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Barbara Biasi
Michael S. Dahl
Petra Moser

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ABSTRACT

This paper investigates the career effects of mental health, focusing on depression, schizophrenia, and bipolar disorder (BD). Individual-level registry data from Denmark show that these disorders carry large earnings penalties, ranging from 34 percent for depression and 38 percent for BD to 74 percent for schizophrenia. To investigate the causal effects of mental health on a person's career, we exploit the approval of lithium as a maintenance treatment for BD in 1976. Baseline estimates compare career outcomes for people with and without access in their 20s, the typical age of onset for BD. These estimates show that access to treatment eliminates one third of the earnings penalty associated with BD and greatly reduces the risks of low or no earnings. Importantly, access to treatment closes more than half of the disability risk associated with BD.

Barbara Biasi
Yale School of Management
165 Whitney Avenue
New Haven, CT 06520
and NBER
barbara.biasi@yale.edu

Michael S. Dahl
Aalborg University Business School
Fibigerstraede 11
Aalborg SO 9220
Denmark
msd@business.aau.dk

Petra Moser
Department of Economics
NYU Stern
44 West 4th Street
New York, NY 10012
and NBER
pmoser@stern.nyu.edu

A data appendix is available at http://www.nber.org/data-appendix/w29031

One in eleven people in the world are affected by a mental health disorder, such as depression, schizophrenia, or bipolar disorder.[1] According to the World Health Organization (WHO, 2011), mental health disorders are the leading cause of lost disability-adjusted years of life. Yet, anecdotes about prominent executives have linked mental health disorders – and in particular bipolar disorder (BD) – with professional success, to the point that BD is often called a "CEO's disease" (Cooper et al. 1988).

Estimating the effects of mental health and its treatments on a person's career involves two major empirical challenges. First, privacy regulations often restrict access to individual-level data on diagnoses that researchers need to estimate causal effects of changes in mental health. Second, differences in mental health and access to treatment are rarely random: For example, people who grow up in low-income families are more likely to face traumatic events that trigger depression (Mortensen et al. 2003; Gardner and Oswalt 2007) and less likely to receive treatment (Katz et al. 1997; Wang et al. 2005).[2]

To overcome these challenges and investigate the career effects of mental health, we combine individual-level registry data on mental health and career outcomes with a significant change in treatment. Our data cover mental health diagnoses, earnings, employment and disability status for the population of Denmark, including 2.4 million people born between 1946 and 1977. Nearly 100,000 of these individuals were affected by depression, 23,000 by BD, and 42,000 by schizophrenia; these three major disorders are the focus of our analyses. To study the causal effects of changes in access to treatment on a person's career, we exploit the approval of lithium as a maintenance treatment for BD by Denmark's drug authority in 1976 and compare cohorts with and without access to treatment in their 20s, the typical age of onset for BD.

Registry data show that mental health disorders are associated with large earnings penalties. People with depression, BD, and schizophrenia earn 36, 38, and 74 percent less than the general population, respectively. People with mental health conditions are also substantially more likely to decline into the bottom quantiles of earnings or have no earnings at all. For example, people with depression and BD are 99 percent and 120 percent more

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nditions.

likely, respectively, to have earnings in the lowest decile and 110 percent more likely to have no earnings at all. These findings are consistent with quantile regression analyses of data from the National Comorbidity Study, which indicate that mental health disorders are associated with larger earnings losses at the lower tail of the distribution (Marcotte and Wilcox 2003).

To control for socio-economic status and other characteristics that vary across families, we compare career outcomes between people with a disorder and their healthy siblings. Controlling for family background reduces earnings penalties only slightly, indicating that these penalties are not driven by differences in the family backgrounds of people with and without mental health conditions.

Event studies indicate that earnings decline dramatically after a diagnosis of depression, BD, and schizophrenia. Earnings begin to recover two years after a diagnosis, but never return to their pre-diagnosis levels. Ten years after the diagnosis, people with depression, BD, and schizophrenia earn 9, 23, and 31 percent less, respectively, relative to their pre-diagnosis earnings. Earnings begin to decline four years before a diagnosis consistent with people experiencing symptoms that reduce their ability to work or with job loss triggering a mental health episode (Ahammer, Grübl, and Winter-Ebmer 2020; Ahammer and Packham, 2020).

Next, we examine possible mechanisms for the dramatic decline in earnings. Mental health symptoms could impact a person's ability to work directly, leading to the loss of income. In addition, the scarring effects of unemployment may further reduce earnings and job security. Examining both mechanisms, we find that earnings penalties are more likely to be driven by mental health symptoms that make people unable to work, rather than by the scarring effect of unemployment. First, we document that people with depression, BD, and schizophrenia are 1.2, 2.7, and 7 times more likely, respectively, to receive disability pay. Second, while the probability of unemployment peaks in the year of the diagnosis, unemployment is not associated with larger earnings penalties for people with BD conditional on the severity of BD, proxied by the number of diagnoses.

While suggestive of a strong link between mental health and career outcomes, the estimates presented so far cannot measure the causal effect of mental health on career outcomes. In fact, it is possible for causality to operate in the opposite direction if negative labor market shocks trigger episodes of a mental health disorder. To establish the causal effects of changes in mental health on labor market outcomes we exploit a major change in the treatment of BD. In 1976, the *Lægemiddelstyrelsen* (Denmark's equivalent of the US

Food and Drug Administration, or FDA) approved lithium as a maintenance treatment for BD. Compared with other pharmaceuticals used to treat mental health disorders, lithium consumption is highly effective for treating BD and associated with a significant reduction in suicide and hospitalizations (Tondo et al 1999; Angst et al 2005, Kessler et al 2005a).

To estimate the causal effects of access to treatment, we compare labor market outcomes of people with and without access at age 20, the typical age of onset for BD (Kessler et al. 2005) and a critical period for a person's career (Kahn 2010; Oreopoulos 2012; Arellano-Bover 2020). Under the assumption that people with BD born before and after 1956 would have had similar labor market outcomes without access to treatment, this identification strategy estimates the causal effect of access to treatment on people with BD. If access to treatment eliminates the adverse labor market effects of BD, these estimates capture the career penalties associated with BD.

Our analyses indicate that access to treatment leads to large improvements in career outcomes for people with BD. Specifically, access to treatment eliminates 28 percent of the earnings penalty associated with BD. It also reduces the risk of declining into the bottom earnings decile by 17 percent and lowers the risk of zero earnings by 33 percent. Cohort-specific estimates reveal that penalties start to gradually decline for cohorts born after 1956, confirming that access to treatment is most critical at age 20 and that the effect increases with the length of exposure. Comparing individuals to their siblings reveals even larger benefits of access to treatment.

Controlling for a person's family background through family fixed effects further strengthens these estimates. Access to treatment eliminates nearly two thirds of the earnings penalty that people with BD face compared with their siblings. It also lowers the risk of earnings in the bottom decile by 42 percent and reduces the risk of zero earnings by 36 percent.

A challenge for our identification strategy is that unobservable factors, such as reductions in stigmatization or improvements in access to healthcare, may improve career outcomes for people with mental health disorders over time. To address this challenge, we use depression and schizophrenia as an additional control group to account for changes that affect career outcomes for people with any mental health disorder over time and estimate the additional penalties associated with BD with a triple-difference model. All estimates are robust to this alternative specification, which indicates that our results cannot be explained by secular trends.

Notably, our estimates suggest that a large portion of the benefit of access to treatment is due to a reduced risk of disability for people with BD. Access to treatment eliminates 59 percent of the excess risk of disability for people with BD relative to the population and 57 percent relative to their siblings. Using the number of diagnoses as a measure for the intensity of the disorder, we find that the benefits from treatment are greatest for people with a more severe form of BD.

We also find that people with lower socioeconomic status (SES) benefit disproportionally from access to treatment. Existing studies have documented a connection between health and socioeconomic status (SES) (Aizer and Currie 2014). People with lower SES are also less likely to access mental health treatments (Katz et al. 1997; Wang et al. 2005). Measuring SES with parental assets, we find that the earnings penalties from BD are 12.6 percent lower for people with parental assets in the top quartile compared with people in the second and third quartile. People in the second and third quartile, however, benefit twice as much from access to treatment compared with people in the top quartile. People with parental assets in the bottom quartile benefit three times as much.

While our identification strategy leverages the introduction of lithium as an early effective treatment for BD, other improvements in treatment (including cognitive behavioral therapy (CBT), mood stabilizers, antidepressants, and antipsychotics) became available over time and not everyone who received a diagnosis of BD was treated with lithium. CBT, for example, began in the early 1980s (Cochran 1984) after the introduction of lithium. To reflect these changes in treatments over time, our preferred interpretation of the main specifications is as the intent-to-treat (ITT) of improvements in treatment. Taken together, our findings indicate that mental health disorders are associated with immense career penalties and that access to treatment mitigates a large proportion of these penalties, particularly for people with lower SES.

This paper contributes to the literature on the causal effects of mental health on socio-economic and labor market outcomes. Most of these studies use survey data and are either correlational (Bartel and Taubman, 1986; Goodman, Joyce, and Smith 2011; Hakulinen et al. 2019) or observational, relying on instrumental variables (Ettner, Frank, and Kessler 1997; Lu, Frank, Liu, and Shen 2009; Banerjee, Chatterji, and Lahiri 2017), selection models (Chatterji, Alegria, and Takeuchi, 2011), and correlated random effects (Peng, Meyerhoefer, and Zuvekas 2015) to establish causality. We contribute to this literature in two ways. First, the use of administrative data on medical diagnoses linked to labor market outcomes, for individuals and their siblings, enables us to track people over a longer time period and to

account for family background. Second, a large-scale quasi-experiment allows us to identify the causal impacts of mental health on outcomes.

This study also connects with recent research that has quantified the causal effects of mental health by exploiting differences in the availability and use of medications. These differences are driven by changes in spending on drug advertisements (Shapiro, forthcoming), the introduction of black-box warnings for SSRI (Butikofer, Kronin, and Skira 2020), or physicians' propensity to prescribe drugs (Laird and Nielsen, 2017).[3] Building on these existing analyses, we compare the labor market penalties associated with different types of mental health conditions and we use a major change in treatment to investigate the causal effects of changes in access to treatment. We perform these analyses for BD, which has been the subject of much research in psychology (e.g., Jamison 1996; Kyaga et al. 2011; Kyaga et al. 2013) but received little attention from economists, despite its prevalence and severity.

Our estimates on the effects of lithium on earnings and disability relate to the literature on the effects of health treatments, and specifically access to medication, on labor market outcomes (see Currie and Madrian 1999 for a review). In this literature, our paper is most closely related to Garthwaite (2012), which shows that the removal of a branded Cox-2 inhibitor (Vioxx), a class of pharmaceuticals used for the treatment of chronic pain, in 2005 was associated with a 0.35 percentage point decline in overall labor force participation and $19 billion in lost wages in the United States. Using Norwegian administrative data, Bütikofer and Skira (2018) show that the withdrawal of Vioxx increased sick days for individuals with joint pain by 12 to 16 percent and raised their probability of receiving disability benefits by 6 to 15 percent. Our research complements these estimates by examining the effects of access to treatment for mental health disorders. Given the high prevalence of mental health disorders and their debilitating effects, our estimates imply that universal access to treatment could save $88 million in wages per year, roughly 9 percent of total healthcare costs associated with mental health in Denmark (Santini et al. 2021).[4]

In addition, our findings provide new evidence on the differential impact of mental health conditions and access to treatment across the spectrum of socio-economic status and

[3] For instance, Shapiro (forthcoming) shows that increased spending on advertisement of anti-depressants in the US leads to more prescriptions and fewer lost days of work. Butikofer et al. (2020) document that the introduction of black box warnings for SSRIs in 2004 decreased antidepressant prescriptions and reduced labor supply. Exploiting quasi-random separations of individuals from their physicians, Laird and Nielsen (2017) find that having a physician who is prone to prescribe mental health drugs has no discernable labor market effects.
[4] Specifically, we find that treatment increases wages of people with BD by 11 percent; there are 22,694 people with BD in the population, earning an average of $35,359 without access to treatment. This implies that access to treatment leads to a $35,359 * 11% * 22,694 = $88,268,086 increase in total wages.

wealth. Building on existing research on the effects of economic status on mental health (Haushofer and Shapiro 2016; Ridley, Rao, Schilbach, and Patel 2020; Ahammer, Grübl, and Winter-Ebmer 2020; Ahammer and Packham, 2020), on the intergenerational persistence of mental health outcomes (Aizer and Currie 2014, Persson and Rossin-Slater 2017, Van der Bergh et al. 2015), and on the relationship between parents' earnings and children's mental health (Adhvaryu et al. 2019), we demonstrate that access to treatment can be a powerful tool to reduce inequality in labor market outcomes 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 the three disorders that are the focus of this paper – depression, bipolar disorder (BD), and schizophrenia. Our data cover mental health diagnoses, earnings, and disability payments for the population of Denmark, including 2,692,479 people in birth cohorts from 1946 to 1977.[5]

A. Mental Health Disorders

We measure people's mental health using registry-level data from the Central Psychiatric Register (*Landspatientregistret for Psykiatri Diagnoser*), which includes all mental health diagnoses from psychiatric departments in Denmark 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.[6] Appendix Table A2 includes a detailed description of this classification.

We construct indicators for people with at least one diagnosis of three among the most frequent mental health disorders: depression, bipolar disorder, and schizophrenia.[7]

Depression

A major depressive disorder, or *depression* in 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

[5] These data are administered by Statistics Denmark. Appendix Table A1 describes the individual registries.
[6] See http://apps.who.int/classifications/icd10/browse/2016/en#/F30-F39.
[7] These variables are not mutually exclusive: each individual can be diagnosed with different disorders over his or her lifetime. Approximately 0.4 percent of the population receives diagnoses for more than one type of disorder between 1995 and 2015. Appendix Table A3 tabulates comorbidities by disorder.

decisions, and thoughts of death or suicide. For a diagnosis of depression, symptoms must last at least two weeks.

In our data, this condition is identified by diagnosis code ICD-10: F32: "Mild, moderate, severe or recurrent depressive episodes, the patient suffers from lowering of mood, reduction of energy, and decrease in activity." According to the WHO, depression affects 264 million people worldwide; in our data, 97,932 people (3.6 percent) receive at least one diagnosis of depression between 1995 and 2015.[8]

Bipolar Disorder

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, 2000) distinguish between two types of BD:

- BD I is defined by at least one lifetime manic or mixed episode. Manic episodes are characterized by irritability, euphoria, a decreased need for sleep, increased activity, grandiose ideas, racing thoughts, impulsivity, and distractibility. For a diagnosis of BD I, manic episodes must last at least a week or require hospitalization. Mixed episodes combine symptoms of mania with simultaneous symptoms of depression for at least one week. Symptoms of depression are not necessary for a diagnosis of BD I.
- 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, […] accompanied by increased energy, resulting in overactivity, pressure of speech, and a decreased need for sleep." The variable *BD* variable is an indicator for a diagnosis of BDI or BDII, captured by diagnosis codes ICD-10: F31 and ICD-10. In our data, 22,694 people (0.8 percent) are diagnosed at least once with BD. Worldwide, BD affects about 45 million

[8] World Health Organization Fact Sheet, April 2017 (http://www.who.int/mediacentre/factsheets/fs396/en/). In the National Comorbidity Study-Replication of 9,282 people in the continental United States, 16.2 percent had been affected by depression at least once and 6.6 percent within the 12 months prior (Kessler et al. 2003).

people, most of whom remain. Estimates of suicide risks range between 3.5 and 50 percent around an average of 15 percent (Simpson and Jamison 1999).

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).[9] The median age of onset for BD is 18 years (Kessler et al. 2005). We exploit this fact to compare people with and without access to treatment when they entered their twenties.

Schizophrenia

The variable *schizophre*nia 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."

Reassuringly, the share of people with BD is stable across cohorts, with 0.9 percent for the 1946, 1954, and 1960 cohorts and 0.8 for the 1975 cohort, respectively (Appendix Figure A2). Rates of diagnosis for schizophrenia are stable around 1.4 percent, while rates of diagnosis for depression increase over time, from 2.8 percent for birth cohorts until 1956 to 3.3 for younger cohorts (Appendix Figure A2).

B. 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 et al. 1976).[10] 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.

To measure lithium usage and to further identify people with BD, we modify our indicator for people with BD to include people with either (i) a diagnosis or (ii) at least one lithium prescription. To do so, we combine data on medical diagnoses 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. On average, 1.0

[9] Imaging studies of the brain have found that people with BD and their family members have less grey matter and lower levels of activity in the pre-frontal cortex, an area of the brain that is typically associated with moderating executive functions (Drevets et al. 1997, Krüger et al. 2006, Naranjo et al. 2001).

[10] *Acta Psychiatrica Scandinavia* 1976, Price and Heninger 1994, McInnis et al. 2014. The US FDA had approved lithium two years earlier, in January 1974.

percent of all people have at least one lithium prescription during our time period, including 64 percent of people with at least one diagnosis of BD (Appendix Figure A3).

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.[11] Among all treatments, however, lithium has the strongest scientific record of controlling mania and preventing recurrences. Approximately 60%–70% of persons with BD show a remission of manic symptoms on lithium (Goldberg 2000). 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; Tondo et al. 1999).

Despite its effectiveness, many people with BD are reluctant to take it due to side effects that include tremors, weight gain, feelings of sedation, stomach irritations, thirst, and kidney problems (Miklowitz and Johnson 2006; Price and Heninger 1994; McInnis et al. 2014).[12] People also report stopping treatment because they miss "periods of exuberance or creativity" (Goodwin and Jamison 2007; Jamison and Akiskal 1983).

C. 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 dollars using the Danish CPI and the 2015 exchange rate. Individuals with positive earnings earn $52,307 on average, with a standard deviation of $83,476 (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 severity of the disability and family status. People who receive disability can work part-time, earning up to an amount that depends on household structure, income, and wealth; if they earn more they forfeit

[11] Recent approaches in CBT focus on psychoeducation and cognitive restructuring to challenge overly negative or positive cognitions. By 2005, the American FDA had approved four additional mood stabilizers for the treatment of BD: the anticonvulsant divalproex sodium (also known as valproate or valpro), the antipsychotic chloprozaine, the atypical antipsychotic olanzapine, and the anticonvulsant lamotrigine.

[12] Between 25 and 50 percent of patients experience hand tremors. Abnormalities in the thyroid and parathyroid affect 10 to 20 percent (Price and Heninger 1994; McInnis et al. 2014).

disability pay for that calendar year.[13] Eleven percent of people with depression, BD, or schizophrenia receive disability pay in an average year, including 6,026 people with BD (26 percent of all people with BD), 16,981 with depression (17 percent), and 19,327 with schizophrenia (46 percent, Table 1).

To measure whether a person experienced *unemployment* in a given year, we use an indicator that equals one if they were unemployed for one day or more within the year.

D. 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 1,788,166 people (71 percent of the population). Seventy-five percent of all people have one or more siblings. Among people with BD, the share of people with siblings is slightly larger (82 percent).

Among people who can be linked with their parents, 38 percent have at least one parent who had financial assets for at least one year between 1980 and 2015. For the remaining observations, we set parental assets to zero.[14] 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.

II. Mental Health and Labor Market Outcomes

We start our analysis by examining earnings and other career outcomes for people with three major mental health disorders: depression, bipolar disorder (BD) and schizophrenia.

A. Average Earnings Penalties

First, we investigate whether mental health disorders are associated with lower earnings. We estimate the following model:

$$(1) \qquad ln(earnings_{it}) = \beta_1 Depression_i + \beta_2 BD_i + \beta_3 Schizophrenia_i + \theta_{c(i)} + \tau_t + \varepsilon_{it}$$

[13] After a reform on March 1, 2013, restricted disability pay to Danish citizens below the age of 40, the number of new recipients declined from 14,450 in 2012 to 5,684 in 2014. Our results are robust to excluding data after the reform (Appendix Tables A4 and A5).

[14] All results are robust to excluding individuals without information on parental assets from the analyses. Assets are reported by banks and other financial institutions.

where the dependent variable ln*(earnings$_{it}$)* is the natural logarithm of earnings of individual *i,* born in cohort *c(i),* in the calendar year *t*. The indicator variable *Depression* equals one for people who have been diagnosed with depression at least once. Indicators for *BD* and *Schizophrenia* are defined accordingly. Year fixed effects control for changes in aggregate rates of employment and other economic factors that may influence earnings and employment over time. Cohort fixed effects θ_c control for unobservable factors that vary across birth cohorts and affect the earnings of healthy and sick people in the same way (for example the state of the economy).

OLS estimates show vast earnings penalties for all three mental health disorders. People with depression earn 36 percent less (with an estimate of -0.438, Table 2, column 1, significant at 1 percent). People with BD earn 38 percent less (significant at 1 percent), and people with schizophrenia earn 74 percent less (significant at 1 percent).

B. Controlling for Family Background

Both earnings and the incidence of mental health conditions may vary across families. Medical research has shown that mental health disorders can be triggered by abuse, neglect, the death of a parent, or other family-related stress (Mortensen et al. 2003; Persson and Rossin-Slater 2017). In addition, a person's family background and socioeconomic status can influence the incidence of the condition and the odds of diagnosis and treatment (Adhvaryu et al. 2019).[15] If families with lower earnings have a higher rate of mental health disorders, a simple comparison of people with BD with the population may overstate the earnings penalties from mental health disorders. To address this issue, we re-estimate equation (1) with controls for family fixed effects. This specification compares people with mental health conditions with their healthy siblings.

Including controls for a person's family background leaves the estimates substantially unchanged. Only the estimated earnings penalty associated with depression is reduced slightly by controlling for family background, but it stays large at 31 percent (Table 2, column 2, significant at 1 percent), compared with 35 percent when calculated relative to the population. These results are particularly striking considering that siblings may be affected by mental health disorders either indirectly (if parents focus time and attention on children with mental health disorders) or directly (if siblings are affected by undiagnosed and untreated

[15] Low income is associated with an increased risk for the manic and hypomanic symptoms of BD (Bauer et al. 2011, Sareen et al. 2011, Hakulinen et al. 2019), and access to specialized mental health care is associated with socio-economic status (Katz et al. 1997; Wang et al. 2005).

forms of a disorder, e.g., Kruger et al. 2006).[16] Our results suggest that the effects on the siblings are small relative to the earnings penalties for people with the disorder.[17]

C. Event Studies Surrounding the Date of First Diagnosis

Changes in earnings might not be instantaneous after a diagnosis. First, earnings may decline before the diagnosis if a person experiences symptoms before the diagnosis.[18] Second, earnings may recover with some delay after the diagnosis because treatments require time to have an effect. To investigate the timing of these changes, we estimate event studies of earnings in the 10 years before and after a diagnosis:

$$(2) \quad ln(earnings_{it}) = \sum^{10}_{k=-10} \delta_k C_i \mathbf{1}(t\text{-}Y(C)_i = k) + \beta_1 BD_i + \beta_2 Depression_i + \beta_3 Schizophrenia_i + \theta_{c(i)} + \tau_t + \varepsilon_{it}$$

where C_i is an indicator for *Depression, BD*, *or Schizophrenia* and $Y(C)_i$ denotes the first year in which person i is diagnosed with condition C_i in our data. Normalizing δ_{-2} to zero, the parameters δ_k capture changes in earnings k years after a diagnosis relative to the two years preceding the diagnosis.

OLS estimates of equation (2) show that earnings decline dramatically and persistently after the diagnosis. Two years after the diagnosis, people with depression earn 29 percent less than they did two years before the diagnosis (Figure 1, significant at 1 percent). Similarly, people with BD earn 34 percent less and people with schizophrenia earn 49 percent less two years after the diagnosis. Declines in earnings are long-lasting: Ten years after the diagnosis, people with depression earn 21 percent less than they did two years before the diagnosis, people with BD earn 34 percent less, and people with schizophrenia earn 57 percent less.

Consistent with symptoms before the diagnosis, earnings decline in the decade leading up to the diagnosis. Between 10 and 2 years before a diagnosis, earnings for people with depression decline by 9 percent (significant at 1 percent). People with BD and schizophrenia experience even larger declines, with 23 percent and 31 percent, respectively (Figure 1, significant at 1 percent).

[16] Siblings may also be affected by "courtesy stigma," distancing and rejecting family members and other people who are associated with a devalued group (Hinshaw and Stier 2008, p. 372).
[17] We can identify siblings for 71 percent of the population. Restricting the sample for the baseline estimate to people with known siblings yields results similar to our baseline estimates (Appendix Tables A6 and A7).
[18] Calabrese et al (1996), for example, find that roughly one in five people who enter outpatient treatment for BD have experienced four or more episodes within the prior year.

D. Differences in the Probability of Extremely High or Low Earnings

In addition to influencing average earnings, mental health disorders may determine a person's place in the *distribution* of earnings. Medical studies have found that people with BD have an elevated tolerance for risk; this may lead some of them to select into high-risk, high-return careers and reach the top of the distribution (Mason et al. 2014; Reddy et al. 2011; Swann 2009).[19] Referring to BD as a CEO's disease, Cooper et al. (1999) note that people with BD share a high tolerance for risk and other personality traits with entrepreneurs.[20] Yet, debilitating symptoms may cause people with mental health disorders to have zero earnings or receive disability pay, forcing them into the lower quantiles of earnings.[21]

We find that people with mental health disorders are much more likely to fall into the bottom quantiles of earnings. People with BD are 12 percentage points (120 percent) more likely to be in the bottom 10 percent of earnings compared with the population (Table 3, column 1, significant at 1 percent) and 110 percent more likely compared with their siblings (column 2, significant at 1 percent). Estimates are similar for depression (with a 99 percent higher probability compared to the population and an 86 percent higher probability compared with their siblings, significant at 1 percent) and much larger for schizophrenia (a 319 percent higher probability compared to the population and a 309 percent higher probability compared with their siblings, significant at 1 percent). Examining the bottom 25 percent of earnings yields similar results (columns 3 and 4).

Population data also show that people with mental health disorders are substantially *less* likely to reach the top quantiles of earnings. People with depression are 52 percent less likely than the population to be in the top 10 percent of the distribution (Table 3, column 7, significant at 1 percent) and 41 percent less likely compared with their siblings (column 8, significant at 1 percent). Similarly, people with BD are 3 percentage points (30 percent) less

[19] Mason et al. (2014) show that brain circuits involved in pursuing rewarding experiences (the *nucleus accumbens)* are more strongly activated in people with BD, guiding them towards riskier gambles, while the prefrontal cortex is more strongly activated in control subjects, guiding them towards safer gambles. Experimental evidence from a balloon analogue risk task (BART) analysis suggests that people with BD take the same levels of risks as other people, even though they score higher on self-reported tests of impulsiveness (Reddy et al 2011). Swann (2009) argues that impulsivity, the tendency to pursue rewards without considering negative consequences, is elevated in people with mania.

[20] Successful entrepreneurs overestimate their firm's probability of survival (Cooper, Woo, and Dunkelberg 1988), employment expansion, and sales growth (Landier and Thesmar 2008). Incorporated entrepreneurs are also more likely to have engaged in risky and illicit behavior in their youth (Levine and Rubinstein 2017).

[21] Jamison (1993), for instance, documents that exceptionally creative people, such as Vincent Van Gogh, Ernest Hemingway, and Virginia Woolf exhibited traits of BD. Using administrative data from Sweden, Kyaga et al. (2011) find that people with mental health disorders may be more likely to pursue creative professions.

likely to reach the top earnings decile compared with the population and 3.3 percentage points (33 percent) less likely than their siblings. People with schizophrenia are 58 and 44 percent less likely (Table 3, columns 7 and 8). Examining the top 25 percent of earnings corroborates these patterns (columns 5 and 6).

E. Differences in the Probability of No Earnings

While our analyses so far have focused on people with positive earnings; people with mental health disorders may also face an elevated risk of having no earnings at all. Examining these differences in the Danish population data, we find that people with mental health disorders are substantially more likely to have no earnings. In the population, 13.4 percent of people have zero earnings in a given year. For people with depression, this share is 15.3 percentage points higher, which implies that depression is associated with a 1.1-fold increase in the risk of no earnings (Table 2, column 3, significant at 1 percent). People with BD are 15 percentage points more likely to have no earnings, implying a 1.1-fold higher probability. People with schizophrenia are 45 percentage points more likely to have no earnings, implying a 3.36 times higher probability (Table 2, column 3, significant at 1 percent). Controlling for family fixed effects leaves these estimates substantially unchanged (Table 2, column 4, significant at 1 percent).

Event study estimates show that a person's risk of having no earnings increases dramatically after a mental health diagnosis. Two years after the diagnosis, people with depression, BD, and schizophrenia have a 1.2-times higher risk of no earnings compared with 2 years before the diagnosis (Figure 2, significant at 1 percent). For people with depression, the risk of no earnings declines slightly over time after a diagnosis. For people with BD and schizophrenia, however, the risk of no earnings remains high in the ten years after a diagnosis.

Event study estimates also show that the risk of no earnings begins to increase before the diagnosis. For a person with depression, the risk of no earnings increases by 18 percent between the tenth and the second year before their diagnosis (significant at 1 percent). For people with BD, the risk of no earnings increases by 61 percent, and for people with schizophrenia, it increases by 87 percent.

E. Mechanisms (I): Disability Risk

A higher risk of no earning suggests that symptoms of mental health disorders may prevent people from participating in the labor force. Estimates by the WHO suggest that mental

illness is the leading cause of lost disability-adjusted life years (DALYs) worldwide, accounting for more than one third of years lost due to non-communicable diseases (WHO 2011 and Ormel et al., 2008).[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).

To examine the extent to which the estimated earnings penalties for people with mental health conditions might be due to an increased risk of disability, we test whether people with these conditions face significantly higher risks of disability compared with the population. Estimating equation (1) with an indicator for people who receive disability pay as the outcome variable, we find that people with BD are 2.7 times more likely to receive disability pay compared with the population (12.8 percentage points compared with a population average of 5.9 percent, Table 2, column 5, significant at 1 percent). People with schizophrenia have the highest disability risk; they are 7 times more likely than the population to receive disability pay (41 percentage points, Table 2, column 5, significant at 1 percent). People with depression face the lowest risk of disability; they are 1.2 times more likely to receive disability pay compared with the population (7.4 percentage points compared with a population average of 5.9 percent). All results are robust to controlling for family fixed effects (Table 2, column 6).

Event-study estimates show a large and persistent increase in the risk of disability after the diagnosis. Ten years after a diagnosis, a person with depression is 4.2 times more likely to receive disability pay compared with the year prior to the diagnosis (Figure 3). A person with BD is 5.8 times more likely, and a person with schizophrenia is 8.5 times more likely to receive disability pay. Similar to other career outcomes considered above, the risk of disability increases in the years leading to the diagnosis. For people with depression, the risk of disability grows by 63 percent between the tenth and the second year before the diagnosis (significant at 1 percent). For people with BD, the risk of disability increases by 101 percent, and for people with schizophrenia, it increases by 140 percent.

F. Mechanisms (I): Unemployment

In addition to an increased risk of disability, the symptoms of a mental health condition may cause some people to lose their jobs. Unemployment reduces earnings not only directly,

[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. 2003). 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.

through the immediate loss of income and indirectly, by worsening future labor market opportunities through “unemployment scarring" (Jacobson, LaLonde, and Sullivan 1993; Davis and von Wachter 2012). We examine both types of effects by estimating event studies for three groups of people with a mental health condition: (a) people who received a single diagnosis and experienced an unemployment spell between two years before and two years after a diagnosis, (b) people who received a single diagnosis but did not experience unemployment; and (c) people who received multiple diagnoses (and thus are likely to have more severe symptoms) but did not experience unemployment. A comparison between (a) and (b) isolates the scarring effect of unemployment on people with a milder expression of the condition, while a comparison of (b) and (c) illustrates the impact of severe symptoms.

Event study estimates in Figure 4 indicate that earnings losses are due primarily to severe symptoms of BD, rather than unemployment scarring. People who receive only one diagnosis and experience an unemployment spell see their earnings fall by 42 percent in the year of the diagnosis, relative to two years before the diagnosis. Earnings then start to recover, returning to their pre-diagnosis levels six years after the diagnosis. People who also receive one diagnosis but do not become unemployed have a similar earnings trajectory, with earnings falling by 32 percent two years after a diagnosis and then returning to pre-diagnosis levels ten years after it. The absence of differences in earnings between these two groups suggests that the scarring effect of unemployment is unlikely to drive the earnings decline that follows a diagnosis. Instead, our data support the hypothesis that the post-diagnosis earnings decline is due to an impairing effect of mental health symptoms: People who receive more than one diagnosis and do not become unemployed see their earnings fall significantly more, by 56 percent two years after the first diagnosis. For these people, earnings also remain at this lower level in the ten years following the first diagnosis.

People with mental health disorders may not be recorded as unemployed because they leave the labor force. In fact, even for people who do not experience unemployment, the odds of no earnings and disability increase leading up to a diagnosis and peak two years afterwards (Appendix Figure A4). This is true especially for people with a more severe type of BD (measured by multiple diagnoses) and are never unemployed.

Taken together, these results suggest that lost earnings are mostly due to the direct effects of symptoms rather than the scarring effect of unemployment.[23]

[23] Using data from the NESARC survey of the U.S. Census, Ettner Maclean and French (2011) show that personality traits and symptoms experienced by people with mental health conditions (such as antisocial, paranoid, and obsessive-compulsive behavior) are associated with an increased probability of unemployment.

III. Effects of Access to Treatment

Reduced earnings for people with mental health conditions point to an important link between mental health and labor market outcomes, but they cannot establish a causal effect of mental health on creativity. In fact, causality may operate in the oppositive direction if negative labor market shocks trigger mental health episodes (Ahammer, Grübl, and Winter-Ebmer 2020; Ahammer and Packham, 2020).[24] To address this issue and investigate the causal effect of mental health on labor market outcomes, we exploit the approval of lithium as a maintenance treatment for BD.

A. Access to Treatment Greatly Increases Average Earnings

Baseline OLS estimates compare differences in earnings between the population and people with BD who had access to treatment when they turned 20, with the same differences for people with BD who did not have access to treatment at age 20, the typical age of onset for BD (Kessler et al. 2005):

$$(3) \qquad ln(earnings_{it}) = \alpha\, BD_i + \beta\, BD_i \times post_{c(i)} + \theta_{c(i)} + \tau_t + \varepsilon_{it}$$

where the dependent variable $ln(earnings_{it})$ represents the natural logarithm of earnings for individual i in year t. The variable $post_c$ equals 1 for cohorts born after 1956, who had access to lithium treatment at age 20. Cohort fixed effects θ_c control for differences in earnings across cohorts and year fixed effects τ_t control for variation in earnings over time. Baseline specifications focus on people with positive earnings; separate analyses in Section III.D examine the risk of zero earnings. Under the identifying assumption that differences in earnings for people with and without BD would have been comparable for cohorts born before and after 1956, the coefficient β on the interaction $BD_i \times post_c$ estimates the effect of access to treatment.

OLS estimates of equation (3) confirm large penalties for people with BD without access to treatment and reveal that treatment eliminates one third of these penalties. An estimate of -0.560 for *BD* indicates that people with BD who did not have access to treatment

[24] Ahammer et al. (2020) show that downsizing has negative effects on mental health of non-laid off employees, who might be fearing for their jobs. Ahammer and Packham (2020) compare unemployed workers with and without access to unemployment benefits and find that the latter have worse mental health outcomes.

earned 42.9 percent less than the population (Table 4, column 1, significant at 1 percent). An estimate of 0.112 for *BD x post* (significant at 1 percent) indicates instead that people with BD who did have access to treatment earned 12 percent more than people with the same disorder but without access to treatment. These estimates imply that treatment closes 28 percent of the earnings penalty associated with BD. Controlling for family characteristics further increases the estimated benefits from treatment. Compared with their siblings, people with BD earn 42 percent less, and access to treatment closes 64 percent of this gap (with an estimate of 0.240 for *BD x post* Table 4, column 2, significant at 1 percent).[25]

Since only 64 percent of people diagnosed with BD receive lithium (Appendix Figure A3), our estimates capture the intent to treat, rather than the average treatment effect of lithium.[26] The estimates may also be attenuated because diagnoses are only observable starting in 1995, so that we cannot observe people who were sufficiently ill to die before we observe their diagnosis. We also might assign people who were diagnosed before 1995 (but not after) to the control group. If these people are less sick, this assignment further attenuates our estimates.[27] Finally, our results may be influenced by secular changes in labor market outcomes for people with mental health conditions, e.g., because of changes in stigmatization over time. We examine these forces in Section VI.A.

B. Event Study Estimates

To investigate the timing of changes in earnings, we estimate event studies in equation (2) separately for cohorts with and without access to lithium. Leading up to a diagnosis, earnings of people with and without access to treatment are similar. Ten years before a diagnosis, people with access to treatment earn 26 percent more compared with two years before the diagnosis, and people without access earn 24 percent more (Figure 5). In the year of the diagnosis, earnings decline by 34 percent for both groups.

After the diagnosis, the earnings trajectories of people with and without access to treatment diverge. Without access to treatment, people with BD earn 16 percent less in the year after the diagnosis than in the last year before the diagnosis; ten years after the diagnosis, they earn 43 percent less. With access to treatment, earnings of people with BD begin to recover four years after a diagnosis; ten years after the diagnosis, people with access

[25] See Appendix Table A7 for estimates without family fixed effects for the sample of people with siblings.
[26] Aagaard and Vestergaard (1990) find that 58 percent of 133 patients, initially prescribed with lithium at the Aarhus Psychiatric Hospital (Denmark) between 1981 and 1983, continue treatment for at least two years.
[27] The composition of the sample of people with BD relative to the population is constant across cohorts in terms of gender, education, comorbidity, and parental wealth (Appendix Figure A5).

to treatment earn just 29 percent less. Access to treatment closes nearly one third of the decline in earnings associated with BD.

C. Access to Treatment Improves a Person's Position in the Distribution of Earnings

Next, we investigate the effects of access to treatment on a person's position in the distribution of earnings. These estimates indicate that access to treatment greatly reduces the risks of low earnings and increases the probability of high earnings. Notably, these effects are *stronger* when we control for a person's family background.

Specifically, access to treatment reduces the risk that a person with BD has earnings in the bottom decile by 17 percent compared with the population (estimate for *BD x post* equal to 1.7 percentage points, Table 5, column 1, significant at 1 percent) and more than twice as much, by 42 percent, compared with their siblings (Table 5, 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 21 percent compared with their siblings (*BD* x *post* = 0.021, Table 5, column 1, significant at 1 percent) though there is no effect compared with the population (*BD* x *post* = -0.004, Table 5, column 1).

D. Access to Treatment Greatly Reduces the Risk of No Earnings

Treatment may allow people with BD to stay in the labor force, reducing their risks of no earnings. To investigate this mechanism, we estimate equation (3) with an indicator for zero earnings as the dependent variable.

OLS estimates imply that people with BD are 1.5 times more likely than the population to have no earnings at all (19.6 percentage points more likely compared with a population share of 0.134, Table 4, column 3, significant at 1 percent). Treatment reduces that risk by 6.5 percent or 33 percent (Table 4, column 1, significant at 1 percent), which implies that, with access to treatment, people with BD are only 98 percent more likely than the population to have no earnings. Controlling for family fixed effects leaves these estimates substantially unchanged. Compared with their siblings, people with BD are 19.7 percentage points more likely to have no earnings; access to treatment eliminates 36 percent of this risk (-7.1 percentage points, column 2, significant at 1 percent).

Event studies show that, leading up to the diagnosis, the probability that a person with BD has zero earnings is similar with and without access to treatment (Figure 6). After the diagnosis, estimates diverge: Without access to treatment, people with BD face a 1.5- times

higher risk of zero earnings 10 years after the diagnosis compared with the year before the diagnosis. With access to treatment, they only face a 1-time increase in the risk of earnings.

E. Access to Treatment Eliminates more than Half the Risk of Disability

Access to treatment may enable people with BD to work. Examining depression, Shapiro (forthcoming) finds that encouraging people to take drugs for depression via advertising leads them to miss fewer days at work. Garthwaite (2012) shows that the removal of Vioxx (a nonsteroidal anti-inflammatory drug, or NSAIDs, and a branded Cox-2 inhibitor) from the market was associated with a 0.35 percentage point decline in overall labor force participation. If treatments for BD are similarly effective, they may reduce the risk of disability.

OLS estimates in Table 4 indicate that access to treatment reduces the risk of disability for people with BD by more than half. Without access to treatment, people with BD are almost 4 times more likely to receive disability pay compared with the population (21.8 percentage points, Table 4, column 5, significant at 1 percent, compared with a population average of 5.9 percent). Access to treatment eliminates 59 percent of this risk (with an estimate of *BD x post* equal to 0.128, Table 4, column 5, significant at 1 percent).

Controlling for a person's family background increases the disability risk associated with BD slightly but leaves the benefits from treatment substantially unchanged. Compared with their siblings, people with BD are nearly 5 times more likely to receive disability pay (21.4 percentage points, Table 4, column 6, significant at 1 percent, compared with a population average of 4.7 percent for people with one or more siblings). Access to treatment closes 57 percent of this gap (with an estimate of 0.122 for *BD x post* compared with 0.214 for *BD*, Table 4, column 6, significant at 1 percent).

Event study estimates reveal significant post-diagnosis differences in disability risks for people with and without treatment (Figure 7). Before the diagnosis, the risk of disability follows a similar trend for people with and without access to treatment. In the year of the diagnosis, this risk increases by 9.8 percent for people without access to treatment and 4.3 percentage points for people with access (166 and 73 percent, respectively). The likelihood of receiving disability pay continues to rise for both groups; ten years after a diagnosis, however, the increase is substantially more pronounced for people without access to treatment (with a 6.3-times increase compared to a 5.6-times increase with access).

F. No Significant Effects of Treatment on Siblings

In addition to directly affecting people with BD, the disorder may also create negative spillover effects on siblings, for instance if parents shift resources to the sibling with BD. To investigate whether siblings are affected by BD, we compare "healthy" siblings of people with BD with the population (Table 6).

OLS estimates confirm that BD creates negative spillovers for siblings of people with BD. Healthy siblings of people with BD earn 6.6 percent less than the population (with an estimate of -0.067 for *BD sibling*, Table 6, column 1, significant at 1 percent). Notably, siblings, do not appear to benefit from treatment (with an estimate of -0.032 for *BD sibling x post*, Table 6 column 1, significant at 10 percent), possibly because the shift in family resources is permanent. Alternatively, "healthy" siblings may be affected by a "subthreshold" form of BD, even if they are not diagnosed (Mortensen et al 2003, Kruger et al. 2006).[28]

IV. Treatment Effects Across Birth Cohorts

Our baseline specifications estimate the average benefits of access to treatment by comparing people with BD who had access to lithium by age 20 (born before 1956) with people who did not have access at the same age (born in or after 1956). Using the 1956 cohort as a cutoff capture the true effect of lithium if the following assumptions hold: a) treatment is most important when a person enters their 20s and b) lithium was not available at all until 1976 and became available immediately to everyone afterwards.

In reality, these assumptions might fail. First, it could take years for a new drug to reach all patients (Agha and Molitor, 2018) and some patients might have used lithium before it was approved.[29] This would lead us to under-estimate the benefits of treatment. Moreover, the impact of treatment may increase with the length of exposure instead of changing discontinuously for cohorts born after 1956. Take-up rates (defined as the share of people who receive prescriptions of lithium each year) increased gradually across cohorts, from 47 percent of people with BD born in 1946 to 84 percent born in 1976 (Appendix Figure A3, controlling for year effects and a cubic polynomial for age).

To investigate the heterogeneous effects of lithium across cohorts, we estimate cohort-specific treatment effects β separately for two-year cohorts between 1946 and 1976

$$(4) \qquad ln(earnings_{it}) = \alpha\, BD_i + \Sigma_c\, \beta_c\, BD_i \times \theta_c + \gamma\, Z_{it} + \delta_f + \theta_c + \tau_t + \varepsilon_{ict}$$

[28] 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).
[29] Agha and Molitor (2018) show that, within the first four years after the approval of a new cancer drug, patients who live near the lead investigator are more likely to be treated.

where the birth year 1953-54 is the omitted cohort.

These estimates show that our baseline specification captures the most salient change in access to treatment for BD. Cohort-specific estimates indicate no positive treatment effects for people born before 1955 who did not have access to lithium when they turned 20. Estimates range from -0.054 for the 1946 cohort to 0.127 for 1948 (Figure 8) and are not statistically significant.

Cohort-specific estimates first become positive for people born in 1960: An estimate of 0.170 implies a 19 percent increase in earnings (exp(0.17)-1, significant at 5 percent, Figure 8, darker series). This four-year delay after access to treatment is consistent with delays in the diffusion of drugs (Agha and Molitor 2018). Estimates further to 0.200 for people born in 1963-64 (significant at 1 percent) and 0.262 for people born in 1975-76 (significant at 1 percent, Figure 8), implying a 22 and 30 percent increase, respectively. Controlling for family fixed effects increases the size of the estimates (Figure 8, lighter series).

A. People with Access in their Early 20s have Much Lower Risks of Zero Earnings

Next, we estimate cohort-specific effects for the risk of no earnings. These estimates also show no measurable effects of treatment on people in cohorts born before 1955. The risk of no earnings is flat across cohorts born between 1946 and 1954 (Figure 9).

Estimates first become statistically significant for cohorts born in 1957-58, with a 2.5 percentage points (-0.025) decline in the probability of no earnings (significant at 5 percent). Estimates decline continuously, reaching -0.089 for people born in 1975-76 (significant at 1 percent, Figure 9). Compared with a population share of 0.154, these estimates imply a 16 and 58 percent reduction in the risks of no earnings. Younger people, who had access to lithium for a larger share of their professional lives, are substantially more likely to have positive earnings.

B. People in Cohorts with Access to Treatment are Less Likely to Receive Disability Pay

Cohort-specific estimates indicate that access to treatment reduces the risk of disability. For cohorts without access to treatment (born between 1946 and 1954) there are no significant differences in the probability of disability (Figure 10).

The risk of disability declines for cohorts after 1956, with an estimate of -0.039 for the 1957-58 cohort (significant at 5 percent) and -0.218 for the 1975-76 cohort (significant at

1 percent, Figure 10). Compared with an average probability of 0.059, this corresponds to a 66 and 369 percent lower probability of disability, respectively. Estimates are robust to controlling for family fixed effects (Figure 10, lighter series).

C. Sensitivity to Violations of the Parallel Trends Assumption

Our estimates of the effects of access to treatment across cohorts rely on the assumption that the outcomes of people with and without BD would have been on parallel trends in the absence of the treatment. While the assumption of parallel trends is untestable, we can examine the sensitivity of our estimates to violations of this assumption. Following Rambachan and Roth (2019), we compare 95-percent confidence intervals of OLS estimates of the parameters β_c in equation (5), for $c = 1966$ and $c = 1976$, with estimates that allow for deviations from a linear trend up to an amount M. Appendix Figure A6 shows sensitivity plots for $0 < M < \text{se}(\beta_c)$, where $\text{se}(\beta_c)$ is the standard error of β_c (panel (a) shows estimates on log earnings, panel (b) shows estimates on P(no earnings), and panel (c) shows estimates on P(disability)). All estimates remain largely significantly different from zero.

V. Heterogeneous Outcomes Across the Distribution of Parental Wealth

Population data on mental health diagnoses and earnings reveal immense career effects of mental health disorders and large benefits from treatment. In this section, we examine how these costs and benefits vary with a person's socio-economic status (SES), measured by their parents' position in the distribution of wealth.

Existing research has documented a strong link between SES and the incidence of mental health conditions. For example, adverse health shocks in utero or during childhood have been linked to mental health disorders in adults (McClellan et al. 2006; Neugebauer et al. 2006, Van der Bergh et al. 2005; Persson and Rossin-Slater 2017; Adhvaryu, Finske, and Nyshadham 2019; Gardner and Oswalt 2007).[30] Moreover, SES influences access to treatment. For example, Katz et al. (1997) and Wang et al. (2005) show that low-income urban populations in the United States are less likely to receive appropriately targeted treatment for mental health conditions. Unequal access to care may be due to the monetary

[30] McClellan et al. (2006) and Neugebauer et al. (2006) show that maternal exposure to famine increases rates of schizophrenia and anti-social behavior among children. Van der Bergh et al. (2005) and Persson and Rossin-Slater (2017) show that in utero exposure to maternal stress and anxiety increase the incidence of mental health conditions during adulthood. Adhvaryu et al. (2019) use variation in the price of cocoa in Ghana to show that children who are exposed to negative wealth shocks in utero have lower mental health outcomes as adults. Gardner and Oswalt (2007) find that lottery winners in Britain experienced an improvement in their well-being and that larger wins are followed by stronger improvements.

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.

First, we estimate whether the penalties associated with depression, BD, and schizophrenia vary with a person's position in the distribution of parental assets, measured by a person's median percentile in the distribution of parental assets over time. Then, we investigate whether the benefits of treatment differ across the distribution of parental wealth.

A. Parental Wealth Mitigates Earnings Penalties Associated with Mental Health Disorders

OLS estimates indicate that high levels of parental wealth can help shield a person from the negative career effects of a mental health disorder. People with depression experience an earnings penalty of 31 percent if they are in the second and third quartile of parental wealth; this is captured by the coefficient for *Depression* in column 1 of Table 7, equal to -0.378 and significant at 1 percent, and the conversion (exp(-0.378)-1=-0.315). By comparison, people with depression in the fourth, top quartile earn 4.0 percentage point more compared with people with depression and parental assets in the second and third quartile (with an estimate of 0.039 for *Depression x Parents >= 75th percentile* in Table 7, column 1, significant at 1 percent). This implies that moving from the middle to the top quartile of parental assets eliminates 12.6 percent of the earnings penalty associated with depression. By comparison, the estimate for *Depression x Parents < 25th percentile* is small (-0.015) and not statistically different from zero (Table 7, column 1, p-value equal to 0.21).

For people with BD, the benefits of having wealthy parents are even larger. People with BD who have parental assets in the second and third quartiles suffer an earnings penalty of 35 percent (significant at 1 percent). That penalty is 5.3 percentage points lower for people with BD and parental assets in the top quartile (with an estimate of 0.052 for *BD x Parents >= 75th percentile* in Table 7, column 1, significant at 10 percent). This implies that moving from the middle to the top quartile of parental assets eliminates 15.4 percent of the earnings penalty associated with BD. The estimate of *BD x Parents < 25 percentile* is not statistically significant (at 0.042 with a p-value of 0.18, Table 7, column 1).

In the case of schizophrenia, high levels of parental wealth are less effective at mitigating adverse career effects while low levels are more damaging. People with schizophrenia and parental assets in the second and third quartile experience an earnings penalty of 71 percent (with an estimate for *Schizophrenia* equal to 1.234, significant at 1 percent). This penalty is 6.0 percentage point higher for people with schizophrenia and

parental assets in the top quartile (with an estimate of 0.058 for *Schizophrenia x Parents >= 75th percentile* in Table 7, column 1, significant at 10 percent), which implies that moving from the middle to the top quartile of parental assets eliminates only 8.4 percent of the earnings penalty associated with schizophrenia. People in the bottom quartile of parental wealth experience an even larger penalty, 9.6 percentage points (or 13.6 percent) compared with people with parental assets in the second and third quartiles (estimate for *Schizophrenia x Parents < 25th percentile* equal to -0.101, Table 7, column 1, significant at 1 percent).

Parental wealth also protects people with depression and BD but not people with schizophrenia. People with depression and BD are less likely to have no earnings when their parents' assets are in the top quartile (3.6 and 2.8 percentage points less, respectively, Table 7, column 2). On the contrary, parental assets do not appear to move the risk of no earnings for people with schizophrenia (with an estimate for *Schizophrenia x Parents >= 75th percentile* equal to -0.002 and a p-value of 0.77, Table 7, column 2).

People with wealthy parents also face a reduced risk of disability from mental health disorders (3.4 percentage points less likely for BD, 1.5 percentage points less likely for depression, and 1.6 percentage points more likely for schizophrenia, Table 7, column 3).

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

To examine whether benefits from access to treatment vary across the distribution of parental wealth, we interact *BD* and *BD * post* in equation (3) with indicators for quartiles of parental assets.

While OLS estimates have wide confidence intervals, they suggest that the benefits from treatment are much larger for people with lower parental wealth. An estimate of 0.103 for *BD* x *post* indicates that access to treatment reduces the earnings penalty associated with *BD* by 11 percentage points for people with parental assets in the second and third quartile (Table 8, column 1, p-value equal to 0.44). An estimate of 0.191 for *BD* x *Parents < 25 pctile* x *post* shows that this reduction is nearly three times as large for people with BD and parental assets in the bottom quartile (Table 8, column 1, p-value equal to 0.47). People at the top quartile of parental wealth benefit the least; for them, the effect of access to treatment is 50 percent smaller (with an estimate for *BD* x *Parents >= 75 pctile* x *post* equal to -0.047, Table 8, column 1, p-value equal to 0.83).

People in the lower quartiles of the earnings distribution also experience a disproportionate reduction in the risk of no earnings and disability. Access to treatment reduces the risk of no earnings by 5.7 percentage points for people with parental assets in the

second and third quartile (*BD* x *post,* Table 8, column 2, significant at 10 percent. This reduction is 7.0 percentage point (123 percent) larger for people with BD and parental assets in the bottom quartile (*BD* x *Parents < 25 pctile* x *post,* Table 8, column 2, p-value equal to 0.29) and 2.4 percentage point (48 percent) smaller for people with BD and parental assets in the top quartile (*BD* x *Parents >= 75 pctile* x *post,* Table 8, column 2, p-value equal to 0.83). Similarly, treatment reduces the risk of disability by 15.2 percentage points for people with parental assets in the second and third quartile (*BD* x *post,* Table 8, column 3, significant at 1 percent), with a 5.8 percentage point (38 percent) larger reduction for people with BD and parental assets in the bottom quartile (*BD* x *Parents < 25 pctile* x *post,* Table 8, column 3, p-value equal to 0.33) and a 9.0 percentage point (59 percent) smaller reduction for people with BD and parental assets in the top quartile (*BD* x *Parents >= 75 pctile* x *post,* Table 8, column 3, p-value equal to 0.12).

Although imprecise, our estimates suggest that family wealth plays an important role in shaping the career effects of mental health conditions. High levels of parental wealth help shield individuals with BD from the most severe effects of a disorder. In the absence of monetary barriers to treatment, people with lower levels of financial 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 et al (2013) for Denmark and Chetty et al. (2014) for the United States.

VI. Heterogeneity and Robustness

In this final section, we examine heterogeneous effects on people with more or less severe forms of BD. We also investigate whether our results may be driven by changes in the stigmatization of mental health disorders or other forces that change career outcomes of people with mental health disorders over time. Additional tests use prescriptions, rather than diagnoses, to identify people with BD.

D. Controlling for Changes in Unobservable Factors that Influence Outcomes for People with Mental Health Disorders Over Time

Our identification strategy implicitly assumes that labor market outcomes for people with BD would have remained unchanged had lithium not been introduced as a maintenance treatment for BD. Yet, this period saw many other changes that may have affected outcomes for people with mental health disorders, such as the de-institutionalization of mental health care and the

growth of community-based treatment centers (Geddes and Miklowitz, 2013), as well as changes in health insurance coverage[31] and in the stigmatization of mental health disorders (Hinshaw 2007).[32] All of these forces may have influenced career outcomes for people with mental health disorders over time, confounding our estimates.

To control for the influence of these unobservable factors we estimate a triple-difference model using people with depression or schizophrenia as an additional control:

$$(5) \quad ln(earnings_{it}) = \alpha_1 Depr_i + \alpha_2 BD_i + \alpha_3 Schizo_i + \Sigma_c \beta_{1,c} Depr_i \times \theta_c + \Sigma_c \beta_{2,c} BD_i \times \theta_c + \Sigma_c \beta_{3,c} Schizo_i \times \theta_c + \gamma Z_{it} + \theta_c + \tau_t + \varepsilon_{ict}$$

The coefficients $\beta_{1,c}$ and $\beta_{3,c}$ estimate cohort-specific differences in log earnings between people with depression and schizophrenia, respectively, and the population; the coefficients $\beta_{2,c}$ estimate the cohort-specific differences for people with BD. Controlling for $\Sigma_c \beta_{1,c} Depr_i \times \theta_c$ and $\Sigma_c \beta_{3,c} Schizo_i \times \theta_c$, estimates of $\beta_{2,c}$ for $c>1956$ capture the effects of access to treatment that is specific to BD, controlling for the influence of changes in stigmatization and other unobservable factors that are shared with other mental health disorders.

Triple-difference estimates confirm that access to treatment greatly improved the career outcomes of people with BD, even controlling for other unobservable factors that may have impacted all people with a mental health disorder across cohorts. Estimates of $\beta_{2,c}$, shown in panel A of Figure 11, are indistinguishable from zero for cohorts before 1955-56 and become positive for people born in 1960, with an estimate of 0.204, implying a 23 percent increase in earnings (significant at 5 percent, Figure 11). Estimates for the risk of no earnings (Panels B, Figure 11) and for the risk of disability (Panel C) further corroborate substantial improvements in response to access to treatment.

E. Variation in Severity of BD

To assess whether the labor market penalties and the benefits from treatment vary with the intensity of BD, we exploit variation in the number of diagnoses that a person receives. People with just one diagnosis may have just experienced a single episode and be therefore

[31] 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). The Social Assistance Act of 1976 transferred psychiatric services from the state to local county responsibility. A Patients' Right law of 1992 prohibited treatment without consent and required providers to explain treatment options to patients (European Observatory on Health Care Systems, 2001).

[32] 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).

less sick, while people with multiple diagnoses must have observed as least as many episodes. On average, people with BD receive 2.4 diagnoses of BD between 1995 and 2015, with a median of 2 diagnoses. To incorporate this information, we estimate:

$$(6) \quad ln(earnings_{ict}) = \alpha_1 BD_i + \beta_1 BD_i \times post_c + \alpha_2 \# BD\ episodes_i + \beta_2 \# BD\ episodes_i \times post_c + \gamma Z_{it} + \theta_c + \tau_t + \varepsilon_{ict}$$

where $\# BD\ episodes_i$ is the number of BD episodes experienced by individual *i.*
OLS estimates show that even people with just a single diagnosis suffer earnings penalties from BD; however, the size of the earnings penalties increases with the number of diagnoses. People with just one single diagnosis of BD have 44 percent lower earnings compared with the population (calculated as the sum of the exponents of the estimates for *BD* and *# BD episodes* in Table 9, column 1, significant at 1 percent). On top of this, each additional diagnosis of BD is associated with an additional 22 percent loss in earnings.

People with a more severe expression of BD benefit the most from access to treatment. For people with a single diagnosis, access to treatment closes 25 percent of the earnings gaps associated with BD (exp(0.008) -1+ exp(0.098)-1/0.438, Table 9, column 1). For people with more than one diagnosis, the benefits from treatment increase by 10 percentage points for each additional diagnosis. Controlling for family fixed effects reduces the estimated additional benefit from treatment for people with additional diagnoses (Table 9, column 2).

People with more frequent episodes are also more likely to have zero earnings and benefit more from treatment. People with a single diagnosis of BD are 1.2 times more likely to earn nothing (with an estimate of 0.167 for *BD + BD x #BD episodes* and compared with a 13.4 percent population share of zero earning, Table 9, column 3, significant at 1 percent). Access to treatment eliminates 30 percent of this penalty (*BD + BD x # BD episodes x post* is -0.051, Table 9, column 3, p-value equal to 0.2). Each additional diagnosis of BD is associated with a 7.1 percentage point increase in the probability of zero earnings (with an estimate of 0.071 for *# BD episodes*, Table 9, column 3, significant at 1 percent). Access to treatment eliminates more than half of this penalty, with an estimate of 4.1 percentage for *# BD episodes x post* (Table 9, column 3, significant at 1 percent). For the median person with BD, who receives 2 diagnoses of BD, these estimates imply a 23.8 percentage point increase in the risk of zero earnings; access to treatment eliminates 5.1 percentage points of this increased risk.

VII. Conclusions

This paper has used registry data on mental health diagnoses, earnings, and disability to investigate the career effects of mental health. Population data indicate that mental health disorders carry enormous adverse career effects, with earnings penalties that range from 34 percent for a person with depression to 74 percent for a person with schizophrenia. Risks of no earning range from 110 percent for depression and BD to 336 percent for schizophrenia. Risks of disability range from 120 percent for depression and 270 percent for BD to 700 percent for schizophrenia.

Using the approval of lithium as a maintenance treatment for BD in 1976, we evaluate the effects of a major change in access to treatment. Baseline difference-in-differences estimates indicate that access to treatment closed one third of the earnings penalties from BD compared with the population and 44 percent compared with siblings. Access to treatment also greatly reduces the risks of low or no earnings. Moreover, it eliminates 59 percent of the excess risk of disability compared with the population and 57 percent compared with siblings.

These results imply that policies that expand access to mental health treatments could create major economic and social benefits by increasing earnings, reducing the risk of low earning, and mitigating the risk of disability. In the United States, estimates from the National Comorbidity Survey (NCS-R) indicate that one in three people with BD remain untreated (Kessler et al 2003).[33] Expansions in Medicaid coverage have increased access to psychotropic prescriptions for mental illness by 22 percent (Maclean, Cook, Carson, and Pesko 2017). Our findings suggest that such changes have major welfare effects: Access to treatment could save $88 million in wages.

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 most from access to treatment. For example, the effect of access to treatment on earnings is three times larger for people with BD with parents in the bottom quartile of financial assets compared to the second and third quartile. It is important to remember that Denmark offers universal health care, so that our results estimate the benefits of access to treatment in a

[33] Even when people are treated, the quality of treatment is highly uneven. In the NCS-R, more than one third of all people with BD were treated by mental health professionals who are not psychiatrists (35.4 percent, Kessler et al 2003), even though a striking 73 percent in general medical treatment received the wrong drugs (compared with an also large 43 percent in specialist treatment). See also Kessler, Merikangas, and Wang (2007).

context where treatment is free. 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.

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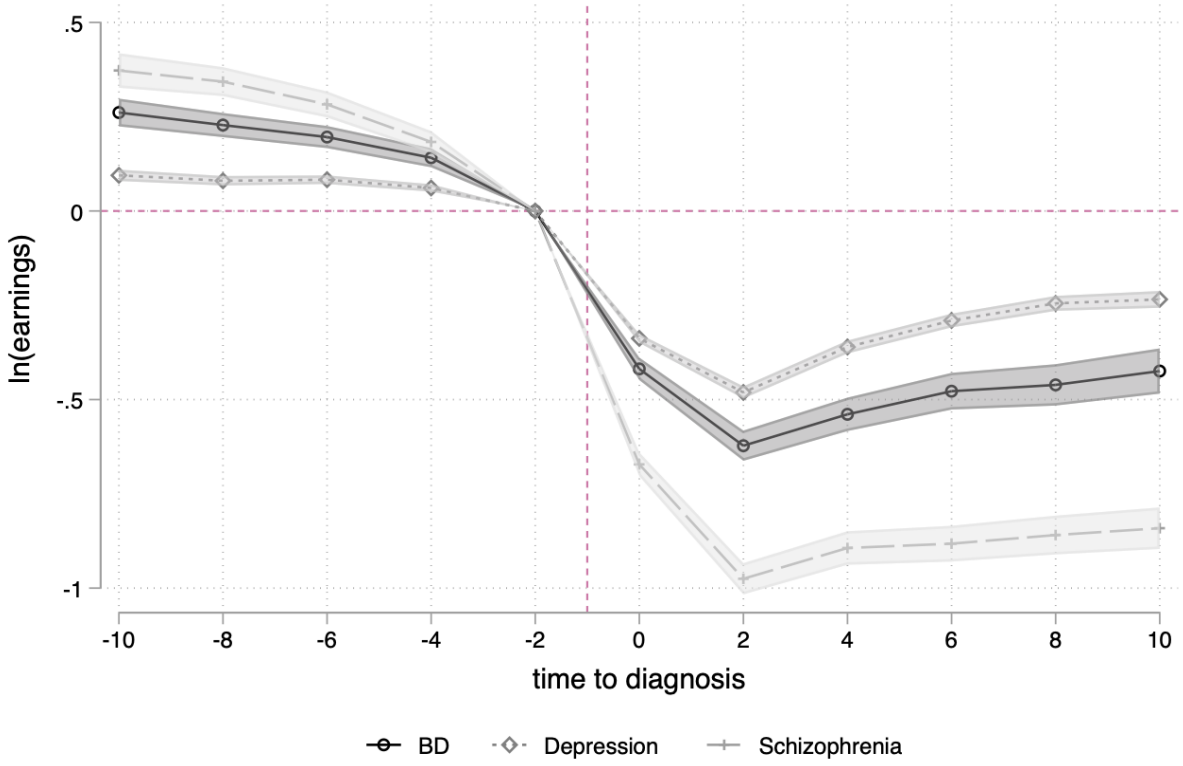
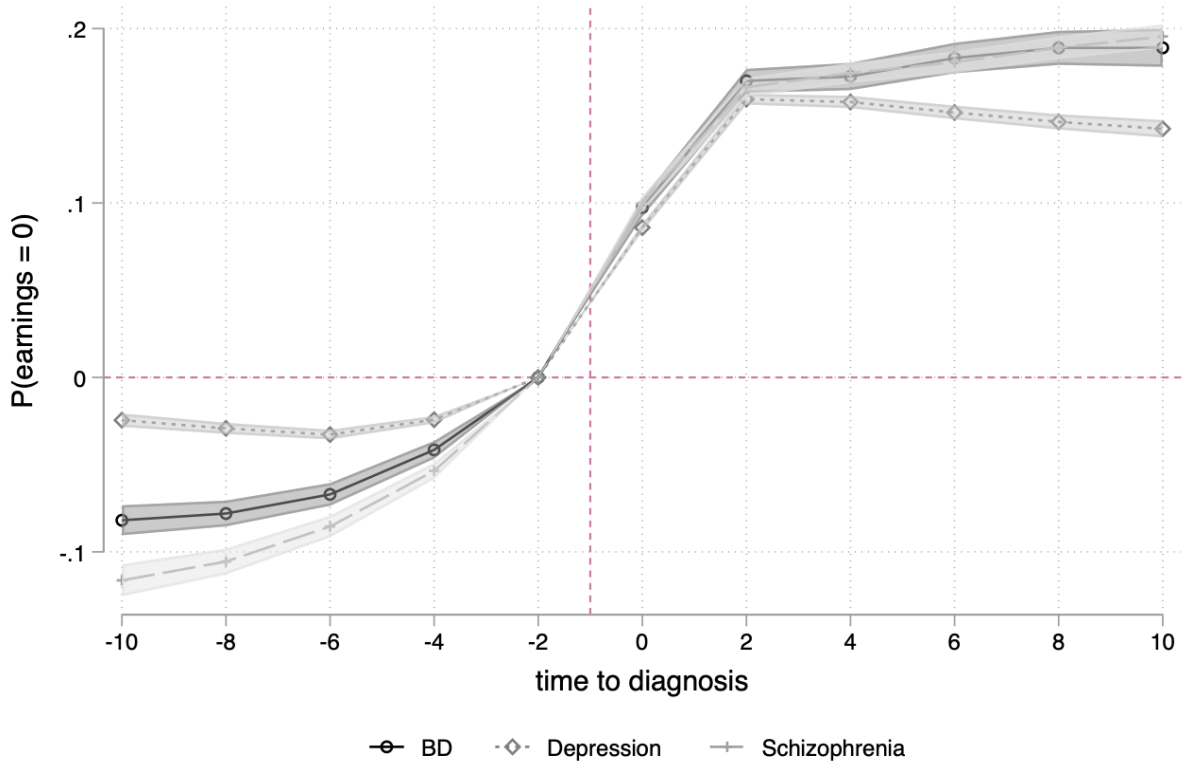
FIGURE 1– EVENT STUDY OF LN(EARNINGS) AROUND A DIAGNOSIS
BD, DEPRESSION, AND SCHIZOPHRENIA



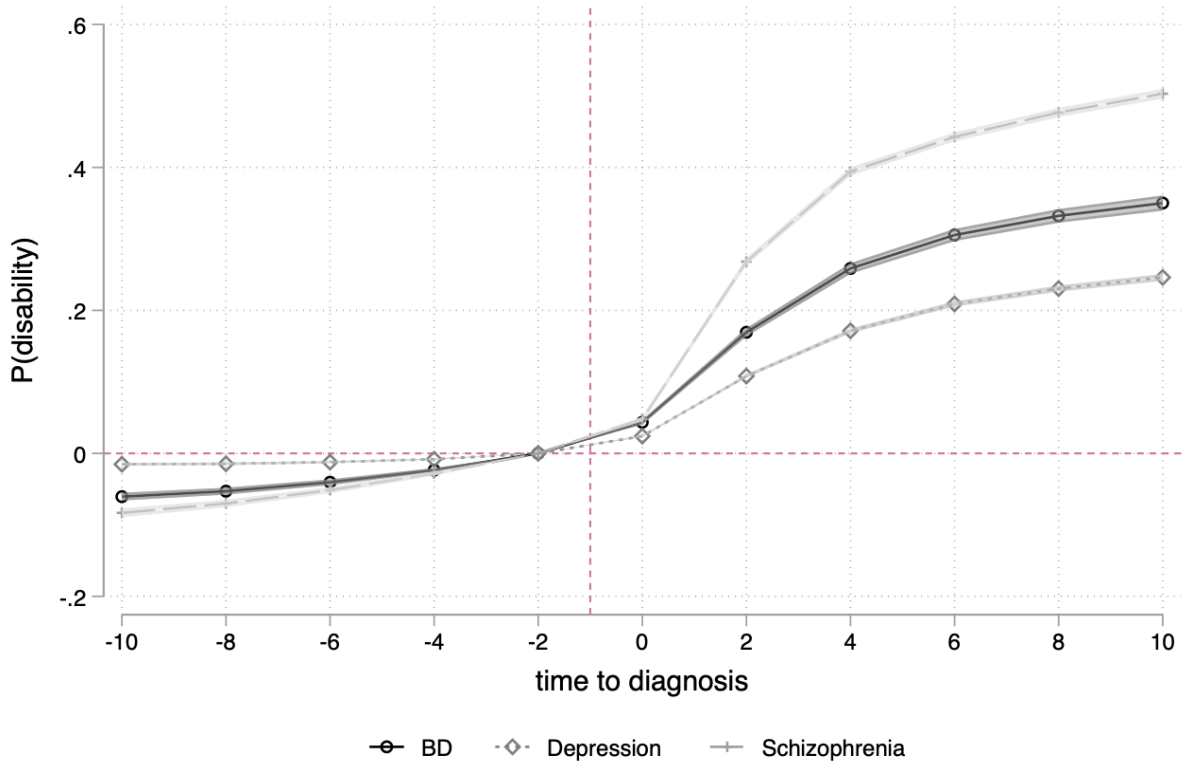
Note: Point estimates and 95 percent confidence of the parameter δ in equation $\log(earnings_{ict}) = \sum^{10}_{k=-10} \delta_k C_i I(t\text{-}Y(C)_i = k) + \beta_1 BD_i + \beta_2 Depression_i + \beta_3 Schizophrenia_i + \theta_c + \tau_t + \varepsilon_{ict}$
where the dependent variable is the natural logarithm of earnings, C_i is an indicator for either *BD*, *Depression*, *or Schizophrenia,* $Y(C)_i$ indicates the year when individual *i* is diagnosed with condition *C*, and *I()* is an indicator function. The vector θ_c contains cohort fixed effects, and τ_t are year fixed effects. Standard errors are clustered at the individual level. The sample is restricted to individuals between 20 and 60 years of age, born between 1946 and 1977, and with positive earnings.

FIGURE 2– EVENT STUDY OF P(EARNINGS = 0) AROUND A DIAGNOSIS
BD, DEPRESSION, AND SCHIZOPHRENIA



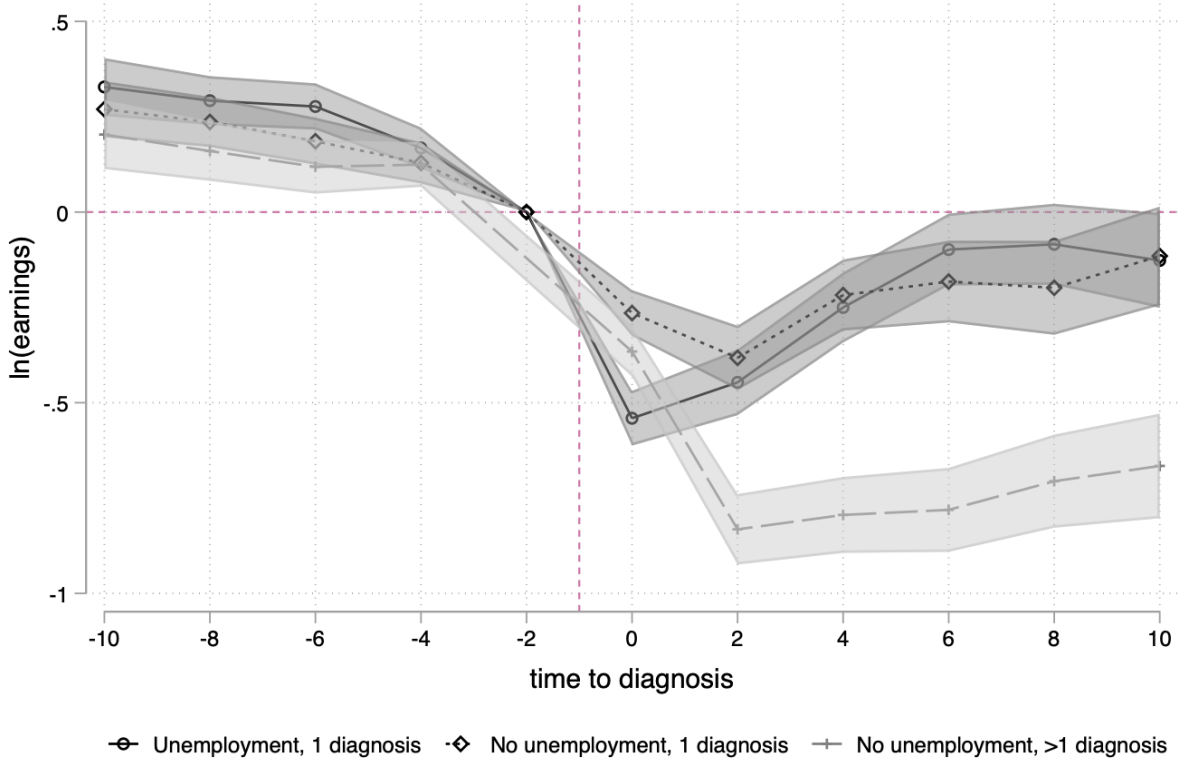
Note: Point estimates and 95 percent confidence of the parameter δ in equation $P(earnings_{ict}=0) = \sum^{10}_{k=-10} \delta_k C_i I(t\text{-}Y(C)_i = k) + \beta_1 BD_i + \beta_2 Depression_i + \beta_3 Schizophrenia_i + \theta_c + \tau_t + \varepsilon_{ict}$, where the dependent variable is an indicator for having no earnings, C_i is an indicator for either *BD*, *Depression*, *or Schizophrenia,* $Y(C)_i$ indicates the year when individual *i* is diagnosed with condition *C*, and *I()* is an indicator function. The vector θ_c are cohort fixed effects, and τ_t are year fixed effects. Standard errors are clustered at the individual level. The sample is restricted to individuals between 20 and 60 years of age, born between 1946 and 1977.

FIGURE 3– EVENT STUDY OF P(DISABILITY) AROUND A DIAGNOSIS
BD, DEPRESSION, AND SCHIZOPHRENIA



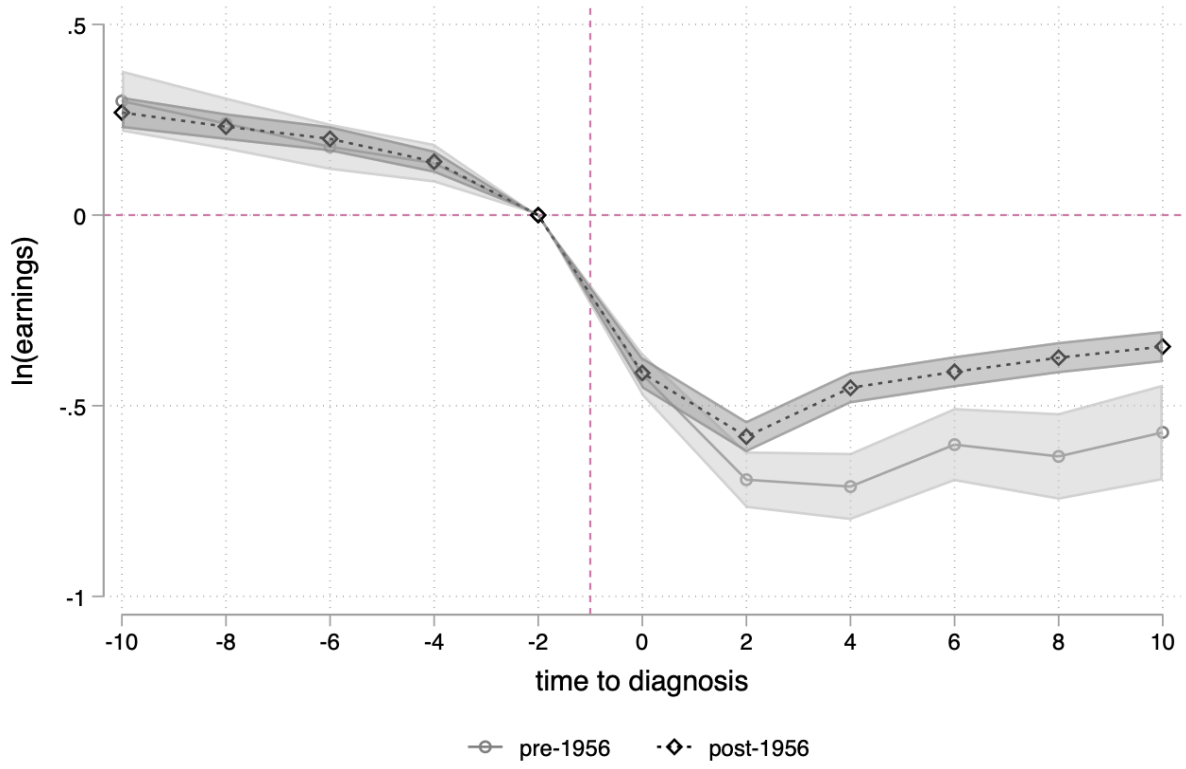
Note: Point estimates and 95 percent confidence of the parameter δ in equation $P(disability_{ict}) = \sum^{10}_{k=-10} \delta_k C_i I(t-Y(C)_i = k) + \beta_1 BD_i + \beta_2 Depression_i + \beta_3 Schizophrenia_i + \theta_c + \tau_t + \varepsilon_{ict}$, where the dependent variable is an indicator for being on disability, C_i is an indicator for either *BD*, *Depression*, *or Schizophrenia,* $Y(C)_i$ indicates the year when individual *i* is diagnosed with condition *C*, and *I()* is an indicator function. The vector θ_c are cohort fixed effects, and τ_t are year fixed effects. Standard errors are clustered at the individual level. The sample is restricted to individuals between 20 and 60 years of age, born between 1946 and 1977.

FIGURE 4– EVENT STUDY OF LN(EARNINGS) AROUND A DIAGNOSIS
BY UNEMPLOYMENT AND #DIAGNOSES



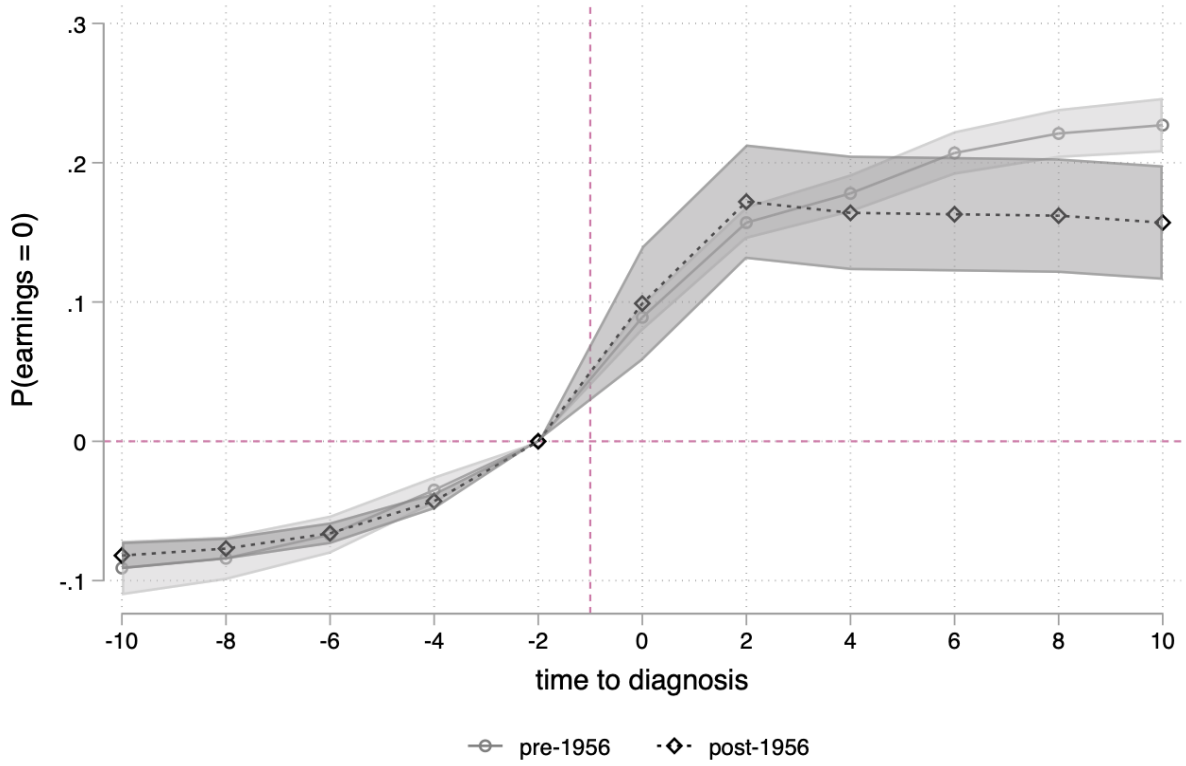
Note: Point estimates and 95 percent confidence of the parameter δ in equation $\log(earnings_{ict}) = \sum^{10}_{k=-10} \delta_k C_i I(t\text{-}Y(C)_i = k) + \beta_1 BD_i + \beta_2 Depression_i + \beta_3 Schizophrenia_i + \theta_c + \tau_t + \varepsilon_{ict}$
where the dependent variable is the natural logarithm of earnings, C_i is an indicator for any of *BD*, *Depression*, *or Schizophrenia,* $Y(C)_i$ indicates the year when individual *i* is diagnosed with any of these conditions, and *I()* is an indicator function. The vector θ_c contains cohort fixed effects, and τ_t are year fixed effects. Standard errors are clustered at the individual level. In the *Unemployment, 1 diagnosis* series, we compare healthy individuals with people with mental health conditions who receive only one diagnosis between 1995 and 2015 and experience at least one unemployment episode in the two years preceding and following the diagnosis. In the *No unemployment, 1 diagnosis* series, we compare healthy individuals with people with mental health conditions who receive only one diagnosis between 1995 and 2015 and do not experience any unemployment in the two years preceding and following the diagnosis. In the *No unemployment, >1 diagnosis* series, we compare healthy individuals with people with mental health conditions who receive more than one diagnosis between 1995 and 2015 and do not experience any unemployment in the two years preceding and following the diagnosis. The sample is restricted to individuals between 20 and 60 years of age, born between 1946 and 1977, with positive earnings.

FIGURE 5– EVENT STUDY OF LN(EARNINGS)
PEOPLE WITH BD WITH AND WITHOUT ACCESS TO LITHIUM



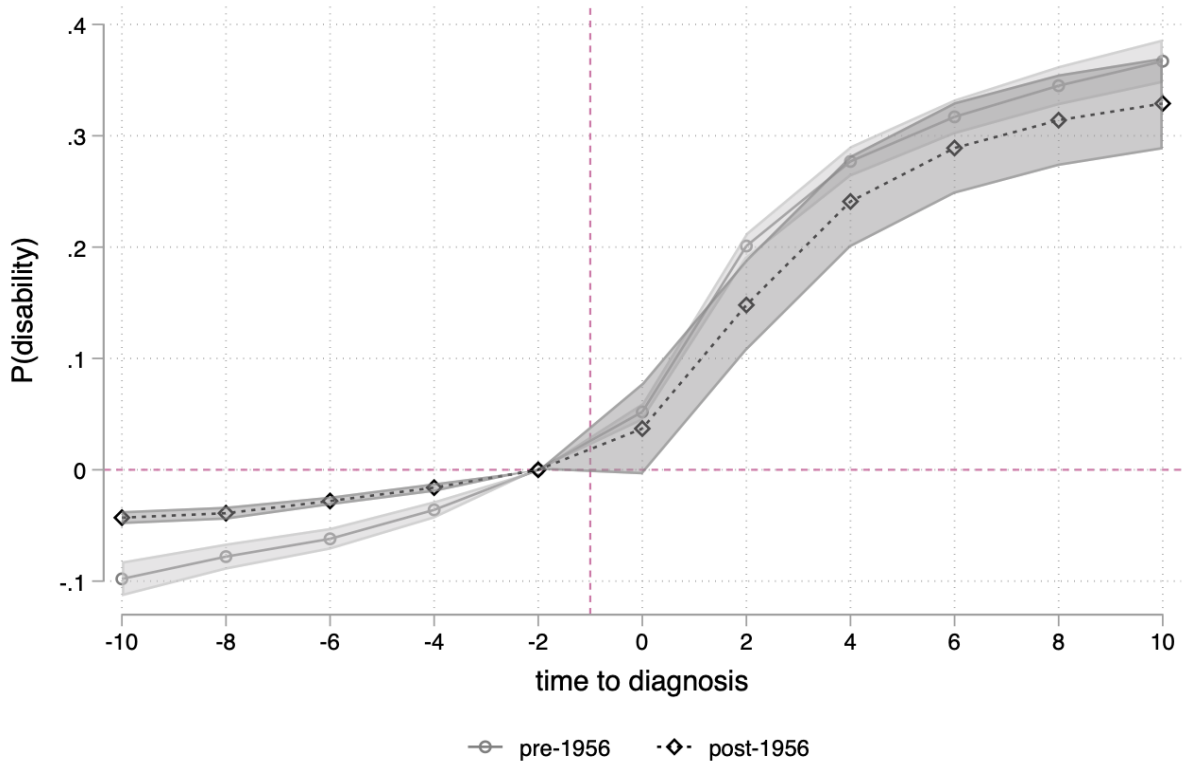
Note: Point estimates and 95 percent confidence of the parameter δ in equation $\ln(earnings_{ict}) = \sum^{10}_{k=-10} \delta_s \, BD_i \, I(t\text{-}Y(BD)_i = k) + \beta_2 \, Depression_i + \beta_3 \, Schizophrenia_i + \theta_c + \tau_t + \varepsilon_{ict}$, where the dependent variable is the natural logarithm of earnings, *BD* equals 1 for individuals who have been diagnosed with this condition at least once between 1995 and 2015, $Y(BD)_i$ is the year of the diagnosis, and *I()* is an indicator function. The vector θ_c contains cohort fixed effects, and τ_t are year fixed effects. Standard errors are clustered at the individual level. Estimates are shown separately for individuals born before and after 1956. The sample is restricted to individuals between 20 and 60 years of age, born between 1946 and 1977, with positive earnings.

FIGURE 6– EVENT STUDY OF P(EARNINGS = 0)
PEOPLE WITH BD WITH AND WITHOUT ACCESS TO LITHIUM



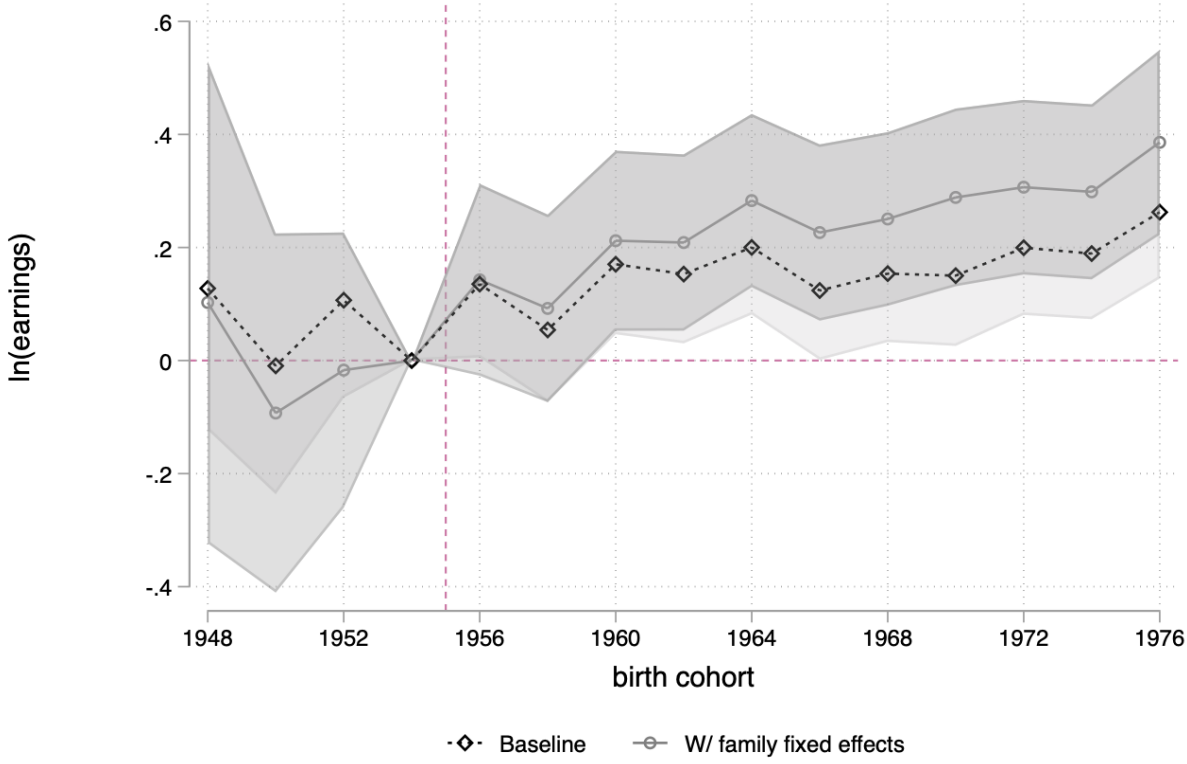
Note: Point estimates and 95 percent confidence of the parameter δ in equation $P(earnings_{ict}=0) = \sum^{10}_{k=-10} \delta_s BD_i I(t\text{-}Y(BD)_i = k) + \beta_2 Depression_i + \beta_3 Schizophrenia_i + \theta_c + \tau_t + \varepsilon_{ict}$, where the dependent variable is an indicator for having no earnings, *BD* equals 1 for individuals who have been diagnosed with this condition at least once between 1995 and 2015, $Y(BD)_i$ is the year of the diagnosis, and $I()$ is an indicator function. The vector θ_c contains cohort fixed effects, and τ_t are year fixed effects. Standard errors are clustered at the individual level. Estimates are shown separately for individuals born before and after 1956. The sample is restricted to individuals between 20 and 60 years of age, born between 1946 and 1977.

FIGURE 7– EVENT STUDY OF P(DISABILITY = 0)
PEOPLE WITH BD WITH AND WITHOUT ACCESS TO LITHIUM



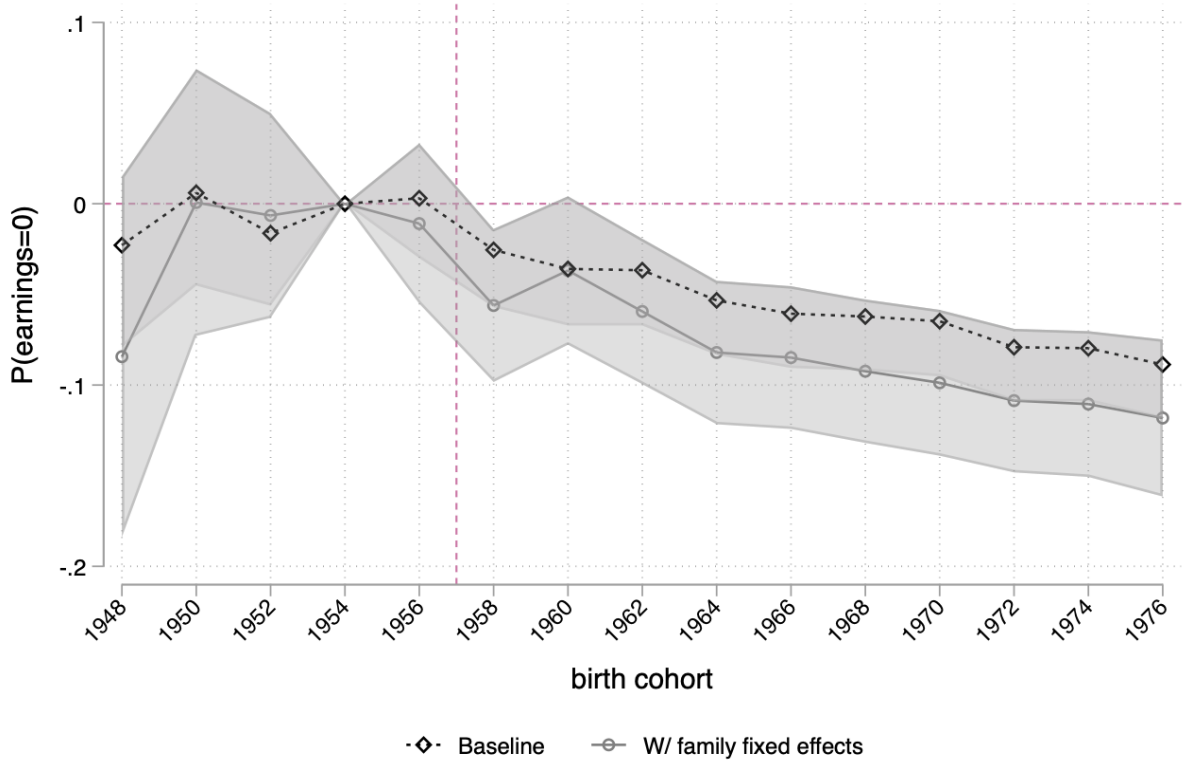
Note: Point estimates and 95 percent confidence of the parameter δ in equation $P(disability_{ict}=0) = \sum^{10}_{k=-10} \delta_s \, BD_i \, I(t\text{-}Y(BD)_i = k) + \beta_2 \, Depression_i + \beta_3 \, Schizophrenia_i + \theta_c + \tau_t + \varepsilon_{ict}$, where the dependent variable is an indicator for being on disability, *BD* equals 1 for individuals who have been diagnosed with this condition at least once between 1995 and 2015, $Y(BD)_i$ is the year of the diagnosis, and $I()$ is an indicator function. The vector θ_c contains cohort fixed effects, and τ_t are year fixed effects. Standard errors are clustered at the individual level. Estimates are shown separately for individuals born before and after 1956. The sample is restricted to individuals between 20 and 60 years of age, born between 1946 and 1977.

FIGURE 8– COHORT-SPECIFIC EFFECTS OF ACCESS TO LITHIUM ON LN(EARNINGS)



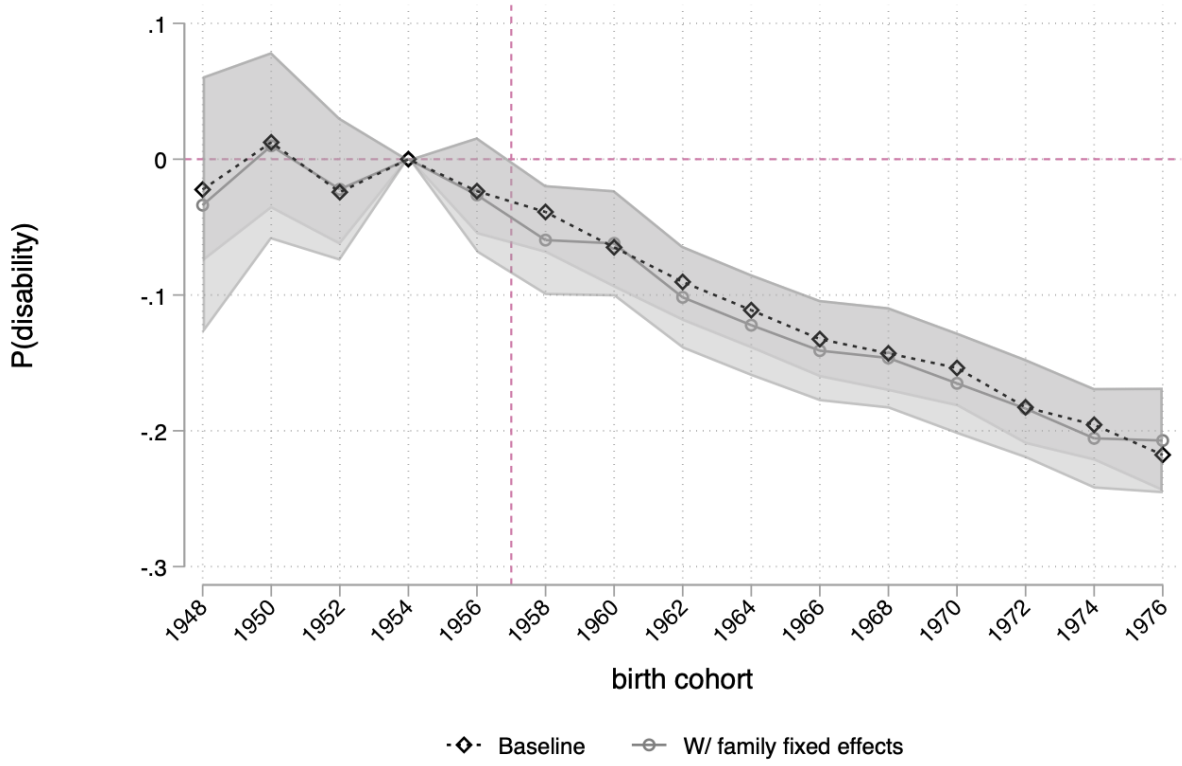
Note: OLS point estimates and 95 percent confidence intervals of the parameter β_c in the equation $ln(earnings_{ict}) = \Sigma_c \beta_c BD_i \times \theta_{c(i)} + \gamma_1 BD_i + \gamma_2 Depression_i + \gamma_3 Schizophrenia_i + \delta_{f(i)} + \theta_{c(i)} + \tau_t + \varepsilon_{it}$. The variables *BD, Depression, Schizophrenia* equal 1 for individuals who have been diagnosed with these conditions at least once between 1995 and 2015. The vectors θ_c, δ_f, and τ_t contain cohort, family, and year fixed effects respectively. Standard errors are clustered at the individual level. The sample is restricted to individuals between 20 and 60 years of age, born between 1946 and 1977, with positive earnings.

FIGURE 9– COHORT-SPECIFIC EFFECTS OF ACCESS TO LITHIUM ON P(ZERO EARNINGS)



Note: OLS point estimates and 95 percent confidence intervals of the parameter β_c in the equation $P(earnings_{ict}=0) = \Sigma_c \beta_c BD_i \times \theta_{c(i)} + \gamma_1 BD_i + \gamma_2 Depression_i + \gamma_3 Schizophrenia_i + \delta_{f(i)} + \theta_{c(i)} + \tau_t + \varepsilon_{it}$, where $P(earnings_{it}=0)$ equals 1 for individuals with zero earnings in year t. The variables *BD, Depression, Schizophrenia* equal 1 for individuals who have been diagnosed with these conditions at least once between 1995 and 2015. The vectors θ_c, δ_f, and τ_t contain cohort, family, and year fixed effects respectively. Standard errors are clustered at the family level. The sample is restricted to individuals between 20 and 60 years of age, born between 1946 and 1977.

FIGURE 10– COHORT-SPECIFIC EFFECTS OF ACCESS TO LITHIUM ON P(DISABILITY)



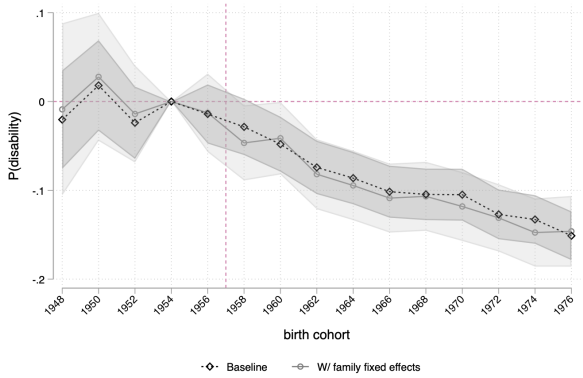
Note: OLS point estimates and 95 percent confidence intervals of the parameter β_c in the equation $P(disability_{ict}) = \Sigma_c \beta_c BD_i \times \theta_{c(i)} + \gamma_1 BD_i + \gamma_2 Depression_i + \gamma_3 Schizophrenia_i + \delta_{f(i)} + \theta_{c(i)} + \tau_t + \varepsilon_{it}$, where $P(disability_{ict})$ equals 1 for individuals on disability in year t. The variables *BD, Depression, Schizophrenia* equal 1 for individuals who have been diagnosed with these conditions at least once between 1995 and 2015. The vectors θ_c, δ_f, and τ_t contain cohort, family, and year fixed effects respectively. Standard errors are clustered at the family level. The sample is restricted to individuals between 20 and 60 years of age, born between 1946 and 1977.

FIGURE 11– COHORT-SPECIFIC EFFECTS OF ACCESS TO LITHIUM – TRIPLE DIFFERENCE

PANEL A) LOG EARNINGS

PANEL A) P(EARNINGS=0)

PANEL C) P(DISABILITY)



Note: OLS point estimates and 95 percent confidence intervals of the parameter β_c in the equation $Y_{ict} = \alpha_1 BD_i + \beta_1 BD_i \times post_c + \alpha_2 \# BD\ episodes_i + \beta_2 \# BD\ episodes_i \times post_c + \gamma Z_{it} + \theta_c + \tau_t + \varepsilon_{it}$, where the dependent variable is either the natural logarithm of earnings (panel A), an indicator for zero earnings (panel B), and an indicator for disability (panel C). The variables *BD, Depression, Schizophrenia* equal 1 for individuals who have been diagnosed with these conditions at least once between 1995 and 2015. The vectors θ_c, δ_f, and τ_t contain cohort, family, and year fixed effects respectively. Standard errors are clustered at the family level. The sample is restricted to individuals between 20 and 60 years of age, born between 1946 and 1977.

TABLE 1 – COUNT OF PEOPLE WITH DEPRESSION, BIPOLAR DISORDER, AND SCHIZOPHRENIA

	All	Depression	BD	Schizophrenia
All	2,692,479	97,932	22,694	41,813
pre-1956	877,265	27,121	7,705	12,096
post-1956	1,815,214	70,811	14,989	29,717
Receiving disability pay (average per year)	150,261	16,981	6,026	19,327
pre-1956	70,311	6,244	2,537	5,952
post-1956	79,950	10,734	3,489	13,375
With zero earnings (average per year)	307,237	28,953	8,002	22,137
pre-1956	108,656	7,671	2,732	6,191
post-1956	198,581	21,281	5,269	15,946
Average earnings ($)	52,307	37,643	35,359	24,661
	(83,476)	(33,599)	(35,319)	(27,826)
pre-1956	54,180	42,269	38,076	26,041
	(140,099)	(41,023)	(41,386)	(27,772)
post-1956	51,583	36,292	34,411	24,317
	(45,499)	(30,969)	(32,887)	(27,829)

Note: Counts of observations for individuals aged 20-60 born in cohorts 1946-1976 in Denmark between 1995 and 2015, and average earnings measured in 2015 US dollars ($). The variables *BD, Depression,* and *Schizophrenia* equal 1 for individuals who have ever been diagnosed with these pathologies at least once between 1995 and 2015. Diagnoses data are available for calendar years 1995-2015.

TABLE 2 – OLS: MENTAL HEALTH DISORDERS AND CAREER OUTCOMES

	ln(Earnings)		P(Earnings = 0)		P(Disability)	
	(1)	(2)	(3)	(4)	(5)	(6)
BD	-0.478***	-0.446***	0.150***	0.133***	0.128***	0.105***
	(0.009)	(0.010)	(0.002)	(0.003)	(0.002)	(0.002)
Depression	-0.438***	-0.370***	0.153***	0.106***	0.074***	0.048***
	(0.003)	(0.004)	(0.001)	(0.001)	(0.001)	(0.001)
Schizophrenia	-1.354***	-1.328***	0.447***	0.388***	0.411***	0.401***
	(0.011)	(0.012)	(0.002)	(0.002)	(0.002)	(0.002)
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Family FE	No	Yes	No	Yes	No	Yes
Mean of Dep. Var.	--	--	.134	.105	.059	.047
R-squared	0.045	0.306	0.048	0.342	0.092	0.424
N	41,619,160	31,404,955	48,071,128	35,077,362	48,071,128	35,077,362

Standard errors in parentheses are clustered at the individual level.

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

Note: The dependent variable is the natural logarithm of earnings (columns 1-2), an indicator for individuals having zero earnings (columns 3-4), and for receiving disability benefits (columns 5-6). Earnings are measured in nominal DKK and are the sum of all wages and income from self-employment. The variables *BD, Depression, Schizophrenia* equal 1 for individuals who have been diagnosed with these conditions at least once between 1995 and 2015. Diagnoses data are available for calendar years 1995-2015. All regressions include cohort and year fixed effects; columns 2, 4, and 6 include family fixed effects. The sample is restricted to individuals aged 20-60 born in cohorts 1946-1977; columns 1 and 2 refer to individuals with positive earnings.

TABLE 3 – OLS: MENTAL HEALTH DISORDERS AND THE PROBABILITY OF EXTREME EARNINGS

	Bottom 10%		Bottom 25%		Top 25%		Top 10%	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BD	0.120***	0.111***	0.152***	0.146***	-0.070***	-0.077***	-0.030***	-0.033***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)	(0.001)	(0.002)
Depression	0.099***	0.086***	0.161***	0.141***	-0.112***	-0.091***	-0.052***	-0.041***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Schizophrenia	0.319***	0.309***	0.333***	0.303***	-0.137***	-0.111***	-0.058***	-0.044***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.001)	(0.002)	(0.001)	(0.002)
Family FE	No	Yes	No	Yes	No	Yes	No	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of Dep. Var.	.10	.10	.25	.25	.25	.25	.10	.10
R-squared	0.024	0.210	0.030	0.277	0.014	0.381	0.009	0.373
N	41,619,160	31,404,950	41,619,160	31,404,950	41,619,160	31,404,950	41,619,160	31,404,950

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

Note: The dependent variable equals 1 for individuals with earnings in the bottom 10 percent (columns 1-2), bottom 25 percent (columns 3-4), top 25 percent (columns 6-7), and top 10 percent (columns 7-8) of the earnings distribution. The variables *BD, Depression, Schizophrenia* equal 1 for individuals who have been diagnosed with these conditions at least once between 1995 and 2015. Diagnoses data are available for calendar years 1995-2015. All regressions include cohort and year fixed effects; columns 2, 4, 6, and 8 include family fixed effects. Data include all people with positive earnings aged 20-60 and born in cohorts 1946-1977.

TABLE 4 – OLS: MENTAL HEALTH CONDI DISORDERS, ACCESS TO TREATMENT, AND CAREER OUTCOMES

	ln(Earnings)		P(Earnings=0)		P(Disability)	
	(1)	(2)	(3)	(4)	(5)	(6)
BD	-0.560***	-0.662***	0.196***	0.198***	0.218***	0.214***
	(0.019)	(0.034)	(0.004)	(0.008)	(0.004)	(0.008)
BD x post	0.112***	0.240***	-0.065***	-0.073***	-0.128***	-0.122***
	(0.021)	(0.036)	(0.005)	(0.009)	(0.005)	(0.008)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Family FE	No	Yes	No	Yes	No	Yes
Mean of Dep. Var.	--	--	.134	.105	.059	.047
R-squared	0.045	0.306	0.049	0.344	0.092	0.424
N	41,619,160	31, 404,955	48,071,128	35,077,362	48,071,128	35,077,362

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

Note: The dependent variable is the natural logarithm of earnings, defined as the sum of all wages and income from self-employment (columns 1-2); an indicator for individuals receiving zero earnings in a given year (columns 3-4); and for individuals on disability (columns 5-6). The variable *BD* equals 1 for individuals who have been diagnosed with this condition at least once between 1995 and 2015. *Post* equals 1 for individuals who were born after 1956, and turned 20 after lithium, the main treatment for bipolar disorder, became available in Denmark in 1976. Controls include indicators for having received at least one diagnosis of *Depression* and *Schizophrenia*. Diagnoses data are available for calendar years 1995-2015. All regressions include cohort and year fixed effects; columns 4-6 include family fixed effects. The sample is restricted to people aged 20-60 born in cohorts 1946-1977; in columns 1-2, we further restrict the sample to people with positive earnings.

TABLE 5 – OLS: MENTAL HEALTH DISORDERS, ACCESS TO TREATMENT, AND THE PROBABILITY OF EXTREME EARNINGS

	Bottom 10%		Bottom 25%		Top 25%		Top 10%	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BD	0.133***	0.149***	0.148***	0.182***	-0.059***	-0.114***	-0.027***	-0.052***
	(0.004)	(0.008)	(0.005)	(0.010)	(0.005)	(0.010)	(0.003)	(0.008)
BD x post	-0.017***	-0.042***	0.007	-0.039***	-0.015***	0.040***	-0.004	0.021***
	(0.005)	(0.008)	(0.006)	(0.011)	(0.005)	(0.011)	(0.003)	(0.008)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family FE	No	Yes	No	No	No	No	No	Yes
Mean of Dep. Var.	.10	.10	.25	.24	.25	.25	.10	.10
R-squared	0.024	0.210	0.030	0.277	0.014	0.381	0.009	0.373
N	41,619,160	31,404,955	41,619,160	31,404,955	41,619,160	31,404,955	41,619,160	31,404,955
Standard errors in parentheses are clustered at the individual level. *** p<0.01, ** p<0.05, * p<0.1								

Note: The dependent variable equals 1 for individuals with earnings in the bottom 10 percent (columns 1-2), bottom 25 percent (columns 3-4), top 25 percent (columns 6-7), and top 10 percent (columns 7-8) of the earnings distribution. The variable *BD* equals 1 for individuals who have been diagnosed with this condition at least once between 1995 and 2015. *Post* equals 1 for individuals who were born after 1956, and turned 20 after lithium, the main treatment for bipolar disorder, became available in Denmark in 1976. Controls include indicators for having received at least one diagnosis of *Depression* and *Schizophrenia*. Diagnoses data are available for calendar years 1995-2015. All regressions include cohort and year fixed effects; columns 2, 4, 6, and 8 include family fixed effects. The sample is restricted to individuals aged 20-60 born in cohorts 1946-1977, with positive earnings.

TABLE 6 — OLS: MENTAL HEALTH DISORDERS, ACCESS TO TREATMENT, AND THE PROBABILITY OF EXTREME EARNINGS, FOR PEOPLE WITH CONDITIONS AND THEIR SIBLINGS

	ln(Earnings)	P(Earnings = 0)	P(Disability)
	(1)	(2)	(3)
BD	-0.563***	0.187***	0.208***
	(0.031)	(0.008)	(0.007)
BD x post	0.109***	-0.050***	-0.117***
	(0.032)	(0.008)	(0.007)
BD sibling	-0.067***	0.022***	0.022***
	(0.017)	(0.006)	(0.005)
BD sibling in post cohort	-0.032*	0.012*	-0.005
	(0.018)	(0.006)	(0.005)
Cohort	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Family FE	No	No	No
Mean of Dep. Var.	--	.105	.047
R-squared	0.063	0.055	0.101
N	31,404,955	35,077,362	35,077,362

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

Note: The dependent variable is the logarithm of earnings (column 1), an indicator for zero earnings (column 2), and for disability (column 3). The variable *BD* equals 1 for individuals who have been diagnosed with this condition at least once between 1995 and 2015. *Post* equals 1 for individuals who were born after 1956, and turned 20 after lithium, the main treatment for bipolar disorder, became available in Denmark in 1976. *BD sibling* equals 1 for individuals with siblings with *BD*, and *BD sibling in post cohort* equals 1 for individuals with *BD* siblings born in cohorts after 1956. Controls include indicators for having received at least one diagnosis of *Depression* and *Schizophrenia*, the natural logarithm of the unemployment rate, an indicator for being enrolled in education, and an indicator for part-time work. Diagnoses data are available for calendar years 1995-2015. All regressions include cohort and year fixed effects. The sample is restricted to individuals aged 20-60 born in cohorts 1946-1977; in column 1, the sample is further restricted to include individuals with positive earnings.

TABLE 7 – OLS: MENTAL HEALTH DISORDERS AND THE PROBABILITY OF EXTREME EARNINGS, BY PARENTAL WEALTH

	ln(Earnings) (1)	P(Earnings=0) (2)	P(Disability) (3)
Parents assets < 25	-0.081***	0.036***	0.011***
	(0.009)	(0.003)	(0.002)
Parents assets >= 75	0.048***	-0.012***	-0.006**
	(0.012)	(0.004)	(0.003)
BD	-0.425***	0.137***	0.102***
	(0.017)	(0.004)	(0.004)
BD x Par. assets < 25	0.042	-0.014	-0.020***
	(0.031)	(0.009)	(0.007)
BD x Par. assets >= 75	0.052*	-0.028***	-0.034s
	(0.029)	(0.008)	(0.007)
Depression	-0.378***	0.108***	0.045***
	(0.007)	(0.002)	(0.002)
Depression x Par.assets < 25	-0.015	0.013***	-0.004
	(0.012)	(0.004)	(0.003)
Depression x Par.assets >= 75	0.039***	-0.036***	-0.015***
	(0.012)	(0.003)	(0.003)
Schizophrenia	-1.234***	0.374***	0.381***
	(0.020)	(0.004)	(0.004)
Schizophrenia x Par.assets < 25	-0.101***	-0.014**	-0.007
	(0.036)	(0.007)	(0.006)
Schizophrenia x Par.assets >= 75	0.058*	-0.002	-0.016**
	(0.034)	(0.007)	(0.007)
Cohort	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Family FE	No	No	No
Mean of Dep. Var.	--	.092	.034
R-squared	0.293	0.302	0.387
N	19,660,052	21,656,217	21,656,217

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

Note: The dependent variable is the logarithm of earnings (column 1), an indicator for zero earnings (column 2), and for disability (column 3). The variables *BD, Depression, Schizophrenia* equal 1 for individuals who have been diagnosed with these conditions at least once between 1995 and 2015. Diagnoses data are available for calendar years 1995-2015. The variable *Parent < 25th percentile* equals 1 for individuals whose parents have median assets below the *25th percentile*. Information of parents' assets is available for years 1985 to 2010 and for 38 percent of the sample. All regressions include cohort and year fixed effects. The sample is restricted to individuals aged 20-60 born in cohorts 1946-1977; in column 1, the sample is further restricted to include individuals with positive earnings.

TABLE 8 – OLS: MENTAL HEALTH DISORDERS, ACCESS TO TREATMENT, AND THE PROBABILITY OF EXTREME EARNINGS, BY PARENTAL WEALTH

	ln(earnings)	P(earnings=0)	P(disability)
	(1)	(2)	(3)
BD	-0.561***	0.200***	0.246***
	(0.133)	(0.033)	(0.032)
BD x post	0.103	-0.057*	-0.152***
	(0.134)	(0.034)	(0.032)
Parents < 25 pctile	-0.107***	0.063***	0.043***
	(0.011)	(0.005)	(0.004)
BD x Parents < 25 pctile	-0.179	0.074	0.051
	(0.262)	(0.066)	(0.060)
Post x Parents < 25 pctile	-0.050***	0.009*	-0.019***
	(0.011)	(0.005)	(0.004)
BD x Parents < 25 pctile x post	0.191	-0.070	-0.058
	(0.264)	(0.066)	(0.060)
Parents >= 75 pctile	0.152***	-0.026***	-0.023***
	(0.010)	(0.003)	(0.003)
BD x Parents >= 75 pctile	0.119	-0.064	-0.127**
	(0.219)	(0.060)	(0.058)
Post x Parents >= 75 pctile	-0.033***	0.009***	0.013***
	(0.010)	(0.003)	(0.003)
BD x Parents >= 75 pctile x post	-0.047	0.024	0.090
	(0.220)	(0.060)	(0.058)
Cohort	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Family FE	No	No	No
Mean of Dep. Var.	--	.089	.032
R-squared	0.086	0.060	0.098
N	19,660,052	21,656,217	21,656,217

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

Note: The dependent variable is the logarithm of earnings (column 1), an indicator for zero earnings (column 2), and for disability (column 3). The variable *BD* equals 1 for individuals who have been diagnosed with this condition at least once between 1995 and 2015. *Post* equals 1 for individuals who were born after 1956, and turned 20 after lithium, the main treatment for bipolar disorder, became available in Denmark in 1976. Controls include indicators for having received at least one diagnosis of *Depression* and *Schizophrenia*, the natural logarithm of the unemployment rate, an indicator for being enrolled in education, and an indicator for part-time work. Diagnoses data are available for calendar years 1995-2015. The variable *Parent < 25 (Parents >= 75)* equals 1 for individuals whose parents have median assets below the 25th percentile (above the 75th percentile). Information of parents' assets is available for years 1985 to 2010 and for 38 percent of the sample. All regressions include cohort and year fixed effects. The sample is restricted to individuals aged 20-60 born in cohorts 1946-1977; in column 1, the sample is further restricted to include individuals with positive earnings.

TABLE 9 – INTENSITY OF CONDITIONS. OLS, DEPENDENT VARIABLE IS LN(EARNINGS), P(EARNINGS = 0), P(DISABILITY)

	Log(earnings)		P(earnings = 0)		P(disability)	
	(1)	(2)	(3)	(4)	(5)	(6)
BD	-0.241***	-0.352***	0.096***	0.098***	0.099***	0.095***
	(0.030)	(0.058)	(0.007)	(0.014)	(0.007)	(0.013)
BD x post	0.008	0.201***	-0.010	-0.039***	-0.105***	-0.109***
	(0.035)	(0.061)	(0.009)	(0.015)	(0.008)	(0.014)
# BD episodes	-0.253***	-0.209***	0.071***	0.064***	0.085***	0.076***
	(0.022)	(0.036)	(0.004)	(0.008)	(0.004)	(0.007)
# BD episodes x post	0.098***	0.016	-0.041***	-0.019	-0.019***	-0.003
	(0.025)	(0.034)	(0.005)	(0.008)	(0.005)	(0.007)
Cohort	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Family FE	No	Yes	No	Yes	No	Yes
Mean of Dep. Var.	--	--	.134	.105	.059	.047
R-squared	0.045	0.306	0.049	0.342	0.093	0.425
N	41,619,160	31,404,955	48,071,128	35,077,362	48,071,128	35,077,362

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

Note: The dependent variable is the natural logarithm of earnings, defined as are the sum of all wages and income from self-employment (columns 1-2), an indicator for zero earnings (columns 3-4), and an indicator for disability (columns 5-6). The variable *BD* equals 1 for individuals who have been diagnosed with this condition at least once between 1995 and 2015. *Post* equals 1 for individuals who were born after 1956, and turned 20 after lithium, the main treatment for bipolar disorder, became available in Denmark in 1976. The variable *# BD episodes* counts the number of separate BD diagnosed received between 1995 and 2015 Controls include indicators for having received at least one diagnosis of *Depression* and *Schizophrenia*, the natural logarithm of the unemployment rate, an indicator for being enrolled in education, and an indicator for part-time work. Diagnoses data are available for calendar years 1995-2015. All regressions include cohort and year fixed effects; columns 2, 4, and 6 include family fixed effects. The sample is restricted to individuals aged 20-60 born in cohorts 1946-1977; columns 1-2 further restrict the sample to individuals with positive earnings.