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CAREER EFFECTS OF MENTAL HEALTH: EVIDENCE FROM AN INNOVATION IN TREATING BIPOLAR DISORDER*

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We use the approval of lithium as treatment for bipolar disorder (BD) in Denmark in 1976 to investigate the career effects of mental health. Comparing people with and without BD, across cohorts that gained access to lithium at different ages and relative to siblings with other conditions, we find that access to treatment innovations increases labor market participation by 22 percent and earnings by 20 percent among people with BD. These benefits operate largely through a reduction in the risk of disability, rather than through changes in occupation or educational achievement. Benefits are larger for people with less parental wealth.

KEYWORDS: Mental Health, Careers, Treatment Innovations, and Bipolar Disorder

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One in eleven people suffers from a mental health disorder, such as depression, anxiety, schizophrenia, or bipolar disorder (BD).[1] These conditions may create severe costs for a person's career: They are associated with lost days of work (Kessler and Frank, 1997; Kessler et al., 2006) and are among the leading causes of lost disability-adjusted years of life (WHO, 2011). As a result, the welfare gains of treatment innovations could be very large.

Yet, the economic benefits of treatment innovations are difficult to quantify. First, both the incidence of mental health disorders and access to treatment can be related to family background, which also influences career outcomes.[2] In addition, family disadvantage can undermine people's labor market success. The important role of family background for both a person's mental health and their career outcomes thus makes it difficult to identify the career effects of mental health disorders and treatments.

To address these empirical challenges and investigate the career effects of treatment innovations, we exploit an important change in the treatment of BD. In 1976, the Danish drugs authority approved lithium – a superior drug compared with previously available options – as the primary maintenance treatment for BD. To quantify the career effects of this change, we compare differences in labor market outcomes for people with BD with and without access to lithium in their 20s. To account for the role of family background, we further compare these two groups with their healthy siblings and with people with other mental health conditions, for which lithium is not used as the primary treatment. We find that access to improved treatment dramatically improved the careers of people with BD relative to their siblings, increasing their chances to participate in the labor market and helping them earn more.

BD is a severe disorder that affects over two million people in the United States and 0.6 percent of the population worldwide. It causes extreme shifts in mood, energy, and the ability to carry out day-to-day tasks. Until 1976 BD was primarily treated with sedatives, with limited effectiveness (López-Muñoz et al., 2018). In 1976, however, the treatment options for BD improved dramatically with the approval of lithium as the primary treatment. This change initiated a revolution in treatment: Lithium consumption is associated with major reductions in rates of relapse (Davis, Janicak, and Hogan, 1999) and in the risk of suicide and hospitalizations (Baldessarini, Tondo, and Hennen, 1999; Angst et al., 2005). These features make lithium the preferred maintenance treatment for BD to this day. Its approval was followed by advances in

[1] Vos et al. (2020) and https://ourworldindata.org/mental-health.
[2] For example, people living in poverty may be more likely to suffer trauma, which can trigger mental health disorders (Persson and Rossin-Slater, 2018; Adhvaryu, Fenske, and Nyshadham, 2019), and they are less likely to receive treatment (Katz et al., 1997).

cognitive behavioral therapy (CBT) and the development of improved mood stabilizers, antidepressants, and antipsychotics, further expanding treatment options for people with BD. Our analyses investigate the joint effects of lithium and these additional treatment innovations.

To estimate the career effects of access to improved treatment, we use individual-level data on medical diagnoses, labor force participation, and earnings for the population of Denmark between 1995 and 2015. These data cover 3.1 million people born between 1940 and 1977, including over 34,000 people with BD and their siblings. A major advantage of these data is that we can link individuals to their siblings. This allows us to compare career outcomes of siblings with and without mental health disorders, fixing family background characteristics that could impact both people's labor market outcomes and their likelihood of having a mental health condition and receiving treatment for it.

To quantify the impact of improved treatment on people's careers, we compare differences in labor market outcomes of people with BD and their siblings for people who gained access to treatment at different ages. We start from simple difference-in-differences specifications, which compare differences in labor force participation and earnings for people with BD and their siblings across cohorts of people born before and after 1956, who were above and below the age of 20, respectively, when lithium was approved in Denmark in 1976. We choose age 20 as the cutoff for these tests because it is a typical age of onset for BD (Kessler et al., 2005). In complementary tests, we estimate differences by cohort.

Under the assumption that, in the absence of treatment innovations, differences in labor market outcomes between people with BD and their healthy siblings would have remained constant for people born before and after 1956, difference-in-differences estimates capture the causal effect of access to treatment innovations by age 20 on people's careers. Importantly, comparing differences in career outcomes for people with BD and their siblings allows us to control for unobservable factors that vary across families and may impact both a person's career and the incidence and treatment of BD.

With this identification strategy, we begin by studying the effects of BD and access to treatment innovations on labor force (non-)participation, and more specifically on the probability of having no earnings each year. Compared with their siblings, people with BD who did not have access to treatment in their 20s were 1.2 times more likely to have no earnings. By comparison, people who did have access at age 20 were 75 percent more likely to have no earnings. Taken together, these estimates imply that access to treatment at age 20 eliminated 40 percent of the gap in labor force participation for people with BD.

A potential threat to our empirical strategy is that the penalties associated with *all* mental health conditions – not just BD – may have declined for cohorts born after 1956, for example due to a decline in the stigmatization of mental health disorders. We address this challenge by estimating a triple difference model, using people with other mental health conditions (such as depression, anxiety, and schizophrenia) as an additional control group. This model estimates (i) the changes in outcomes of people with any mental health conditions (including BD) born after 1956 relative to before (and relative to their siblings); and (ii) the additional change experienced by people with BD. Since lithium is almost uniquely used by people with BD, the latter change can be attributed to the improved treatment for BD.[3]

Triple-difference estimates confirm our findings. Compared with people who did not have access to improved treatment at age 20, cohorts with access had a 22 percent smaller risk of zero earnings relative to their healthy siblings. In contrast, the risk of zero earnings did not change significantly across cohorts for people with depression, anxiety, or schizophrenia.

To investigate the dynamics of the impact of access to improved treatment, we estimate differences in the risk of no earnings between people with BD and their siblings with other conditions, separately by two-year cohorts. Relative to the people born in 1954-55 (our reference group), the difference in the likelihood of having zero earnings became significantly smaller starting from the 1956-57 cohorts, who entered their twenties after the approval of lithium, and continued to decline for younger cohorts. Notably, differences in the risk of zero earnings are indistinguishable from zero across all cohorts who did not have access to treatment by age 20 (i.e., those born prior to 1956). These results support our identification assumption.

In addition to improving the odds of labor market participation for people with BD, treatment innovations may also increase earnings. Conditional on having positive earnings, people with BD who did not have access to treatment at age 20 experienced a 50 percent earnings penalty compared with their healthy siblings; people who did have access, however, only experienced a 40 percent penalty, 20 percent smaller. Access to treatment also impacts the odds that people with BD have earnings in the top and bottom echelons of earnings.

What explains these findings? We investigate two possible channels. First, access to improved treatment may reduce symptoms and allow people to participate in the labor market. We test this hypothesis by studying whether access to improved treatment changes the likelihood of receiving disability payments, a type of welfare support designed to help people

[3] When lithium is used for other mental health disorders, it is mostly described as an "add-on" rather than a primary treatment, e.g., to treat mania for people with schizophrenia (Leucht et al., 2015).

who cannot work full-time. We find that people with BD without access to treatment are a staggering 4.5 times more likely to receive disability pay compared with their healthy siblings. Access to improved treatments eliminates 38 percent of their excess likelihood of disability.

Second, access to treatment may make people more likely to sort into jobs that pay more. Our data partly supports this hypothesis: Access to treatment leads people to switch towards slightly higher-paying jobs. However, our estimates for baseline earnings penalties and the impact of treatment remain unchanged if we control for occupation-by-year fixed effects, indicating that occupational sorting cannot entirely explain our findings.

Lastly, access to treatment might increase the odds that people with BD obtain a college degree, associated with higher earnings. We do not find any evidence of this. This result is consistent with evidence that people with BD typically do well in school (Vreeker et al., 2016). It could also be due to educational choices being largely realized by age 20. This finding further supports the hypothesis that improvements in earnings occur primarily through an increase in a person's ability to work.

Next, we investigate whether the penalties from BD and the benefits from treatment differ across gender. In our data, women are 30 percent more likely to be diagnosed with BD and face larger career penalties from BD. The benefits of access to treatment are comparable across genders, indicating that treatment does not mitigate gender gaps in career outcomes.

The benefits from treatment may also differ across socioeconomic status (SES). To investigate whether and how a person's SES influences the career effects of mental health, we estimate the penalties from BD and the impacts of access to improved treatment across the spectrum of SES using parental assets as a proxy for SES. Both the penalties associated with BD and the benefits from treatment are much larger for people with parental assets in the three lowest quartiles of the distribution. Lastly, treatment benefits could be related to the severity of the condition. Using the number of BD diagnoses as a measure of severity, we find that people who receive multiple diagnoses of BD experience larger penalties and benefit more from access to improved treatment.

Taken together, our estimates indicate that innovations in treatment for mental health conditions are associated with important economic gains. Our findings contribute to an emerging literature on the economic effects of mental health and its treatment, most of which has focused on depression. This literature includes experiments providing patients with psychotherapy and pharmacotherapy (Angelucci and Bennett, 2021; Baranov et al., 2020), as well as quasi-experimental studies of expansions of insurance coverage of psychotherapy services (Serena, 2022), the introduction of black-box warnings for SSRI (Bütikofer, Kronin,

and Skira, 2020), spending on drug advertisements (Shapiro, 2022), and physicians' propensity to prescribe drugs (Laird and Nielsen, 2017). We contribute to this literature in two ways. First, we use registry data and a major, large-scale discontinuity in treatment to identify the causal effect of pharmaceutical treatments on mental health. Second, we perform these analyses for BD, a common condition with severe symptoms that has been thoroughly researched in medicine and psychology (e.g., Kyaga et al., 2011; Kyaga et al., 2013) but has received little attention in economics to date.

Our paper also speaks to the literature on the economic effects of treatment innovation, which has focused primarily on disorders outside of mental health, such as chronic pain (Grthwaite, 2012; Bütikofer and Skira, 2018). We contribute to this literature by assessing the economic impacts of treatment innovations for mental health conditions.

More broadly, our findings relate to the literature on the causal effects of mental health on socioeconomic and labor market outcomes. Most of these studies have used survey data and are either correlational or observational.[4] In this paper, a large-scale quasi-experiment allows us to identify the causal impacts of mental health on outcomes. Administrative data on medical diagnoses linked to labor market outcomes, for individuals and their siblings, also enable us to track people over a longer time span and to account for family background.

In addition, our findings provide new evidence on the differential impact of mental health conditions and access to treatment across the spectrum of SES. Building on existing research on the effects of economic status on mental health (Haushofer and Shapiro, 2016; Ridley et al., 2020; Ahammer, Grübl, and Winter-Ebmer, 2020; Ahammer and Packham, 2020), on the intergenerational persistence of mental health outcomes (Aizer and Currie, 2014), and on the relationship between parents' earnings and children's mental health (Adhvaryu et al., 2019), we demonstrate that access to improved treatments can reduce inequality due to differences in mental health.

I. Data and Background on Mental Health Disorders

This section describes our data and summarizes relevant research from medicine and psychology on BD and its treatment, as well as on other mental health conditions. We link individual-level data on diagnoses and career outcomes from multiple public registries, which cover the population of Denmark between 1995 and 2015. We restrict our attention to people

[4] Correlational studies include Bartel and Taubman (1986); Goodman, Joyce, and Smith (2011); Hakulinen et al. (2019); Wang, Frank, and Glied (2022).

born in cohorts 1940 to 1977 who are between the ages of 20 and 65; this leaves us with 3,103,605 people observed between 1995 and 2015.[5]

A. Mental Health Diagnoses and Medication

In Denmark, severe mental health diagnoses (such as BD) are made by psychiatrists, to whom patients are referred by primary-care physicians.[6] We draw information on inpatient and outpatient diagnoses from the Central Psychiatric Register (*Landspatientregistret for Psykiatri Diagnoser*), covering the period between January 1, 1995, and December 31, 2015. The register uses the World Health Organization (WHO)'s International Statistical Classification of Diseases and Related Health Problems (ICD-10) to classify mental health disorders.[7] Appendix Table A2 includes a detailed description of this classification. We complement diagnoses data with information on drug prescriptions from the Prescription Register (*Lægemiddeldatabasen),* which includes all prescriptions from 1995 to 2015 from all doctors and hospitals in Denmark.

For our analysis, we construct indicators for people with at least one diagnosis of BD, depression, anxiety, and schizophrenia. The following paragraphs describe each mental health condition and discuss treatments for BD.

Bipolar Disorder (*BD*) is a brain disorder that causes extreme shifts in mood, energy, and activity levels, limiting a person's ability to carry out day-to-day tasks. The National Institute of Mental Health (NIMH) and the American Psychiatric Association (APA) distinguish between two types of BD, I and II. BD I is defined by at least one lifetime manic episode (characterized by irritability, euphoria, a decreased need for sleep, increased activity, grandiose ideas, racing thoughts, impulsivity, and distractibility) or mixed episode (combining symptoms of mania and depression). BD II is defined by a pattern of depressive and hypomanic episodes, without the full-blown manic episodes that are typical of BD I.

The ICD classification does not distinguish between BD I and II and only categorizes "Bipolar Disorder" and "Manic Episode." "Bipolar disorder" (diagnosis code ICD-10: F31) is described as "A disorder characterized by […] some occasions of an elevation of mood and increased energy and activity (hypomania or mania) and on others of a lowering of mood and decreased energy and activity (depression)." "Manic episode" (diagnosis code ICD-10: F30) is "A disorder […] which varies from carefree joviality to almost uncontrollable excitement, […]

[5] These data are administered by Statistics Denmark. Appendix Table A1 describes the individual registries.
[6] Diagnosis and treatment guidelines require that primary-care physicians refer patients with suspected or diagnosed BD to the psychiatric hospital system (Danish Health Authority, 2016; Doctors' Handbook, 2023).
[7] See http://apps.who.int/classifications/icd10/browse/2016/en#/F30-F39.

accompanied by increased energy, resulting in overactivity, pressure of speech, and a decreased need for sleep."

Worldwide, BD affects about 40 million people, most of whom remain untreated.[8] Although the precise causes of BD are unknown, existing evidence points towards differences in the brain systems that regulate emotions and a dysregulation in the use of dopamine, a neurotransmitter that helps regulate reward-motivating behavior (Miklowitz and Johnson, 2006). Medical studies have found the median age of onset for BD to be 18 years (Kessler et al., 2005), with 62 percent of patients being diagnosed before age 20 (Oedegaard et al., 2009). We exploit this fact to compare people with and without access to treatment at age 20.

Lithium as a Treatment for BD. Denmark's equivalent to the Federal Drug Administration, the *Lægemiddelstyrelsen*, approved the mood-stabilizer lithium as a "maintenance" treatment for BD in 1976 (Bech, Vendsborg, and Rafaelsen, 1976). As a treatment for BD, lithium is typically given in stages. The first is the acute treatment of an episode that has already developed. The second is maintenance treatment to delay and moderate future episodes and to reduce symptoms between episodes. Before 1976, treatment options for BD mostly consisted of sedatives (such as morphine, hyoscyamine, chloral hydrate, and barbiturates). These treatments, however, had limited efficacy (López-Muñoz et al., 2018). In our data, one percent of all people had at least one lithium prescription, including 64 percent of those with at least one diagnosis of BD (Appendix Figure A2).

Complementary treatments in the form of psychosocial interventions ("therapy") and other drug treatments (such as antidepressants, anti-anxiety medications, and other types of mood stabilizers) also improved substantially after 1976. For example, interest in the application of cognitive behavioral therapy (CBT) began in the early 1980s (Cochran, 1984), after the introduction of lithium. Among all treatments, however, lithium has the strongest scientific record of controlling mania and preventing recurrences. Approximately 60%–70% of people with BD show remission of manic symptoms while on lithium (Goldberg and Harrow, 2004). Lithium take-up is also associated with a significant reduction in the risk of hospitalization and with a 7-fold reduction in suicide rates for people with BD (Baldessarini et al., 1999). Importantly for our analysis, treating BD in earlier stages of the illness is most effective in reducing symptoms and relapse rates over time (Joyce, Thompson, and Marwaha, 2016). To maximize our ability of spotting people with BD, we construct our variable *BD* as

[8] BD is highly comorbid with other mental health conditions. In our data, approximately 90% of people with BD are ever diagnosed with either depression or anxiety, and 70% are ever diagnosed with schizophrenia (Appendix Figure A1).

an indicator for either at least one diagnosis of bipolar disorder, one diagnosis of mania, or one prescription of lithium. Using this definition, our data contain 34,331 people with BD (1.1 percent, Table 1).

Other Mental Health Conditions. Major depressive disorder, or *depression* for short, is a common and serious mental disorder that negatively affects how people feel, think, or act. Symptoms include sadness, a loss of interest in activities, trouble sleeping, a loss of energy, difficulties concentrating or making decisions, and thoughts of death or suicide. For a diagnosis of depression, symptoms must last for at least two weeks.

In our data, this condition is identified by either diagnosis code ICD-10: F32: "[…] mild, moderate, severe or recurrent depressive episodes, [in which] the patient suffers from lowering of mood, reduction of energy, and decrease in activity," or by the prescription of SSRIs or benzodiazepines (Appendix Table A2).[9] According to the WHO, depression affects 264 million people worldwide.[10]

Anxiety is a condition characterized by feelings of tension; worried, recurring intrusive thoughts; and physical changes like increased blood pressure, sweating, trembling, dizziness, or a rapid heartbeat. In our data, this condition is identified by either diagnosis codes ICD-10: F40-F43 (including phobic anxiety disorders, other anxiety disorders, obsessive-compulsive disorders, and reaction to severe stress disorders), or by the prescription of benzodiazepines. Because of high comorbidity, we combine diagnoses of depression and anxiety in a single indicator.

The variable *schizophrenia* is an indicator for having at least one diagnosis with code ICD-10: F20-F29: "Schizophrenia, schizotypal, delusional disorders and a larger group of acute and transient psychotic disorders," or at least one prescription of second-generation anti-psychotics (Appendix Table A2). Schizophrenia involves problems with thinking (cognition), behavior, and emotions, with symptoms that include delusions, hallucinations, or disorganized speech.

The share of people with BD is stable across cohorts, with 1.2 percent for the 1946, 1954, and 1960 cohorts and 1.0 for the 1975 cohort, respectively. Rates of diagnosis for schizophrenia are also quite stable at around 1.5 percent, while rates of diagnosis for depression and anxiety decrease across cohorts (Appendix Figure A3).

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[9] SSRIs and benzodiazepines are the main medications for depression according to Danish guidelines (see https://www.sundhed.dk/sundhedsfaglig/laegehaandbogen/psykiatri/tilstande-og-sygdomme/depressioner/depression/
and https://www.sundhed.dk/borger/patienthaandbogen/psyke/sygdomme/laegemidler/benzodiazepiner/).

[10] World Health Organization Fact Sheet, April 2017 (http://www.who.int/mediacentre/factsheets/fs396/en/).

B. Earnings and Disability

To calculate a person's *earnings,* we add income from wages and self-employment (Appendix Table A1). We convert earnings from Danish Kroner (DKK) to 2015 US dollars using the Danish CPI and the 2015 exchange rate. Individuals with positive earnings earn $51,928 on average, with a standard deviation of $82,375 (Table 1).

A separate variable measures *disability* receipt (*førtidspension*). People with disabilities apply for these benefits with their municipal government, which evaluates their ability to work (*ressource-forløb*), and assigns payments based on the severity of the disability and family status. People who receive disability payments can work part-time, earning up to an amount that depends on household structure, income, and wealth. Thirteen percent of all people receive disability pay at least once during our sample period, including 17,918 people with BD (52 percent of all people with BD, Table 1).

C. Family Identifiers and Parental Wealth

To control for unobservable factors that vary across families, we link each person to their siblings using their mother's or father's anonymized social security number as a family identifier. Family identifiers are available for 1.8 million people (58 percent of the population); 79 percent of all these people and 76 percent of people with BD have at least one sibling.[11] Seventy-one percent of people whom we link with their parents have at least one parent who reported positive financial assets to a bank for at least one year between 1980 and 2015. To define a person's position in the distribution of parental wealth, we calculate the percentile of parental assets for each year and assign the person to their parents' median percentile across all years.

*D. Job Descriptions: O*NET*

We classify job types by link each person's occupation (recorded in the Danish administrative data using 3-digit ISCO classifications) to detailed information about the characteristics of that occupation from O*NET.[12] With these data, we characterize five different "dimensions" of an occupation: management, decision-making, work under pressure, artistic work, and social

[11] Our main results remain robust when we exclude family fixed effects from all specifications and estimate them on the sample of all people, including those without a family identifier (Appendix Table A4). They are also robust when we exclude family fixed effects from our main sample (Appendix Table A6). Lastly, they are robust when estimated on families with just one child (Appendix Table A5).

[12] Sponsored by the US Department of Labor, O*NET is a survey database containing information on each occupation's required tasks, skills, competences, interests, and work context.

skills. Each dimension is calculated as an occupation-specific average of the associated skills, interests, contexts, and activities, measured in levels and standardized to have mean zero and variance one. Appendix Table A3 details the construction of these variables.

II. Penalties from BD and Impacts of Treatment Innovations

This section estimates the effects of access to improved treatment on labor market outcomes of people with BD, including labor market participation, earnings, and the probability of disability pay. Since lithium became available only in 1976, people in younger cohorts had access to treatment from a young age, while people in older cohorts remained untreated for a greater portion of their life.[13] Our baseline estimates use 20 as the reference age to define early access to treatment, the average age at onset for BD and a critical moment for a person's career (Kahn, 2010; Oreopoulos, von Wachter, and Heisz, 2012; Arellano-Bover, 2024).

A. Difference-in-Differences

To quantify the impact of access to improved treatment, we leverage differences in access to lithium across cohorts. For simplicity, we begin by comparing the difference in outcomes between people with BD and their siblings and for cohorts born after 1955, who had access to improved treatments when they turned 20, and older cohorts, who did not have access at that same age. Intuitively, the former should have had better access to a treatment for BD than the latter. The difference in the excess probability of having no earnings in a given year, for people with BD relative to their siblings and between cohorts born after 1955 and older cohorts, is captured by β in the following equation:

$$(1) \quad \mathrm{I}(earnings_{it} = 0) = \alpha\, BD_i + \beta\, BD_i * access_{c(i)} + \tau_t + F_i * \tau_t + \theta_{c(i)} + F_i * \theta_{c(i)} + \delta_{f(i)} + \varepsilon_{it}$$

where the dependent variable $\mathrm{I}(earnings_{it} = 0)$ equals one if person i in cohort $c(i)$ (e.g., 1950) earns zero in year t. BD_i equals one for people who have been diagnosed with BD at least once and $access_{c(i)}$ equals one for cohorts born after 1956, who had access to improved treatment at age 20. Year fixed effects τ_t control for changes in aggregate rates of employment and other

[13] Early exposure is also associated with higher odds of using lithium later in life. The lack of prescription data before 1995 prevents us from measuring changes in lithium usage at the time of its approval. Data only start in in 1989. These data show that among patients with BD in a veterans' hospital in the US (where lithium was approved in 1974), lithium was the main treatment, with over 85% of patients using it in 1989 (Fenn et al., 1996). Our data, which start in 1995, indicate that people with BD in younger cohorts are more likely to use lithium, controlling for age (Appendix Figure A2).

forces that influence labor market participation over time. Cohort fixed effects $\theta_{c(i)}$ control for unobservable factors that vary across birth cohorts and may affect the labor market outcomes of people with and without BD. We include year and cohort fixed effects, alone and interacted with F_i (an indicator for women), to account for secular changes in labor market outcomes over time, which may differ by gender. We cluster standard errors at the family level.[14]

Family fixed effects $\delta_{f(i)}$ allow us to compare people with BD with their healthy siblings. If families with lower earnings or labor force participation have a higher rate of mental health disorders, a simple comparison of people with BD with the population may overstate the penalties from mental health disorders. Comparing people with BD with their siblings helps to account for family-specific factors that could act as triggers of the condition, influence its incidence, and impact the odds of a diagnosis and treatment.

In equation (1), the parameter α captures the excess probability of having zero earnings for people with BD who did not yet have access to improved treatment at age 20, relative to their siblings. The parameter β measures how much this excess probability differs for people with BD who did have access to improved treatment by age 20. Under the assumption that, without changes in treatment, differences in labor market outcomes of people with and without BD would have remained stable across cohorts, estimates of β represent the causal effects of access to improved treatment on people with BD.

Investigating the Identification Assumption. There are two main challenges to our empirical strategy. The first concerns the validity of the identification assumption. This assumption would be violated if the composition of people diagnosed with BD changed across cohorts, generating differences in labor market outcomes unrelated to access to improved treatments. For example, if people diagnosed in earlier cohorts had more severe symptoms on average compared with those diagnosed in later cohorts, we may observe improvements in labor market outcomes for people with BD over time even if treatments are ineffective, simply because later cohorts are less sick. While we cannot completely rule out this possibility, the data do not support it. If people with less severe symptoms became more likely to be diagnosed

[14] Since we test several hypotheses, we examine the significance of our estimates accounting for multiple hypothesis testing. Our analysis tests three main null hypotheses – that access to lithium has no effects on the probability of having zero earnings, on earnings, and on disability. We additionally perform heterogeneity analyses of earnings and the probability of zero earnings with respect to gender (men vs women), SES (parental assets in top, middle two, and bottom quartiles), and intensity of the condition (a continuous variable), for a total of 15 different hypotheses. Implementing the Bonferroni adjustment implies that, if we want our estimates to be significant at the 5% level, we should assess the statistical significance of our estimates against an adjusted confidence threshold $\alpha = 0.05/15=0.003$. This corresponds roughly to having t-statistics around 3. All estimates for *BD * access* indicated as significant throughout the paper have t-statistics larger than 3, except for Table 6.

over time, the population share of people with BD should have increased across cohorts; instead, it is stable at around 1.3 percent (Appendix Figure A3). Moreover, a comparison of the characteristics of people with BD across cohorts does not suggest a decrease in sickness or an improvement in labor market advantage. Education, parental wealth, and gender are all stable across cohorts relative to the population, and the share of people with comorbidities increases (Appendix Figure A4).[15] Our results are also robust to retaining only data for the first 15 years when a cohort is observed (Appendix Table A7).

A second challenge arises because we can only observe diagnoses after 1995. This affects our definition of the subsample of people with BD: We cannot observe people who were ill enough to have died by 1995, and we might mistakenly assign people who were only diagnosed before 1995 to the control group. Both issues, though, would bias our estimates towards zero. The inability to observe diagnoses before 1995 may also affect the identification assumption that outcome penalties from BD would have been comparable across cohorts in the absence of treatment. Specifically, since we cannot observe diagnoses for people in older cohorts at an early age, people with BD in older cohorts could be sicker and earn less because they have more severe symptoms, irrespective of access to treatment.

Reassuringly, our data indicate that, relative to the population, the composition of people diagnosed with BD at different ages is comparable across cohorts. Appendix Figure A5 shows observable characteristics of people with BD relative to the population, separately by age and cohort. These ratios are comparable across people whom we observe at different ages, both within and across cohorts.

People with Access in Their Early 20s Have Much Lower Risks of Zero Earnings. Overall, people with BD face an elevated risk of having no earnings at all. In the population, 42 percent of people have zero earnings in at least one year; for people with BD, this share is much higher at 80 percent (Table 1). Early access to improved treatment may allow people with BD to stay in the labor force, reducing their risks of no earnings.

Estimates of equation (1) confirm this hypothesis. An estimate of 0.137 for *BD* implies that people with BD and no access to improved treatment by age 20 are 14 percentage points more likely to have no earnings, or 1.2 times more likely compared with a population mean of 0.11 (Table 2, column 1, significant at 1 percent). An estimate for *BD* * *access* of -0.055

[15] To examine stability over time, we compare cohort-specific ratios of the share for people with BD and the population share of women, people with at least one college degree, people with at least one diagnosis of depression/anxiety or schizophrenia, and quantiles of parental wealth (Appendix Figure A4). The share of people with depression/anxiety or schizophrenia increases across cohorts in the BD sample relative to the population; this could bias our effects towards zero.

indicates that access to improved treatment by age 20 reduces this probability by 5.5 percentage points, or 40 percent (0.055/0.137) of the excess risk for people without access to improved treatments. These large estimates are consistent with the hypothesis that lithium is most effective when used during the earlier stages of the condition.

Estimates by Cohort. The empirical specification in equation (1) implicitly assumes that the labor market penalties for people with BD, relative to their healthy siblings, are constant across cohorts with access to improved treatment at age 20 and across older cohorts. To relax this assumption and explore the dynamic effects of treatment across cohorts, we estimate cohort-specific differences in the probability of zero earnings, captured by β_k in the equation:

$$(2) \quad I(earnings_{it} = 0) = \alpha\, BD_i + \sum_k \beta_k\, BD_i\, \mathbf{1}(k \leq c(i) \leq k+1) + \tau_t + F_i * \tau_t + \sum_k \theta_k\, \mathbf{1}(k \leq c(i) \leq k+1) + \sum_k \theta_{F,k}\, F_i * \mathbf{1}(k \leq c(i) \leq k+1) + \delta_{f(i)} + \varepsilon_{it}$$

Here, each parameter β_k captures the difference in the probability of zero earnings between people with BD born in cohorts k to $k+1$ (where k varies between 1950 and 1976 in two-year intervals) and their siblings.[16] We normalize β_{1954} to zero so that all these differences are expressed relative to the difference for the 1954-55 cohorts. Under the assumption that, without changes in treatment, differences in labor market outcomes of people with BD and their siblings would have remained stable across cohorts (the standard parallel trends assumption of difference-in-differences models), estimates of β_k for $k>1954$ represent the causal effects of access to improved treatment at age 20 on the labor market outcomes of people with BD. Estimates of β_k for $k<1954$ capture the differences in outcome penalties among cohorts who did not have access to treatment at age 20.

Estimates of β_k for $k>1954$ indicate that people who had access to treatment innovations earlier in life experienced a significantly smaller chance of having zero earnings. Compared with the 1954-55 cohort, penalties become significantly smaller starting from the 1956-57 cohort and continue to decline for younger cohorts. Specifically, the probability of having zero earnings is 6.1 percentage points smaller for cohorts born in 1960-61 (55 percent relative to an average of 11 percent for the population), 9.7 percentage points smaller for cohorts born in 1966-70 (87 percent), and 12.5 percentage points smaller for cohorts born in 1971-75 (112

[16] Because our data start in 1995, we have few observations for cohorts born prior to 1950 (Appendix Figure A6). We thus exclude these when estimating cohort-specific estimates of BD treatment in equations (2) and (4).

percent, Figure 1, solid thin series). In line with the identifying assumption of parallel trends, estimates of β_k for $k<1954$ are indistinguishable from zero.

The decline in labor market penalties for BD across cohorts might reflect significant delays in the diffusion of drugs, as it typically takes physicians several years to adopt new treatments (Agha and Molitor, 2018). It also reflects the fact that, following the "lithium revolution" of the mid-1970s, additional treatments became available for people with BD, whose effects might have compounded over time (see Table 2 of Lopez-Muñoz et al., 2018).

B. Triple Difference: Using People with Other Conditions as Controls

An additional challenge for our empirical strategy is that labor market outcomes might have changed over time (and across cohorts) for people with *any* mental health condition. This would confound our estimates of the impact of access to improved treatment. This change might have occurred, for example, due to the de-institutionalization of mental health care, the growth of community-based treatment centers (Geddes and Miklowitz, 2013), changes in health insurance coverage,[17] and a reduction in the stigmatization of mental health disorders (Hinshaw and Stier, 2008).[18] To control for time-varying factors affecting all people with mental health conditions, we use people with depression, anxiety, and schizophrenia as an additional control group:

$$\text{(3)} \qquad \mathrm{I}(earnings_{it} = 0) = \alpha\, BD_i + \beta\, BD_i * access_{c(i)} + \alpha_M\, M_i + \beta_M\, M_i * access_{c(i)} + \tau_t + F_i * \tau_t + \theta_{c(i)} + F_i * \theta_{c(i)} + \delta_{f(i)} + \varepsilon_{it}$$

In this equation, the variable M_i equals one for people with at least one diagnosis of BD, depression, anxiety, and schizophrenia. The parameter α_M captures the gap in the outcome variable between people with any mental health condition and the population born before 1956; the parameter β_M measures the difference in this gap between cohorts born after 1955 and older cohorts. As a result, estimates of β capture differences in the probability of zero earnings, relative to siblings *with other mental health conditions*, for people with BD and access to improved treatment at age 20 compared with people without access. Even in the presence of secular changes in labor market experiences for all people with mental health conditions,

[17] Mental health care in Denmark has undergone considerable change during the last decades, including an increase in outpatient treatment, a reduction in the number of hospital beds, and the establishment of community mental health centers (Danish Ministry of Health, 2017).

[18] In principle, evidence on the genetic drivers of mental health may mitigate stigmatization. Yet, surveys show that stigmatization towards BD and other disorders has intensified since the 1950s (Phelan et al., 2000).

estimates of β can be attributed to the approval of lithium as a maintenance treatment for BD, since this medication is prescribed primarily to people with BD.[19]

An estimate of 0.206 for *BD* implies that, relative to siblings with other mental health conditions, people with BD but without access to improved treatment by age 20 are 20.6 percentage points more likely to have no earnings, or 187 percent relative to the 11 percent population share (Table 2, column 2, significant at 1 percent). An estimate of -0.045 for *BD* * *access* confirms that access to improved treatment by age 20 reduces this probability by 4.5 percentage points, or 22 percent of the excess risk for people with no access.

We also estimate cohort-specific estimates β_k in the following equation:

$$
\begin{aligned}
(4) \qquad & I(earnings_{it} = 0) = \alpha\, BD_i + \textstyle\sum_k \beta_k\, BD_i\, \mathbf{1}(k\text{-}1 \le c(i) \le k) + \alpha_M\, M_i \\
& + \textstyle\sum_k \beta_{M,k}\, M_i\, \mathbf{1}(k \le c(i) \le k+1) + \tau_t + F_i * \tau_t + \textstyle\sum_k \theta_k\, \mathbf{1}(k \le c(i) \le k+1) \\
& + \textstyle\sum_k \theta_{F,k}\, F_i * \mathbf{1}(k \le c(i) \le k+1) + \delta_{f(i)} + \varepsilon_{it}
\end{aligned}
$$

As before, estimates of β_k for $k<1954$ (the solid thick series of Figure 1) are indistinguishable from zero. Estimates of β_k for k>1954 confirm that people with BD who had access to treatment innovations earlier in life experienced a significantly smaller chance of having zero earnings even compared with changes for siblings with other mental health disorders. Relative to the 1954-55 cohort, the probability of having zero earnings is 4.7 percentage points smaller for people with BD born in 1960-61 (or 43 percent compared with the population), 8.0 percentage points smaller for cohorts born in 1965-66 (87 percent), and 111.1 percentage points smaller for cohorts born in 1976-77 (99.3 percent).

In equation (4), the parameters $\beta_{M,k}$ capture the difference in the probability of zero earnings between people with any mental health condition, born in cohort *k-4* to *k*, and their healthy siblings. Estimates of these parameters (the dashed series in Figure 1) indicate that the risk of zero earnings for these people progressively declines across cohorts. This is consistent with advances in treatments such as cognitive behavioral therapy, antidepressants, antipsychotics, and other mood stabilizers. The decline, though, is significantly smaller compared with the additional decline experienced by people with BD.[20] These findings indicate

[19] While lithium is sometimes prescribed as a treatment for schizophrenia, its use is not recommended because there is little evidence that it is an effective treatment (Leucht et al., 2015). If, however, lithium was a common and effective treatment for schizophrenia, our estimates of β would be biased towards zero.

[20] Estimates for $\beta_{M,k}$ *(All conditions)* in Figures I and II are significantly more precise than estimates for β_k (*BD)* because the *All conditions* group is much larger, containing 1,258,285 people with depression/anxiety and 293,048 people with schizophrenia, in addition to 34,331 people with BD (Table I). Condition-specific estimates are shown in Appendix Figure A7 (panel A).

that changes over time that affect all mental health conditions are unlikely to explain improved outcomes for people with BD after the approval of lithium.

The parallel trends assumption is untestable by construction. To examine the sensitivity of our estimates to possible violations of this assumption, we follow Rambachan and Roth (2023) and compare 95-percent confidence intervals of OLS estimates of β_k in equations (2) and (4), for k={1960, 1966, 1970, 1976}, with estimates that allow for differential trends which evolve smoothly over time with a change in slope equal to M times the maximum change in trend slopes observed in the pre-treatment period. Appendix Figure A8 (panel A) shows sensitivity plots for M between 0 and 1 (difference-in-difference estimates are in Figure A9, panel A). Estimates remain statistically significant for M<=0.8, but confidence intervals grow substantially, likely due to the imprecision of estimates of β_k for k<1956.

Taken together, these estimates confirm that early access to improved treatment for BD improves the likelihood of employment. They also indicate that our results are unlikely to be driven by secular changes (such as reforms of the mental healthcare system) that affected people with any mental health condition. In the remainder of the paper, we focus on the triple-difference model using all three conditions (depression, anxiety, and schizophrenia) as controls. Difference-in-differences estimates yield similar results unless otherwise noted.

C. No Significant Effects of Treatment on Siblings

In addition to affecting people who are diagnosed, BD may also create spillovers for their siblings. For example, parents may shift resources away from healthy siblings towards children with BD. Moreover, even siblings who have never been diagnosed with BD may be affected by a milder "subthreshold" form of BD (Mortensen et al., 2003; Krüger et al., 2006), which could impact their careers.[21]

To investigate the effects of BD on siblings, we compare healthy siblings of people with BD with the population, omitting family fixed effects:

$$
\begin{aligned}
(5) \quad & \mathrm{I}(earnings_{it} = 0) = \alpha\, BD_i + \beta\, BD_i * access_{c(i)} + \alpha_s\, BD\ sibling_i \\
& + \beta_s\, BD\ sibling_i * access_{c(i)} + \alpha_M\, M_i + \beta_M\, M_i * access_{c(i)} + \tau_t + F_i * \tau_t + \theta_{c(i)} \\
& + F_i * \theta_{c(i)} + \varepsilon_{it}
\end{aligned}
$$

[21] Analyses of US data indicate that people with a family history of BD are more likely to be affected by a milder form of (subthreshold) BD than the population (Judd and Akiskal, 2003).

where *BD sibling*$_i$ equals one if person *i* has a sibling with BD.

OLS estimates of α_s show that BD creates small negative spillovers for siblings of people with BD (Table 3). Healthy siblings of people with BD are 2.1 percentage points more likely than the population to have zero earnings, or 19 percent (with an estimate of 0.021 for *BD sibling*, Table 3, column 2, significant at 1 percent). The estimated effects of access to treatment are positive, but small at 0.009 for *BD sibling* * *access*; they are marginally significant and become insignificant when accounting for multiple hypothesis testing.

D. Impacts of BD and Its Treatment on Earnings

Our analyses so far have focused on labor market participation, measured by the probability of zero earnings. In this section we investigate whether and how BD and innovations in treating BD affect the earnings of people who are in the labor force.

Average Earnings. First, we estimate earnings penalties for people with BD and investigate whether these penalties change with access to improved treatments. We substitute the natural logarithm of a person's earnings as the dependent variable in equation (3) and re-estimate the equation for the subsample of people with positive earnings.

Triple difference estimates reveal large earnings penalties for people with BD without access to treatment; 20 percent of these penalties disappear with access to treatment. An estimate of -0.690 for *BD* implies that, conditional on having positive earnings, people with BD who did not have access to treatment earn 50 percent less than their siblings with other conditions (exp(-0.690)-1=-0.50, Table 2, column 4, significant at 1 percent). Re-estimating equation (1) yields similar results (column 3). An estimate of 0.175 for *BD * access* (significant at 1 percent) indicates that people with BD who had access to improved treatments experienced an earnings penalty of only 40 percent compared with their siblings (exp(-0.690+0.175)-1=-0.40, significant at 1 percent). Treatment thus closes 20 percent of the earnings penalty associated with BD (1-0.40/0.50).

To investigate the dynamics of earnings effects across cohorts, we re-estimate equation (4) with the logarithm of earnings as the dependent variable. Estimates of β_k in this specification capture the difference in the earnings penalty (relative to siblings with other conditions) between people with BD born in cohorts *k* to *k+1* and those born in 1954-55.

Estimates of β_k for $k<1954$ are indistinguishable from zero, ranging from 0.003 for the 1950-51 cohort (p-value 0.97) to 0.13 for the 1952-53 cohort (p-value 0.19, Figure 2, solid

thick line; the solid thin line shows estimates of equation (2)). This supports the identification assumption of parallel trends.

Estimates of β_k for k>1955 indicate that people who had access to treatment innovations earlier in life experienced a significantly smaller earnings penalty. Compared with the 1954-55 cohort and with their siblings with other conditions, people with BD in the 1956-57 cohort have 17 percent higher earnings (with an estimate of β_k equal to 0.159, significant at 5 percent); people in the 1960-61 cohort have 24 percent higher earnings; and people in the 1976-77 cohort have 41 percent higher earnings (Figure 2, solid thick line). These estimates confirm that having access to treatment innovations early in life mitigates the negative earnings impacts associated with BD. The fact that estimates are increasing over time is consistent with delays in the adoption of treatments (Agha and Molitor, 2018).

Effects on the Probability of Extremely High and Low Earnings. So far, we have focused on the effects of BD and its treatments on average earnings. These estimates, though, might mask differences across the earnings distribution. On the one hand, BD may reduce earnings by increasing the risk of falling to the bottom of the earnings distribution; access to treatment may mitigate this risk. On the other hand, examples of extremely successful people with BD in business and the arts (e.g., Jamison, 1993) suggest that BD might increase the odds of extremely high earnings.

To investigate the effects of BD and its treatment on a person's position in the earnings distribution, we re-estimate equation (3) with indicators for earnings at the top and bottom of the distribution as the dependent variable, restricting our sample to people with non-zero earnings. These estimates indicate that access to treatment innovations greatly reduces a person's risks of low earnings and increases their probability of high earnings. People with BD have a 16 percentage-point higher risk of earnings in the bottom decile compared with their siblings and people with other mental health conditions. Access to improved treatment reduces this risk by 23 percent (with an estimate for *BD* * *access* equal to -3.6 percentage points, Appendix Table A8, column 2, significant at 1 percent). Access to treatment also increases the probability that a person with BD has earnings in the top decile by 25 percent compared with their siblings (column 8, significant at 1 percent). Results are similar without controls for other mental health conditions (columns 1 and 7), and in specifications with the probability of earnings in the top and bottom quartiles as the outcome variable (columns 4 and 6).

III. MECHANISMS:
DISABILITY, OCCUPATIONAL SORTING, AND EDUCATIONAL ATTAINMENT

Access to treatment innovations reduces the huge penalties that people with BD suffer in terms of labor force participation and earnings. We now examine three possible explanations for these effects: changes in the risk of disability, occupational sorting, and educational attainment.

A. Disability

An elevated risk of zero earnings suggests that symptoms of mental health disorders may prevent people from participating in the labor force. According to the WHO (2011), mental illness is the leading cause of lost disability-adjusted life years (DALYs).[22] In the United States, mental illness accounts for over half of the rise in disability receipt after 1990 for men (Duggan and Imberman, 2009). In our data, the share of people who receive disability pay is much higher for people with BD, at a staggering 51 percent compared with just 12 percent in the population.

Access to improved treatments may thus enable people with BD to work and reduce the likelihood of disability.[23] To test this hypothesis, we re-estimate equation (3) with an indicator for disability as the dependent variable. These estimates show that people with BD who did not have access to improved treatments by age 20 have vastly higher odds of disability. Compared with their siblings with other conditions, their likelihood of receiving disability pay in a given year is 22 percentage points or 4.5 times higher (with an estimate for *BD* equal to 0.226, Table 4, column 2, significant at 1 percent, compared with an average share of people with disability equal to 0.05). Access to improved treatments greatly reduces this likelihood: The odds of disability associated with BD are 8.7 percentage points smaller for cohorts with treatment by age 20, a 38 percent reduction in the baseline probability for people with BD (with an estimate of -0.087 for *BD* * *access*, Table 4, column 2, significant at 1 percent).

Impacts on Total Income By providing payments to people who cannot work, disability pay reduces the impact of missed earnings on their total income. We investigate effects on total income by estimating models with the sum of earnings, disability, and other welfare payments as the outcome variable. Triple-difference estimates indicate that people with BD and without

[22] In a survey of 253 people with BD, Suppes et al. (2001) found that 57 percent of respondents were unable to work, and another 9 percent held part-time jobs. In self-reported data from the World Health Organization's Health and Work Performance Questionnaire (HPQ), BD and depression are associated with 65.5 and 27.2 excess lost workdays per worker, respectively (Kessler et al. 2006). Projecting these estimates to the US labor force suggests that 225.0 million workdays are lost to depression each year, and 96.2 million are lost to BD.
[23] Examining depression, Shapiro (2022) finds that encouraging people to take drugs for depression through advertising leads them to miss fewer days at work.

access to treatment have 15 percent lower total income than their healthy siblings (Table 4, column 4, significant at 1 percent), a smaller gap compared with the one in earnings reported in Table 2. Access to treatment does not significantly affect this variable.

B. Occupational Sorting

A second, possible explanation for the change in labor market penalties is that improvements in mental health may change the jobs that people with BD have. In the absence of treatment, people with BD might be limited to occupations that are compatible with their symptoms. If, for example, symptoms such as mania or depression preclude people with BD from performing non-routine tasks, they may be restricted to jobs with routine tasks that pay lower wages.[24]

To investigate occupational sorting as a mechanism for reduced earnings, we perform three tests. First, we calculate the median earnings for each occupation and year and re-estimate equation (3) using the log of median earnings of each person's occupation as the dependent variable. An estimate for BD = -0.054 indicates that, compared with their siblings with other conditions, people with BD and without access to treatment hold jobs that pay 5 percent less (Appendix Table A9, column 1, significant at 1 percent), just a small fraction of the 50 percent baseline earnings penalty we estimated using individual-level earnings. Thus, occupational sorting cannot explain the baseline earnings penalties for people with BD. Access to treatment leads people to switch to slightly higher paying jobs (with an estimate of 0.016, column 1, significant at 5 percent).

Second, we test whether access to treatment makes people more likely to select into jobs with a strong managerial, decision-making, pressure, artistic, or social component. We use standardized measures of these job dimensions from O*NET as the dependent variable in equation (3). These estimates indicate that people with BD and without access to treatment at age 20 have jobs with a 0.067 standard deviations (sd) lower managerial component (Appendix Table A9, column 2, significant at 5 percent), 0.054 sd lower decision-making component (column 3), 0.043 sd lower artistic component (column 5) and 042 sd lower social component (column 6). Access to treatment does not change the intensity of these components in the jobs held by people with BD.

Third, we check whether the earnings results presented in column 4 of Table 2 change if we control for occupation or occupation-by-year fixed effects. If our earnings results were

[24] Notably, unstructured occupations and those that have a strong social and decision-making component have been growing faster than all others (Autor, Levy, and Murnane 2003; Deming 2017, 2021).

explained, all or in part, by occupational sorting, estimates of *BD* and *BD* * *access* should become smaller. Instead, they remain robust (Appendix Table A9, column 7). This further confirms that, rather than an improvement in the type of occupation, the relative earnings increase experienced by people with BD and access to treatment at age 20 are likely due to an improvement in their productivity and wages, within occupations.

C. Educational Attainment, Marriage, and Divorce

We also explore the possibility that the positive effects of treatment on labor market outcomes may be driven by an increase in educational attainment or improvements in other life circumstances. We begin by testing whether college attainment is higher for people with BD who had access to treatment by age 20, compared with people without access and relative to their siblings and people with other mental health conditions.

Our findings do not support this hypothesis. We do not find significant differences between people with BD without access to treatment at age 20 and either their siblings, or people with other conditions; if anything, people with BD and access to treatment are less likely to attend college (Appendix Table A10, column 2). One possible explanation for this finding is that educational investment decisions have already been made by the time people develop BD. Existing studies also indicate that patients with BD do not show the same cognitive deficits before onset as patients with other conditions (for example schizophrenia, Reichenberg et al., 2002; Zammit et al., 2004) and may even do especially well in school (Vreeker et al., 2016). This may result in them not having lower educational attainment at baseline and in a zero, or even negative, effect of access to treatment on college attainment.

Our data also indicate that people with BD and no access to treatment are 12.9 percentage points (18%) less likely to be married and 8.6 percentage points (37%) more likely to be divorced. Access to treatment increases the likelihood of marriage by 27% and reduces the odds of divorce by 49% (Appendix Table A10, columns 4 and 6).

IV. WHO BENEFITS MORE FROM MEDICAL INNOVATIONS?

Population data on mental health diagnoses and earnings reveal large benefits from treatment. We now examine whether these benefits are larger for some subgroups of people with BD. We focus on three dimensions of heterogeneity: gender, socioeconomic status (SES), measured by their parents' position in the distribution of wealth, and the severity of the condition.

A. Gender

Women are at a higher risk for BD compared with men. In our data, 1.3 percent of all women receive at least one diagnosis of BD, compared with 1.0 percent for men. Women are also less likely to participate in the labor market, and when they do, they earn less than men. In Denmark, 12 percent of women report zero earnings in any given year (compared with 9 percent of men). Women who report positive earnings earn $43,182 on average, compared with $60,633 for men. Differences in labor market experiences and BD incidence across gender may thus lead to differences in the career impacts of access to improved treatment.

Estimates of equation (3) for women indicate that women with BD and no access to improved treatment at age 20 are 23.4 percentage points (1.8 times the population share) more likely to receive no earnings in any given year compared with their siblings (Table 5, column 1, significant at 1 percent). Access to treatment reduces this probability by 4.7 percentage points, or 20 percent of the baseline probability. Men with BD and no access have a smaller likelihood of no earnings, 18.1 percentage points (181 percent of the population share) relative to siblings. Access to treatment reduces this likelihood by 5.9 percentage points, or 33 percent (column 2, significant at 1 percent). Thus, even if the absolute impact of treatment is indistinguishable across genders (the estimate for *BD * female * access* in column 3 of Table 5 is small and statistically insignificant), the relative impact is smaller for women because they have a higher baseline probability.

The impact of treatment on earnings is also comparable across gender, both in absolute and relative terms. Women with BD and no access to improved treatment at age 20 earn 49 percent less compared with their siblings (estimate of *BD* equal to -0.665, column 4, significant at 1 percent). Access to treatment closes 17 percent of this gap. Men with BD and no access to improved treatment earn 47 percent less compared with their siblings, and access to treatment closes 18 percent of this gap (Table 5, column 5). Taken together, these results indicate that access to improved treatment for BD, while effective in improving the careers of both men and women, does not affect the gender gap in earnings and labor market participation.

B. The Benefits of Treatment are Largest for People with Low Parental Wealth

Existing research has documented a strong link between SES and the incidence of mental health conditions (see, for example, McClellan, Susser, and King, 2006; Adhvaryu et al., 2019).[25]

[25] McClellan, Susser, and King (2006) show that maternal exposure to famine increases rates of schizophrenia and anti-social behavior among children. Adhvaryu et al. (2019) use variation in the price of cocoa in Ghana to

Moreover, SES influences access to treatment (Katz et al. 1997, Wang et al. 2005). Unequal access to care may be due to the monetary costs of treatment or to informal barriers and stigmatization. In our empirical setting, health care is essentially free, allowing us to shut down monetary costs and isolate the influence of other factors.

We investigate whether the benefits of treatment differ across the distribution of parental wealth by interacting *BD* and *BD * access* in equation (3) with *TopW, MiddleW,* and *BottomW,* indicators for parental assets in the top (fourth), middle (second and third), and bottom (first) quartile, respectively (using people with missing parental assets as the omitted category):

$$
\begin{aligned}
(6) \qquad & I(earnings_{it}=0) = \alpha\, BD_i + \beta\, BD_i * access_{c(i)} + \eta_{0,bottom}\, BottomW_i \\
& + \alpha_{bottom}\, BD_i * BottomW_i + \beta_{bottom}\, BD_i * BottomW_i * access_{c(i)} \\
& + \eta_{0,middle}\, MiddleW_i + \alpha_{middle}\, BD_i * MiddleW_i + \beta_{middle}\, BD_i * MiddleW_i * access_{c(i)} + \\
& \eta_{0,top}\, TopW_i + \alpha_{top}\, BD_i * TopW_i + \beta_{top}\, BD_i * TopW_i * access_{c(i)} \\
& + \alpha_M\, M_i + \beta_M\, M_i * access_{c(i)} + \tau_t + F_i * \tau_t + \theta_{c(i)} + F_i * \theta_{c(i)} + \delta_{f(i)} + \varepsilon_{it}
\end{aligned}
$$

OLS estimates indicate that the benefits from treatment are significantly smaller for people with parental wealth in the top quartile. At baseline (i.e., for people with missing parental assets), access to treatment innovations reduce the odds of zero earnings by 3.7 percentage points (with an estimate of *BD * access* equal to -0.037, Table 6, column 2, significant at 1 percent). This reduction is 4.5 percentage points larger for people with parental assets in the bottom quartile (-0.045 for *BD * BottomW * access*, although insignificant from zero) and 9.1 percentage points *smaller* for people with parental assets in the top quartile (with an estimate of 0.091 for *BD * TopW * access*, column 2, significant at 10 percent).

People in the lowest quartile of the parental assets distribution also experience a larger reduction in the earnings penalty from BD compared with people with higher or missing parental assets. An estimate of -0.697 for *BD* and 0.125 for *BD * access* indicates that access to treatment reduces this penalty by about 13 percent for people with missing parental assets (column 4, significant at 1 percent). This reduction is significantly larger for people with BD and parental assets in the bottom quartile (with an estimate of *BD * < 25 pctile * access* equal

show that children who are exposed to negative wealth shocks in utero have lower mental health outcomes as adults.

to 0.347) and much smaller for people in the top quartile (with an estimate for *BD * >= 75 pctile * access* equal to -0.254), although these estimates are imprecise.

These estimates suggest that family wealth plays an important role in shaping the career effects of mental health conditions. High levels of parental wealth appear to shield individuals with BD from the most severe effects of the disorder. When universal health insurance eliminates financial barriers to treatment, people with less wealth benefit most from access to treatment. Combined with existing evidence on disparate access to mental health treatment across the spectrum of SES, these results suggest that mental health might be an important driver for the persistence of low SES across generations, documented by Boserup, Kopczuk, and Kreiner (2013) for Denmark and Chetty et al. (2014) for the United States.

C. Penalties Are Larger for People with More Severe Forms of BD, but Benefits from Treatment Are Not

Next, we assess whether the labor market penalties and the benefits from treatment vary with the intensity of BD, measured by the number of diagnoses that a person receives. People with only one diagnosis may have just experienced a single episode and therefore are less sick, while people with multiple diagnoses have experienced many episodes of BD. On average, people with BD receive 2.4 diagnoses between 1995 and 2015, with a median of 2 diagnoses.

To test whether earnings penalties and benefits from treatment are related to the number of diagnoses, we estimate:

$$
\begin{aligned}
(7) \qquad & I(earnings_{it}=0) = \alpha_1 BD_i + \beta_1 BD_i * access_{c(i)} + \alpha_2 \# BD\ episodes_i \\
& + \beta_2 \# BD\ episodes_i * access_{c(i)} + \alpha_M M_i + \beta_M M_i * access_{c(i)} + \tau_t + F_i * \tau_t \\
& + \theta_{c(i)} + F_i * \theta_{c(i)} + \delta_{f(i)} + \varepsilon_{it}
\end{aligned}
$$

where $\# BD\ episodes_i$ is the number of BD episodes experienced by individual *i*.

OLS estimates of equation (7) show that, relative to their siblings, even people with just a single diagnosis suffer earnings penalties from BD; however, the size of these penalties is larger for people with more diagnoses. People with a single diagnosis of BD who did not have access to treatment innovations at age 20 are 1.5 times more likely to earn zero (with an estimate of 0.155 for *BD* and compared with a 11 percent population share, Table 7, column 2, significant at 1 percent). On top of this, each additional diagnosis of BD is associated with an additional 2.5 percentage point increase in the probability of zero earnings (with an estimate of

0.025 for # *BD episodes*, significant at 1 percent). For the median person with BD, this implies a 1.8 times higher chance of zero earnings ((0.155 + 2 * 0.025)/0.11=1.51). The benefits of treatment, instead, are not different for people with more diagnoses (with an estimate of -0.004 for # *BD episodes* * *access*, indistinguishable from zero).

People with more frequent episodes also experience larger earnings penalties compared with siblings. People with a single diagnosis of BD have 37 percent lower earnings than their healthy siblings (with an estimate for *BD* = -0.467, Table 7, column 4, significant at 1 percent). Access to treatment eliminates 19 percent of this penalty (with an estimate of *BD* * *access* = 0.110 and an associated 30 percent earnings penalty: exp(-0.467+0.110) -1=-0.30 for people with access). Each additional diagnosis of BD is associated with an additional 13 percent loss in earnings (with an estimate for # *BD episodes* = -0.131, significant at 1 percent). This implies a 48 percent earnings penalty compared with siblings for people with a median number of diagnoses (exp(-0.467-2*0.131) -1=-0.53). An estimate of 0.031 for # *BD episodes* **access* indicates that the benefits from treatment are equivalent to a 3 percent higher salary for each additional diagnosis (Table 7, column 4, significant at 10 percent). For the median person with BD, this implies a reduction of 10 percent of the initial earnings penalty (exp(-0.477 + 2 *(-0.135) + 0.128 + 2*0.034)-1=-0.43, 1-0.43/0.48=0.10).

VI. CONCLUSIONS

This paper has used registry data on mental health diagnoses, earnings, and disability and a major innovation in the treatment of BD to investigate the career effects of mental health and improved treatments. Using the approval of lithium as an effective maintenance treatment for BD in 1976, we estimate the impact of access to improved treatment on people's labor force participation and earnings. Comparing differences in outcomes between people with BD and (i) their healthy siblings and (ii) people with other mental health conditions, across cohorts with and without access to treatment innovations in their 20s, we find that access to treatment reduces the likelihood of zero earnings by one-third. In addition, access to treatment closes one-fourth of the earnings penalties from BD. Our analyses of disability pay suggest that a dramatic reduction in the likelihood of disability is a major driver for these benefits.

These results imply that policies that improve and expand access to mental health treatments could create major economic and social benefits by increasing earnings, reducing the risk of low earnings, and mitigating the risk of disability. Our results also suggest that parental wealth plays an important role in shaping the career impact of mental health and that

people whose parents are less wealthy benefit the most from access to treatment. For example, the effect of access to treatment on labor force participation is much larger for people with BD with parents in the lowest three quartiles of financial assets compared with the top quartile. It is important to remember that Denmark offers universal health care; our results therefore estimate the benefits of access to treatment in a context where the financial costs of treatment are minimal. In countries where access to mental health care treatment is costly, such as the United States, the distributional impact of mental health – and the potential benefits of expanding access to treatment – is likely to be greater.

DATA AVAILABILITY

Code and information on how to access the administrative data used in this study can be found at https://doi.org/10.7910/DVN/JLPLMJ.

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TABLES

TABLE 1 – PEOPLE WITH MENTAL HEALTH CONDITIONS COMPARED WITH THE POPULATION

	All	BD	Depression/ Anxiety	Schizophrenia
All	3,103,605	34,331	1,258,285	293,048
born until 1956	1,288,391	15,151	624,896	126,511
share of total	*41.5%*	*44.1%*	*49.7%*	*43.2%*
born after 1956	1,815,214	19,180	633,389	166,537
share of total	*58.5%*	*55.9%*	*50.3%*	*56.8%*
W/ no earnings at least once	1,621,784	28,978	819,032	231,028
born until 1956	866,362	13,437	466,171	106,282
share of total	*53.4%*	*46.4%*	*56.9%*	*46.0%*
born after 1956	755,422	15,541	352,861	124,746
share of total	*46.6%*	*53.6%*	*43.1%*	*54.0%*
Average earnings ($)	51,928	37,137	47,449	39,810
	(82,375)	(48,597)	(48,694)	(38,713)
born until 1956	52,299	39,471	49,125	42,896
	(124,680)	(59,080)	(55,130)	(46,540)
born after 1956	51,729	35,944	46,277	38,068
	(45,628)	(42,192)	(43,599)	(33,373)
On disability at least once	410,096	17,918	305,021	122,356
born until 1956	256,304	9,406	185,296	60,518
share of total	*62.5%*	*52.5%*	*60.1%*	*49.5%*
born after 1956	153,792	8,512	119,725	61,838
share of total	*37.5%*	*47.5%*	*39.2%*	*50.5%*
With family ID	1,807,135	20,803	674,065	163,734
born until 1956	273,416	3,921	127,726	28,855
share of total	*15.1%*	*18.9%*	*19.0%*	*17.6%*
born after 1956	1,533,719	16,882	546,339	134,879
share of total	*84.9%*	*81.1%*	*81.0%*	*82.4%*
With fam. ID and at least 1 sibling	1,422,038	15,880	519,891	127,054
born until 1956	161,024	2,240	71,950	16,537
share of total	*11.3%*	*14.1%*	*13.8%*	*13.0%*
born after 1956	1,261,014	13,640	447,941	110,517
share of total	*88.7%*	*85.6%*	*86.2%*	*87.0%*

Note: Counts of observations and shares for individuals between the age of 20 and 65 from 1995 to 2015, in birth cohorts between 1940 and 1977. Average earnings are reported in 2015 US dollars ($). Standard errors in parentheses.

TABLE 2 – OLS: BD, ACCESS TO TREATMENT, AND LABOR MARKET OUTCOMES

	P(Earnings=0)		ln(Earnings)	
	(1)	(2)	(3)	(4)
BD	0.137***	0.206***	-0.472***	-0.690***
	(0.008)	(0.009)	(0.035)	(0.035)
BD * access	-0.055***	-0.045***	0.165***	0.175***
	(0.009)	(0.009)	(0.037)	(0.037)
B/D/A/S	✓	✓	✓	✓
B/D/A/S * access		✓		✓
Gender*cohort FE	✓	✓	✓	✓
Gender*year FE	✓	✓	✓	✓
Family FE	✓	✓	✓	✓
R-squared	0.35	0.35	0.32	0.31
Mean Y	0.112	0.112	--	--
N	35913324	35913324	31900736	31900736
Sample	Full	Full	Earn>0	Earn>0

Standard errors in parentheses are clustered at the family level

*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variable is an indicator for zero earnings (columns 1-2) or the natural logarithm of earnings, defined as the sum of wages and income from self-employment (columns 3-4). *BD* equals 1 for people who have been diagnosed with this condition at least once between 1995 and 2015. *Access* equals 1 for individuals born after 1956, who had access to lithium when they entered their 20s. *B, D*, *A*, and *S* are indicators for people who have ever received a diagnosis of either bipolar, depression, anxiety, and schizophrenia, respectively; *B/D/A/S* indicates people with at least one diagnosis of one of these conditions. All regressions include gender-by-cohort, gender-by-year, and family fixed effects. Data are available for calendar years 1995-2015. The sample is restricted to people between the ages of 20 and 65 in cohorts between 1940 and 1977, with family identifiers. Columns 3-4 report results for people with positive earnings.

TABLE 3 — OLS: BD, ACCESS TO TREATMENT, AND LABOR MARKET OUTCOMES FOR PEOPLE WITH BD AND THEIR SIBLINGS

	P(Earnings = 0)		ln(Earnings)	
	(1)	(2)	(3)	(4)
BD	0.116***	0.210***	-0.371***	-0.642***
	(0.006)	(0.006)	(0.025)	(0.025)
BD * access	-0.040***	-0.036***	0.070**	0.112***
	(0.006)	(0.006)	(0.026)	(0.026)
BD sibling	0.016**	0.021***	-0.038**	-0.052***
	(0.005)	(0.005)	(0.014)	(0.014)
BD sibl. * access	0.008	0.009*	-0.037**	-0.032**
	(0.005)	(0.005)	(0.015)	(0.015)
B/D/A/S	✓	✓	✓	✓
B/D/A/S * access		✓		✓
Gender * cohort/year FE	✓	✓	✓	✓
Mean Y	0.11	0.11	--	--
R-squared	0.08	0.06	0.06	0.08
N	35913324	35913324	31900736	31900736

Standard errors in parentheses are clustered at the family level.
*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variable is an indicator for zero earnings (columns 1 and 2) and the logarithm of earnings, defined as the sum of all wages and income from self-employment (columns 3-4). *BD* equals 1 for people who have been diagnosed with this condition at least once between 1995 and 2015. *Access* equals 1 for individuals who were born after 1956 and thus had access to lithium, the main treatment for bipolar disorder, when they entered their 20s. *BD sibling* equals 1 for individuals with siblings with *BD*, and *BD sibling w/access* equals 1 for individuals with *BD* siblings born in cohorts after 1956. *B, D*, *A*, and *S* are indicators for people who have ever received a diagnosis of either bipolar, depression, anxiety, and schizophrenia, respectively; *B/D/A/S* indicates people with at least one diagnosis of one of these conditions. All regressions include gender-by-cohort and gender-by-year fixed effects. Diagnoses data are available for calendar years 1995-2015. The sample is restricted to individuals between the age of 20 and 65 in cohorts between 1940 and 1977, with family identifiers. Columns 3-4 report results for people with positive earnings.

TABLE 4 – OLS: BD, ACCESS TO TREATMENT, DISABILITY, AND TOTAL INCOME

	P(disability)		ln(total income)	
	(1)	(2)	(3)	(4)
BD	0.183***	0.226***	-0.081***	-0.159***
	(0.008)	(0.008)	(0.013)	(0.013)
BD * access	-0.108***	-0.087***	0.007	0.013
	(0.009)	(0.009)	(0.014)	(0.014)
B/D/A/S	✓	✓	✓	✓
B/D/A/S * access		✓		✓
Gender * cohort FE	✓	✓	✓	✓
Gender * year FE	✓	✓	✓	✓
Family FE	✓	✓	✓	✓
Mean Y	0.05	0.05	--	--
R-squared	0.42	0.41	0.36	0.36
N	35913324	35913324	35646801	35646801

Standard errors in parentheses are clustered at the individual level.

*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variable is an indicator for individuals with positive disability payments in a given year (columns 1-2) and the logarithm of total income, calculated as the sum of earnings, disability, and other welfare payments (columns 3-4). *BD* equals 1 for people who have been diagnosed with this condition at least once between 1995 and 2015. *Access* equals 1 for individuals born after 1956, who had access to lithium when they entered their 20s. *B, D*, *A*, and *S* are indicators for people who have ever received a diagnosis of either bipolar, depression, anxiety, and schizophrenia, respectively; *B/D/A/S* indicates people with at least one diagnosis of one of these conditions. All regressions include gender-by-cohort, gender-by-year, and family fixed effects. The sample is restricted to individuals between the ages of 20 and 65 in birth cohorts 1940-1977, with family identifiers. In columns 3 and 4, the sample is further restricted to individuals with positive income.

TABLE 5 – OLS: BD, ACCESS TO TREATMENT, AND CAREER OUTCOMES BY GENDER

	P(earnings = 0)			ln(Earnings)		
	Women	Men	All	Women	Men	All
	(1)	(2)	(3)	(4)	(5)	(6)
BD	0.234***	0.181***	0.184***	-0.665***	-0.638***	-0.716***
	(0.017)	(0.014)	(0.012)	(0.065)	(0.061)	(0.051)
BD * access	-0.047**	-0.059***	-0.058***	0.146**	0.147**	0.172**
	(0.018)	(0.016)	(0.013)	(0.068)	(0.065)	(0.054)
BD * female			0.044**			0.055
			(0.017)			(0.070)
BD * female * access			0.017			-0.005
			(0.018)			(0.074)
B/D/A/S	✓	✓	✓	✓	✓	✓
B/D/A/S * access	✓	✓	✓	✓	✓	✓
Gender * cohort FE	✓	✓	✓	✓	✓	✓
Gender * year FE	✓	✓	✓	✓	✓	✓
Family FE	✓	✓	✓	✓	✓	✓
R-squared	0.42	0.42	0.35	0.35	0.38	0.31
Mean Y	0.13	0.10	0.11	--	--	--
N	17158864	18754460	35913324	14976185	16924551	31900736

Standard errors in parentheses are clustered at the family level.

*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variable is an indicator for zero earnings (columns 1-3) or the natural logarithm of earnings, defined as the sum of wages and income from self-employment (columns 4-6). Columns 1 and 4 are estimated on women; columns 2 and 5 are estimated on men. *BD* equals 1 for people who have been diagnosed with this condition at least once between 1995 and 2015. *Access* equals 1 for individuals born after 1956, who had access to lithium when they entered their 20s. *Female* indicates women. *B, D*, *A*, and *S* are indicators for people who have ever received a diagnosis of either bipolar, depression, anxiety, and schizophrenia, respectively; *B/D/A/S* indicates people with at least one diagnosis of one of these conditions. All regressions include gender-by-cohort, gender-by-year, and family fixed effects. Data are available for calendar years 1995-2015. The sample is restricted to people between the ages of 20 and 65 in cohorts between 1940 and 1977, with family identifiers. Columns 4-6 report results for people with positive earnings.

TABLE 6 – OLS: BD, ACCESS TO TREATMENT, AND CAREER OUTCOMES, BY PARENTAL WEALTH

	P(no earnings)		ln(Earnings)	
	(1)	(2)	(3)	(4)
BD	0.139***	0.209***	-0.474***	-0.697***
	(0.009)	(0.009)	(0.038)	(0.038)
BD * access	-0.046***	-0.037***	0.113**	0.125**
	(0.010)	(0.011)	(0.043)	(0.044)
< 25 pctile (*BottomW*)	0.016**	0.014**	-0.039**	-0.037**
	(0.006)	(0.006)	(0.016)	(0.016)
BD * < 25 pctile	0.049	0.029	-0.305	-0.269
	(0.055)	(0.057)	(0.253)	(0.252)
Access * < 25 pctile	-0.013**	-0.010*	0.021	0.018
	(0.005)	(0.005)	(0.014)	(0.014)
BD * < 25 pctile * access	-0.062	-0.045	0.380	0.347
	(0.056)	(0.057)	(0.255)	(0.254)
[25,75] pctile (*MiddleW*)	-0.024***	-0.025***	0.045***	0.047***
	(0.004)	(0.004)	(0.012)	(0.012)
BD * [25,75] pctile	0.009	0.004	-0.032	-0.009
	(0.033)	(0.034)	(0.120)	(0.120)
Access * [25,75] pctile	0.001	0.000	-0.002	-0.001
	(0.003)	(0.003)	(0.009)	(0.009)
BD * [25,75] pctile * access	-0.016	-0.011	0.096	0.075
	(0.034)	(0.035)	(0.123)	(0.123)
>= 75 pctile (*TopW*)	-0.035***	-0.036***	0.109***	0.110***
	(0.005)	(0.006)	(0.018)	(0.018)
BD * >= 75 pctile	-0.117**	-0.130**	0.352**	0.384**
	(0.053)	(0.051)	(0.168)	(0.172)
Access * >= 75 pctile	0.003	0.003	-0.020	-0.020
	(0.004)	(0.004)	(0.013)	(0.013)
BD * >= 75 pctile * access	0.076	0.091*	-0.223	-0.254
	(0.054)	(0.052)	(0.171)	(0.175)
B/D/A/S	✓	✓	✓	✓
B/D/A/S * access		✓		✓
Gender * cohort FE	✓	✓	✓	✓
Gender * year FE				
Family FE	✓	✓	✓	✓
Mean of Dep. Var.	0.11	0.11	--	--
R-squared	0.35	0.35	0.32	0.31
N	35913324	35913324	31900736	31900736

Standard errors in parentheses are clustered at the individual level.
*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variable is an indicator for zero earnings (columns 1-2) or the natural logarithm of earnings, defined as the sum of wages and income from self-employment (columns 3-4). *BD* equals 1 for people who have been diagnosed with BD at least once. *Access* equals 1 for individuals born after 1956, who had access to treatment innovations at age 20. *B, D*, *A*, and *S* are indicators for people who have ever received a diagnosis of either bipolar, depression, anxiety, and schizophrenia, respectively; *B/D/A/S* indicates people with at least one

diagnosis of one of these conditions. The variables *< 25 pctile*, *[25,75] pctile*, and *>= 75 pctile* equal 1 for individuals whose parents have median assets below the 25th percentile, between the 25th and 75th percentile, and above the 75th percentile, respectively. Individuals with missing parental assets are also included in the estimation as the baseline category. Information on parents' assets is available for years 1986 to 2010 and for 38 percent of the sample. All regressions include gender-by-cohort, gender-by-year, and family fixed effects. Data are available for calendar years 1995-2015; they include people between the age of 20 and 65 in birth cohorts 1940-1977, with family identifiers. Columns 3-4 report results for people with positive earnings.

TABLE 7 – OLS: BD, ACCESS TO TREATMENT, AND CAREER OUTCOMES, BY INTENSITY OF THE CONDITION

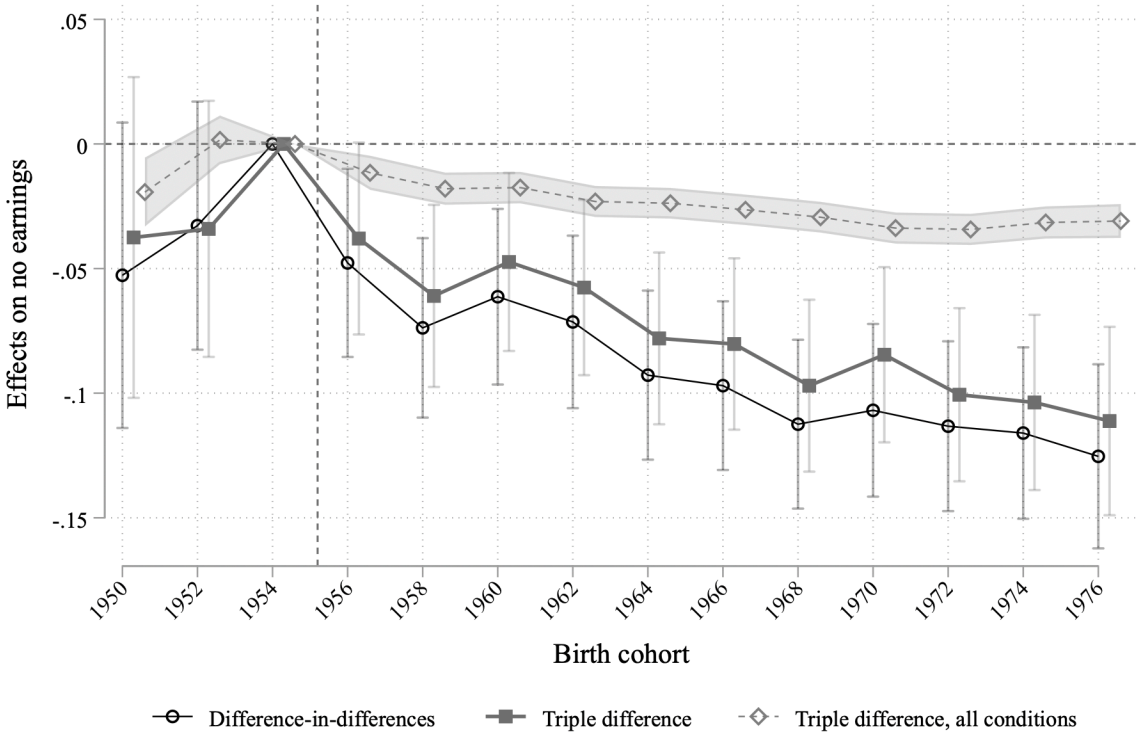
	P(earnings = 0)		ln(Earnings)	
	(1)	(2)	(3)	(4)
BD	0.095***	0.155***	-0.275***	-0.467***
	(0.010)	(0.010)	(0.042)	(0.042)
BD * access	-0.042***	-0.031**	0.103**	0.110**
	(0.011)	(0.011)	(0.044)	(0.044)
# BD episodes	0.021***	0.025***	-0.116***	-0.131***
	(0.003)	(0.003)	(0.015)	(0.015)
# BD episodes * access	-0.004	-0.004	0.030*	0.031*
	(0.003)	(0.003)	(0.016)	(0.016)
B/D/A/S	✓	✓	✓	✓
B/D/A/S * access		✓		✓
Gender * cohort	✓	✓	✓	✓
Gender * year FE	✓	✓	✓	✓
Family FE	✓	✓	✓	✓
Mean of Dep. Var.	0.11	.011	--	--
R-squared	0.35	0.35	0.32	0.31
N	35913324	35913324	31900736	31900736

Standard errors in parentheses are clustered at the individual level.
*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variable is an indicator for receiving zero earnings each year (columns 1-2) or the natural logarithm of earnings, defined as the sum of wages and income from self-employment (columns 3-4). *BD* equals 1 for people who have been diagnosed with this condition at least once between 1995 and 2015. *Access* equals 1 for individuals born after 1956, who had access to lithium at age 20 or earlier. The variable *# BD episodes* counts diagnoses of BD between 1995 and 2015. *B, D*, *A*, and *S* are indicators for people who have ever received a diagnosis of either bipolar, depression, anxiety, and schizophrenia, respectively; *B/D/A/S* indicates people with at least one diagnosis of one of these conditions. All regressions include gender-by-cohort, gender-by-year, and family fixed effects. The sample is restricted to people between the ages of 20 and 65 in birth cohorts 1940-77, with family identifiers. Columns 3-4 report results for a subsample of people with positive earnings.

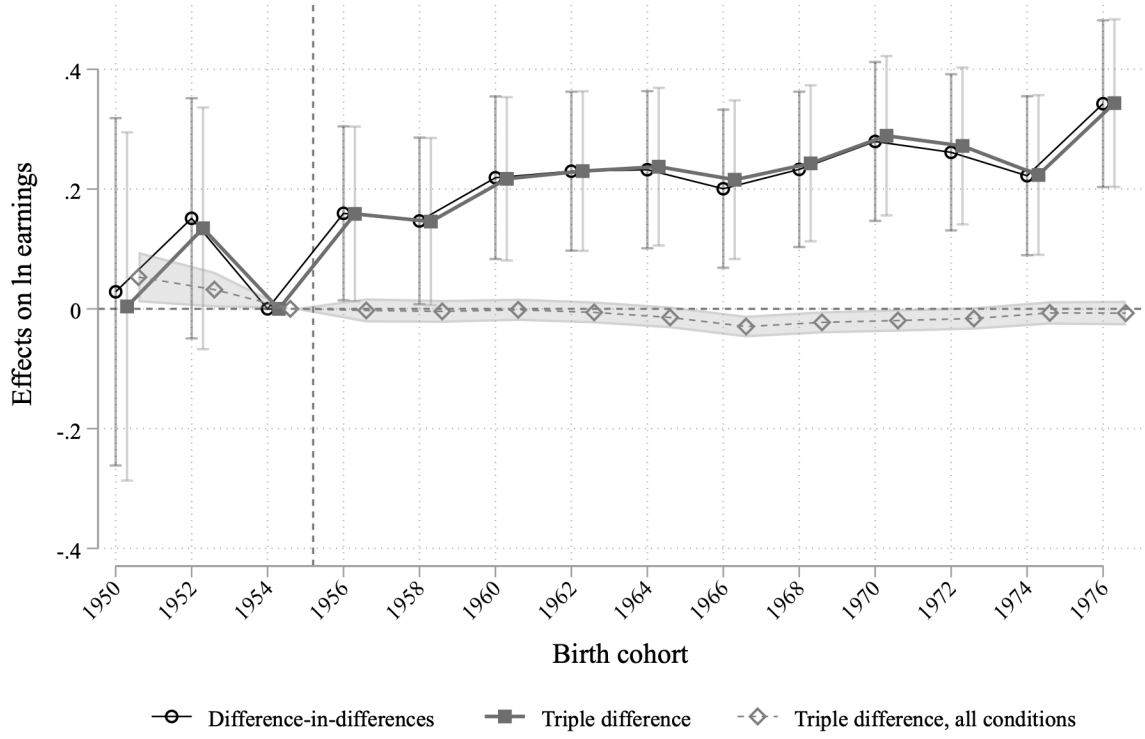
FIGURES

FIGURE 1–OLS COHORT ESTIMATES: P(EARNINGS=0), PEOPLE W/BD AND OTHER CONDITIONS VS SIBLINGS



Note: OLS point estimates and 95 percent confidence intervals of the parameters β_k in equations (2) *(Difference-in-differences*) and (4) (*Triple difference, BD*) and $\beta_{M,k}$ in equation (4) (*Triple difference, all conditions*), obtained using an indicator for zero earnings as the dependent variable. Standard errors are clustered at the family level. The sample is restricted to individuals between 20 and 65 years of age, born between 1950 and 1977.

FIGURE 2–OLS COHORT ESTIMATES: LOG EARNINGS, PEOPLE W/BD AND OTHER CONDITIONS VS SIBLINGS



Note: OLS point estimates and 95 percent confidence intervals of the parameters β_k in equations (2) *(Difference-in-differences*) and (4) (*Triple difference, BD*) and $\beta_{M,k}$ in equation (4) (*Triple difference, all conditions*), obtained using the natural logarithm of earnings as the dependent variable. Standard errors are clustered at the family level. The sample is restricted to individuals between 20 and 65 years of age, born between 1950 and 1977, with positive earnings.