Kim 2009:120). In a later article, Jasanoff & Kim use the case of energy system transformations to exemplify sociotechnical imaginaries as important guides for energy policies (Jasonoff & Kim 2013). Adding to this line of research, the present article investigates macroeconomic inquiry engaged in the articulation of energy policy imaginaries for the purpose of governmental decision-making regarding the transformation of the energy system in Denmark.

5. Macroeconomic modelling and national accounting

Adding to the previous reflections on issues and issue articulation, it is interesting to observe that, ever since their inception, macroeconomic modelling and energy modelling have been engaged in the articulation of emergent issues from the Great Depression to present day climate change. To exemplify this, the world's first computational macroeconomic model was developed by Tinbergen in a response to the hardships following the Wall Street crash in 1929 (Zalm 2000), while the first large-scale energy models in the USA came as a response to skyrocketing oil prices in 1973, which very quickly became a national security issue for the US government (Hogan 2002). This modelling mobilisation can be interpreted as publics – in this case nation states – responding to emerging issue by incorporating modelling inquiry in their perception of these issues and their responses to them.

This connects to Dewey's notion of inquiry or more precisely a specific instrumentality of inquiry named, national accounting, which serves as a foundation for macroeconomic modelling (Bjerkholt 2000). Thus, one way to understand macroeconomic modelling is that it concerns causal relationships between national accounting variables and the investigation of other forces which cause national

accounting variables to change. Modern systems of national accounting date back to the Great Depression, which called for tangible accounts of the economic status of nation states (Vanoli 2008). Since then, national accounting has gradually been formalised and harmonised such that most countries employ comparable standards (Vanoli 2008). This institutionalisation has also induced a very strong political focus on national accounting, such that emergent issues which affect, or merely threaten to affect, these indicators have the potential to become issues of great concern to governments.

Cast in the vocabulary of this article's theoretical framework, this can be interpreted as an example of traditionalist issue articulation, which at least partly explains the need for macroeconomic models in policy-making since such models provide frameworks for imagining the future status of national accounting variables and the effects of various policy proposals on these variables. Having this in mind, it is noteworthy that macroeconomic forecasts are notoriously flawed, yet they are used for multiple political purposes (Evans 1997). One explanation for this is that they provide consistent, non-contradictory frameworks in which fundamental national accounting identities are respected (Smith 2000). In Denmark, the macroeconometric model, ADAM, maintained by Statistics Denmark and operated by the Ministry of Finance, plays an important role in this regard. Since the late seventies, it has been the main celestial body for managing the macroeconomic concerns of shifting Danish governments.

6. The story

6.1 The pioneers

The story begins in 1973 on November 25th with the introduction of *car free Sundays*, a government intervention banning all car driving[10] in Denmark[11] on Sundays. A complex situation in the Middle East, spurred by the Yom Kippur war, had led to skyrocketing oil prices in the wake of which followed disturbing national account articulations such as an increasing balance of payment deficits, decreasing consumption and growing unemployment (Bjørnholm et al. 1976, Handelsministeriet 1976, Issawi 1978, Meyer 2000). This threatened economic growth[12] and stability in the West and left many oil importing countries in a state of emergency; also articulated as the first oil crisis (Tennant 2013). The Danish government needed to act, and car free Sundays aimed at immediate cuts in oil consumption. However, probably more than anything else, car free Sundays was a moral statement telling the Danes to stand together in this critical situation [Bjørnholm].

The year before, in 1972, another important event had taken place: the publication of the first Club of Rome report named *Limits to Growth* (LtG) (Meadows et al. 1972). LtG was based on computations performed on a system dynamics model named,

[10] There were some emergency exceptions to the law, and it was possible to acquire a permission to drive for certain vital purposes.

[11] Actually, this intervention was also introduced in other European countries.

[12] At that time, growth had in fact already been declining for some years (Midttun & Baumgartner 1986), which only made the crisis more disturbing for the government.

World3, which, "[…] became an important vehicle in bringing the new problem perception of a global ecological crisis to national and international policy attention" (van Dalen et al. 2002:5). Even though LtG was not the first publication to problematise perpetual economic growth, its global scope and far-reaching narrative marked the advent of a 'new' issue and called an international environmentalist public into being.

The concerns of this public immediately turned out to be in stark opposition to the concerns and interests of the traditionalist public for whom continued economic growth, employment and societal stability were the primary political priorities. These two publics carried the potential for severe conflict, and soon after its publication, LtG became subject to aggressive attacks from traditionalists, and heated discussions broke out [Meyer].

In spite of this controversy, the LtG issue had the ability to mobilise both competent business leaders and long-haired students [Bjørnholm]. Along these lines, Bjørnholm explains how the LtG issue influenced the Rockefeller Foundation and the Nobel Foundation to establish a scientific network called, IFIAS, which involved high-ranking research institutes from several countries. The basic idea of this initiative was to see whether international, interdisciplinary research collaborations could lead to useful responses to the complex, multifaceted future challenges articulated by LtG and other related studies [Bjørnholm]. The famous Niels Bohr Institute for theoretical physics in Copenhagen was invited to join IFIAS and the invitation was accepted. Using Dewey's vocabulary, the IFIAS community can be understood as a public which brought the traditionalist and environmentalist together around a somewhat common agenda.

At the first IFIAS meeting in Copenhagen in February 1973, it was decided that the Danish contribution would be a pilot study of energy issues in Denmark. Later that same year, the oil crisis emerged and pushed the Danish IFIAS project up the political agenda. Thus, the oil crisis became a factor in turning the project focus towards the concerns of the traditionalists, such that the main question for the Danish project became: *how to become independent of oil from the Middle East?* Denmark was the perfect case for such a study due to its utter dependence on foreign energy and the availability of well-ordered statistics in many categories [Holm].

The oil crisis and the economic concerns of western nation states thus became factors which directed the Danish project focus towards energy supply security and increased the government's attention, to such an extent that the project was subject to continuous interest from high-ranking officials in the Danish ministries of State, Finance and Commerce; the latter being responsible for national energy issues at the time [Holm]. The high priority status of the project was also reflected in the appointment of Thorkil Kristensen – the first secretary general of OECD and former Danish Minister of Finance – as the public face of the project.

The daily work of the IFIAS group consisted of talking to representatives of a wide range of professional capabilities within the energy industry and gathering energy system data from every corner of the country in order to build a model strongly

grounded in empirical data [Holm]. This work was facilitated by the high priority status of the project, which made almost anything possible, or as Holm expresses it, "all doors were open so to say, and if information existed at all, it was accessible to us".

However, as Holm also remembers, they needed a framework for the figures: "we had plenty of data for houses, gasworks and oil burners, but needed a framework in order to say something about the overall economy and energy consumption". For this purpose, it was decided, under the influence of the economist, Bent Thage, a high-ranking official from Statistics Denmark, that a macroeconomic model would be built based on the Norwegian Multi-Sector Growth (MSG) framework [Holm]. Hence, Holm, the programmer of the group, reconstructed the Norwegian MSG model to fit Danish data. As the work progressed, the IFIAS group developed a joint instrument consisting of two models: MSGE (E for energy), an energy demand model, and ESM (Energy System Model), an energy supply model. This description exemplifies issue articulation as a process of associating material circumstances – houses, gasworks, and oil burners – by means of data collection and the incorporation of these data into a wider framework of macroeconomic calculation.

Using the article's theoretical patchwork to express the procedure of operating the IFIAS models, one could say that the interests and economic concerns of the traditionalist public came to dominate the operation. To begin the procedure, MSGE would receive an exogenous input, which was the official economic growth forecast provided by the Ministry of Finance. Based on this input, MSGE would calculate the total amount of energy needed to achieve the level of production forecasted by the ministry. By means of an input-output[13] (IO) matrix, MSGE would disaggregate the total energy demand into sectors and energy sources. ESM was then used for exploring energy system opportunities and developing scenarios of less oil-dependent energy system configurations able to meet this demand. There was no programmatic feedback from ESM to MSGE. Thus, ESM had no direct influence on the total energy demand or the disaggregation into energy sources demanded by industry and households [Holm]. Based on this procedure, the IFIAS group produced and published energy system scenarios for the purpose of policy debate and decision-making, thus articulating imaginaries in agreement with the traditionalists' economic growth priority.

The theoretical interpretation of the preceding section is that it exemplifies the role of macroeconomic calculation in a nexus between issues, publics and imaginaries: an issue – the oil crisis – emerges and is articulated by means of national accounting. The traditionalist public reacts by making the IFIAS project a high priority, which leads to inquiry into the Danish energy system and macroeconomic articulations with the purpose of informing governmental decision-making and public debate.

[13] An IO matrix is a mathematical subdivision of the economy into sectors of production and final consumers. For more information, see Leontief (1970).

6.1.1 Publications and confrontations

The Danish IFIAS project terminated in 1976 when two group members were headhunted to work in the Ministry of Commerce on energy issues. Even though the project finished abruptly and the work of the group has now been more or less forgotten, the project must be recognised as a pioneer project. As an economist, who was later involved in similar projects, puts it, "the IFIAS group started a tradition" [Morthorst].

A part of this tradition was to publish energy policy scenarios, and the year 1976 witnessed no less than three such publications. First came the IFIAS scenarios (Bjørnholm et al. 1976), then the first official energy plan of Denmark (Handelsministeriet 1976), and finally, a so-called alternative energy plan (Blegaa et al. 1976) authored by growth sceptical members of the environmentalist public. The IFIAS scenarios and the official plan were actually more or less identical - reflecting the high level of coordination between the IFIAS project and the Ministry of Commerce (the publisher of the official plan) – whereas the alternative energy plan especially deviated on one specific issue: nuclear energy.

The IFIAS scenarios and the official plan both relied on the introduction of nuclear energy (amongst many other very well-considered technical solutions, which would later prove to be successful) to reduce the oil component of the overall energy mix. However, the introduction of nuclear energy was a highly controversial issue in Denmark (Meyer 2000), and in spite of the fact that most of the authors of the alternative plan held strong antagonistic views on economic growth, they accepted this priority in order to fight the battle against nuclear.

They did this by first explicitly denouncing the economic growth imperative, although they accepted the overall projections of economic growth presented in the official plan in order to show that it was possible to make an energy system scenario which was able to saturate the overall demand for energy projected in the official plan without nuclear. For this purpose, the alternative plan relied on coal and, to a much greater extent than the two other plans, on renewable energy. As history has shown, nuclear has not been introduced in Denmark and the country has since witnessed what could reasonably be termed a renewable energy revolution (Karnøe in progress). The growth sceptical authors of the alternative energy plan (and the environmentalist public more generally) thus ended up as winners of the nuclear power battle, albeit at the cost of accepting the economic growth imperative. Since nuclear has not yet become part of the Danish energy system, the preceding exemplifies how the battle over nuclear in Denmark was always a battle of imaginaries, and how imaginaries can be understood as strong political forces able to determine actual decision-making.

The authors behind the alternative energy plan belonged to a group of researchers[14] centred at the Technical University of Denmark, spearheaded by the physics professor and economic growth antagonist, Niels I. Meyer. As was also the case for

[14] This group based their understanding of economic growth and energy systems on, amongst other things, systems dynamics and thermodynamics.

the LtG authors, Meyer's group was occasionally met by attacks from mainstream economists and a general distrust from the traditionalist public. This is exemplified by one of the former group members in the following way: "we operated in a hostile environment and were often met by hard feelings" [Member of Meyer's group, who wishes to remain anonymous]. This indicates a sharp divide between the traditionalist and the environmentalist public. However, this is not entirely precise since the boundaries between the two were blurred by multiple crossing and interrelations. An example of this is the fact that some members of Meyer's group actually ended up working in state organisations such as the Energy Agency, while Meyer himself chaired various governmental renewable energy committees and councils from the seventies and several decades onwards (Meyer 2000).

Regarding the energy issue more generally, the members of Meyer's group held an entirely different view than most mainstream economists. In mainstream economics, energy was, and for many practical purposes still is, considered one of the less influential factors of production, whereas a former member of Meyer's group emphasises how the energy crises revealed energy as a key socio-economic factor having multiple environmental implications [Josephsen].

6.2 The golden age

In the early eighties, the energy question was, from a traditionalist perspective, still mainly a question of security of supply, while environmental problems in relation to energy consumption was a marginal concern (Meyer 2000). This changed in the late eighties with the emergence of the international sustainable development discourse, spearheaded by the publication of the Brundtland Report in 1987 (Hajer 1995, Blok 2005, Røpke 2005). As opposed to LtG, the sustainable development discourse was more in line with the traditionalist agenda since it promised a reconciliation between environmental concerns and the unquestionable economic growth imperative. Thus, the Brundtland Report became a turning point, which marked an increased interest in environmental issues in Danish policy-making (Miljøstyrelsen 2015).

The increased interest led, among many other things, to the establishment, in 1992, of the Strategic Environmental Research Programme, the objective of which was to provide environmental knowledge for policy-making in Denmark (Blok 2005). Amongst many research projects, the programme also funded a project with the purpose of creating a modelling tool for the coherent assessment of economy-environment relations in Denmark (Andersen et al. 1998). This project resulted in the development of a collection of models named EMMA, which is still used by different state agencies for energy demand forecasting today [Andersen, Pedersen].

The main organisations involved in developing EMMA were the sectoral energy research institute, Risø, and Statistics Denmark. Risø employed an interdisciplinary energy systems group (also including economists), while Statistics Denmark commanded a macroeconomic modelling group (comprising only economists). Economists in the Risø group had previously been involved in MEM projects funded by the European Community (Fenhan & Morthorst 1981, Bâtiment 1993), while the group at Statistics Denmark were in charge of maintaining and developing the macroeconometric model ADAM used by the Danish Ministry of Finance for

forecasting and policy assessment. The connection between the groups at Risø and Statistics Denmark has been vital to the MEM community in Denmark, not least due to the fact that most of the economists involved in the development of this discipline received their training in either one or both of these groups.

The relatively long history of EMMA indicates how changing policy issues and public interests are able to influence the development of a model. Even though I do not possess all the ethnographic detail and empirical pieces to fully explain this, I argue that there is a connection between the sustainable development agenda, the environmental issues it brought along, and the demand for further macroeconomic inquiry for which purpose EMMA was developed. Indicating this, the first version of EMMA[15] was merely a single energy demand satellite to ADAM [Andersen], while during the nineties, EMMA evolved into a collection of ADAM-satellites able to couple several environmental issues, such as CO_2, SO_2 and NO_x emissions, to ADAM's macroeconomic machinery.

An important force in this development was the then Minister of Energy and Environmental affairs, Svend Auken, who had a strong voice in the centre-left government (1993-2001) and was able to bring environmentalist concerns further up the traditionalist agenda. This resulted, amongst other things, in the passing of a law which dictated environmental assessments of policy plans and the annual budget (Andersen 2000). The environmental assessments of the annual budget quickly became subject to heavy criticism, and they were abandoned already after three years. However, they left an imprint on EMMA by being the catalyst for its expansion and elaboration in terms of environmental detail. This development required much time and labour, however, according to one of its designers, EMMA was actually capable of handling the assessments at the time of the abandonment [Andersen].

Broadly speaking, EMMA is a collection of energy specific satellites to ADAM. In concert, this setup is able to perform three core articulations: first to quantify industry and household energy consumption and disaggregate it into different energy types[16], second to model the energy supply sector's conversion of fuels into other forms of energy, and finally to calculate the total amount of CO_2, SO^2 and NO_x emissions due to energy consumption[17] (Andersen & Trier 1995). In order to do so, EMMA is dependent on an exogenous projection of economic growth (provided by the Ministry of Finance using ADAM). In this respect, EMMA can be seen as an energy/emissions extension of the macroeconomic concerns of the traditionalist public.

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[15] This was before the model was actually dubbed EMMA during a naming session involving two model builders and a bottle of red wine [Grinderslev].

[16] In the 1997 version, the six energy types were: transport fuel, electricity, natural gas, district heating, solid fuel and liquid fuel. A subsequent version included seven types: gasoline, electricity, gas, district heating, coal, oil and biomass (Andersen et al. 2010).

[17] The disaggregation into energy types is necessary in order to provide a good description of emissions since each fuel type has a specific emission intensity and results in the emission of different pollutants.

Even though the IFIAS models and EMMA thus exhibit a basic similarity, there are still quite a few differences between the two. First of all, the development of EMMA reveals an interesting double movement: *increasing interest in environmental issues* and a *gradual take over by the economics discipline*. The first aspect has already been treated, while the second refers to the fact that the IFIAS project was an interdisciplinary project characterised by a mix of physics, engineering and economics competencies, whereas EMMA was developed by economists, who incorporated energy systems engineering knowledge in their framework. This is indicative of how economists gradually expanded their sphere of influence on the inquiry into the energy issue, which is also exemplified by the fact that the IFIAS collections was a combination of a macroeconomic and an energy systems model, whereas EMMA is solely macroeconometric. In other words, IFIAS's energy system model was a mathematical model based on an engineering approach to the energy system, whereas EMMA is based on estimated behavioural equations (and IO-matrices) determined by mainstream economic theory.

As opposed to the IFIAS models, feedback from EMMA to ADAM is technically possible (Andersen et al. 2010). However, interviews reveal that this is a slightly tricky business, and such iterations can easily go astray [Andersen]. Over the years, the emissions and supply satellites and the feedback possibility of EMMA have not been employed for many practical purposes (Energistyrelsen 2015). EMMA has, thus, always been mainly used for imaginary purposes such as the articulation of energy demand forecasts.

6.2.1 More energy plans

During the eighties and nineties, new energy policy imaginaries in the form of three official energy plans – *Energy Plan 81* (Energiministeriet 1981), *Energy 2000* (Energiministeriet 1990) and *Energy 21* (Miljø- og Energiministeriet 1996) – where published. These three plans were exponents of the changing policy focus described in the preceding. Thus, Energy Plan 81 was mainly concerned with energy security (Meyer 2000), whereas the latter two plans exhibited an increased emphasis on the concerns of the environmentalist public, especially climate change. However, all the plans still consisted of imaginaries which complied with the official economic growth forecasts provided by the Ministry of Finance using ADAM.

Providing a more nuanced perspective to this general tendency, it is interesting to observe that the 81 plan actually presented a so-called low growth scenario, which halved the official future economic growth rate to 1.5 per cent and relied on tighter government control of energy system developments. The reason for incorporating this imaginary was, most likely, parliamentary pressure motivated by the concerns of the environmentalist public (Meyer 2000). That said, Energy 81 emphasised that the low growth approach would substantially affect the balance of payments and employment negatively. Furthermore, it was emphasised that the low growth projection of GDP was not the Ministry of Finance's official forecast (Energiministeriet 1981).

Finally, it should be mentioned that the official 81 plan was followed by the publication of a very elaborate alternative plan in 1983 (Hvelplund et al. 1983),

authored by a group including several of the authors of the first alternative plan (Meyer 2000). This plan was characterised by a holistic systems perspective with serious attention paid to renewables, which inspired the makers of Energy 2000 seven years later (Meyer 2000). Once again, this exemplifies the ability of imaginaries, to exercise influence; influence which is traceable in actual policy and energy system transformations.

5.3 Present trends

During the 2000s, Denmark witnessed a policy shift from a willingness to an aversion to financially support state institutions to care for the environment [Holten-Andersen]. The main protagonist of this shift was Anders Fogh Rasmussen, head of the right-wing government, which came into office in 2001. According to public myth, one of Rasmussen's aims was to demolish Auken's empire. This aim was carried out, amongst other things, by shutting down several environmental boards and councils [Holten-Andersen]Holten-Andersen], (Jerking 2009) and establishing a new institute of environmental assessment headed by the now notorious climate action obstructer, Bjørn Lomborg (Jerking 2009).

As a consequence of Rasmussen's low concern for environmental issues, his reign became a dark era for the environmentalist public [Holten-Andersen]. However, during his second term, Rasmussen changed his attitude towards climate change, and not long after[18], an interdisciplinary climate commission to explore the possibility of achieving a zero-carbon energy future by 2050 was commissioned. This shift in political attention characterises the present day where the focus on climate change and a zero-carbon future dominates the public debate on environmental issues.

Not least thanks to impressive grassroots activities and innovative entrepreneurship, Denmark is, at least for the time being, one of the leading renewable energy nations in the world (Karnøe in progress, IEA 2011). This status makes it realistic for Danish politicians to discuss the possibility of a zero-carbon energy system in 2050. Even though the coming into office of a new right-wing government in 2015 has added serious doubts to the feasibility of this ambition, the Danish Energy Agency still possesses a large selection of instruments with which to explore this issue. As the main agency handling the government's energy concerns, the Danish Energy Agency thus provides an appropriate site for an account of energy models currently in use for energy issue articulation and the drafting of energy policy imaginaries.

At the beginning of the story in 1973, the energy concerns of the state were more or less handled by two people, who kept track of coal imports in the Ministry of Commerce [Holm]. With the outbreak of the first oil crisis, it quickly became apparent that the number of employees and level of expertise was insufficient. Hence, in 1976, the Danish Energy Agency[19] was established, and since then, the agency has expanded dramatically, to the extent that it has approximately 300 employees today.

[18] At that time, however, Rasmussen had left office to become the new Secretary General of NATO.

[19] The Danish Energy Agency is now a part of the Ministry of Climate, Energy and Housing.

In the early seventies, the general selection of energy models was sparse (Hogan 2002), whereas today a diverse array of such models is in use at university departments and sectoral research institutes. This is also the case for the Danish Energy Agency, which has a large model selection including energy models for areas such as transportation, housing, district heating and electricity [Pedersen]. This reflects a very different situation from the situation in which the IFIAS models operated. The IFIAS project consisted of a small group of people who had two models at their disposal, whereas the models in the Danish Energy Agency are distributed amongst several areas of responsibility. This is indicative of an increase in modelling capabilities, which has taken place over the years and has led to a situation where the energy agency is able to respond to many different political requirements using its models either separately or in concert. In the latter case, the agency's selection of models is a fairly streamlined apparatus held together by a so-called compilation model. This apparatus regularly provides an elaborate baseline forecast of the energy situation in Denmark approximately ten years ahead in time [Pedersen].

As was also the case for the previously described models, the models in the Danish Energy Agency can be grouped according to an economic conceptualisation of the energy issue. A central distinction in this regard is made between supply and demand models. On the demand side, EMMA is responsible for the overall energy demand forecast, which is dependent on the official macroeconomic forecast provided by the Danish Ministry of Finance. This reveals a one-directional demand forecasting procedure, where the agency's energy models are not in a position to provide any feedback to ADAM.

In relation to this 'deficiency', it is noteworthy that a new integrated modelling collection is currently under construction at the Energy Agency. This collection is called IntERACT[20] and is supposed to become a supplement to the model selection already in use at the agency [Termansen]. The decision to initiate the IntERACT project was part of a parliamentary energy agreement from 2012 (under a centre-left government 2011-2015), in which it is stated that 15.2 million Danish Kroner has been earmarked for the, "[d]evelopment of a general equilibrium (GE) model for modelling the energy system and economic system to identify effective policies and future regulatory initiatives" (Termansen et al. 2013).

As a part of the energy agreement from 2012, the objective of which is to push in the direction of making Denmark fossil-free by 2050, IntERACT is designed to articulate the effects of a transition to a zero-carbon-future on the Danish economy. IntERACT consists of two integrated models: a computable general equilibrium (CGE) model and an energy supply model named TIMES-DK[21]. The CGE model is based on neoclassical assumptions such as rational economic behaviour, utility and profit maximisation (consumers and firms respectively) and perfect information. These

[20] The IntERACT project had a time frame of three years and the initial funding terminated in 2015.

[21] TIMES is one of the modelling tools of the Energy Technology Systems Analysis Program (ETSAP), a consortium, under the International Energy Agency (IEA), which includes a large number of member countries.

assumptions combined with the mechanics of prices and market forces make it possible to obtain a general equilibrium solution for the entire economy, where all markets achieve equilibrium simultaneously (Termansen & Gersfelt 2013).

TIMES-DK, on the other hand, is a very detailed linear programming energy systems model, which optimises a single objective function under a number of constraints. The objective which TIMES-DK optimises is: *how to deliver a specified amount of energy services in the most cost-efficient way?* To answer this question, TIMES-DK uses a rich technical description of the Danish energy system.

Even though both models operate by optimisation, they are considered to represent two opposite approaches: top-down (CGE) and bottom-up (TIMES-DK). According to Termansen, integrating the two is not straight forward. In intERACT, the integration goes through energy services such as heating, light and transportation. The basic idea is that the CGE model provides an overall demand for energy services, while TIMES-DK calculates how this demand can be met 'at the lowest cost'[22] under specified constraints [Termansen].

Unlike the two previously described model collections, feedbacks between the energy system and macroeconomic variables are of high priority to IntERACT, and the collection is designed to perform iterations between the two models. The iterative loop starts in the CGE model, which is calibrated according to the latest national account figures from Statistics Denmark. Based on these figures, the model provides an energy service demand output, which is fed into TIMES-DK, which then performs its optimisation and feeds the result back into the CGE model, which reacts by adjusting prices and, consequently, the entire macroeconomic output from total production and energy services to unemployment and export. The new demand is then fed into TIMES-DK and so on. Termansen refers to a similar Swedish model when he states that it will take three to four iterations before convergence is established[23].

Basically, IntERACT is designed to calculate the 'costs' of a transition to a zero-carbon future, which is calculated by means of a comparison between IntERACT scenarios and the Energy Agency's baseline forecast [Termansen]. The deviation between the baseline projection and the scenarios determines the overall future societal costs (or benefits) in terms of GDP. This procedure is indicative of a very common approach to articulating the future costs to society of sustainable energy transitions (or any other economic policy proposal for that matter). The procedure is not well know to the public and the end result is often communicated as if it was scientific fact, which reveals how mainstream macroeconomic articulations are so ingrained in economic policy that they have become solid reality which is hardly ever contested. This is a good example of 'successful' issue articulation.

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[22] The quotation marks are inserted to stress that what is considered the lowest cost depends on the context and the regime of valuation in use.

[23] Convergence means that the difference between output t and t_1 remains within a predefined numerical interval.

Comparing IntERACT with the two previously described models reveals a stronger resemblance to the IFIAS models than EMMA. As was the case with the IFIAS models, IntERACT also consists of a combination of a CGE model and a technical energy systems model. However, the IFIAS models were not designed to investigate feedbacks, and its energy systems model was not based on linear optimisation. Furthermore, the range of research questions which characterised the IFIAS project also deviated from IntERACT. Thus, the main focus of the IFIAS project was energy security and independence from the Middle East regarding oil, while the cost of a renewable energy transition is the main focus of IntERACT.

5.3.1 The Climate Commission

Since the publication of Energy 21, Denmark has not seen any new official energy imaginaries. However, in 2010, the aforementioned Climate Commission published the results of its study (based on several models, two of which was ADAM and a model similar to IntERACT) of the possibility of achieving a fossil-free energy future in Denmark. More precisely, the research question was as follows: *is it possible for Denmark to reduce its greenhouse gas emissions by more than 80 per cent by 2050?* (Klimakommissionen 2010b:18). The commission concluded: yes it is possible, and the 'costs' will be modest; an uplifting imaginary, but in my view, it has not been as strong and influential as the authors probably hoped it would be.

What the authors actually mean by costs in the report is the *welfare loss* induced by higher energy prices (Klimakommissionen 2010b:79), where welfare loss simply means negative effects on GDP (the mainstream macroeconomic proxy for societal welfare). Thus, the welfare aspects of the energy transition were assessed by means of GDP, the traditionalist's value metric par excellence. Once again, this reveals the ability of the economic growth imperative to determine and assess energy policy imaginaries. This imperative is further highlighted by the fact that the commission's mandate, decided by government, explicitly stated that the commission had to take continued high economic growth rates as a given (Klimakommissionen 2010a:16). Thus, economic growth entered the imaginary policy space and constrained it by only allowing growth imaginaries.

7. Discussion

The empirical focus of this article is macroeconomic modelling involved in articulations of Danish energy policy imaginaries. An important observation in this regard is that MEM articulations are political and have concrete policy implications. An example of this is their ability to provide calculations for drafting energy policy scenarios, which define a spectrum of possible energy futures for politicians to discuss and decide upon. In this respect, MEM is part of determining what can be thought of, planned and chosen regarding the future energy system.

An important factor in these choices is the economic growth imperative, which must be preserved thereby ruling out any possible energy futures which violate this rule. This is indicative of the reciprocity of policy and modelling, where the former sets the conditions for the latter with the latter then producing results which determine the imaginary scope of the former. To describe this reciprocity, I show how concerned publics use instruments of enquiry such as national accounting and

macroeconomic models in order to articulate troubling situations, turn them into well-defined problems and, finally, propose energy policy imaginaries (in the form of energy plans).

This leads back to the celestial bodies and satellites mentioned in the introduction and the epistemic divide between mainstream macroeconomics and inquiry which takes a thermodynamics perspective on energy systems (Illum & Gibson 2006). In the preceding story, the role of celestial body was always played by a macroeconomic model (in most cases ADAM), which secured the top priority of traditionalist concerns such as economic growth, unemployment and the public balance of payments. This choice meant that energy system futures became subordinate to these concerns and had to conform to the demands of a growing economy, rendering no-growth energy system futures more or less unthinkable. Thus, the choice of celestial body is a political choice, which determines the range of energy policy imaginaries.

Conversely, choosing exergy as the celestial body changes the conditions for policy imaginaries and renders economic growth a subordinate of thermodynamic forces and concerns. This leads to precaution, serious attention to the environmental consequences of energy consumption and calls for energy system futures determined not first and foremost by the need for economic growth, but a deeper understanding of the thermodynamic aspects of energy systems (Illum & Gibson 2006). More practically, such an approach emphasises collective energy system planning and allows for zero-carbon energy scenarios based not only on renewable energy and efficiency improvements, but also on voluntary simplicity (Heikkinen 2015). Thus, such approaches contribute to the expansion of energy policy imaginaries and make alternative approaches to energy transitions thinkable. However, due to a non-existent anchoring in traditionalist strongholds such as the Ministry of Finance, exergy imaginaries are not very likely (not yet at least) to determine any concrete energy policy decisions.

8. Conclusion

In the preceding, a historical case for the promotion of two interconnected arguments – one theoretical and one empirical – has been presented. The first argument regards issues, publics and imaginaries as a nexus for energy policy, while the latter concerns the dominant role of economic growth in the articulation of energy imaginaries. A recurring pattern in the story is the emergence of issues, which publics respond to by means of articulation of these issues and imaginaries of how to deal with them. In this sense, energy policy can be seen as a battle of imaginaries, where environmentalists have achieved some significant victories over the years, yet have never been able to seriously challenge the dominance of economic growth over the imaginary space of energy system futures.

The answer to the research question proposed in the introduction is that macroeconomic energy modelling has been developed as an instrument for energy policy in Denmark as a result of a traditionalist public responding to energy issues in the need for imaginaries of the future energy system. Gradually, some of the concerns of another public – the environmentalists – entered the traditionalist policy agenda, which led to an expansion of modelling capabilities in relation to environmental

detail. Ever since the early 1970s, economic growth has played a key role in the energy imaginaries by being incorporated as a basic precondition provided by the Danish Ministry of Finance.

The lesson to learn from it all is that macroeconomic modelling can be used as a powerful articulator of issues and imaginaries, and is, hence, to be understood as an effective instrument for constructing the realities confronting governmental decision-makers and the wider public. Thus, if someone wishes to change the world of economic policy, changing the models and the imaginaries they articulate might be a good place to start.

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Appendix 1: interviewees and seminars

Interviewees

- Andersen, Frits M.; professor of economics, Technical University of Denmark, Risø. Involved in the development of several macroeconomic models for energy and environmental analysis since the late 1970s.
- Bjørnholm, Sven; senior lecturer of physics (retired), the Niels Bohr Institute, Copenhagen. Day-to-day head of the Danish IFIAS group from 1973 to 1976.
- Blegaa, Sussanne; high school teacher (retired). During the 1970s employed at Technical University of Denmark. Co-author of the first alternative Danish energy plan.
- Grinderslev, Dorte; at the time of the interview, consultant at The Danish Economic Councils. Currently, chief consultant at The Danish Council on Climate Change. Previously, also consultant in the macroeconomic modelling group at Statistics Denmark.
- Holm, Anders; senior lecturer of physics (retired), the Niels Bohr Institute, Copenhagen. Member of the IFIAS group in charge of coding and programming from 1973 to 1976.
- Holten-Andersen, John; senior lecturer in engineering (emeritus), Aalborg University Copenhagen. Previously, head of the secretariat of the Danish Nature Council.
- Jespersen, Jesper; professor of economics, Roskilde University.
- Josephsen, Lars; consultant (retired), the Danish Ministry of Energy and Environment. Co-founder of the Danish environmental NGO NOAH. Previously, also involved in some of the IFIAS publications.
- Knudsen, Dan; chief consultant in the macroeconomic modelling group at Statistics Denmark.
- Meyer, Niels I.; professor of physics (emeritus), Technical University of Denmark. Key figure in the Danish alternative energy transition since the 1970s.
- Morthorst, Poul E.; professor of economics, head of the systems analysis division at Technical University of Denmark, Risø. Involved in the development of several macroeconomic models for energy and environmental analysis since the late 1970s.
- Nørgaard, Jørgen; senior lecturer in physics and engineering (emeritus), Technical University of Denmark.
- Pedersen, Sigurd L.; chief consultant, the Danish Energy Agency.
- Thomsen, Thomas; economist, self-employed developer of solution algorithms for macroeconomic models.
- Werner, Morten; consultant in the macro-policy centre at the Danish Ministry of Finance.

Seminars

- Multi-sector models, Danish Energy Agency, Copenhagen, Denmark, March 20, 2015. The seminar consisted of several presentations. I only refer to the presentation about IntERACT by Termansen, Lars B., specialist consultant, the Danish Energy Agency.

Article 5

Urhammer, E. in progress, To model or not to model - that is the question (but is it an epistemic one?), unpublished working paper.

To model or not to model – that is the question
(but is it an epistemic one?)

Introduction
Since the financial crash in 2008 and the long lasting subsequent period of economic crisis, it has become increasingly common to speak of the current global state of affairs as one of multiple crises, where climate change, income inequality, high unemployment rates and widespread ecological degradation act in concert with financial volatility and low economic growth rates to create a complex situation of threat and uncertainty. This situation presents a hitherto unseen challenge to the global community of nation states and their governments and calls for novel approaches to economic policy. As the main academic discipline of economic policy, macroeconomics is tightly connected to this challenge and can be considered a central battlefield for academics in favour of radical economic policy changes.

Traditionally, macroeconomics concerns the economies of nation states and consists, for a large part, of theorising over forces which cause national accounting variables, such as the gross domestic product (GDP), unemployment and the public balance, to change. The history of the modern theory of such causal relationships dates back to the Great Depression and the work of Keynes (Jespersen 2007), although, at present, Keynes's ideas have, for the most part, been replaced by neoclassical approaches, which now constitute the main methodological basis and set the tone for mainstream macroeconomics.

Yet, more recently, the aforementioned conglomerate of crises has lead to an increasing interest in heterodox schools of economic thought, including post-Keynesian economics and the development of an ecological macroeconomics, better suited to the multiple crises of the 21st century (Jackson et al. 2015). With this revitalisation of heterodox approaches, macroeconomics has become an increasingly contested issue, which different economic schools struggle to define according to their respective worldviews and methodological frameworks. A key part of this struggle is fought by means of models, and in recognition of this circumstance, this working paper focuses on macroeconomic models and modelling as tools for engaging with the multiple crises of our age from an economic policy perspective.

Ecological macroeconomics is rooted in the wider, interdisciplinary field of ecological economics and can be seen as an attempt to situate the traditional concerns of macroeconomics in an ecological framework, which conceptualises economies as metabolic organisms, the growth of which is constrained by biophysical limits. While this basic ontology dates back to the early history of ecological economics (Røpke 2004), attempts to develop a consistent macroeconomic framework rooted in this ontology are more recent and have been especially intensified since the financial crash in 2008 (Berg et al. 2015, Jackson et al. 2015, Naqvi 2015).

Given the complexity of the issue, reducing ecological macroeconomics to a few key elements is not straight forward, yet in my view, the basic objective of ecological macroeconomics is to integrate traditional macroeconomic concerns into an

ecological framework, which acknowledges biophysical limits to economic growth (Berg et al. 2015). In line with this, a key issue for ecological macroeconomics is how to achieve a stable non-growing economy (in material terms) with high levels of employment and equity and low levels of pollution and resource consumption (Jackson et al. 2015). This focus demands special attention be paid to the account of the biophysical scale of economies, fair distribution of income and wealth, but also to the design of a stable financial system to the benefit of the wider public and the quest for a sustainable transition.

Not least in order to handle the complexity and interconnectedness of such problems in a consistent manner, ecological macroeconomists have turned to the building of computational macroeconomic models capable of incorporating a wide range of environmental, financial and social aspects in different macroeconomic modelling frameworks (Berg et al. 2015, Jackson et al. 2015). Such attempts have also been carried out by several mainstream economic model builders since the early 1970s. These endeavours have resulted in the creation of a vast amount of models and have led me to propose the existence of a very wide spectrum of macroeconomic models for sustainability (MMS).

Several model families on the mainstream side of this spectrum have been surveyed and documented (Bhattacharyya 1996, Bergman 2005, Krey 2014), while an attempt to survey the growth-sceptical side is also currently underway (Bunse & O'Neill in progress). Nonetheless, to my knowledge, no one has yet been crazy enough to engage in a survey which cuts across mainstream and growth sceptical approaches. This was my initial intention, and the scattered results of this ambition are what I present in the following chapters.

The working paper can be seen as some preliminary steps in the direction of drafting a journal article, which means that it is not organised as a traditional research article, but as a selection of thematic chapters treating a host of different topics in relation to MMS. Chapter 1 concerns the scope of MMS and discusses the most common modelling methodologies and a few examples of applications. Chapter 2 provides a brief historical overview of MMS. Chapter 3 presents an overview of critical issues in relation to pro-growth MMS. Chapter 4 tries to challenge MMS and asks questions regarding the purpose and soundness of this type of modelling, while Chapter 5 briefly summarises.

The empirical basis of the paper consists of scholarly literature, interviews and seminars. When I refer to an interview, this is indicated by a square bracket [...]. To see the institutional affiliation of the interviewees and a list of relevant seminars, the reader can consult the list of data material presented in appendix 1 of the thesis.

In the title of this paper, I ask whether the question 'to model or not to model' is an epistemic question. By this I refer to the dichotomy between a domain of objective science on the one side, and a value-laden domain of politics on the other, where macroeconomic modelling often appears to belong to the former. By asking this question, I try to challenge the perception of macroeconomic modelling as a 'pure' epistemic discipline which is merely interested in knowledge and discovering

economic 'truths'. One of my approaches in this regard is to use the concept of 'politics as world making' (Brown 2015), which is presented in the theory chapter of the general introduction to the thesis, as a means of interpreting macroeconomic models as scientific technologies which engage in politics by formatting economic realities.

Chapter 1: the spectrum

The intention of this working paper is to provide useful perspectives on the role of computational modelling in the development of ecological macroeconomics and the quest for a sustainable transition. A part of this intention concerns the wish to obtain some sort of comprehensive overview of existing computational models that try to incorporate macroeconomic concerns and sustainability issues in various modelling frameworks. One way to approach the provisioning of such an overview is to define an overall spectrum of models and then to divide it into (overlapping) segments according to different criteria. The overall spectrum of models which is investigated in this paper is *computational macroeconomic models for sustainability* (MMS)[1], where the prefix 'computational' is implicit. Thus, in order for a model to belong to the MMS spectrum, it has to fulfil three criteria: *computational*, *macroeconomic*, and *for sustainability*.

The first criterion implies that the models under investigation can be defined as equations that are solved using a computer, thus providing numerical results, which are often presented in tables and visualised in various graphs. Whether the computational model is estimated or calibrated to actual country-specific, regional or global data is not crucial, which means that numerical results may equally well be based on 'synthetic' data without any reference to specific geographical locations just as they may concern actual countries or regions and be based on data from these locations. Adding to this, it should be mentioned that the computational models investigated here are also often presented in the form of visual diagrams explaining the causal relations and flows between variables in the model.

The second criterion means that in order for a model to belong to the spectrum it has to incorporate national accounting entities such as unemployment, balance of payment and total production. How many of these variables and how they are incorporated varies, but they have to be present because I am interested in models that try to integrate the core concerns of economic policy and the environmental problems confronting today's global community, which can not be ignored any longer.

This leads to the third criterion –sustainability – which means that the models have to have some sort of environmental or ecological focus and, hence, incorporate one or more environmental variables such as energy, emissions of pollutants, or material flows. In the case of ecological macroeconomics, the models often incorporate 'social' parameters, such as inequality and the distribution of income, as sustainability

[1] I also sometimes use MMS to signify *computational macroeconomic modelling for sustainability*. When doing so, I wish to highlight MMS as a spectrum of practices or activities.

parameters. However, such parameters do not need to appear in order for a model to qualify as being 'for sustainability' in this review.

Description of the spectrum

Before proceeding with an explanation of some of the properties of the MMS spectrum, it must be stressed that it is an intellectual construct devised with the purpose of defining a research object. This is achieved by identifying and grouping models and modelling methodologies used in research and policy regarding macroeconomics and sustainability.

The MMS spectrum is a wide selection of models which can be grouped in different segments and methodological families, a description of which could beneficially be initiated with a few historical considerations. Since its inception in the early 1970s (more about this in the following chapter), MMS has been carried out by means of mainstream macroeconomic methods, especially the neoclassical general equilibrium approach, and the neoclassical synthesis[2] framework named macroeconometric modelling. Due to this reliance on mainstream methodologies, MMS is dominated by GDP and a strong focus on economic growth. This means that all environmental issues and concerns incorporated in mainstream MMS are adapted to an overall GDP growth framework. This tradition, however, has been challenged more recently by model builders within the ecological macroeconomics research community. Thus, since 2007, a new family of models has entered the scene and established a small niche of growth sceptical models within the MMS spectrum. To begin with, MMS can, thus, be crudely divided into a *pro-growth* regime and *post-growth* niche, where the former includes all modelling families to which GDP is the fundamental value metric, and hence the backbone of the calculation of societal costs and benefits, while the latter is sceptical of GDP and acknowledges biophysical limits to economic growth (Berg et al. 2015).

Within these two segments, models have been built for multiple purposes using a wide range of methodologies, such that the two segments can again be divided into overlapping sub-groups according to methodologies and research interests. Complicating things further, models all across the spectrum share multiple modelling tools. Exemplifying this, *production functions*, *input-output* (IO) tables, and *social accounting matrices* (SAM) are deployed widely across the pro-growth/post-growth boundary. Furthermore, MMS models depend on statistical environmental accounting in order to incorporate aspects such as energy, materials and emissions. So called environmentally extended IO tables are widely used for this purpose in pro-growth as well as post-growth models. Another tool for incorporating energy and materials in the models is the production function, which can be designed to do this in various ways (Thomsen 2014, Berg et al. 2015).

The preceding remarks highlight the complexity of the spectrum, which is not easily dealt with. Nonetheless, with the purpose of providing some sort of insight, I now

[2] For a brief explanation of this concept, see the theory section of the general introduction to this thesis.

proceed to present some of the most salient overall modelling methodologies applied in MMS and a few examples of applications.

Methodologies

Having surveyed what I believe to be a fairly representative selection of the MMS modelling literature, I am inclined to conclude that the most important methodological concepts to take into consideration in a review of MMS are: *general equilibrium* (GE), *welfare optimisation*, *macroeconometrics* (ME), *system dynamics* (SD), *stock flow consistency* (SFC), and *agent-based modelling* (ABM).

GE and welfare optimisation are neoclassical methods mostly deployed in pro-growth MMS. ME is widespread and used by pro-growth and post-growth modellers alike, while SFC and SD are more or less only used in post-growth MMS. Finally, ABM seems to be attractive to a very wide range of modellers, from systems ecology to finance, however, it has not yet gained a strong foothold in MMS, although its potential for macroeconomic modelling has been emphasised by several authors (Farmer & Foley 2009, Seppecher 2012, Gräbner 2014) [Willis]. In the following, I very briefly introduce the methodologies sorted into three categories: *pro-growth*, *shared*, and *post-growth* methods. ABM is finally treated in a section of its own because it does not fit into any of these categories.

Pro-growth methods

General equilibrium

A GE model is one in which all markets clear in equilibrium. This means that the equations of the model are constructed in such a way that there will always exist at least one set of prices at which all markets clear, meaning that supply equals demand on all markets simultaneously (Bhattacharyya 1996, Bergman 2005, Stanton et al. 2009). More concretely, GE models try to mimic market interactions between consumers and producers and portray the "whole" economy as a set of aggregate sectors described as markets for: goods, services, capital and labour (Löschel 2002). Hence, GE models are often referred to as multi-sector models, as opposed to partial equilibrium models, which portray one sector or a sub-set of sectors of the entire economy.

When GE models are calibrated to specific data and solved on a computer, they are often referred to as computable (CGE)[3]. CGEs can be designed for a single country, a region or a global setting and focus on the so-called 'real' side of the economy, which means that they do not incorporate markets for financial assets. This choice is justified by the theoretical assumption that money is neutral, i.e. that money *per se* has no effect on the economy (Gräbner 2014).

The GE methodology depends heavily on a set of *a priori* assumptions about economic agents and markets. Probably the most important of these is the existence

[3] It should be mentioned that the most dominant approach to GE-modelling today is dynamic stochastic GE (DSGE) (Gräbner 2014). I, however, do not cover this methodology since it is not widely used for addressing environmental and sustainability issues.

of a representative agent, who optimises utility (on the demand side) and profits (on the supply side) (Termansen & Gersfelt 2013). To do so, the agent needs to be rational, meaning that he has a clear ordering of preferences and always knows the outcome (at least probabilistically) of his choices (Hodgson 1988).

As mentioned, there are many different approaches to CGE and several ways of applying the method to specific data. The most frequently used approach is calibration, which means that a specially drafted data set, a SAM, for a given year is assumed to be the expression of a general equilibrium situation, where supply equals demand on all markets. The model is then calibrated such that its GE solution equals the SAM entries. When this has been achieved, experiments can be conducted by exogenously changing parameters and solving the equations to achieve new equilibria (Gräbner 2014). In order to perform such experiments, it is common to make a so-called *business as usual* (BAU) scenario, against which alternative exogenous settings can be tested. Such alternatives are often referred to as counter-factual, assigning a certain factual status to the BAU scenario.

CGE modellers distinguish between static, quasi-static and dynamic approaches. These distinctions all concern the time dimension of the models. A static model is solved for one equilibrium representing one time step. Depending on the assumptions, this step could be interpreted as one year or a period of years. A quasi-static model is solved for a series of consecutive equilibria, each representing a time step, where the first equilibrium is used as the initial condition for taking the next step and so on (Krey 2014). The fully dynamic approach attempts to endogenise time steps by making further assumptions about the forward-looking behaviour of households and firms, and by endogenising stock accumulation (Bergman 2005).

To conclude, it should be emphasised that CGE is a deterministic modelling approach, which portrays the economy and economic transactions by means of mechanistic market interactions. The main focus of CGE is equilibrium allocation and economic growth, and thus, CGEs are not built to handle business cycles or disequilibrium phenomena (Bergman 2005).

Application of GE in MMS

GE is probably the most widely used methodology in MMS, and this methodology has been applied in an increasing number of studies investigating economy-energy-environment relations since the1990s (Böhringer & Löschel 2006). Thus, the two most common applications of GE in MMS have so far been to couple CGE models to energy systems models or climate models, with the purpose of investigating problems such as: the costs of greenhouse gas abatement, the costs of environmental policy measures, the cost of climate change, and the connections between energy system developments and climate outcomes. In relation to costs, it should be mentioned that, in the GE methodology, cost is always calculated in terms of GDP, such that a cost is defined as a loss of GDP. The investigation of economy-energy-environment relations and research interests is often referred to as *sustainability impact assessment* (SIA) or *integrated assessment modelling* (IAM), in which the GE methodology is a very widespread approach.

Furthermore, since the early days of MMS, more and more sector-models, such as agriculture, fishery, forestry and transport models, have been coupled to CGEs. The purpose in these cases is very often to assess the impacts of policies regarding a single sector on the rest of the economy, but also how wider economic changes affect a single sector (Löschel 2002).

Well-known examples of GE applied in MMS are: the GEM-E3 model used by the European Commission and the GREEN model developed by the OECD (Næss-Schmidt et al. 2013).

Welfare optimisation
As mentioned, CGE and welfare optimisation are closely related, not least since they both rely on the idea of utility maximisation and on GDP as an aggregate welfare metric. However, in comparison with GE models, welfare optimisation models tend to be less specific in terms of markets and smaller in terms of equations. In fact, a welfare optimisation model is often simply a so-called economic growth model inspired by scholars such as Solow and Ramsey.

The ethical basis of welfare optimisation is the concept of utility, which, according to neoclassical theory, can be measured for all individuals and then aggregated into societal utility or social welfare. More practically, this is done by optimising an aggregate economic objective function, which "refers to economic well-being (or utility) associated with a path of consumption" (Nordhaus & Sztorc 2013:6). Although consumption might include non-market goods, it is closely related to economic output measured by GDP, such that a reduction in GDP is equivalent to a reduction in consumption and, hence, a loss of welfare.

Application of welfare optimisation in MMS
As was the case for GE, welfare optimisation is an important method in IAM, where it can be applied by connecting a social welfare function to a climate model with the purpose of calculating the optimal consumption path. Given the output from the climate model, the welfare optimisation might imply a decrease in consumption at present in order to achieve emissions reductions, so that harmful climate change does not diminish future consumption. In order for such a calculation to be meaningful, it is necessary to assume that countries, regions or the entire world (depending on the analytical scope) have well-defined preferences, so that different paths of aggregate consumption can be ranked and the optimal path can be chosen (Nordhaus & Sztorc 2013:6).

Well-known examples of welfare optimisation models in MMS are: DICE and RICE developed by Nordhaus, and WHITCH, a growth model developed by Fondazione Eni Enrico Mattei (Næss-Schmidt et al. 2013).

Shared methods

Macroeconometrics
Macroeconometrics refers to both a certain approach to macroeconomic modelling and to a set of statistical techniques for estimating parameters and systems of

equations, where the latter is used as a tool to draft the former. Macroeconomectric modelling is the earliest example of computable macroeconomic modelling and dates back to the interwar period, when Tinbergen drafted the first such model for the Dutch economy (Zalm 2000). With the development of computer science, macroeconometric models became easier to solve, grew bigger and gained influence on economic policy (Zalm 2000).

Macroeconometric modelling can be considered part of the neoclassical synthesis, which is an attempt to integrate aspects of Keynesian economics into the neoclassical framework (Jespersen 2007). Very briefly, this means that macroeconometric models are short or medium-term models built to investigate business cycles and the adjustment to a long-term general equilibrium. In accordance with the synthesis, macroeconometric models are demand driven as opposed to GE models, which are considered to be supply driven. Macroeconometric models are often labelled empirical models, which means that macroeconometric techniques have been applied to estimate the parameters of theoretical equations using time series of specific countries. This sort of estimation has, by the way, also been applied in several GE models (Bhattacharyya 1996).

Application of Macroeconometrics in MMS
Since the early 1970s, macroeconometric models and techniques have been applied in multiple MMS models. One common application in this regard has been to couple one or more so-called 'satellite models' to a macroeconometric model in order to calculate energy demand and various emissions, such as CO_2, SO_2, NO_x, and waste, associated with a certain level of future economic growth (Andersen & Trier 1995). Exemplifying this type of application, one could mention the Danish model EMMA (the history of which is told in Article 4 of this thesis), which is a good and rather elaborate example of this type of modelling (Andersen et al. 1998).

More recently, macroeconometrics has also been deployed by post-growth modellers, such as Victor & Jackson, who have incorporated the Keynesian demand driven approach and used econometric estimation techniques in models such as LowGrow and SIGMA (Victor & Rosenbluth 2007, Jackson et al. 2015).

Post-growth methods

Stock-flow consistency
SFC is a macroeconomic modelling framework built upon a very detailed financial accounting method, which dates back to the mid-twentieth century and, more recently, has been adopted and elaborated on by the Post-Keynesian school of economics (Caverzasi & Godin 2015). The fundamental concept of SFC is that any financial asset is somebody else's liability, which means that a matrix of financial transaction flows for the entire economy can be devised by accounting for the aggregate assets and liabilities of all sectors (Berg et al. 2015). This matrix puts extra constraints on the possible macroeconomic modelling outputs and expands the consistency inherent in national accounting to the financial side of the economy (Berg et al. 2015). According to Berg et al., SFC makes macroeconomic models behave differently and brings them closer to the institutional realities of modern

monetary systems. In relation to SFC, it ought to be mentioned that it can also be applied in neoclassical modelling frameworks (Berg et al. 2015), however, this is not very common, and I have not discovered any examples of this in pro-growth MMS.

Application of SFC in MMS
When applied in MMS, SFC has been used by post-growth modellers to obtain a consistent account of the financial aspect of the economy in post-growth models. Exemplifying this, SFC has been incorporated in models such as FALSTAF, EcoGro, and an unnamed model by Berg et al. (Jackson & Victor 2015, Naqvi 2015, Berg et al. 2015). In these studies, FALSTAF was calibrated using empirical data from Canada and the UK (Jackson & Victor 2015), EcoGro was calibrated to model the EU region using publicly available databases or literature (Naqvi 2015), while Berg et al. did not calibrate the model to any particular country or region, thus achieving more theoretical simulations (Berg et al. 2015). FALSTAF has been used to investigate whether credit creates a growth imperative; EcoGro has been used to perform post-growth policy assessments using a scenario approach, while Berg et al.'s model was used for basic research concerning the incorporation of biophysics, real economy and finance in one modelling framework (Berg et al. 2015).

System dynamics
SD is a very simple approach to thinking about and modelling dynamic processes, which takes its point of departure in stocks and flows, and the feedback loops between them (Yamaguchi 2013). Due to its very basic building blocks, the SD methodology can just as well be applied in ecosystem analysis as economic analysis since stocks and flows play key roles in both. Stocks and flows of natural resources, material goods or financial assets are the same in this methodology, however, the big challenge lies in determining the causal relations and feedback loops between them. This is where theory enters the discussion, and the SD methodology is definitely sensitive and flexible in the direction of many different theoretical inclinations.

Similar to the GE methodology, SD is a deterministic framework based on cause-effect relationships, yet in a far more multifaceted manner, which allows for so-called chaotic dynamics, where equilibrium states are not considered universal laws, but more or less stable attractors in a chaotic system (Yamaguchi 2013). To exemplify this, Yamaguchi shows, by means of numerical simulations, how chaotic features can emerge from basic market transactions, thus debunking the GE assumption of neoclassical macroeconomics (Yamaguchi 2013).

Application of SD in MMS
One of the most famous modelling applications of SD is the World3 model, which was used to draft the Limits to Growth scenarios (Meadows 1972). However, due to its lack of macroeconomic variables, this model cannot be considered an actual MMS. Hence, in order to find examples of SD applications in MMS, one has to turn to Victor's LowGrow model and Jackson & Victor's models, where SD has been used as a framework for modelling Keynesian inspired, demand driven macroeconomic dynamics (Victor & Rosenbluth 2007, Jackson et al. 2015).

Although I have labelled SD a post-growth methodology almost solely deployed in this segment of MMS, it ought to be mentioned that SD has in fact also been applied in a model used for pro-growth purposes. By this, I refer to the T21 model, which was built using the SD methodology and has been deployed by UNEP to draft its green growth scenarios (UNEP 2011).

Agent-based modelling

The basic building blocks of ABM are agents and and their environment, where the agents are equipped with a host of behavioural rules determining how they respond to their environment and to other agents. This combined focus on both individual behaviour and environment makes ABM appealing to neoclassical method individualists as well as systems ecology modellers. However, the computational aspect of ABM is quite different from all other modelling methodologies mentioned so far. One way to explain this difference is to emphasise the non-causality of ABM, which means that an ABM is not based on causal equations, which can be solved numerically (Seppecher 2012). Instead, it is a set of algorithms which iteratively perform the choices and actions of a number of agents. This, however, does not mean that ABM is theory free since the behavioural rules, which are coded into the algorithms, are often based on various theories, such that the agents might be able to perform optimisation in accordance with neoclassical assumptions for instance.

One of the compelling features of ABM is its ability to produce emergent 'macro' dynamics (changes of aggregate variables over time), which is not predefined by any macro-theory. Such aggregate dynamics can be coded to influence individual agents in various ways, which induces complex interactions between agents and their 'macro' environment. Similar to this, Farmer & Foley (2009) explain how ABM can be seen as a methodology in which decision makers and institutions interact through prescribed rules. In its capacity to produce emergent un-prescribed dynamics, ABM presents a radical alternative to the GE methodology, where explanatory and predictive laws are imposed from the beginning and assumed to be time and space invariant (Gräbner 2014).

As economists with a predilection for ABM, Farmer & Foley (2009) highlight how this modelling approach can handle the non-linearity and complexity of financial bubbles and crashes, which is far beyond the reach of the GE methodology. Furthermore, they emphasise how adaptation and learning can be incorporated into the ABM framework, thus mimicking the behaviour of observable agents (Farmer & Foley 2009).

An interesting question in relation to ABM is whether it is able to transcend method individualism or whether it is stuck in a fairly reductionist reliance on the behaviour of agents. Given my rather limited knowledge, I must admit that I am simply not capable of providing a reliable answer to this question. Yet forced to do so, I would observe that, on the one hand, ABM seems utterly dependent on individual behaviour, yet on the other hand, it is also able to produce emergent dynamics, which is not dictated by any individualistic behavioural rules. Furthermore, ABM seems void of institutions and the possibility for institutional change. Yet, if institutions are considered to be norms and rules shared and followed by individuals, institutions are,

in fact, possible to model in ABM, and if learning is part of the framework, institutional change might be modelled by means of agents learning and developing new norms and rules.

Application of ABM in MMS
So far, ABM has been applied in both macroeconomic (Dosi et al. 2010, Seppecher 2012) and environmental sustainability research (Cao et al. 2009). Yet, I have not been able to find an ABM which integrates the two research fields to an extent which would grant it the label MMS. One explanation for this might be the degree of complexity, which this integration induces. Generally, as models grow bigger, and more and more variables and relations are incorporated, the risk of messy outcomes that can not be interpreted increases [Knoeri]. This problem seems especially salient in ABM, where fairly simple behavioural rules and patterns tend, very quickly, to lead to incredibly complex outcomes [Knoeri]. Having said this, I am confident that ABM can be used for MMS purposes, and I am aware of modellers who intend to pursue these opportunities.

General remarks

In the preceding, I have tried to sketch the spectrum of MMS and present some of the methodologies deployed in this type of modelling. When describing the spectrum, I have proposed a division between a pro-growth regime and a post-growth niche, where pro-growth is characterised by orthodoxy and method monism in the form of a heavy reliance on neoclassical methods and economic growth, while post-growth is characterised by heterodoxy and the acknowledgement of biophysical limits to economic growth.

Pro-growth MMS has branched out in multiple directions, yet the most important applications for this survey are satellite modelling and IAM, where the former concerns the calculation of entities such as future energy demand, carbon emissions, and waste associated with a specific economic growth path (Andersen & Trier 1995), while the later primarily regards the investigation of impacts between the economy and the climate system (Stanton et al. 2009). IAM has so far mainly consisted of combining one or more different disciplinary models – a CGE and a climate model in many cases. More recently, however, authors have promoted so-called hard-linking, where the CGE approach is deployed to handle both economy and climate in one model (Böhringer & Löscel 2006). Furthermore, pro-growth MMS is characterised by a strong emphasis on policy and policy-making, which is often framed as a question of finding the policies which lead to the optimal consumption path as a trade-off between economic growth and climate change (Nordhaus & Sztorc 2013).

Due to its rather recent emergence, it is not straight forward to pinpoint the characteristics of post-growth MMS, although limits to growth and planetary boundaries seem to be key terms (Bunse & O'Neill in progress, Berg et al. 2015). Thus, one way to interpret these models is to see them as attempts to operationalise various aspects of the post-growth agenda in computational macroeconomic models. Some modellers have been especially concerned with the achievement of full employment in a stable non-growing economy (Victor & Rosenbluth 2007, Jackson et al. 2015); others have focused on more basic research concerning how to impose

planetary boundaries on a macroeconomic model by integrating several different accounting frameworks (Berg et al. 2015), while questions of inequality, interest rates, and climate change have also been addressed in post-growth MMS (Chancel et al. 2013, Jackson & Victor 2015, 2016). Furthermore, one ambition, which seems to recur in several post-growth models, is a desire to integrate real economy, finance, and biophysics in one framework. Perhaps the most elaborate example of this ambition can be found in Berg et al. (2015). Finally, the question of long-term green investments in favour of a sustainable transition is also an important concern of post-growth modellers (Jackson 2009, Jackson et al. 2015, Berg et al. 2015).

Chapter 2: a short history of MMS

In the following, I briefly sketch some contours of the historical development of MMS focussing on the emergence and accumulation of research questions which these models have been deployed to address. The account is divided into two sections covering the history of pro-growth and post-growth MMS respectively. The chapter ends with a few considerations regarding the importance of the development of modern computers for the craft of macroeconomic modelling.

Pro-growth

Although it is always a challenge to figure out where to begin a historical account, 1973 presents itself as a good starting point for the history of (pro-growth) MMS. At the end of that year, the world witnessed its first oil crisis caused by skyrocketing oil prices, which very quickly became a serious threat to the stability and future growth of most Western economies (Hogan 2002). As Hogan describes it, the Yom Kippur war and the Arab oil embargo of October 1973 had the effect of transforming energy-policy from an afterthought to a first-order security issue (Hogan 2002). Governments wanted answers to the crisis, and, as so many times before and after, the discipline of economics quickly got involved.

In the US, the Ford Foundation had, already prior to the oil embargo, initiated a major energy-policy project, which focussed on energy conservation and energy efficiency (Hogan 2002). As a part of the Ford studies, Hudson & Jorgensen designed a GE model for addressing relations between energy-policy and economic growth (Hudson & Jorgenson 1974). Due to Hudson & Jorgensen's work, the USA became the first country to command a macroeconomic energy-policy model, however, the widespread urgency of the oil crises, soon led to similar modelling projects in several other Western countries (Zalm 2000, Urhammer Forthcoming).

These modelling efforts gradually accumulated into a wider family of models, which integrated energy issues into mainstream macroeconomic frameworks and had a strong focus on energy security and economic growth. The research questions which the models were build to answer reflected this focus: *how to become independent of oil from the Middle East? How much energy will the economy demand in the future? What are the impacts of energy prices on economic growth?* And *how will changes of the energy system impact the economy?* (Bhattacharyya 1996, Bergman 2005, Urhammer forthcoming).

Following the increasing focus on energy, environmental aspects of energy consumption also gradually entered Western policy arenas and made an impact on

macroeconomic modelling. Exactly how this happened is not clear to me, yet it is unquestionable that the 'acid rain' issue, which emerged during the 1980s, played an important role in getting environmental issues on the political agenda (Hajer 1995). This development gained momentum with the publication of the Brundtland report in 1987 and the sustainable development discourse which it disseminated, and during the late 1980s and the 1990s, the world saw a significant increase in macroeconomic models designed to address economy-environment relations, with carbon emissions and climate change being the most prominent issues (Bhattacharyya 1996, Bergman 2005, Urhammer forthcoming). What especially characterised this second generation of MMS was not so much path breaking methodological innovation as it was the introduction of other environmental problems, which led to models capable of addressing questions such as: *how to forecast the emission levels of CO_2, SO_2 and NO_x? What are the costs of greenhouse gas abatement? What are the costs of environmental policy measures?* (Bhattacharyya 1996, Bergman 2005, Urhammer forthcoming). An important example of an environmental policy measure in relation to the last question is environmental taxation, which has been the subject of macroeconomic modelling for decades.

During the 1990s, the modelling activities became the foundation of a research programme often labelled SIA, which includes IAM, the most prominent example of which is the DICE model developed by Nordhaus (Nordhaus & Sztorc 2013). The development of these programmes included the formulation of new research questions, such as: *how to estimate the cost of climate change?* And *how to analyse connections between energy system developments and climate outcomes?* (Nordhaus & Sztorc 2013, Krey 2014), which were added to the list of research interests.

In recent years, SIA and the IAM programme have further expanded and have gradually integrated more and more sustainability indicators to the framework, thus engaging in addressing questions such as: *how to expand the integration of sustainability indicators?* And *how to model the joint development of human and natural systems?* (Krey 2014). This latest development is most likely indicative of increasing attention to the multiple dimensions and entangled nature of today's environmental problems.

To put the preceding into perspective, pro-growth MMS and the research questions it addresses are characterised by a strong reliance on GDP as a universal value metric and on GDP growth as a predicament for a stable economy and a prosperous society. This reliance implies a calculation of societal costs based on calculating the optimal trade-off between environmental havoc and economic growth.

Post-growth

Post-growth MMS is rooted in several models such as World3, designed to draft the Limits to Growth scenarios (Meadows 1972), Ricker's GE models, used to investigate and confirm the existence of biophysical limits to economic growth (Ricker 1997), and Ayers & Warr's exergy production functions, deployed to challenge and reject mainstream economic growth theory (Ayres & Warr 2005). However, in spite of these earlier ancestors, I propose the great financial crash, culminating in 2008 with the collapse of Lehman Brothers, to be the main historical

incubator, which spurred the emergence of the still expanding post-growth family of MMS.

The crash in 2008 and the subsequent economic policy disruptions led to a new opening for growth scepticism and for the formulation of a policy agenda which can be labelled 'prosperity without growth' (Jackson 2009) and a research programme dubbed ecological macroeconomics. This programme often articulates the multiple environmental, social, and economical crises of our age as a growth crisis and uses MMS as one of the means for paving the path to a post-growth economy. As such, post-growth MMS is a radical modelling alternative to pro-growth, not least due to its intention to demonstrate the feasibility of a stable, non-growing economy (Victor & Rosenbluth 2007).

Since the publication of the LowGrow model in 2007, more and more research questions have been added to the post-growth modelling agenda including questions such as: *how to assess low-, no- and de-growth policies? How to model the transition to a sustainable economy that respects planetary boundaries? How to integrate the financial and the 'real' economy in a model with explicit ecological boundaries?* And *how to investigate the stability of a non-growing economy?* (Victor & Rosenbluth 2007, Berg et al. 2015, Jackson et al. 2015). Adding to this, some of the post-growth models have also been applied to debunk various theoretical propositions, which have challenged the feasibility of a non-growing capitalist economy (Jackson & Victor 2015, 2016).

Summarising the short history of post-growth MMS, one could claim that it started with a very simple model showing how to manage without growth (Victor & Rosenbluth 2007). Then came the financial crash in 2008, which led to increasing efforts to incorporate finance into the models (Berg et al. 2015, Jackson et al. 2015). Along with this came ambitions to make unified models incorporating real economy, finance and biophysical aspects in one framework (Berg et al. 2015), while recently, some of these models have been deployed to address and debunk certain theoretical propositions by investigating whether credit creates a growth imperative, and whether slow growth leads to rising inequality (Jackson & Victor 2015, 2016:32 and 206).

Finally, it ought to be stressed that post-growth MMS can also be seen as part of a critical movement, the roots of which go as far back as the classical economists, some of whom also questioned the feasibility of perpetual economic growth (Friman 2002). In this respect, post-growth MMS can also be interpreted as an obvious next step for the growth critique turning the critique in a more positive direction by asking "can we do a better job?"

The significance of digital computers

To end this chapter, I wish to emphasise the importance of the emergence of digital computers for computational macroeconomic modelling. Although the first computational macroeconomic model became operational as early as 1936 (Zalm 2000), the gradual enhancement of digital computing, especially from the 1960s onwards, had a tremendous influence on the size, complexity, number and availability of models (Bjerkholt 2000, Hogan 2002, van Daalen et al. 2002). Thus, already in the

1970s, computers allowed a significant expansion in the number of models by providing tools for solving fairly large sets of equations. Yet, as Andersen explains, the procedure for solving the models would still involve punch cards, their manual transportation to a large (in spatial terms) computer somewhere in town, and a couple of days of waiting for the results [Andersen]. This situation, however, changed rapidly, and a few decades later, personal computers were able to perform far more complex calculations in a split second. Altogether this reveals a historical development from computational modelling being a 'manual' process of solving equations on paper to a situation where software packages and programming languages, such as GAMS (for GE), STELLA (for SD), and NetLogo (for ABM), provide opportunities for practically anyone to engage in computational modelling. This means that, nowadays, models can very easily be shared and adapted to new purposes.

Chapter 3: critique

There exist multiple critical issues in relation to MMS, almost all of which concern the pro-growth segment. This bias can be explained by the fact that post-growth MMS is a new and fairly marginalised modelling approach, the discussion and critique of which is mainly confined to ecological macroeconomic and post-Keynesian circles, whereas pro-growth MMS rests on methodologies and worldviews which have been subject to criticism for ages. Taking this into consideration, the following critical chapter only concerns pro-growth MMS and the methodologies it employs.

To begin with, I wish to divide the critique of pro-growth MMS into two overall themes, where the first is the critique of neoclassical methodologies in general, while the latter concerns the application of these methodologies in MMS. Although a substantial body of literature covering the first theme exists, I still wish to say a few words on it, not least due to the fact that the financial collapse in 2008 spurred a renewed critique of neoclassical economics. Hence, the next section is devoted to the critique of neoclassical methodologies and models, while the subsequent section treats the application of these methodologies in MMS.

Critique of neoclassical methodologies

The critique of neoclassical economics often concerns its highly mechanistic framework inspired by classical mechanics. The founding fathers of neoclassical economics wanted to devise an economic theory based on rigorous mathematical principles and used classical mechanics as an inspirational model for doing so (Mirowski 1984). This approach, however, did not go unnoticed with contemporary physicists stressing that the subject area of social theory was not quantifiable in the same manner as that of classical mechanics and they criticised neoclassical economists for using a non-measurable quantum – utility – as the foundation of their theory (Mirowski 1984).

Following these nineteenth century physicists, many economists have confronted neoclassical economics, not least Keynes, who entirely rejected its basic tenets and introduced a fundamentally different approach to economics (Jespersen 2007). Likewise institutional economists have attacked the basic assumptions of neoclassical economics and elaborately argued why its methodological individualism, based on

rational behaviour, utility optimisation and perfect information, is flawed and inadequate (Hodgson 1988). In a similar vain, Keen has debunked more or less all the basic tenets of neoclassical economics, showing that it is fundamentally unsound (Keen 2011).

Thus, the critique of neoclassical economics dates as far back as neoclassical economics itself and has persisted ever since. Yet, in spite of this long tradition, neoclassical economists hold on to their mechanistic principles, and neoclassical economics is probably more influential and widespread than ever. More recently, however, the calamitous financial crash in 2008 and the following economic upheavals have strengthened the critical positions and revitalised the opposition against neoclassical economics. One of the explanations for this renewed momentum is that neoclassical economists where not able (or did not want) to use their expertise and models to predict the crash in 2008, while various heterodox economists actually managed to do so (Bezemer 2010).

The post 2008 crash critique of neoclassical economics has emerged from several angles and is not merely forwarded by the usual suspects such as institutional and post-Keynesian economists. Thus, a more mainstream critique has also emerged as exemplified by Colander et al. (2009), who consider the inability of neoclassical economics to understand financial crises to be a systemic failure of the economics profession; a failure rooted in an equilibrium methodology, which conveys the view that "markets and economies are inherently stable and that they only temporarily get off track (Colander et al. 2009:250). Adding to this, Colander et al. argue that economists were partly responsible for the financial crisis, first by providing flawed models, which have been used by market actors, and second by not seeing it as their role to warn the public of potential financial threats (Colander et al. 2009). Along these lines, Colander argues that contemporary GE models have acquired an aura of policy relevance, which is strongly contradicted by their unrealistic assumptions of economic behaviour; assumptions which imply that such models have to be equipped with ad hoc additions in order to make them fit empirical data (Colander 2011).

Furthermore, the debunking of neoclassical models has emerged from modelling quarters such as econometrics, SD and ABM. From the econometrics side of the spectrum, Juselius (2009) argues that econometrics has wrongly been reduced to the art of providing models with parameter estimates, without asking the fundamental question of whether the models are in fact empirically relevant at all. This has led Juselius to propose 'reality first' instead of 'theory first' as the correct research approach in econometrics (Juselius 2009). More concretely, this approach rejects *a priori* acceptance of neoclassical assumptions and encourages economists to: "use a strict econometric methodology based on sound statistical principles", "assess the empirical relevance of influential theory models", and "learn from data how to best modify or change economic theory when needed" (Juselius 2009:1). Following these principles, Juselius has devised methods for taking GE models to the data and concludes that most of their assumptions do not pass the test (Juselius & Franchi 2007). Clearly, this is a complicated matter, which I am not able to explain in any detail, yet one important result of the 'reality first' approach has been to show that there is no empirical evidence of the fundamental stable behavioural rules on which

the neoclassical models depend. Instead, economic time series are characterised by nonstationarity, which implies that there is no long-term parameter stability (Juselius 2009).

Taking another methodological approach, Yamaguchi has used the SD methodology to build a macroeconomic simulation model able to perform so-called off-equilibrium analysis, in which equilibrium prices are not a general rule and markets do not necessarily clear (Yamaguchi 2013). In order to do so, Yamaguchi introduces an inventory to the classical supply-demand relation to facilitate the possibility of excess supply and off-equilibrium market situations (Yamaguchi 2013). Using this basic building block, Yamaguchi builds a full macroeconomic model (including finance), which exhibits chaotic price dynamics, where general equilibrium is merely a fairly unlikely special case of a more general model. In this respect, Yamaguchi's model is better equipped to model observable economic dynamics including financial bubbles and busts, and, thus, his model can be seen as an indirect critique of neoclassical economics, which works by presenting a 'better' model.

In a similar vain, Gräbner explains how ABM can be used to generate chaotic economic dynamics in which general equilibrium is merely one rather unlikely stable attractor out of multiple possible attractors (Gräbner 2014). This can be done by abandoning the axiomatic foundation of neoclassical economics and introducing heterogeneous agents, who follow diverse behavioural rules. Thus, also ABM can be used to create a positive critique of neoclassical models by providing simulations, which present a more general spectrum of market outcomes, thus, more adequately mimicking actual macroeconomic dynamics.

Critique of pro-growth MMS

Now turning to the critique of neoclassical methods applied in MMS, I initially wish to present a few general reflections concerning the increasing divergence between the problems of our age, epitomised by climate change, and an economics discipline stuck in a nineteenth century enlightenment state of mind. Articulating this divergence, Nelson uses the phrase 'enlightenment beta' to describe the neoclassical worldview characterised by a perception of nature as clockwork and a fondness for disembodied rationality and mathematical crispness utterly disconnected from the "unsafe, interdependent, and uncertain world" we actually live in (Nelson 2013). In Nelson's view, the enlightenment ethos of neoclassical economics is characterised by an inadequate vocabulary, misguides our decisions, and is party to preventing the immediate climate action which is needed. Thus, the neoclassical conception of costs and benefits, and finding the optimal is simply not the right vocabulary in a situation where the issue instead concerns how to avoid the worst rather than find the optimal. In this respect, neoclassical economics misguides our decisions by asking the wrong questions and putting an emphasis on irrelevant issues and prevents a radical responses to climate change by prescribing further research instead of immediate action (Nelson 2013). Adding to this, Nelson explains how neoclassical economics has managed to acquire an ethos of being value-free, objective, and rational, while it is, in fact, value-laden, normative and subjective. Recognising this, Nelson argues that there is a strong need to redefine the ethical dimension of economics and abandon the

narrow neoclassical emphasis on the individual as the fundamental ethical unit (Nelson 2013).

Following these brief introductory remarks, I wish to delve into more modelling-specific issues and present some of the contemporary critique of pro-growth MMS especially SIA, IAM and the use of CGE.

Economic growth
The general critique of GDP as a welfare metric and GDP growth as the source of welfare par excellence also applies to pro-growth MMS. Adding to this line of critique, Scrieciu (2007) stresses that the CGE approach assumes economic growth to be inherently pro-poor, meaning that poor people will always benefit from GDP growth. This assumption removes the incentives to address issues of inequality and distribution because economic growth is assumed to be beneficial to all (Scrieciu 2007). Furthermore, there is a common assumption across pro-growth that the world will constantly grow richer over time, meaning that future generations will always be richer than present generations (Stanton et al. 2009). This assumption has the effect of weighing the expenses of future generations, due to climate change for instance, lower relative to the present expenses of avoiding such changes because, due to this assumption, future generations will be better equipped to pay for the costs of climate change than present generations are to pay to avoid them (Stanton et al. 2009).

Trade-off's
In the pro-growth MMS literature, environmental or climate action is regularly expressed as a well-defined trade-off between welfare (GDP growth) and environmental benefits. According to DeCanio, this is an unrealistic simplification inherent in neoclassical maximisation assumptions, which imply that "something must be given up in order to gain something else" (DeCanio 1997). Stanton exemplifies this by explaining how carbon abatement costs are considered dead-weight loss, which leads to diminishing welfare. According to Stanton, many costs, however, do not fit this pattern (Stanton et al. 2009); abatement costs are likely to have unexpected benefits and are widely considered to be a necessity in order to avoid catastrophic climate change.

Money and finance
According to Scrieciu (2007), the CGE methodology assumes money neutrality, meaning that money *per se* has no effect on the economy. This means, roughly speaking, that financial aspects of the economy are ignored in CGE (Bergman 2005) and in all pro-growth MMS I have examined. Hence, pro-growth models are not built to take financial booms and busts into account. As demonstrated by the financial crash in 2008, this omission is questionable in a world of interconnected markets, where financial crashes can rapidly lead to global economic crises. Furthermore, from an ecological economics point of view, it is problematic that such models are not capable of accounting for interconnections between finance and the state of ecosystems.

Technological change
Technological development is a crucial element of neoclassical growth theory and, thus, also of many pro-growth models (Löschel 2002). One central discussion in this regard concerns opportunities to endogenise technological change, especially in relation to energy and resource efficiency (Löschel 2002). However, regardless of many efforts, mainstream models for sustainability assessment still depend on an unrealistic description of technological change, which favours future technological fixes against rapid large-scale climate abatement in the present (Stanton et al. 2009).

Uncertainty, complexity and catastrophic outcomes
A large part of the critique of pro-growth MMS regards IAM and addresses the clash between hyper-deterministic neoclassical 'mechanics' and the uncertainty and complexity of climate and environmental sciences (Scrieciu 2007). To illustrate this, the neoclassical part of an IAM can be considered a mathematically consistent, yet empirically irrelevant model pretending knowledge and precision, which is illusory (DeCanio 1997, Pindyck 2013). Such an illusion fits climate modelling frameworks, characterised by complex, chaotic features and uncertainty, poorly (Stanton et al. 2009). Yet, in IAM, neoclassical models dominate other disciplinary models, such that models and results are harmonised to fit the neoclassical framework (Scrieciu 2007). Exemplifying this, Stanton stresses that IAMs seriously underestimate the potential dangers, risks and damages of climate change (Stanton et al. 2009) because only average climate outcomes are incorporated, and the possibility of catastrophic outcomes is ruled out (Stanton et al. 2009, Pindyck 2013).

Long term projections
The critique of IAM for not taking uncertainty seriously also applies to the practice of making extremely long-term projections (sometimes up to 200 to 300 years into the future) based on calibrations to one single year (Scrieciu 2007). When these models address highly uncertain issues, such as climate sensitivity, which is likely to belong to the realm of the 'unknowable' (Allen & Frame cited in Pindyck 2013), this can fairly be termed a presumptuous approach to modelling future events.

Judgement calls, politics and value choices
A key critique of the integrated assessment literature regards a prevalent tendency to present judgement calls and debatable hypotheses as if they were hard science. The result is that IAM has become a modelling practice, which appears to be value free and objective, but influential value judgments are in fact buried deep inside computer code and mathematical functions (Stanton et al. 2009). This discourages democratic debate (Stanton et al. 2009) and turns such models into political black-boxes (Scrieciu 2007). For policy-models designed to inform processes of policy-making, this seem particularly problematic.

Finally, adding an extra point to the list of critical issues, I wish to highlight the lack of focus on special interests and political institutions in the pro-growth models (and in post-growth for that matter). Thus, these models tend to assume the economy is ruled merely by the fundamental laws of economics, while the interests of multinational corporations and the influence of governmental institutions are left out of the equation. Acknowledging this deficiency, I am, however, not proposing that

such forces ought to be built into these models; rather I tend to think that the difficulty of doing so might be an argument in favour of scepticism towards the entire project of MMS altogether.

Chapter 4: to model or not to model

In this chapter, I explore what macroeconomic modelling and MMS are used for, whether they are useful, and their role in policy-making.

Why do we model?

Obviously there are multiple reasons for devising models. In natural sciences, for instance, models are often drafted with the purpose of understanding and explaining observed phenomena. Yet, when it comes to computational macroeconomics, modelling is very often directed towards contributing to policy debate and decision-making, which is most certainly also the case for MMS, particularly the pro-growth side of the spectrum. Thus, policy, policy advice, and decision-making can be seen as key to pro-growth MMS, as exemplified by Böhringer & Löschel, who explain how SIA modelling starts with a policy issue – such as resource depletion, stock pollution, or the regulation of energy technologies – which demands some kind of epistemological (own phrasing) treatment (Böhringer & Löschel 2006).

Having thus indicated a close link between pro-growth MMS and policy-making, I must admit that opening the interface between the two and explaining how interactions between them take place more concretely is not straight forward. However, it is possible to list a set of well-established general applications of computational macroeconomic modelling and MMS, which appear, somehow and through multiple channels, to influence economic policy-making. The three most common applications are: *forecasting*, *policy assessment* and *scenario building*.
Forecasting very often concerns the prediction of future GDP, yet it could also be the prediction of future energy demand and various emissions for instance [Andersen]. Although forecasting is very much a pro-growth discipline, growth opponents have also practiced this form of soothsaying, as exemplified by Randers, who has used the SD methodology to devise a general prospect of the world in 2052 (Randers 2012).

Traditionally, policy assessment is a discipline that attempts to assess the outcomes of a given policy change under the assumption that everything else remains unchanged. Such assessments are very often carried out in terms of GDP and, thus, explore how a given policy – ecological tax reform for instance – will impact economic growth; or in neoclassical terms, whether the policy will impose a 'welfare loss' on society. This type of application is widespread in pro-growth MMS, where the *ceteris paribus* assumption makes such uses 'meaningful'. Policy assessment has, however, also been performed on post-growth models, as exemplified by LowGrow, which was used to test a series of policies including the reduction of the working week in a Canada (Victor & Rosenbluth 2007).

Scenario building consists of devising one or more imaginaries of the future given different initial conditions and key drivers. As opposed to forecasting, scenario building does not concern prediction, but the envisioning of possible futures and the provisioning of a basis for dialogue and discussion [Blegaa]. A very famous example

of the scenario approach is the Limits to Growth report, which consisted of a set of future world scenarios, drafted using the World3 model. Since the publication of the report, the scenarios have often been framed as predictions, but they were, in fact, meant as the basis for discussion and dialogue (Cerasuolo 2012). In retrospect, however, it is interesting to note that one of the Limits to Growth scenarios – the collapse scenario – has, in fact, turned out to be a rather precise prediction of actual developments (Turner 2008).

In the pro-growth segment, scenarios are a standard tool for calculating the cost of policy changes. For this purpose, a so-called BAU or 'baseline' scenario is compared to one or more so-called 'counterfactual' scenarios, to which a so-called policy-shock has been applied in order to calculate the GDP-difference between a scenario in which the policy is implemented and one in which it is not. Traditionally, BAU scenarios have been 'no policy baselines', where it is assumed that no new policies are implemented, while more recently, 'policy baselines', which incorporate certain very likely or already decided future policies (climate policies for instance), seem to be a new trend.

In relation to scenarios, Krey states that scenarios "provide 'a plausible description of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces" (Krey 2014: 369). This statement underlines how computational macroeconomic models and MMS are often considered to be means for providing consistent and non-contradictory results, which the human mind is not capable of producing due to the complexity which arises from a large number of variables, relations, and accounting identities involved in macroeconomic and environmental analyses (Böhringer & Löschel 2006). The value of consistency and non-contradiction is evident in economic policy debate, where inconsistency and contradiction are considered to be weaknesses which invite debunking and invalidation [Knudsen].

The issue of consistency, however, induces the discussion of consistency in relation to what? In macroeconometric modelling, consistency could mean compliance with national accounting identities [Knudesen], in a GE model, the consistency could mean abiding by very rigorous neoclassical principles (Böhringer & Löschel 2006), while in post-growth MMS, the emphasis is often on consistency in relation to a certain conceptualisation of financial stocks and flows (Jackson et al. 2015). Thus, consistency is contingent and dependent on worldviews and theoretical frameworks.

A final reason for producing models which I would like to mention is that there seems to be something rather persuasive about models and they provide the commanders of such technologies a certain aura of authority and reliability. Thus, the mere fact that a policy agenda is based on a model increases its strength and knowledge claims.

In summary, computational macroeconomic models and MMS are built for multiple purposes not least to support activities of prediction and to intervene in policy debate. Furthermore, such models can be used to introduce various forms of

consistency to arguments and reasoning, and finally, they can provide debaters with an aura of authority and reliability.

Which battles to fight?

Taking a controversy perspective on MMS makes it relevant to talk of models as epistemic weapons engaged in struggles to draft the economic realities which decision-makers try to navigate, govern and decide about. In this regard, it is interesting to observe the explicit concern with policy and policy-making of pro-growth MMS, and the confident attitude with which this concern is attended to; a confidence which includes using the vocabulary of societal costs, optimal consumption paths, and counterfactual scenarios as if such words referred to scientific facts in the same league as gravity, the speed of light and electromagnetism. To me, this indicates the confidence of a ruling discipline, which is able to set the tone for and shape the reality of economic policy-making, not least by providing its basic vocabulary. In relation to this, pro-growth MMS can be seen as the extension of a ruling economics regime (the neoclassical) into new territories such as the environment and climate.

Although the post-growth segment of MMS has a strong normative aspiration, it is noteworthy that the policy orientation is less outspoken. Thus, it is not easy to detect a clear set of policy objectives for post-growth MMS. However, the LowGrow model (Victor & Rosenbluth 2007) expresses a spirit of confidence, in spite of a fairly unsophisticated framework, which has the aspiration and perhaps even some power to turn the world around by showing, amongst other things, that GDP growth is not a necessity for securing full employment. This ethos of confidence and policy purpose, however, seems somehow lost in more recent post-growth studies, where the emphasis has moved to grand unified modelling ambitions, extensive consistency, and the answering of slightly esoteric research questions mainly of interest to narrow ecological macroeconomics debates (Jackson & Victor 2015, 2016).

This tendency makes it relevant to ask whether ecological macroeconomists are, in fact, building the right models and using them to fight the right battles. If the objective is to overthrow the GDP-regime and engage in radical policy change, is it appropriate to choose huge, universalistic macroeconomic models, which are designed to incorporate biophysics, real economy and finance, and answer the question of whether credit creates a growth imperative (Jackson & Victor 2015)? Or are smaller, simplistic models with a clear policy message more useful arms in the battle? Asked to choose between the two, I would probably go for the latter, arguing that the important battle is not one of universal models and deep truth, but a battle over who defines the realities of economic policy.

A telling example in relation to this discussion was presented to me by a former UK Treasury employee, who explained how the chief economist of the newly-elected Thatcher government in 1979 declared that he had no trust in the Treasury's current grand, Keynesian-inspired macroeconometric model, and that he would not take notice of its results. Yet, he realised that it was not possible to get rid of it and fire all fifty or so employees who operated it. Instead, he installed a few economists in his own office to operate a far smaller monetarist macro-model consisting of

approximately six to twelve equations, on which he based his advice to the government [Laslett]. This can be seen as part of the paradigm shift from Keynesian to monetarist economics in the UK also described by Hall (1992), yet it is interesting to observe that this shift required a longer period of institutional change, during which old routines and models were only gradually changed and replaced [Laslett]. Along these lines, ecological macroeconomists and post-growth MMS could perhaps learn a few tricks from the global institutionalisation of neoliberalism, elaborately explained by Mirowski (2014).

Which models to build?

If we accept that models are useful weapons in battles for change, it is relevant to continue along this line of reasoning and ask which models to choose for which battles. Starting with the intention to change economic policies and overthrow the GDP-regime, one question concerns whether to go for heavy artillery or smaller weapons. I tend to think that both are useful, yet in a time of guerrilla warfare against an empire (neoclassical economics and neoliberalism), smaller weapons might be easier and less resource demanding to operate. Thus, one way to proceed could be to draft smaller very specific policy models intended to continuously provide alternative results and undermine the truth regime of neoclassical models. Furthermore, such models could be used to push post-growth agendas, as was the case with the LowGrow model (Victor & Rosenbluth 2007).

However, the strength of such models would most likely increase if they had a strong and convincing organisational base. Thus, along with the development of policy-models, the post-growth agenda could benefit from the establishment of a network of think tanks and media platforms to promote post-growth viewpoints and modelling results. If such a stronger organisational base were established, larger and more elaborate models might then be used to reinforce the aura of authority and reliability and as a means for drafting more elaborate policy plans and documents. For this strategy to work, however, the post-growth modelling community would have to come together and establish an agreement about the most important issues and policies to push and leave the more subtle epistemic challenges and disagreements to the academic battlefields.

Thus, accepting the relevance of academic battles and the usefulness of basic research concerning ecological macroeconomics, I now wish to briefly present a few more fundamental considerations in relation to the modelling practices and models I have engaged with during the last three years.

Intention versus method

When reading on the topic of macroeconomics and models, it is evident that the method is central, and that the battle for economic truth is often presented as a methodological one (my interpretation of Jespersen (2007)). Clearly this understanding is fair and valid, not least because methods tend to incorporate and materialise powerful theories and worldviews. Yet, to supplement this view, I wish to make the point that the intention of the model builder is a force, which can stretch methodology in multiple directions and make a given methodology a weapon for multiple, even opposing purposes. Exemplifying this, Ricker has used the CGE

methodology to show that there are limits to growth (Ricker 2007), while CGE is most often used to promote eternal growth. In a similar vain, SD has been used to promote both 'limits to growth' (Meadows 1972) and 'green growth' (UNEP 2011), ABM can be built to exhibit general equilibrium as well as highly non-stationary dynamics, and SD can be used equally well for post-Keynesian (Jackson & Victor 2015, 2016) and the analysis of off-equilibrium dynamics (Yamaguchi 2013).

My point here is that methodologies and models are malleable media for all sorts of theoretical and political intentions, and without the modellers' deliberate steering, the model-output would more often than not be useless nonsense. Hence, tinkering and ad hoc adjustments are common in macroeconomic modelling and a necessity for making these technologies useful. Exemplifying this, Danish macroeconomic modellers explain how their models can easily run astray, how specific data points sometimes have to be removed from time series, and how the interaction between a macroeconomic model and a satellite is a highly handheld procedure [Andersen, Grinderslev]. Furthermore, I have been informed that a model run of the Danish Ministry of Finance's model ADAM, requires months of preparation [Werner] and is likely to involve all sorts of tinkering, debugging and troubleshooting along the way. Finally, as will be explained later, models can become subject to political demands, which force their operators to tweak them to give certain pre-ordered results [Sakai]. Thus, instead of being truth machines, macroeconomic models are rather human-method interfaces, constantly adapted to specific tasks, circumstances and purposes under the influence of theoretical and political intentions.

Grand ambitions

A topic of specific interest in relation to MMS is the ambition to build what I somewhat ironically have referred to as 'grand unified models'. This term is inspired by particle physics, which nurtures the ambition to draft a 'grand unified theory' incorporating different, so far disjointed, theories into one. In the world of MMS, an equivalent ambition has been formulated by Böhringer & Löschel, who promote the CGE methodology as a tool for building fully integrated economy-environment models by means of hard-linking, as opposed to soft-linking (Böhringer & Löschel 2006). The soft-linking approach is currently the predominant approach in pro-growth MMS and consists of combining two or more models, based on different disciplinary frameworks and methodologies – a macroeconomic, an energy system, and a climate model for instance. In soft-linking, the models are developed independently and are able to run separately, while the flow of information between models is highly controlled either by the modeller or some sort of algorithm. In some cases, the flow is one-directional: flowing from the macroeconomic model to the sub-models, which use this output as an exogenous input. However, a feedback from sub-models back to the macroeconomic model can also be established, in which case the risk of models running astray increases[Andersen].

Hard-linking, on the other hand, consists of one single model, which takes care of everything – economy, climate, energy, etc. According to Böhringer & Löschel (2006), the advantage of this approach is the attainment of a greater consistency and the absence of problems of iterations between models. However, as Böhringer & Löschel also observe, the hard-linking approach requires substantial data

adjustments and the prefabrication and simplification of outputs from other disciplinary models such as climate models (Böhringer & Löschel 2006). Consequently, hard-linking is, in my opinion, just another form of soft-linking, where the input from models from other disciplines is meticulously, 'manually' formatted to be incorporated in the CGE model, so that nothing interferes with the crisp and clear consistency of the CGE methodology. In a sense, this ambition can almost be seen as a trademark of neoclassical economics: the conquering of method-worlds and the inauguration of neoclassical method as the ruler of worlds, such as energy, climate and biodiversity, which were previously investigated by other methods.

In post-growth MMS, somewhat similar Universalist ambitions can be observed, yet here, the ambition does not so much concern how to conquer all worlds using one single methodology, but rather to incorporate as many aspects of interest to ecological macroeconomics as possible in one unified model. This implies that various methodologies, such as SFC, environmentally extended IO and Keynesian dynamics, are used in combination in order to incorporate real economy, finance and biophysics in one single modelling framework (Berg et al. 2015).

These ambitions of unified modelling prompt me to ask what the use and benefit of such models is, and consistency appears to me to be one of the keywords. In the case of hard-linking, the consistency concerns neoclassical theory, while in post-growth MMS, the consistency concerns the desire to build models in accordance with the basic worldview of ecological economics. The first is to me an example of the ongoing strengthening of the neoclassical growth regime, while the latter seems to me a sympathetic research activity, yet perhaps a dead end, when it comes to overthrowing the neoclassical growth regime; the commensuration and unification of disjointed method-worlds is possible, but it requires time, energy and effort, which might be put to use more effectively in smaller models with a more direct policy focus.

Complexity

In relation to model building, the issue of complexity is a recurring theme. Thus, model builders I have interviewed explain how the size of a model and the amount of detail incorporated can easily induce a level of complexity which makes the model useless due to incomprehensible outputs or problems of solving or running it. Formalising this problem, Grimm describes how the level of complexity of a model is related to its usefulness (Grimm et al. 2005). Thus, the question of complexity can be phrased as a question of finding the right balance between the purpose of the model and the level of complexity which serves this purpose best. To give an example of this, I, once again, wish to highlight the LowGrow model, which, in spite of its simplicity, was used to produce a very clear message and show that a non-growing economy might not be such a stupid idea after all. The production function of LowGrow was a traditional Cobb-Douglas function with two inputs: capital and labour (Victor & Rosenbluth 2007). To ecological economists this may seem rather limited, and the incorporation of energy, materials or even exergy in the production function is tempting, yet the model was brilliantly used to tell a strong post-growth story without the use of such extensions.

Hence, if the purpose is to overthrow the GDP-regime and install some sort of new post-growth paradigm, the question might well be whether super complex, fully consistent models are really that important, or whether more simplistic models which are easy to operate and disseminate would be better suited to the task.

Data and statistics

The question of data is core to MMS, and any modeller has to deal with this issue along the way. If a model is intended to portray a country or a region, for instance, significant amounts of data from this country or region must be available in a compatible format. And if a model is built to incorporate environmental circumstances, data of these circumstances must be accessible and compatibility must be established. Sometimes modellers go a long way to compile databases in a format which suits their modelling purposes, while at other times they might prefer to adjust their models to fit available data and the format of official databases. In this vain, the availability and format of data can influence the choice of modelling methodology [Winning], and the battle of models may, thus, also be a battle of data.

Since the 1930s, national accounting and mainstream macroeconomic modelling have co-evolved, such that they tend to match each other. This means that alternative modellers are either stuck with databases which fit mainstream frameworks or have to venture into resource demanding efforts to draft databases fit for their own modelling frameworks and purposes. At a workshop on exergy-economics which I attended as a note-taker during my stay in Leeds, I experienced a telling example of this problem. Here the issue of gathering data and formatting databases for the purpose of exergy-economics took a prominent position in the plenary discussions.

Adding to this comes the question of which statistical methods to apply when analysing the data and incorporating them into the model. This question involves problems of how to incorporate static accounting frameworks in dynamic models. There is no unique solution to this problem, and model builders have ventured into multiple approaches to turning static accounting into dynamic frameworks, which can alter over time.

Models travel and breed

The question of what models to build also concerns the ability of models to travel and breed and hence to transform in multiple unpredictable directions. As such, a 'new' model is never really new since it always builds on something which went ahead of it. The first Danish macroeconomic energy model, for instance, was drafted using a Norwegian prototype (Urhammer forthcoming), the CGE framework builds on the theoretical endeavours of Arrow & Debreu (Gäbner), and LowGrow depends on multiple building blocks from the mainstream and Keynesian toolboxes (Victor & Rosenbluth 2007). As such, macroeconomic models are perhaps dynamic networks of heterogeneous elements, such as equations, solution algorithms, theoretical tenets, figurative diagrams, memories, and databases, rather than tangible and confinable entities.

The modelling-policy interface

Using Brown's concept of politics as world making (Brown 2015), it makes sense to assert that MMS is an expression of politics in a time of multiple environmental threats, where pro-growth can be seen as a stabiliser and conserver of the existing GDP-regime, while post-growth is a world changer, trying to overthrow the existing economic policy reality and replace it with a new one based on different principles. This view is closely related to the performativity take on economics, where macroeconomic models can be seen as co-creators of economic realities and, therefore, as political actors. In Article 4 of this thesis, I try to show how macroeconomic models were part of configuring energy issues for policy purposes by producing energy policy imaginaries, thereby showing that macroeconomic models can be performative and participate in creating our common future (Urhammer forthcoming).

Having thus emphasised the political strength of such models, it is also necessary to observe that models are sometimes strongly influenced by specific political interests. Exemplifying this, a previous employee at the Mexican ministry of finance told me how the overly optimistic economic growth forecast, which he participated in producing during the month prior to the financial crash in 2008, was not an actual prediction. Instead it was supposed to help stabilise the situation and give the impression that everything was normal, although everybody at the office could tell from the incoming numbers that there was something very troubling about to happen in the US [Sakai]. Additionally, the ministry employee explained that the publication of a more realistic economic growth projection with the inclusion of a potential crash would have led to an immediate and very negative reaction from the US government [Sakai]. Similarly, official Danish economic growth projections are also often overly optimistic and have to be gradually downgraded, which once again indicates that economic growth forecasts are part of a stabilisation regime, the purpose of which is to induce trust in governmental policies and future economic stability.

Another telling example of the interplay between specific political interests and macroeconomic models is the story of how the Mexican finance ministry employee was ordered to tweak his model to produce a better growth forecast during election time, when the incumbent government needed a better economic growth forecast than the one he had initially presented to his superiors [Sakai]. The immediate, and also somewhat fair, reaction to such a story is probably that the economics behind the scenes is rigged, yet it is interesting to observe that it was not an option for the government to totally bypass the modelling office and simply produce its own forecast. The reason for this is probably that such forecasts may be subject to public criticism and scrutiny, in which case it is important that it is possible to verify that a specific forecast has been produced by an official authority using standard macroeconomic techniques. This underlines the subtle reciprocity between modelling and policy-making, where political interests and the epistemic apparatus of macroeconomics mutually constrain and support each other.

Discussion

To end this chapter, I wish to ask the question of whether MMS is actually what we need in this time of multiple crises. In favour of an answer in the negative, Nelson has argued that good decisions do not necessarily need consistent machinery for weighing and comparing, and sometimes less information can lead to more satisfactory outcomes (Nelson 2013). Hence, "[u]se of intuition, rules of thumb, and unconscious processes may lead, in some cases, to better outcomes with less regret (Gigerenzer 2007 cited in Nelson 2013)". If this argument is valid, the application of large elaborate MMS might not be the way to proceed. Instead, more direct activist attempts to re-politicise economic policy, as suggested by members of the degrowth movement (Kallis 2015), may be a better path to follow.

However, the question is not necessarily either/or, and if we accept that some sort of modelling may, in fact, be useful in a time of urgently needed radical policy transformation, what sort of modelling should then be used? Having studied MMS for three years, it is rather frustrating that I am not able to give a better answer than to present the following three pleas: *more policy focus*, *less theory/more accounting* and *metric pluralism*.

By proposing more policy focus, I urge the post-growth modelling community to engage more strongly in building policy models with the very clear objective of intervening in current policy debate and undermining the truth regime and the 'politics of necessity' favoured by incumbent elites and supported by mainstream economics. This instead of building complicated unified models for debunking theoretical propositions of esoteric interests to a fairly narrow research community.

Proposing less theory and more accounting implies a wish to encourage greater emphasis on accounts of tangible stuff and less emphasis on dogma and theoretical dynamics. This plea, however, is certainly primarily directed toward pro-growth MMS economists, who seem to be obsessed with mathematical crispness, theoretical consistency, and dubious behavioural assumptions, whereas ecological macroeconomic modellers seem far more interested in actually incorporating solid accounts of money, materials and other tangible factors into their models. Included in this plea is also a suggestion to discard the ambition to gaze far into the future using models based on sophisticated, theoretical dynamics. Instead I propose more static, short-term models based on tangible accounting methods, which recognise the human aspect and participation in the creation of model results. In other words, let us abandon the illusion of models as truth machines and embrace models as human-method interfaces, which provide a basis for dialogue, negotiation and imagining.

Finally, my plea for metric pluralism regards the abandonment of the ambition to measure and model everything using a monetary metric. The situation today resembles Tolkien's universe, where one ring rules them all; instead I proposes that modellers should accept and encourage the use of multiple metrics for multiple purposes. As such, the plea for metric pluralism involves the total rejection of the hard-linking approach proposed by Böhringer & Löscel (2006), and instead encourages the construction of complementary models based on the metrics of several different disciplines. This can be seen as a plea for further soft-linking, where

models are disentangled instead of integrated, and there is no ruling macroeconomic model. It is also a plea for interdisciplinarity, where several disciplines bring their models and expertise to the table and negotiate proper responses to the challenges confronting us. In this regard, it is important to stress that economics should not be offered the seat at the head of the table.

As pointed out by one of my colleagues, however, the plea for metric pluralism potentially involves the risk of increased complexity and confusion regarding the metrics applied, as exemplified by the OECD's 'endless' list of green growth indicators (OECD 2011). However, I do believe that it is possible to find a limited dashboard of key indicators of most concern to our societies in the present situation.

Chapter 5: conclusion

As indicated in the title of this working paper, one of the purposes of the paper is to challenge the perception of macroeconomic modelling (for sustainability) as a pure epistemic practice that merely concerns the acquisition of accurate knowledge about the economy and economy-environment relations. By means of critical perspectives and ethnographic examples, I argue that there is more to the matter, and that macroeconomic models are complex political creatures, which are able to intervene in and set the scene for economic policy processes in multiple ways, and which are also highly sensitive to the particular intentions of modellers and the special interests of politicians. At this point, my argument is not fully elaborated, yet I still hope that this preliminary draft provides useful insights and food for thought for model builders and other academics working for a sustainable transition.

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Article 6

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Value Pluralism and Incommensurability in Ecological Economics

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Abstract

We live in times of global crises, where economic, social and ecological problems are increasingly entangled and therefore require novel answers. Economics is today holding a hegemonic position and dominates the way we understand and relate to the problems we face, and it continues to gain new territory. This is reflected in a value hegemony framing everything from biodiversity to carbon emissions in monetary terms. We consider this a democratic problem since the diversity of values is thus not fairly represented in our current mode of decision-making. We believe that the solutions to the grand problems of our time lie in a democracy where multiple values can be communicated. In order to provide inspiration for thinking about such a democracy, this paper provides an overview of a wide range of philosophical positions on values and value pluralism and analyses how values and value pluralism are treated in a selection of articles in ecological economics. The paper concludes that the treatment of values and incommensurability in ecological economics can be characterised as ambiguous. There is a need for further research on the theoretical aspects of these issues.

1. Introduction

"Aspects of the world are valuable.
That constitutes reasons for action" (Raz 2000:1).

Since the emergence of increasing, human caused, ecological disasters, such as loss of biodiversity, oceanic plastic pollution and mass deforestation, the issue of environmental values has become increasingly important. All over the world destruction and seizure of habitat is causing fierce conflicts, the settlement of which more often than not have devastating outcomes for the species and people who depend on and are constituent parts of these habitats. Economic valuation often plays an important role in such conflicts and economic valuation principles have become powerful political tools that influence decisions and actions regarding habitats all over the world. In this form of valuation, in order for any value to be taken into account it must be given a price and pass through machineries, such as cost-benefit analysis or payment for ecosystem services.

This raises a question of democracy. Is this a just way of representing opposing value interest? Is the interest of the indigenous to protect their habitat just as fairly represented

in these methods of valuation as is the interest of the multinational oil company? According to many ecological economists, this is certainly not the case, and in order to address the injustices and biases of monetary valuation they, among others, have proposed alternative approaches to valuation and settlement of environmental conflicts (Martinez-Alier et al. 1998 and Kallis et al. 2013).

Often these alternative methods of valuation are based on a non-reductionist view on values, which hold that it is not possible to reduce all values to one single value. This is in opposition to the monist view on values, which hold that all values can be reduced to one value and measured by a common metric (O'Neill et al. 2008). The former view is often referred to as value pluralism (ibid.), and it seems fair to say that most ecological economists belong to the pluralists when it comes to values and valuation. However, reading the ecological economics literature on these issues reveals a tendency to focus mostly on the development of alternative valuation methods and less on the more philosophical aspects of values and valuation. In order to fill this gap, this paper summarises a series of philosophical positions in relation to values and value pluralism and investigates how these are reflected (or not reflected) in a selection of ecological economics articles. To guide our investigation, we propose the following research questions: "How are values and value pluralism articulated as philosophical topics"? "How is value pluralism operationalized in a selection of the ecological economics literature"?

In order to answer these questions we have performed two literature reviews; one for each of the two. The first is a review of a loosely defined selection of literature concerning environmental ethics, values and conflicts. This selection, counting 9 articles and two books, was collected using combinations of words such as *values, value pluralism, ontology* and *intrinsic values* in Google Scholar, Web of Science and bibliographies. An analysis of this literature is conducted in section 2. The second review is based on a systematic search in the journal Ecological Economics using Web of Science and Scopus and the following key terms: *value pluralism*, *plural value(s), incommensurability*, and *incommensurable*. This resulted in 26 articles that are analysed in section 3.

2. Axiological positions

When confronting the issue of value pluralism, two aspects have spurred our interest: the first is the ontological status of values and the second is the question of value incommensurability. The first could also be termed the being of values, while the second concerns the (im)possibility of measuring values using a common metric. In the following, we will discuss various methodological approaches to these two aspects.

2.1 The ontological status of values

It is beyond the scope of this paper to account for all the philosophical positions regarding the ontological status of values or to offer an exhaustive taxonomy of these often repellent positions. However, we still wish to give a rough account of some significant and opposing approaches to the ontological status of values.

The first approach, we wish to mention is often referred to as *objectivist* or *value objectivism* (Gracia 1976). This view conveys the understanding that values exists objectively and independent of human conceptions. This means that objects possess qualities, which are intrinsic and as such constitutive of the object (French 1965). Along

these lines Crowder talks about moral objectivity, which states that there are basic human goods that exist and maintain their fundamental qualities regardless of what people might think of them (Crowder 1998). This type of reasoning about values can also be termed *realism* or *value realism* (O'Neill et al. 2008).

In direct opposition to the objectivist view we find an approach which is commonly referred to as *subjectivist* or *value subjectivism.* In this view value is a characteristic of the subject (Gracia 1976). Hence value does not reside in the object but in the perceptions and thoughts of the individual subject, which means that the value of a given object is dependent on how a subject perceives it: to one subject a specific tree might be worthless, while to another the same tree is precious.

A constructive rejection of the two preceding positions can be found in a *relational* view on value, which holds that values exist as a relational quality between a subject and a desired object (Gracia 1976). In a sense this view is objectivist, since it assigns the value to the object, however, this value only exist due to a particular situation which brings the object in relation to a desiring subject (Gracia 1976). The relational view on values can be taken to an extreme by rejecting the usefulness of the subject-object dichotomy. This is the case in Latour's empirical philosophy, which proposes the idea of *being as other* (Latour 2013). Being as other means that any entity exists by virtue of other things, thus subject and object emerge together and cannot be separated; they exist in reciprocity. This view can be applied to the issue of values, by saying that it does not make sense to separate the value and the valuer; they exist by virtue of each other and in relation to a multiplicity of other entities. This can be used to form a *constructivist* view on values, where values exist as multiple, hybrid entities composed of relations between human and non-human constituents.

Finally, there are more practice oriented views, which emphasise that social practices are necessary for the existence of value, since values emerge from social practices and cultural development (Raz 2000). Along these lines O'Neill et al. (2008:1) claim that "There are no such *things* as values. There are rather the various ways in which individuals, processes and places matter, our various modes of relating to them, and the various considerations that enter into our deliberation of action". Familiar to this is the view that institutions such as rules and norms that govern social practices become holders of values (Vatn 2005).

To finish this brief treatment of the ontological status of values, we wish to touch upon a long and on going discussion within environmental ethics regarding *intrinsic* and *instrumental* value. The main crux of this discussion regards the question of whether the mere existence of an entity can make it valuable. This leads to the following definition: "[…] a thing has intrinsic value only if it is judged that, considered in isolation, abstractly, by itself, and without regards to its consequences, its existence is better than its nonexistence" (Elliot 2005:51). This means that a thing has intrinsic value, if its mere existence is more valuable than its nonexistence.

The polar opposite of intrinsic value is called *instrumental* or *extrinsic value*, which Elliot defines as the value of being instrumental in bringing intrinsic value about. Thus, a thing has instrumental value "[…] if it is an instrument that assists in bringing something into existence which is intrinsically valuable" (Elliot 2005:45). This definition links instrumental value to the concept of intrinsic value. However, in our view, it is possible to talk about instrumental value without connecting it to intrinsic value. It is possible to say that a forest can be instrumental in providing valuable things, such as clean water,

peacefulness and beautiful sceneries without having to clarify whether these things have intrinsic value or not. In this sense, it makes sense to say that the forest has instrumental value without a clarification of whether this leads to intrinsic value.

Isomorphic to the preceding, it is possible to define intrinsic and instrumental value in terms of whether a thing can be considered an end in itself or merely a means for something else. If a thing is an end in itself it can be said to have intrinsic value. If it is merely a means for something else, it can only possess instrumental value (O'Neill et al. 2008). This definition relates to Thompson & Barton (1994) who suggest that the distinction between intrinsic and instrumental value resides in a distinction between ecocentrism and anthropocentrism. In this view, the appreciation of intrinsic value is an expression of ecocentrism, while the view that things are valuable only as instruments for human satisfaction reflects anthropocentrism. An ecocentric view on a forest would then be to say that the forest has value simply because it exists, while an anthropocentric view would hold that it has value because it is instrumental in providing valuable services and experiences to human beings.

Some of the earlier mentioned positions in relation to the ontological status of values can be recognised in various discussions of intrinsic and instrumental value. It is thus equally possible to have a moral objectivist and a relational view on intrinsic value. The moral objectivist view is probably the most common view on intrinsic value, since it fits well with the idea that a thing can be valuable in and for itself regardless of how other things relate to it. It is, however, possible also to have a relational view on intrinsic value saying that "[…] a thing has intrinsic value if it is approved of by a valuer in virtue of its properties" (Elliot 1992:140). This statement conveys the idea that value can be an intrinsic quality of a thing, even though this value will only exist in relation to a valuer and certain properties.

Despite the intellectually appealing aspects of the philosophical discussions of intrinsic and instrumental value, we find them rather speculative and displaced from the concreteness of the environmental and social problems of our time. Yes, it is interesting to try and categorise values philosophically, and it certainly does not exclude considerations of values in more concrete social and political contexts. However, to spend efforts discussing, for instance, whether a thing would have value, if nothing else existed (Elliot 2005) simply seems meaningless. We therefore feel encouraged to call for a more pragmatic approach to values that try, less speculatively, to investigate the existence and characteristics of values in specific places and moments involving multiple and often opposing concerns.

2.2 Incommensurability and value pluralism

As mentioned earlier, we live in times of environmental conflicts and controversies. All over the world struggles regarding habitats, resources and pollution take place involving multiple stakeholders and concerns. Often such conflicts are sought settled by attempts to commensurate opposing values by the use of monetary measures that assign the settlement of conflicts to markets or to calculative technologies such as cost-benefit analysis. In spite of the cunning elegance of some of these settlements, they never really seem to satisfy all concerned stakeholders. In most cases environmental conflicts result in great losses, especially for marginalised groups such as indigenous people or threatened species, who are often forced out of their lands or habitats.

This inappropriateness of monetary measures in solving value conflicts could be claimed to have its roots in value incommensurability, which means that the multiplicity of human values cannot be comprehended under one measure. In this sense, it is not possible to reduce all values to one super-value that can ultimately settle value conflicts (Crowder 1998). This is, however, what environmental economists are trying to do and what many ecological economists argue against.

Core to this disagreement is the distinction between value monism and value pluralism (O'Neill et al. 2008). Environmental economics is based on neoclassical economics, which confess to value monism: the idea that all values can ultimately be reduced to one value by the use of a single metric. Whether this value is pleasure, happiness or human dignity varies, however in neoclassical economics this value is called utility and the metric that quantifies it is money (O'Neill et all. 2008). From value monism follows the possibility of commensuration between values and the optimal settlement of value conflicts, which is the settlement with the highest net utility measured in monetary units (O'Neill et al. 2008).

The opposite of value monism is called value pluralism, which means that it is not possible to reduce all values to one value. In this context, incommensurability means the nonexistence of a single metric which can measure the quantity of all values and thus determine the optimal outcome of value disputes. Value pluralism implies that there is no "one size fits all" recipe for settling value conflicts. There is no given ranking of values which can always be applied. This calls for multiple means of valuation, if environmental conflicts are to be justly settled (Martinez-Alier et al. 1998).

The question of incommensurability transcends the previously described positions on the ontological status of values, in the sense that opposing views on the being of value, might still agree on the incommensurability of values. According to Crowder (1998) value pluralism has its roots in moral objectivity, which states that there are fundamental human values, such as liberty, justice and equality that exist and maintain there fundamental qualities regardless of what people might think and do. Since these values are fundamental, they are irreducible, which means they must be plural. In this view, there is a connection between the objective status of values and their plurality. However, we do not consider moral objectivism a necessary precondition for neither value incommensurability nor pluralism.

This view can be qualified by reference to French pragmatism as articulated by Boltansky, Thevenot and Latour and interpreted by Centemeri (2014) and Blok (2013). As Centemeri points out, there is an emphasis in French pragmatism on *modes of valuation*, which discovers and distinguishes sources of incommensurability not in the objective status of values, but in modes of practical engagement and coordination (Centemeri 2014). This does not rule out the question of objectivity, however, instead of objective values, Centemeri observes, French pragmatists stress the importance of modes of objectifying values based on codified knowledge and expert judgment. This indicates an implicit rejection of a substantive view on objects and values in favour of an emphasis on practices of objectification and valuation (Blok 2013, Centemeri 2014).

3. Value pluralism in ecological economics

This section explores how value pluralism and incommensurability are discussed in the Journal *Ecological Economics*, following three streams of thought: what do ecological economists mean when they speak about values, value pluralism and incommensurability? Why do both concepts matter in the community? And: What is being suggested as ways to conceptualise them in practice? We are well aware that the notions of plural values and incommensurability are implicit in a vast number of articles; however, in this study we only include the literature where the terms are made explicit.

A concise definition of "value" can be found only in two of the 26 articles. Lo understands values in a subjectivist sense as "personal judgments or dispositions as to what is right or desirable, and assumed to be of fundamental subjective construct preceding formation of preference, which refers to a ranking of alternatives and is seen as the immediate precursor of personal choices" (Lo 2013:84). Based on this understanding he illuminates that ecological economics is based on an alternative theory of value that draws on multiple philosophical strands, Sagoff's (1988) citizens values thesis and John Rawls's (1971) theory of justice being the most prominent ones. Yet there has not been an evolution to establish a value theory that explicitly takes into account environmental values and larger society wellbeing and future generations *(*Lo 2013*).* In a similar spirit, Chan et al. combine different ethical theories to define values comprehensively as "the preferences, principles and virtues that we (up)hold as individuals or groups" (Chan et al. 2012:10). In this meaning values refer to both fundamental ideals (held values such as justice or happiness) and also to the relative importance we attach to things (assigned values, such as monetary values of commodities) (Chan et al. 2012). To capture the diverse nature of values the authors suggest classifying them along eight dichotomies and applying different empirical valuation methods to account for different kinds of values.

Value pluralism is a colourful term for ecological economists that does not seem to demand specific explanation. It shines through that it is indeed a foundational normative pillar of the community; however, references made are mainly tacit and implicit, even in those articles that contain value pluralism as a keyword. The seminal article by Martinez-Alier et al. (1998) is generally THE reference point. Yet even there a clear characterization of value pluralism is largely absent. The authors describe the act of "valuing" as something that includes different perspectives and practices, hence there is a general agreement that framing any particular one dimension as "the true, real or total picture" is reductionist and thus has to be rejected, no matter whether physical or sociological reductionism is concerned (Martinez-Alier et al. 1998:282). Physical reductionism would be, for instance, defending an energy theory of value where all value is reduced to energetic terms; sociological reductionism could mean a position where all social phenomena are explained as emerging from one dimension, e.g. structure. Martinez-Alier et al (1998) defend that there are no universal values or ethical system that is correct. Söderbaum paraphrases value pluralism in the same spirit as the whole spectrum of "possible ideological or ethical viewpoints" (Söderbaum 1994:54). The other way around, accepting that there are different perspectives and different philosophical and ethical rationalities other than utilitarianism on how to deal with socio-environmental problems means accepting value pluralism (Spash 2013). This stance matches the nature of ecological economics as a discipline driven by issues of (in)equality, (in)justice, moral and

environmental values. On the other hand, valuing also includes different criteria and standards that might, as a general rule, end in valuation conflicts (Martinez-Alier et al. 1998). Going to church on a Sunday morning can be better than sleeping long according to one criterion but worse according to another. This framing establishes value pluralism as a multi-criteria problem: there is no optimal solution but only compromise solutions that require methods and tools that enable people to balancing out different conflicting criteria.

Lo (2013) introduces a subtle distinction between value plurality and value pluralism. For him value plurality means that there are a number of different categories of values, whereas pluralism indicates a normative position that renders an appreciation of plurality possible. As emphasised by Lo and outlined above, value pluralism is primarily considered an ethical and normative position that aims to complement economic values by a range of social, ritual, symbolic, ecological and other values. However it goes beyond that to include a political commitment to oppose developments that narrow down the expression of values (e.g. the increasing commodification of nature). Advocacy of democratic institutions that enable the diversity of values to speak and be heard is put forward as the main strategy.

Let us now turn to the notion of incommensurability. In order to get a deeper understanding of this second principal concept of our paper, we consider it easier to start with a discussion of commensurability first. In a nutshell, commensurability is the "enemy" reductionist mainstream economics approach to dealing with value. According to orthodox theory, economic value equals exchange value, i.e. the value at which goods change hands, usually measured in monetary terms. Monetary values assigned to goods and services make them comparable and tradable in markets, and "the market", in turn, is considered capable of producing "true value". Concerning environmental problems there is recognition of market failure that can be solved by either creating actual markets to internalise externalities into the price mechanism or by creating surrogate markets (shadow prices). There are two shapes commensurability can take. Strong commensurability is defined as a "common measure of the different consequences of an action based on a cardinal scale of measurement" (Martinez-Alier et al. 1998: 280), i.e. numbers taking the form of real numbers 52, 73, 9, etc. Weak commensurability, on the other hand, is a common measure based on an ordinal scale of measurement, i.e. ranks in the form of 1st, 2nd, 3rd, etc. Another crucial distinction is the one between strong and weak comparability. If one term exists by which options can be ranked, one speaks of strong comparability, whereas if this one term does not exist, weak comparability is implied. Weak comparability is the strongest form of not-being-able to measure and compare within and between options. A situation characterised by an inescapable value conflict. Martinez-Alier et al. (1998) argue that ecological economics rests on weak comparability only. This is a very strong assumption and what is commonly understood by incommensurability.

Incommensurability is defined as "the absence of a common unit of measurement across plural values" (Martinez-Alier et al. 1998:280) or "the fact that it is impossible to reduce all relevant features of an object, service or system to a single dimension" (Van den Bergh et al. 2000:53). In other words, ecological economists believe that because values are heterogeneous in nature, they cannot be compared quantitatively with each other, "not even in principle" (Kapp cited in Martinez-Alier et al. 1998:280). This is especially relevant for environmental decisions as they raise ethical and moral issues that are not

comparable with choices people make about ordinary consumer goods. Some values such as justice, love, or respect for non-human beings are seen as sacrosanct and thus considered taboo to be traded-off with other values (Temper and Martinez-Alier 2013). Chan et al. (2012) present several reasons why values are considered incommensurable. One is that because some values are central to worldviews ("sacrosanct"), leaving them out would risk losing the basis for all meaning and value. Another is that some values need to be personally experienced to be fully appreciated, e.g. in the case of transformative values associated with a site ("You had to be there.").

Most of the articles analysed take value pluralism and incommensurability as central properties in environmental decision-making as given. They are most often treated interchangeably and used as straps around the core analysis of papers. Several authors use a very similar way to frame and embed their arguments. Typically, the storyline goes as follows: incommensurability of values and/or value pluralism are mentioned in the introduction of the article as fundamental pillar of ecological economics (mainly citing Martinez-Alier 1998 and other (but few) "usual suspects" such as O'Neill, Vatn and Spash). These references seem to be taken as justification for not being explicit about what is meant by the respective terms. Following, the mainstream compression of values is attacked as being insufficient, misleading, distracting and ineffective and an argument is constructed that effective sustainable development policies demand dealing with conflicting interests and priorities, usually by means of creating some form of deliberative institutions or other new (mainly participatory) decision support methods. An epistemological claim for various sources of knowledge often follows, and a link to post normal science is established. The article usually ends by making some reference again about the importance of value pluralism and/or incommensurability. This approach is taken, for instance, by Shmelev and Rodriguez-Labajos (2009) with a case of multidimensional sustainability assessment in Austria; Ananda and Herath (2009) with a case of forest management policies in India; Bebbington et al. (2007) with a case of sustainability assessment models; or Zendehdel et al. (2008) with a case of a group consensus method applied in Iran.

Having established how our key terms are used (or not used) in the core ecological economics literature, we turn to the question why plural values and incommensurability matter for ecological economists. There is widespread agreement that the nature of the problems around (un)sustainability is fundamentally different from standard applications in economics. "Estimating costs and benefits […] is of little help if the problem faced by contemporary societies is one of values, ethics, ideology and even world views" (Söderbaum 1994:55). Ecological economists are generally not against economic values to natural resources but against the sole use of them. As ecosystem features are highly complex, dynamic and interrelated, their value cannot be condensed in a simple metric. Environmental risks and economic risks are not comparable at all because the nature of them is just too different. Damage to the environment is considered non-monetary in principle, often irreversible, and a collective problem.

Against this background, almost all articles contain a fundamental critique of the mainstream orthodox approach, with varying degrees of acidity. Söderbaum's article is primarily a critique of the mainstream cost-benefit framework to environmental problems (1994). Another example is provided by Temper and Martinez-Alier (2013) who attack net present value, using a case story from India. Overall, severe concern is raised that reducing values to a single one-dimensional standard in market and monetary

terms leads to "risk with human health and survival" (Kapp cited in Martinez-Alier et al. 1998:279). It is argued that it is highly misleading to take decisions based on only one type of value (Martinez-Alier and Temper (2013) providing a full account of the example of climate change; Spangenberg (2007) of biodiversity). By not respecting and accounting for irreversible and irreplaceable environmental damages and losses several goals of ecological economics are endangered simultaneously, e.g. social justice, or addressing the different faces of inequalities.

Decision-making processes are understood as situations were plural values and interests are omnipresent. In other words, decision-making is, at its core, about dealing with conflict. Ultimately, the challenge is to openly articulate different shades of values and finding ways to constructively dealing with them. Taking into account plural values and incommensurability does not mean that all conflicts can be solved, but they allow a deeper understanding into their nature and how they can be balanced out by political compromise and increasing transparency of the choice process (Martinez-Alier et al. 1998). "Environmental policy [...], in order to be realistic, should [...] deal [...] with the higher dimensions of the system, those in which power relations, hidden interests, social participation, cultural constraints, and other "soft" values, become relevant and unavoidable variables that heavily, but not deterministically, affect the possible outcomes of the strategies to be adopted" (Martinez-Alier et al. 1998:282). It is argued that conflict might help sustainability. This view stands in stark opposition to the mainstream view that values can be "objectivised" and glossed over by presenting numbers at the end of a value-compressing exercise as "facts". Again, the standard utility model is completely compensatory, i.e. decisions involve trade-offs that can be offset by a large enough advantage over the disadvantage. For ecological economists, on the other hand, there are issues where no trade-offs are involved (Martinez-Alier et al. 1998 and Kallis et al. 2013). Whether people value something or not, there are certain critical parts without which ecosystems and thus life support systems do not function in the long term.

So, what are the implications of value pluralism and incommensurability in practice? If we assume that there is no and should not be one common unit of value to compare different options the key question arises: how can conflicts be resolved? What tools and strategies do we have to mediate between different values and situations of conflict?

An essential avenue of capturing different values comprehensively is by the application of a broad range of social-science tools and methods. Chan et al. (2012) make a case for such a multi-method and multi-metric approach. They argue that "market-mediated values", for instance, can generally be accessed by applying monetary valuation, whereas "non-market-mediated values" largely cannot. For "biocentric values" (e.g. intrinsic value for non-human beings) and "other-oriented values" (e.g. future people) deliberative approaches are more suitable than economic valuation methods. Some forms of values demand a richer form of communication such as narration. On top of this differentiated tackling of values, a combination of methods seems sensible to account for the fact that usually more than one kind of value is involved (Chan et al. 2012).

Multi-criteria analysis is one of the methods mentioned by most of the authors as a promising approach to compare alternatives under incommensurability of values. It is a methodology to structure complex problems in matrix form, with alternatives on one axis and evaluation criteria on the other. The matrix can consist of qualitative, quantitative or both types of information and can be applied for macro, micro and project evaluation. This framework is expected to enhance a decision process by fostering transparency and

notions of quality and process. Originally not participatory, the approach was further developed to include working with different stakeholders to increase the quality of deliberation, an approach called social multi-criteria analysis (Garmendia and Gamboa 2012).

Biophysical indicators or satellite accounts are another, though only briefly mentioned, option by Martinez-Alier et al. (1998), Söderbaum (1994) and Spangenberg (2006) to represent plural values. Non-monetary measures of the environment matter as they are a relatively direct way to assess both quantities and qualities of environmental media. As such, measuring material use in tons, energy use in Joules or water use in litres or the toxicity of chemical substances seem appropriate for effectively assessing environmental problems. The development and use of such measures also distinguishes ecological economics from environmental economics, where values are traditionally expressed in monetary terms.

The precautionary principle is put forward by Aldred (2013) as another approach based on incommensurability claims. He argues that the precautionary principle can be justified on the basis of a combination of uncertainty and incommensurability. If uncertainty is high, a low incommensurability claim is sufficient to justify the application of the precautionary principle, and vice versa. Opposing views of some economists that the precautionary principle cannot be practically applied he tries to make a case in the context of climate change decision-making. Drawing on political philosophy he argues that incommensurability implies a discontinuous ordering of possible outcomes, which fits the nature of the climate change problem as "climate risks and economic risks are not comparable at all" (Aldred 2013: 137). However, he largely remains unclear about how to operationalise the concept, but rather provides, in his own words, "an explanatory framework for helping decision-makers structure their thinking in a way that focuses discussion and so might facilitate debate and agreement" (Aldred 2013: 139). At the end, he briefly mentions that safe minimum standards endorse incommensurability claims alike.

Deliberative valuation methods are propagated as the most prominent "group of methods" for dealing with plural values. Deliberation means "a particular sort of discussion that involves the careful and serious weighing of reasons for and against some proposition. It is the act of considering different points of view and coming to a reasoned decision that distinguishes deliberation from a generic group activity. Emphasis is given to the product that arises from discussion (e.g. a decision or set of recommendations), and the process through which that product comes about" (Antunes et al. 2009:933). In addition, deliberative approaches "presume the existence of irreducible conflicts in values and beliefs" (Lo 2013:85). Based on Habermas' account of communicative rationality, they are interactive processes of communication coordinated through discussion and socialisation of individuals with the goal to achieve generalizable interests or, in other words, a workable agreement. This is based on the assumption that people are capable and willing to listen to each other and open about sharing subjective values. The hope is that after deliberation people become more sympathetic to each other's position (Lo 2013). A plethora of disaggregated and ethically open methods are suggested, such as citizens' juries, multi-criteria mapping, trade-off analysis, participatory modelling methodology, deliberative visioning, participatory multi-criteria analysis, or alternative water forums (Antunes et al. 2009, Kallis et al. 2013, Kenyon 2007) While strongly

propagated in the ecological economics community, Kallis et al. (2013) highlight that these methods are still marginalised.

Value articulating institutions are highlighted as a way of framing methodologies fit for wrestling with different values so that plural values can speak (Kallis et al. 2013). They are sets of rules that shape social processes of valuation by addressing questions such as: Who shall participate? In what role? What data is considered relevant? How is data processed? (Vatn 2005). The choice of specific value articulating institutions influences what values are included, what are excluded, and what type of conclusion can be reached (Vatn 2005). An example of a plural value articulating institutions is courts, as they enable different logics to be sustained, e.g. historical justice, or expressing values of recognition or responsibility (Kallis et al. 2013).

Besides the application and combination of different methods and methodologies in a sensible way, two other strategies are highlighted in the literature as paving the way towards value pluralism in practice: a more conscious use of language and looking for alliances within and beyond academia. The use of specific language is propagated as one way to change discourses about values. The argument is that certain languages supress other languages and thus values. Concepts such as ecosystem "services" and "natural capital" are not innocent but increasingly frame human-non human relationships as exchange value relationships and thus have to be approached with caution or rejected altogether (Kallis et al. 2013 and Spash 2013 respectively).

Teaming up with other research fields is suggested as another strategy to strengthen a value pluralistic position. Kallis et al. (2013) argue that ecological economics could strengthen its opposition to the mainstream by gaining insights from Political Ecology on issues of power, institutions, institutional change, and explanations why mainstream economics became to dominate. The authors describe that while plural values is a hobby-horse for ecological economists its implementation will remain difficult and "politically ineffective if they do not recognize the social processes and dynamics that make this normative proposal so hard to implement … Why does the World Bank or International Union for Conservation of Nature promote markets for ecosystem services and not deliberative forums? Without a social, political-economic theory such as the one offered by political economists, the critique of ecological economics will remain a methodological and normative one and will not go far" (Kallis et al. 2013:100). In the same spirit, Spash (2013) emphasises that the broad nature of ecological economics based on value pluralism demands links across heterodox schools of thought, e.g. to critical institutionalists, evolutionary and feminist economists, and critical realists. Chan et al. (2012) join the canon by expressing that anthropologists, sociologists, ethicists, etc., attempt to account for a broader set of values too and that alliances to those fields are necessary to make decision-making frameworks more comprehensive in values. Some authors (e.g. Chan et al. 2012 or Hardy and Patterson 2012) formulate the need for extending alliances beyond academia to include other stakeholders as well, such as policy makers, practitioners, CSO representatives, or indigenous groups. These desired collaborations entail a plea for a post normal science approach towards research.

4. Discussion and conclusion

As PhD researchers learning about *Ecological Economics* for a number of years, we have been exposed to repeated claims that plural values and incommensurability are foundational pillars of the discipline. This motivated us to look more closely into this topic. Against this background it is very surprising to discover how little attention is paid towards both notions in the journal. Out of a total of approx. 8500 articles, only a handful of about 6 or 7 articles seriously tackle value pluralism and incommensurability. We are concerned that there is extremely little debate in the core journal about one of the roots of the field and wonder why this is so. Is theory not considered useful to inform normativity? Couldn't a deeper understanding of what values are, how they emerge and exist inform dealing with value conflicts? We believe that it could.

The lack of theoretical grounding gives way to a pragmatic approach of dealing with different values. The main focus within the ecological economics community clearly is on how to put plural values and incommensurability into practice. However, it seems to be some sort of "pick and choose" approach, i.e. author A proposes this method, author B that one, author C yet another one. There seems to be general agreement that the mainstream approach is generally "bad" and that deliberative/democratic/participatory methods are generally "good" but in the sample literature from the journal there is little systematic investigation about what deliberative methods actually are, why they are better, in what contexts, and what their potential problems are[2]. The pragmatic approach taken rests on a huge assumption that more democratic processes will lead to less unsustainability and that social cooperation based on communication is a way to resolve conflicts. Democracy in general, and direct democracy in particular in the form of more public engagement, appeal as a way to achieve consensus about plural values, especially in the case of collectively held sustainability problems. It remains an open question whether this is really the case. The question what the evidence is for and against democracy as a tool to deliver sustainability remains unasked and largely unquestioned. Although we do see great advantages of participatory deliberative processes, we also argue that they are no guarantee for dealing with plural values per se. Participatory approaches are loaded with difficulties and raise questions such as, how to cope with influential social actors who shape opinions? How to make sure that facilitators have the relevant skills to manage participation processes effectively? How to avoid artificial consensus? We suggest that more research is needed to show how, when and why deliberative methods are successful in addressing plural values and to understand why they are still marginalised. Until now the methodologies suggested in the literature are rather technical and largely do not address issues of power: Who values? How? And why? We support voices that suggest learning from other fields such as political ecology (Kallis et al. 2013) or classical institutionalism (Spash 2013) to better understand the dynamics underlying valuation.

In the section about axiological position, we described different positions in relation to the ontological status of values. In spite of a very limited explicit treatment of this subject in the reviewed ecological economics literature, it is still possible to discover expressions of some of these positions. The subjectivist approach to values can be found in Lo's definition of values, which emphasises the personal and subjective origin of values

[2] Lo and Spash (2013) form the exception by showing that not all forms of deliberative methods defend value pluralism, e.g. deliberative monetary valuation (DMV).

(Lo 2013), while the objectivist approach can be found in the view that vital elements of ecosystems are objectively valuable, regardless of human valuation, due to their importance for the overall functionality of these systems (Martinez-Alier et al. 1998, Kallis et al. 2013). Even though it is possible to find both subjectivist and objectivist approaches to values, the most prominent approach seems to be an understanding of values, which emphasises practices of valuation and value articulating institutions (Vatn 2005). This conceptualisation of values is somewhat parallel to French pragmatism, as touched upon earlier, in the sense that it reflects an interest in how values are articulated through modes of valuation. In this view, the question of incommensurability becomes a question of struggles between opposing modes of valuation.

We find that such questions have not been exhaustively treated in ecological economics, and that there is a need for furthering the research on values and methods of valuation. Ecological economics has contributed to the conceptualisation of value articulating institutions such as multi criteria analysis and deliberative methods, but it seems to us that this work can be seen as basis for continued research in and further development of these institutions[3]. This connects to our view that the solution to the problems of our time is a democratic issue. If we want to change things, then we need to transform our democratic institutions and processes. In our view this calls for increased attention to values and value articulating institutions.

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[3] One aspect of this research should include the question of how digital methods and communities participate in present day deliberation, a question which seems absent in ecological economics literature on deliberative methods.

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Appendix 2: list of data material

Interviews

- Andersen, Frits M.; professor of economics, Technical University of Denmark, Risø.
- Bjørnholm, Sven; senior lecturer in physics (retired), the Niels Bohr Institute, Copenhagen.
- Blegaa, Sussanne; high school teacher (retired). During the 1970s, employed at Technical University of Denmark.
- Campiglio, Emanuele; fellow in environment and development economics, London School of Economics.
- Grinderslev, Dorte; chief consultant, The Danish Council on Climate Change.
- Holm, Anders; senior lecturer in physics (retired), the Niels Bohr Institute, Copenhagen.
- Holten-Andersen, John; senior lecturer in engineering (emeritus), Aalborg University Copenhagen.
- Jespersen, Jesper; professor of economics, Roskilde University.
- Josephsen, Lars; consultant at the Danish Ministry of Energy and Environment (retired), the Danish Ministry of Energy and Environment.
- Knoeri, Christof; senior researcher, sustainability and technology, ETH Zürich.
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- Laslett, Robert; professor of economics, University College London, former employee at the UK Treasury.
- Meyer, Niels I.; professor of physics (emeritus), Technical University of Denmark.
- Morthorst, Poul E.; professor of economics, head of the systems analysis devision at Technical University of Denmark, Risø
- Nørgaard, Jørgen; senior lecturer in physics and engineering (emeritus), Technical University of Denmark.
- Pedersen, Sigurd L.; chief consultant, the Danish Energy Agency.
- Sakai, Marco; economics research fellow, University of Leeds, former employee at the Mexican Ministry of Finance.
- Thomsen, Thomas; economist, selfemployed developer of solution algorithms for macroeconomic models.
- Werner, Morten; consultant in the macro-policy centre at the Danish Ministry of Finance.
- Willis, Geoff; independent econophysics researcher.
- Winning, Mathew; research associate, environment, energy and resources, University College London.

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- Mathematical models in macroeconomics, Roskilde University, Denmark, March 14, 2013
- Exergy-economics workshop, University of Leeds, UK, May 19-20, 2014
- Fiscal policy in Denmark, Netøk, Copenhagen, Denmark, January 23, 2015
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