CAREER EFFECTS OF MENTAL HEALTH*

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This paper investigates the career effects of mental health using individual-level registry data from Denmark. Mental health disorders are associated with very large earnings penalties, ranging from 38 for people with BD and 74 for people with schizophrenia. To isolate the effects of access to treatment on these penalties, we exploit the approval of lithium as a maintenance treatment for BD in 1976 and compare cohorts with and without access in their 20s. We find that access to treatment eliminates more than one third of the earnings penalty from BD. Part of this effect is driven by a decreased risk of being on disability: Access to treatment eliminates more than half of the excess risk of disability for people with BD. Lastly, we show that the benefits of treatment are three times larger for people from wealthier background, measured by parental wealth.

KEYWORDS: MENTAL HEALTH, EARNINGS, DISABILITY, INEQUALITY, BIPOLAR DISORDER, DEPRESSION, AND SCHIZOPHRENIA.

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One in twelve Americans is affected by a mental health disorder, such as depression, schizophrenia, and bipolar disorder (National Institute of Mental Health, NIMH 2015).[1] The World Health Organization (WHO, 2011) warns that these disorders are the leading cause of lost disability-adjusted years of life. Yet, news stories about prominent executives have linked mental health disorders – and in particular bipolar disorder (BD) – with professional success, to the point that BD is called a "CEO's disease" (Cooper et al. 1988).

Estimating the causal effects of mental health and its treatments on a person's career involves two major empirical challenges. First, privacy regulations 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 and other mental health conditions (Mortensen et al. 2003; Gardner and Oswalt 2007),[2] and they are less likely to receive treatment (Davis et al 2008).[3]

This paper uses registry data on mental health diagnoses and a major change in the treatment of BD to estimate the causal effects of access to 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. To control for a person's family background, including socio-economic status, parental education, and their location, we use identifiers for a person's mother to compare outcomes for siblings with and without mental health conditions.

Population Our data show that mental health disorders are associated with large earnings penalties. Compared with the population, people with depression, BD and schizophrenia earn 36, 38 and 74 percent less, respectively. Controlling for family background barely affects these penalties, reducing them only slightly: Compared with their healthy siblings, people with depression, BD, and schizophrenia earn 31, 36, and 73 percent less.

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[1] National Institute of Mental Health, 2015, citing evidence from the National Comorbidity Survey Replication (NCS-R, Kessler and Meikangras 2004, Kessler et al 2005).

[2] Mortensen et al. (2003) show that abuse, neglect, the death of a parent, or other family-related stress can trigger mental health disorders. Gardner and Oswalt (2007) use a sample of British lottery winners to show that larger wins lead to better mental well-being relative to smaller wins or no wins.

[3] Davis et al (2008) find that 22% of 220 participants recruited from urban hospital medical clinics met survey criteria for post-traumatic stress disorder (PTSD). Although desiring mental health services, only 13.3% of those with PTSD had prior trauma-focused treatment.

Event studies reveal a dramatic decline in earnings after the diagnosis of a mental health disorder. Earnings start to decline ten years before a diagnosis and reach a minimum two years after the diagnosis. Ten years after a diagnosis, people with depression still earn 21 percent less than they did prior to the diagnosis; people with BD earn 34 percent less, and people with schizophrenia earn 57 percent less.

We also find that people with mental health conditions are substantially more likely to decline into the bottom quantiles of earnings, to have no earnings at all, and to receive disability benefits. For example, people with depression and BD are 99 percent and 120 percent more likely to have earnings in the lowest decile compared with the population, 110 percent more likely to have no earnings at all, and 120 and 270 percent more likely to be on disability.

Interactions between a person's employment history and mental health, however, make it difficult to identify the direction of causality. For example, people with depression or other types of mental health disorders may earn less because they cannot work full time. Alternatively, their disorders may have been triggered by a career shock, like losing one's job (e.g., Ross and Huber 1985). Access to treatment might also vary depending on a person's socio-economic status.

To better isolate the causal effects of mental health and to quantify the benefits of access to treatment we use the approval of lithium as a maintenance treatment for BD in 1976. Compared with other types of drugs for mental health disorders, lithium is exceptionally effective: Its consumption is associated with a significant reduction in the risk of hospitalization and suicide rates for people with BD (Tondo et al 1999; also see Angst et al 2005, Kessler et al 2005a).

To estimate the causal effect of access to lithium we compare the labor market outcomes of people with and without access to treatment at age 20. Twenty is not only the typical age of onset for BD (Kessler et al 2003b), but also a critical period for a person's career (Kahn 2010; Oreopoulos 2012; Arellano-Bover 2019). Under the assumption that people with BD born before and after 1956 would have had similar labor market outcomes, this identification strategy allows us to estimate the causal effect of access to treatment on outcomes for people with BD. Furthermore, if access to lithium eliminates the adverse labor market effects of BD, these estimates capture the career penalties associated with BD.

We find that access to treatment drastically mitigates the labor market effects of a mental health disorder. Access to treatment eliminates nearly one third of the earnings penalty associated with BD. It also reduces a person's risk of declining into the bottom

earnings decile by 13 percent and lowers the risk of zero earnings by 33 percent. Cohort-specific estimates reveal a discontinuity in outcomes for cohorts born after 1956, confirming that 20 is the age at which access to treatment is most critical. Reassuringly, the share of people diagnosed with BD and the total number of diagnoses is stable across cohorts, which suggests that differences in outcomes for younger cohorts are unlikely to be due to changes in the rate of diagnoses or in the composition of the group of people with BD across cohorts.

Controlling for family background further increases the estimated benefits of treatment. Compared with their siblings, access to lithium closes two thirds of the earnings penalty associated with BD. Access to treatment also lowers the risk of declining into the bottom decile by 28 percent and risk of having no earnings by 36 percent.

A large portion of the benefits from treatment is due to a reduced risk of disability for people with BD. We show that access to treatment eliminates 59 percent of the risk of disability for people with BD compared with the population and 57 percent compared with their siblings. Using the number of diagnoses as a measure of intensity of the disorder, we find that the benefits from treatment are largest for people with a more severe or persistent form of BD.

Existing studies document a connection between mental health and parents' socioeconomic status (Aizer and Currie 2014; Adhvaryu et al. 2019).[4] In addition to controlling for parental background we also investigate whether the benefits from treatment vary with parental wealth. In the United States, differences in insurance benefits are a major driver of differences in access to mental health treatment. The fact that Denmark offers universal health care allows us to shut off this mechanism and check whether parental wealth continues to shape the career effects of mental health.[5]

Our data show that the impact of parental wealth on the career effects of mental health is modest. People with BD and parental wealth in the top quartile of the distribution earn 5 percent more than people in the bottom quartiles. Importantly, however, the benefits from treatment are much stronger for people whose parents have little wealth. For people in the bottom half of the parental wealth distribution, access to treatment eliminates 31 percent

[4] People from less privileged socioeconomic backgrounds are more likely to experience stress (Cohen et al. 2006), family ruptures (Persson and Rossin-Slater 2017), anxiety (van der Bergh et al. 2015) and famine (Neugebauer et al. 1999; McClellan et al. 2006).

[5] Partly related to income, there are also enormous differences in coverage across states. In the United States, the share of uninsured people among adults with mental illness ranges from 3.3 percent in Massachusetts to 23.8 percent in South Carolina. http://www.mentalhealthamerica.net/issues/mental-health-america-access-care-data, accessed July 2, 2018.

of the earnings penalty from BD; this effect is almost three times larger than that for people in the top half of the parental wealth distribution.

Our findings contribute to a small, but growing literature in economics on the career effects of mental health. In one of the first economic studies of mental health, Bartel and Taubman (1986) find a negative association between psychosis and neurosis and outcomes, such as earnings and marriage, in a sample of 4,000 twins and establish a positive association with rates of divorce.[6] While Bartel and Taubman's study is correlational, more recent studies have attempted to quantify the causal effects of mental health by exploiting differences in the use of medications. Shapiro (2020), for example, 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. (2019) document that the 2004 black box warnings for SSRIs decreased antidepressant prescriptions and reduced labor supply. Using data from Denmark, however, Laird and Nielsen (2017) find that being randomly assigned to physicians with a higher propensity to prescribe anti-depressants and anti-anxiety medications had no effects on labor market outcomes. We contribute to this research in two ways: First, we compare the labor market penalties associated with different types of mental health conditions. Second, we use a major improvement in treatment to estimate the causal effects of changes in mental health. We perform these analyses for a disorder that has been the subject of much research in psychology (e.g., Jamison 1996; Kyaga 2011 and 2013) but received little attention from economists, despite its prevalence and severity.

Our paper also relates 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). Garthwaite (2012) and Bütikofer and Skira (2018) find a decrease in labor supply following the removal of Vioxx, a Cox-2 inhibitor pain killer and anti-inflammatory drug, from the pharmaceutical market. We offer one of the first empirical analyses of the causal effects on labor market outcomes of access to treatment for a mental health condition.

In addition, our findings provide new evidence on the differential impact of mental health conditions and their treatment across the socio-economic spectrum. Building on existing evidence on the effects of economic status on mental health (Haushofer and Shapiro 2016; Ridley, Rao, Schilbach, and Patel 2020), on the intergenerational persistence of mental health outcomes (Aizer and Currie 2014, Persson and Rossin-Slater 2017, Van der Bergh et

[6] Recent evidence from population-level data for 17 million birth in 72 countries, however, suggests that twin births are systematically different from regular birth. Twins have healthier mothers, with better health-related behaviors, and a better prenatal environment (Bhalotra and Clarke 2019).

al. 2015), and on the effects of parents' earnings on 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 differences in mental health.

I. Background on Mental Health Disorders

This section summarizes relevant research from medicine and psychology on the three disorders that are the focus of this paper – depression, bipolar disorder (BD), and schizophrenia.

Major depressive disorder or, *depression* for short, is a common and serious mental disorder that negatively affects how people feel, think, or act. Symptoms include sadness, a loss of interest in activities, trouble sleeping, a loss of energy, difficulties concentrating or making decisions, and thoughts of death or suicide. For a diagnosis of depression, symptoms must last at least two weeks. In our data, 3.6 percent of people receive at least one diagnosis of depression between 1995 and 2015.[8]

Schizophrenia is a chronic brain disorder whose symptoms include hallucinations (such as hearing voices, paranoid delusions and exaggerated or distorted perception), a decrease in the ability to initiate plans, speak, or express emotions, as well as trouble with thinking, concentration, and memory. Although the precise causes of schizophrenia are unknown, researchers have identified genetic and environmental factors, as well as life events that contribute to the disorder. Approximately 1.5 percent of the Danish population is diagnosed with this disorder.

Bipolar I Disorder (thereafter *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 American Psychiatric Association (2000) defines BD by at least one lifetime manic or mixed episode, which must last at least one week or require hospitalization. Symptoms of mania include irritability, euphoria, a decreased need for sleep, grandiose ideas, impulsivity, increased racing thoughts, flight of ideas, increased activity, and distractibility. Mixed episodes combine symptoms of mania with and simultaneous symptoms of depression for at least one week. A person can have BD without depression, though many people with BD also experience symptoms of depression. Compared with depression, BD is less prevalent but more persistent and impairing (Kessler, Merinkas, and Wang 2007). Suicide risks for people

[8] In the NCS-R survey of 9,282 people in the continental United States, 16.2 percent had been affected by depression at least once in their lifetime, and 6.6 percent had been affected within 12 months before the interview (Kessler et al. 2003b).

with BD are extremely high (Jamison 2000; Angst et al. 2005; Goldberg et al. 2005)[9] According to the WHO, BD affects about 60 million people worldwide and most of them remain untreated.[10] In our data, 0.8 percent of people receive at least one diagnosis of BD.

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, p. 199).[11] 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 "good" and "bad" behaviors and with other types of executive functions (Drevets et al. 1997, Krueger 2006, and Appendix Figure 1).[12] 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.[13]

The median age of onset for BD lies around 18 years (Kessler, Merikangas and Wang 2007, p. 143). We exploit this fact to compare people with differential access to treatment when they entered their twenties. Alternative specifications estimate age-specific effects.

A New Treatment for BD: Lithium

In 1976 Denmark's equivalent to the Federal Drug Administration, the *Lægemiddelstyrelsen*, approved the mood-stabilizer lithium as a "maintenance" treatment for BD (Bech et al. 1976).[14] As a treatment for BD, lithium is typically given in stages. The first

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[9] Rates of attempted suicide for people with BD range from one in three (Goldberg et al. 2005) to one in two (Jamison 2000). Angst et al. (2005) shows that 11 percent of 406 people with BD who were admitted to a Psychiatric University Hospital in Zurich committed suicide. People with BD are also often affected by other (comorbid) disorders, most commonly attention deficit hyperactivity disorder, oppositional defiant disorder, agora-phobia, panic disorder, generalized anxiety disorder, alcohol dependence, and drug abuse (Kessler et al 2005b).

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

[11] Drugs that increase dopamine-related activity in the brain, such as amphetamine, have been found to increase mood, energy and talkativeness in people without BD (Willner 1995). People with BD show pronounced behavioral responses to amphetamine (Anand et al. 2000).

[12] Drevets et al (1997) analyze brain activity in a sample of 20 family members of people with BD and unipolar depression and localize an area of abnormally decreased activity in the pre-frontal cortex. Krueger et al. (2006, N=18) find that siblings of people with BD are more likely to have physical markers of BD, even if they are not diagnosed with BD. Naranjo et al. (2001) link mood disorders (such as BD) to regions of the brain that are believed to be involved in rewarding motivation (including the *nucleus accumbens*, the ventral tegmentum, and the striatum).

[13] By comparison, the prefrontal cortex is more strongly activated in control subjects, guiding them towards safe 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, 68 people with BD, 38 with schizophrenia, and 35 without either disorder).

[14] *Acta Psychiatrica Scandinavia* 1976, Price and Heninger 1994, McInnis et al. 2014. The US FDA had

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.

Complementary treatments in the form of psychosocial interventions ("therapy") and other drug treatments also improved substantially after 1976.[15] Interest in the application of cognitive behavioral therapy (CBT) began in the early 1980s (Cochran 1984), after the introduction of lithium.[16] Among all treatments, however, lithium has the strongest scientific record of controlling mania and preventing recurrences. In clinical studies, lithium consumption is associated a significant reduction in the risk of hospitalization and with a 7-fold reduction in suicide rates for people with BD (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).[17] People also report stopping treatment because they miss "periods of exuberance or creativity" (Goodwin and Jamison 2007; Jamison and Akiskal 1983, Aasgard and Vestergaard 1990).

II. DATA

Our data cover mental health diagnoses, earnings, and disability payments for the population of Denmark, including 2,524,325 people in birth cohorts from 1946 to 1975.[18] Among these 2.5 million people, 80,361 have been diagnosed with depression (3.2 percent Table 1), 36,736 with schizophrenia (1.5 percent), and 18,729 people with BD (BD, 0.7 percent).[19]

Individual-Level Registry Data on Diagnoses

Individual-level data on diagnoses come from the Central Psychiatric Register (*Landspatientregistret for Psykiatri Diagnoser*), which includes all mental health diagnoses in Denmark between January 1, 1995 and December 31, 2015. The register uses the World

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approved lithium two years earlier, in January 1974.

[15] Administered without a mood stabilizer, standard antidepressants can induce mania and accelerate mood cycling in 20-40 percent of patients (Altshuler et al 1995, Goldberg and Whiteside 2002).

[16] Recent approaches in CBT focus on psychoeducation and cognitive restructuring to challenge overly negative or overly 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 antipschotic olanzapine, and the anticonvulsant lamotrigine.

[17] 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).

[18] These data are administered by Statistics Denmark. Appendix Table A1 describes the individual registries.

[19] These shares are comparable to US estimates based on the National Comorbidity Survey (NCS, Kessler et al. 2005) for BD (1 percent) but substantially lower than US estimates for depression (16.6 percent).

Health Organization (WHO)'s International Statistical Classification of Diseases and Related Health Problems (ICD-10) to classify mental health disorders.[20] Appendix Table A3 includes a detailed description of this classification.

We identify people with BD as individuals who have been diagnosed with BD at least once after 1995, when diagnoses data are available. This implies that people who had a BD diagnosis before 1995 but not afterwards would be assigned to the control group, leading us to underestimate the true effects of BD. In practice, this issue should be minor because most people with BD experience recurrences of the disorder (Gitlin et al 1995).[21] It could also be the case that people in older cohorts who are diagnosed late in life may not have been affected in their early 20s. If people who are diagnosed early in life are more likely to experience recurrences, younger cohorts may be "sicker" on average, leading us to underestimate the effects of treatment. Reassuringly, people with BD in older cohorts receive their first observable diagnosis almost immediately after 1995, with a median lag of less than five years (Appendix Figure A2), and 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 A3).

A second data limitation is that we are unable to observe individuals in older cohorts who had BD but died before 1995. If the probability of dying is positively related to the intensity of the disorder, our group of BD individuals not exposed to treatment will contain individuals with a milder form of BD, which would attenuate our estimates of the effect of access to treatment.

We construct indicators for people with at least one diagnosis of the three most frequent mental health disorders: depression, bipolar disorder, and schizophrenia.[22]

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[20] See http://apps.who.int/classifications/icd10/browse/2016/en#/F30-F39. The National Institute of Mental Health explains that bipolar I disorder is "defined by manic episodes that last at least 7 days, or by manic symptoms that are so severe that the person needs immediate hospital care. Usually depressive episodes occur as well, typically lasting at least 2 weeks. Episodes of depression with mixed features (having depression and manic symptoms at the same time) are also possible." US Department of Health and Human Services, National Institute of Mental Health. *First-Generation Versus Second-Generation Antipsychotics in Adults: Comparative Effectiveness*. (2017). The American Psychiatric Association (5th edition) defines a manic episode as a "distinct period of abnormally and persistently elevated, expansive, or irritable mood and abnormally and persistently increased activity or energy, lasting at least 1 week and present most of the day, nearly every day (or any duration if hospitalization is necessary)."

[21] For people born in 1975 (which we observe for the first time when they are 20) the median age at onset of BD/Mania is 30 (Appendix Figure A2).

[22] 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 A5 tabulates comorbidities by disorder.

- *Depression* identifies people with one or more diagnoses of major depressive disorder (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."
- Bipolar disorder (*BD*) includes people with at least one diagnosis of bipolar disorder or mania (ICD-10: F30 and ICD-10: F31). BD (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)." Mania (ICD-10: F30) is described as "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."
- *Schizophrenia* identifies people with at least one diagnosis of "schizophrenia, schizotypal, delusional disorders and a larger group of acute and transient psychotic disorders" (ICD-10: F20-F29).

Rates of diagnosis of BD and schizophrenia are stable across birth cohorts, around an average of 7 people with BD per 1,000, and 14 people with schizophrenia per 1,000. Rates of diagnosis for depression increase slightly across diagnoses, from 28 per 1000 people for birth cohorts until 1956 to 33 per 1000 people for later cohorts (Appendix Figure A5).

Lithium

As an additional way to identify people with BD, we modify our indicator for people with BD to include those with a diagnosis, as well as those who have been prescribed lithium at least once. To construct these measures, we combine data on medical diagnoses with information on drug prescriptions from the Prescription Register (, which includes all prescriptions from 1995 to 2015. On average, 0.6 percent of all people have at least one lithium prescription during our time period, including 55 percent of people with at least one diagnosis of BD.

Earnings and Disability

To calculate a person's *earnings,* we add income from wages and self-employment (Appendix Table A4). We convert earnings from Danish Kroner (DKK) to in 2015 dollars

using the Danish CPI and the 2015 exchange rate. Individuals with positive earnings earn $44,705 on average, with a standard deviation of $42,421 (Appendix Table A4).

A separate variable measures *disability* receipts (*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 on family status. People who receive disability can work part-time and earn up to $46,720; if they earn more they forfeit disability pay for that calendar year.[23] Eleven percent of people with depression, BD, or schizophrenia receive disability pay in an average year, including 5,051 people with BD (28 percent of all people with BD), 13,871 with depression (17 percent), and 17,243 with schizophrenia (47 percent, Table 1).[24]

Family Identifiers

To control for unobservable factors that vary across families, we link each person to their siblings using their mother's or father's 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).

Parental Wealth

Information on parental wealth is available for people whose mother or father reported assets for at least for one year between 1980 and 2015. We set assets to zero for people whose parents are listed but do not have any financial assets.[25] To define a person's position in the distribution of parental wealth, we calculate the percentile of parental assets for each year (from 1980 to 2015) and assign each person to their parents' median percentile across all years.

[23] After a reform on March 1, 2013 restricted disability pay to Danish citizens below 40, the number of new recipients declined from 14,450 in 2012 to 5,684 in 2014. Robustness checks exclude years 2013-2015.
[24] A total of 2,178,704 person-year observations (6 percent) have disability pay and positive earnings (with an average of $332 per year). This total includes 76,594 people with BD (89 percent of all people with BD on disability), who have earnings of $286 per year on average. Another 263,953 people on disability with depression have positive earnings (90 percent of all people with BD on disability, with average earnings of $399 per year), and 213,941 people with schizophrenia on disability have positive earnings (88 percent of people with schizophrenia on disability, average earnings $139 per year).
[25] Assets are reported by banks and other financial institutions and not by the individuals themselves. All results are robust to excluding individuals without information on parental assets from the analyses.

III. Mental Health and Labor Market Outcomes

We start our analysis 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. OLS regressions estimate

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

where the dependent variable $\log(earnings_{it})$ is the natural logarithm of earnings of individual *i,* born in cohort *c,* 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 BD earn 38 percent less (with an estimate of -0.478, Table 2, column 1, significant at 1 percent). People with depression earn 36 percent less (significant at 1 percent), and people with schizophrenia earn 74 percent less (significant at 1 percent).

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).[26] 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

[26] Low income has been 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). Furthermore, access to specialized mental health care has been shown to depend, at least in part, on a person's socio-economic status (Hollingsworth 1992, Alegría, Bijil, and Lin 2000, Dohrenwend et al. 1992).

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 significantly smaller, at 31 percent, when calculated relative to siblings (Table 2, column 2), 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 forms of a disorder, e.g. Kruger 2006).[27] Our results suggest that these effects are small relative to the earnings penalties for people with the disorder.[28]

Event Studies Surrounding the Date of First Diagnosis

What is the timing of the changes in earnings associated with mental health conditions? If mental health affects earnings, earnings may begin to decline before a diagnosis, when people first experience symptoms but before they get diagnosed.[29] Furthermore, it may take some time for treatments to take effect. To investigate the timing of these changes, we estimate event stud of log earnings in the 10 years preceding and following a diagnosis:

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

where C_i is an indicator for either *BD*, *Depression*, *or Schizophrenia* and $Y(C)_i$ denotes the first year in which person i is diagnosed with condition C_i. Normalizing δ_{-1} to zero, each parameter δ_k captures the changes in log earnings k years from a diagnosis, relative to the year prior to the diagnosis.

OLS estimates of δ_k indicate that people with BD experience a 23 percent earnings decline in the ten years leading to a diagnosis (Figure 1). Estimates for BD lie between those

[27] 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).
[28] People for whom we can identify siblings represent 71 percent of the population. Estimates of equation (1) without family fixed effects obtained using this subsample are comparable to our baseline estimates (Appendix Table A6).
[29] Calabrese et al (1996), for example, find that roughly one in five people who enter outpatient treatment for BD have experienced four or more periods within the prior year.

for depression (9 percent decline) and schizophrenia (31 percent decline, Figure 1). The timing of the decline in earnings also differs across conditions. For people with BD and schizophrenia, which have traditionally been more difficult to diagnose, earnings are on a downward trend throughout the ten years prior to the diagnosis. For people with depression, instead, earnings start to decline only two years before a diagnosis.

Earnings recover after a diagnosis, albeit at a different rate for each of the three conditions, but without ever reaching pre-diagnosis levels. For people with depression, earnings are 21 percent lower 10 years after a diagnosis compared with 2 years before the diagnosis. People with BD earn 34 percent less 10 years after the diagnosis, and people with schizophrenia earn 57 percent some. Notably, these estimates may overstate recovery if the people who are extremely sick leave the labor force. (We examine these effects below). Some of the differences across disorders may be due to differences in the persistence of these disorders. Depression is less persistent than BD or schizophrenia.

B. Earnings Distribution

Noting that people with BD share personality traits common among entrepreneurs, Cooper et al. (1999) have called BD a CEO's disease.[30] Moreover, mental health conditions such as BD have been associated with exceptional artistic figures, including Vincent Van Gogh, Ernest Hemingway, Virginia Woolf, and Robert Schumann (Jamison 1993). These associations open the possibility that lower average earnings for people affected by mental health disorders might mask a larger earnings variability and, in particular, a higher chance of earnings at the top of the distribution. Our data refute this hypothesis. Instead, we find that people with BD are 3 percentage points (3 percent) less likely to have earnings in the top decile of the distribution compared with the population (Table 3, column 1, significant at 1 percent) and 3.3 percentage points less likely compared with their siblings (column 2, significant at 1 percent). Similarly, people with depression are 5.2 percent less likely compared with the population and 4.1 percent less likely compared with their siblings, and people with schizophrenia are 5.8 and 4.4 less likely (Table 3, columns 1 and 2). The same patterns hold when we consider the top quartile (rather than the top decile) of the distribution.

[30] Using a balloon analogue risk task (BART), Reddy et al. (2014) find that people with BD display excessive risk tolerance and impulsive behavior, Swann et al. (2004) find that impulsivity – the tendency to pursue rewards without considering negative consequences – is elevated in people who experience mania. Successful entrepreneurs have been shown to 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).

Consistent with our previous findings of lower earnings for people with mental health conditions, we find that these people are significantly more likely to have earnings in the bottom decile and quartile of the distribution. People with BD are 12 percentage points more likely to enter the bottom 10 percent of earnings, 1.2 more than the population (Table 3, column 7, significant at 1 percent). Estimates are similar for depression (with 99 percent) and much larger for schizophrenia (319 percent, Table 4, column 7, significant at 1 percent), and are robust to controlling for family fixed effects (Table 3, column 8)

C. No Earnings,

So far, our analysis has focused on people who report positive earnings in a given year. In fact, mental health disorders raise the risks of having no earnings at all. In our data, 13.4 percent of people have zero earnings in a given year overall. OLS estimates indicate that this share is 15.3 percentage points higher for people with depression (Table 2, column 3, significant at 1 percent). Compared with a 13.4 percent population share of people with zero earnings, this implies a 1.1 times higher risk of earning zero.

People with BD are 15 percentage points more likely to have zero earnings, implying a 1.1-fold higher probability. People with schizophrenia are 45 percentage points more likely to have zero 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 studies around the time of a diagnosis indicate the probability of having no earnings at all increases by 8.2 percentage points (53 percent) for people with BD in the ten years leading to a diagnosis (Figure 2). Again, estimates for BD are between those for depression (16 percent increase) and schizophrenia (75 percent increase, Figure 1). For people with BD and schizophrenia this increase starts to happen ten years prior to the diagnosis; for people with depression, it only starts four years before it.

After a diagnosis, the odds of having no earnings increase rapidly, and they are 1.1 times higher two years after a diagnosis relative to two years before it, for all three conditions. After this point, the probability of having no earnings declines slightly for people with depression, whereas it remains high for people with BD and schizophrenia.

C. Disability

A higher chance of having no earnings suggests that people with mental health conditions might stay out of the labor force for extended periods of time.[31] According to estimates by the World Health Organization (2011), mental illness are 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. Imberman and Duggan (2009) show that mental illness accounts for over half of the rise in disability receipt among men after 1990. Examining depression, Shapiro (2019) finds that people who take drugs for depression are less likely to miss days at work.[32] Similarly, BD is the sixth leading cause of disability worldwide (Murray and Lopez 1996). Only a minority of people with BD work full-time, with the rest either working part-time or not working at all (Suppes et al. 2001).[33]

To systematically analyze the role of disability, we estimate equation (1) with an indicator for people who receive disability pay as the dependent variable. OLS estimates show that people with depression are 1.2 times more likely to be on disability (7.4 percentage points compared with a population average of 5.9 percent). By comparison, BD and schizophrenia are associated with much larger risks of disability. OLS estimates indicate that people with BD are roughly 2.7 times more likely to receive disability payments (12.8 percentage points compared with a population average of 5.9 percent, Table 2, column 5, significant at 1 percent). and people with schizophrenia are 7 times more likely (41 percentage points, Table 2, column 5, significant at 1 percent). All results are robust to the inclusion of controls for family fixed effects (Table 2, column 6).

Event-study estimates show that the probability of disability increases for people with BD and schizophrenia in the ten years leading to a diagnosis, by 101 and 140 percent respectively. For people with depression, the probability is instead on a flat trend during the

[31] Kessler et al. (2003) use self-reported data in the World Health Organization Health and Work Performance Questionnaire (HPQ) and find that BD and depression are associated with 65.5 and 27.2 excess lost workdays per worker respectively. Projections of their estimates to the US labor force yield estimates of 225.0 million work days and $36.6 billion salary-equivalent lost productivity per year from depression, and 96.2 million lost workdays and $14.1 billion salary-equivalent lost productivity per year from BD.

[32] A related strand of literature has examined the role of physical health on labor market participation and disability. García-Gómez, Jones, and Rice (2010) shows that negative shocks to general health significantly affect entry into and exit from the labor market. García-Gómez (2011) shows that individuals who incur a health shock are more likely to leave employment and enter disability. García-Gómez, van Kippersluis, O'Donnell, and van Doorslaer (2013) estimate the effects of sudden illness on employment and income in the long run. Halla and Zweimuller (2013) shows that accidents increase the risks of unemployment and disability.

[33] Suppes et al. (2001) surveyed 253 people with BD and found that only one third of them worked full-time. Another 9 percent worked part-time outside the home, and 57 percent of patients with BD reported being unable to work or working only in sheltered settings. See Dean et al. 2004 for a review of existing estimates of the costs of BD.

same time period. After the diagnosis the probability of being on disability increases steadily for all three conditions, and it is 5.8 times, 4.2 times, and 8.5 times higher for people with BD, depression, and schizophrenia ten years after the diagnosis, respectively.

Taken together, these estimates suggest that mental health disorders create enormous costs by dramatically reducing earnings and increasing the risk of disability.

IV. Effects of Access to Treatment

Simple comparisons of people with mental health disorders, the population, and their siblings indicate enormous earnings penalties associated with these disorders, but they are not sufficient to establish a causal effect. The occurrence of mental health disorders might be related to unobservable factors that also affect people's careers; furthermore, earnings and other career outcomes can have a direct effect on a person's mental health (e.g., Ross and Huber 1985).[35]

To address these issues and make progress towards identifying the causal effects of changes in mental health, we exploit an important change in the treatment of BD, the approval of lithium in1976 by Denmark's FDA, the *Lægemiddelstyrelsen*,

Access to Treatment Greatly Increases Average Earnings

Our baseline strategy compares earnings for people with BD with and without treatment in their 20s, the typical age of onset for BD (Kessler et al. 2005), and the population. We estimate the following equation via OLS:

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

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 when they turned 20. Under the identifying assumption that differences in earnings for people with and without BD would have been comparable for people born before and after 1956, the coefficient β on the interaction BD_i x $post_c$ estimates the benefits of access to treatment. Cohort fixed effects θ_c control for factors that may influence outcomes

[35] Ross and Huber (1985) examine a national sample of married couples who experience economic hardship; they find that men's mental health is strongly affected by earnings, while women's mental health is less affected by earnings and more affected by their education and children.

differentially for people who were born in different cohorts.[36] Our baseline tests estimate these effects separately for people with positive earnings; below we also investigate the effects of treatment on the probability of having no earnings at all.

OLS estimates indicate that access to treatment eliminates one third of the earnings penalty that is associated with BD. An estimate of -0.560 for *BD* indicates that people with BD in cohorts without access to treatment had 42.9 percent lower earnings (Table 4, column 1, significant at 1 percent). An estimate of 0.112 for *BD x post* indicates instead that people with BD and access to treatment had 12 percent higher earnings compared with people with BD and no access. (Table 4, column 1, significant at 1 percent). This further indicates that access to treatment closes 28 percent of the earnings penalty associated with BD.

Estimates with family fixed effects confirm these results and yield even larger estimates of treatment. An estimate of 0.240 for *BD x post* indicates that access to treatment closes 64 percent of the 42 percent earnings penalty from BD (Table 4, column 2, significant at 1 percent).[38]

Event Studies Surrounding the Year of Diagnosis

To further investigate the timing of changes in earnings around the diagnosis we estimate event-study regressions, equivalent to equation (2), separately for cohorts born before and after 1956. In the ten years preceding a diagnosis, earnings of people with and without access to treatment are on a similar, downward trend, declining by 26 and 24 percent over this time period, respectively (Figure 4). In the year of the diagnosis, earnings decline by an additional 34 percent for both groups. After this point, however, the earnings trajectories of the two groups start to diverge. Earnings of people with BD and no access to treatment fall by an additional 16 percent and are 43 percent lower level ten years after the diagnosis relative to the year that precedes it. Earnings of people with BD and access to lithium, on the other hand, start to slowly recover four years after a diagnosis and they are only 29 percent lower ten years after a diagnosis relative to the year before it. These estimates suggest that access to treatment conveys important benefits for people with BD, closing nearly one third of the decline in earnings that follows a diagnosis.

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[36] Perhaps most importantly in our setting, cohort fixed effects control for variation in the stigmatization of mental health, which can vary over time (Hinshaw 2007). Increasing evidence for genetic predispositions may mitigate the stigmatization of mental health over time. Despite such evidence, however, attitude surveys indicate that levels of stigmatization have increased for younger cohorts, at least towards the most serious forms of mental disorders, such as BD (Link et al 1999, Pheland et al. 2000).

[38] Appendix Table A7 shows estimates of equation (3) without family fixed effects, obtained on the sample of people for whom family ide

Access to Treatment And Earnings Distribution

Next, we investigate the effects of access to BD treatment on the earnings distribution, by studying the differences in the probability of having earnings in the top and bottom echelons of the distribution among people with BD with and without access to lithium. Our estimates, shown in Table 5, indicate that access to treatment does not affect the probability that people with BD have earnings in the top decile of the distribution, relative to the population (with estimates of *BD* x *post* equal to -0.004, Table 5, column 1). Access to treatment does, however, increase the probability of earnings in the top decile by 21 percent relative to siblings (with estimates of *BD* x *post* equal to 0.021, Table 5, column 1, significant at 1 percent).

Treatment significantly reduces this probability that people with BD decline into the bottom 10th percentile of earnings, by 17 percent compared with the population (1.7 percentage points for *BD x post*, Table 5, column 5, significant at 1 percent) and 42 percent compared with their siblings (Table 5, column 6, significant at 1 percent). Taken together, these estimates indicate that access to treatment decreases the variability in earnings of people with BD, reducing the probability of falling at the bottom of the distribution and slightly raising the probability of being at the top.

Access to Treatment Greatly Reduces The Risk of Having No Earnings

Access to treatment could also enable people with BD to work who would otherwise be inactive, thus reducting the probability of having no earnings at all. To estimate the effects of BD and treatments on a person's risk of having no earnings at all, we re-estimate equation (3) using an indicator for zero earnings in a given year as the dependent variable.

OLS estimates imply that people with BD are 1.5 times more likely than the population person to have no earnings at all (19.6 percentage points compared with a population share of 0.134, Table 4, column 3, significant at 1 percent). Access to treatment reduces a person's risk of zero earnings by 33 percent: With treatment, people with BD are only 98 percent more likely than the population to have zero earnings (with an estimate of -6.5 percentage points, Table 6, column 1, significant at 1 percent). Estimates are robust to controlling for family fixed effects: People with BD are 19.7 percentage points more likely than their siblings to have no earnings. Access to lithium reduces this risk by 7.1 percentage points (Table 6, column 2).

Event study estimates around the time of a BD diagnosis imply that the risk of having no earnings is similar among cohorts with and without access to treatment, increasing by approximately 9 percentage points (58 percent) in the ten years leading to the diagnosis (Figure 5). This probability continues to increase in the same way for the two groups following a diagnosis, and it is 59 percent higher two years after relative to the year before it. For cohorts without access to treatment, however, the probability continues to rise and reaches a 1.5- times higher level ten years following a diagnosis. For cohorts with access to treatment, instead, the probability remains constant at a 100 percent higher level between two and ten years after a diagnosis. Once more, these estimates show how access to treatment closes a significant portion of the labor market penalties that arise after a BD diagnosis.

Access to Treatment Reduces the Risks of Disability

If access to BD treatment reduces the odds of having no earnings by enabling people to work, it might reduce the likelihood that people with BD are on disability. As a test of this hypothesis we re-estimate equation (1) using the probability that a person receives disability payments as the dependent variable.

OLS estimates indicate that people with BD are almost 4 times more likely to be on disability than the average person in the Danish labor force (21.8 percentage points, Table 11, column 3, significant at 1 percent, compared with an average probability of being on disability of 0.059). Importantly, access to treatment eliminates 59 percent of the excess risk of disability for people with BD (with an estimate of *BD x post* equal to 0.128, Table 6, column 3, significant at 1 percent). Compared with their siblings, people with BD are nearly 5 times more likely to receive disability pay (21.4 percentage points, Table 161, column 4, significant at 1 percent, compared with an average probability of disability of 0.046 for people with at least one sibling). 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 6, column 4, significant at 1 percent).

Event study estimates confirm the decline in disability with access to treatment. In the ten years leading to a diagnosis the risk of disability is on a similar, upward trend for cohorts with and without access to treatment, and it increases by 9.8 and 4.3 percentage points (166 and 73 percent) respectively (Figure 5). After the diagnosis the likelihood of being on disability continues to rise, but the increase is more muted for people with access to treatment (with a 6.3 times increase ten years after a diagnosis relative to the year before) compared with people without access (5.6 times increase).

No Significant Effects of Treatment on Siblings

A diagnosis of BD might bear a relationship with the career prospects not only of the people who are diagnosed, but also their siblings. Medical research indicates that "healthy" siblings may be affected by a "subthreshold" form of BD, even if they are not diagnosed (Mortensen et al 2003, Kruger 2006).[41] Furthermore, siblings might be indirectly affected by growing up with a sibling who has BD, for example via the allocation of intra-household resources. Parents who are resource-constrained may also underinvest in siblings of people with BD, or they may invest *more* in siblings if they expect them to carry a disproportionate share of family responsibilities. These effects are not only interesting in their own right, but they also matter for our interpretation of results with family fixed effects, which effectively compare people with BD to healthy siblings.

To examine this relationship, in Table 6 we compare healthy siblings of people with BD with the population. These comparisons reveal the presence of negative spillovers of BD individuals onto siblings, but show no evidence of an effect of access to treatment. OLS estimates indicate that healthy siblings 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). Access to treatment has a small negative effect on siblings (with an estimate of -0.032 for *BD sibling x post*, Table 7, column 1, significant at 10 percent).

V. Treatment Effects Across Birth Cohorts

Our baseline specifications estimate the average benefits of access to treatment for people with BD who had access to lithium by age 20. These estimates are precise if lithium was completely unavailable until 1976 and became available immediately to everyone in 1976. It may, however, take several years for a new drug to reach all patients (Agha and Molitor 2017, Dickstein, King, and Saxell 2017),[43] and it is possible that lithium was used before it was approved. If these errors are significant, both types of errors will lead the baseline to understate the benefits of treatment for people with BD.

[41] 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).

[43] Agha and Molitor (forthcoming) 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.

In this section we estimate cohort-specific treatment effect as an extension to the baseline. Specifically, we estimate β separately for each two-year cohort class between 1946 and 1976, allowing it to be different from zero before 1956.

$$(5)\ ln(earnings_{ict}) = \alpha\ BD_i + \Sigma_c\ \beta_c\ BD_i \times \theta_c + \gamma\ Z_{it} + \delta_f + \theta_c + \tau_t + \varepsilon_{ict}$$

where the birth year 1953-1954 is the omitted category (i.e. $\theta_{1953\text{-}54} = 0$).

These estimates firmly corroborate our baseline regressions. Cohort-specific estimates show no positive effects of treatment for cohorts before 1955-56, who would not have had access to lithium when they turned 20. For people born before 1956 all estimates are negative and insignificant, ranging from -0.054 for 1946 to 0.127 for 1948 (Figure 7).

Cohort-specific estimates first become positive for people born in 1960, with an estimate of 0.170, which implies a 19 percent increase in earnings (exp(0.17)-1, significant at 5 percent, Figure 7). This four-year delay after access to treatment is consistent with estimated delays in the diffusion of drugs (e.g. Agha and Molitor forthcoming). Estimates further increase 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 7), implying a 22 and 30 percent increase, respectively. Estimates are robust when controlling for family fixed effects (Figure 7, lighter series). We conclude that the baseline approach adequately captures the most salient change in access to treatment.

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

Next, we obtain cohort-specific estimates for the probability of having no earnings. These estimates confirm that there was no measurable effect of the treatment for people who did not have access to treatment when they reached adulthood. The probability of having no earnings is on a flat trend across cohorts born between 1946 and 1954 (Figure 8).

Treatments first become statistically significant for cohorts born in 1957-58, with a 2.5 percentage points (-0.025) decline in the probability of zero earnings (significant at 5 percent). Estimates decline continuously, reaching -0.089 for people born in 1975-76 (significant at 1 percent, Figure 8). Compared with a population share of 0.154, these estimates imply a 16 and 58 percent reduction in the risks of zero earnings. Younger people, who had access to lithium for a larger share of their professional lives, are substantially more likely to have positive earnings.

They are Also Much Less Likely to Be on Disability

Cohort-specific estimates indicate no significant differences in the probability of disability among people with BD born between 1946 and 1054 (Figure 8). Cohorts born after 1956, however, have a lower probability: Cohort-specific estimates are equal to -0.039 for 1958 (significant at 5 percent) and reach -0.218 for the 1976 cohort (significant at 1 percent, Figure 9). Compared with an average probability of 0.059, this correspond to a 66 and 369, and 322 percent lower probability, respectively. Estimates are robust when we control for family fixed effects (Figure 9, lighter series).

V. Parental Wealth

Population data on mental health diagnoses and earnings reveals enormous career costs of mental health disorders. In this section, we examine how differences in parental wealth influences these costs, investigating mental health as a potential mechanism for the persistence of inequality (see Chetty et al. 2014 for evidence from the United States, and Boserup et al. 2013 for evidence from Denmark).

Recent research has found that children who are born into poor family are more likely to suffer in mental health conditions as adults (McClellan et al. 2006, Neugebauer et al. 2006, Adhvaryu et al. (2019).[44] In the United States, low-income urban populations are less likely to receive targeted treatment for mental health disorders (Davis et al. 2018). Such inequality in access may exist because people in low-income families cannot afford the fees that are associated with mental health treatment, or it may be due to informal barriers and the stigmatization of treatment for mental health. In our empirical setting, when health care is essentially free, we can shut down costs as a channel.

Data on parental assets are available for 38 percent of our observations between 1985 and 2015. We first calculate the median percentile of a person's parents' assets between 1985-2015 (the full range of years for which these data are available). We then pinpoint each parents' percentile in the asset distribution for each year and determine parents' median position in assets across 1985-2015. Using this measure of parental assets, we estimate

[44] 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. Cohen et al. (2006) show that socioeconomic status is associated with stress, while Van der Bergh (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.

whether the penalties associated with depression, BD, and schizophrenia vary across people whose parents are in the bottom versus the top quartile of the distribution of assets.

OLS estimates indicate that parental assets play an important role in mitigating the career effects of mental health. For people in the top quartile of the wealth distribution, depression is associated with a relatively small reduction in earnings. An estimate of 0.039 for the variable *Depression x Parents >= 75th percentile* implies that people with depression whose parental assets are in the top quartile earn 4.0 percentage points more than other people with depression whose parental assets are in the second and third quartile (Table 3, column 1, significant at 1 percent). For people in the bottom quartile of parental assets estimates are netative but not statistically significant (Table 3, column 1, p-value equal to 0.21). Relative to a penalty of 32 percent for individuals with assets in the second and third quartile (given an estimate for *Depression* of -0.378, exp(-0.378)-1=-0.315), this implies that moving from the bottom to the top quartile of parental assets eliminates 8.7 percent of the earnings penalty from depression.

For people with BD, the benefits from wealthy parents are even larger: Moving from the bottom to the top quartile of parental wealth eliminates 10 percent of the earnings penalty associated with BD. Having parents in the top quartile of the earnings distribution is associated with a 5.3 percentage points higher earnings (estimate of *BD x Parents >= 75 percentile* equal to 0.052, Table 3, column 1, significant at 10 percent). Having parents in the bottom quartile is associated with a 4.1 percentage points lower earnings, although this estimate is not statistically significant, with a p-value of 0.18 (estimate of *BD x Parents < 25 percentile* equal to -0.042, Table 3, column 1). Given an earnings penalty of 35 percent for people with BD with parents in the second and third quartile, this implies that moving an individual from the bottom to the top quartile of parental wealth eliminates 10 percent of the earnings penalty associated with BD.

By contrast, the mitigating effects of parental assets for schizophrenia are relatively small. For people with schizophrenia, having parents' assets in the top quartile is associated with a 6.0 percentage points higher earnings, whereas having parents' in the bottom quartile is associated with a 9.6 percentage points lower earnings (estimates of *Schizophrenia x Parents >= 75 percentile* and *Schizophrenia x Parents < 25 percentile*, Table 3, column 1, significant at 10 and 1 percent). This implies that moving an individual from the bottom to the top quartile of earnings could eliminate 2.5 percent of the total earnings penalty associated with schizophrenia.

We also find that people with depression and BD are less likely to have zero earnings when parents' assets are in the top quartile (3.6 and 2.8 percentage points more likely respectively, or 39 and 30 percent, Table 3, column 2), whereas parental assets do not seem to matter for the labor force participation of individuals with schizophrenia.

Finally, people with mental health conditions and parents' assets in the top quartile are less likely to be at risk of disability (3.4 percentage points more likely for depression, 1.5 percentage points more likely for BD, and 1.6 percentage points more likely for schizophrenia, or 100 percent, 44 percent, and 47 percent more likely, Table 3, column 2).

Appendix Table A5 shows that the earnings and labor market penalties associated with mental health conditions are significantly smaller for individuals with parents' assets in the top quartile of the distribution. The magnitudes of these estimates suggest that higher family wealth is associated with smaller penalties from mental health conditions, and especially so for individuals with depression.

Benefits of Treatment are Largest for People with Little Parental Wealth

Cross-sectional correlations in Table 3 suggest that parental wealth can help to mitigate the career effects of depression and BD and, to a lesser extent, schizophrenia.[45] In this section, we examine whether benefits from access to treatment also vary across the distribution of parental assets.

Estimates from a triple difference specification indicate that, for people with parental assets in the bottom quartile access to treatment eliminates 31 percent of earnings penalty from (estimate for *BD x Post x Parent < 25 percentile* equal to 0.191, Table 8, column 1, p-value equal to 0.47). By comparison, benefits from access to treatment are much smaller for people whose parents are in the top quartile of assets, with an imprecisely estimated reduction in the earnings penalty of 10 percent (estimate for *BD x Post x Parent >= 75 percentile* equal to -0.047, Table 8, column 1, p-value equal to 0.83). These point estimates imply that moving a person's from the top to the bottom quartile of the distribution of parents' assets makes the effect of access to treatment three times as large.

Similarly, access to treatment reduces the risk of having zero earnings by an additional 7.0 percentage points for individuals with parents' assets in the bottom quartile

[45] Figure A3 compares the distribution of earnings for people with BD and their healthy counterparts. For people with BD, the distribution of earnings residuals distribution is bimodal, with a first mode around 0 and a second mode around $50,000 (Figure A3). By comparison, the distribution of earnings for the healthy population has a much larger mass and a median around $50,000.

(Table 9, column 2, p-value equal to 0.29) and by 2.4 percentage points less for individuals with parents' assets in the bottom quartile (Table 9, column 2, p-value equal to 0.69) relative to individuals with parents' assets in the second and third quartiles. Lastly, the effect of treatment on the risk of disability is 5.8 percentage points larger for individuals with parents' assets in the bottom quartile (Table 9, column 3, p-value equal to 0.33) and 9.0 percentage points smaller for individuals with parents' assets in the bottom quartile (Table 9, column 3, p-value equal to 0.12).

VI. Additional Results: Variation in Severity and Alternative Definitions of BD

In this final section of the analysis we examine heterogeneous effects on people with more or less severe forms of BD and we show that our results do not vary when we use an alternative strategy to identify people with BD.

A. Variation in Severity of BD

To assess whether the labor market penalties and the effects of BD are larger for people with a more severe form of this condition, we measure intensity by the number of diagnoses of BD each person receives. On average, BD individuals experience 2.4 diagnoses between 1995 and 2015, with a median of 2 episodes. We estimate the following equation:

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

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

OLS estimates imply that even 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.)

Each additional episode is associated with an additional 22 percent lower earnings. The benefits of access to treatment, however, are also larger for individuals who experience more episodes. For individuals with only one diagnosis, the gap in earnings is reduced by 25 percent with access to treatment (exp(0.008) -1+ exp(0.098)-1/0.438, Table 9, column 1), and the benefit of treatment increases by 10 percentage points with each additional episode. Estimates which compare individuals with their siblings indicate similar wage gaps and smaller benefits from treatment associated with more episodes (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 72 percent more likely to earn nothing (with an estimate of 0.096 for *BD* and compared with a 13.4 percent population share of zero earning, Table 9, column 3, significant at 1 percent). Access to treatment eliminates 10 percent of this penalty (*BD x post* is -0.010, Table9, 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.

B. Alternative Definition of BD

Our definition of people with BD is based on medical diagnoses. This information is only available starting from 1995, which implies that if a person was diagnosed prior to 1995 and does not receive another diagnosis later on, we might misclassify that person as not having BD. To check whether this data limitation affects our results, we re-obtain our estimates of the effects of treatment on people's careers using an alternative definition of people with BD which combines information on medical diagnoses with information on prescriptions. Specifically, we define as BD a person who, between 1995 and 2015, either (i) receives a diagnosis of BD or (ii) receives at least one prescription of lithium.

Estimates of access to treatment using this alternative definition for BD, shown in Table 10, are very similar to our baseline estimates in Table 4. These estimates confirm that treatment closes approximately one third of the earnings penalty associated with BD (with an estimate of *BD/lithium* equal to -0.560 and an estimate for *BD/lithium* x *post* equal to 0.112, Table 10, column 1, significant at 1 percent). Furthermore, treatment reduces the risk of having no earnings by 25 percent (column 3) and the risk of disability by 52 percent (column 5). Estimates are robust controlling for family fixed effects (columns 2, 4, and 6).

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 social costs, with earnings penalties that range from 34 percent for

a person with depression to 74 percent for a person with schizophrenia. Risks of zero 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.

The approval of lithium as a maintenance treatment for BD in 1976 makes it possible to estimate the effects of major change in access to treatments. Baseline difference-in-differences estimates indicate that access to lithium closed one-third percent of the earnings gap from BD compared with the population and compared with siblings. Access to treatment also greatly reduces the risks of zero earnings, and of declining in the bottom quantiles of earnings. Moreover, access to treatment eliminates 59 percent of the excess risk of disability compared with the population and 57 percent compared with siblings. These results imply that policies which improve access to treatments for mental health disorders could create large economic and social benefits by increasing earnings, encouraging labor force participation, and reducing the risk of disability.

Notably, gains from access are concentrated at the lower end of the earnings distribution, which suggests important distributional effects of treatments for mental health disorder. Denmark offers universal health care, granting better access to drugs to people in the lower quantiles of the earnings distribution. In countries without universal healthcare, such as the United States, variation in access to treatment across the earnings distribution may further exacerbate the distributional effects on mental health.

For the United States, estimates from the National Comorbidity Survey (NCS-R, Kessler et al 2003b) indicate that one in three people with BD remain untreated.[46] 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.

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[46] 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 2003b), even though a striking 73 percent in general medical treatment received the wrong drugs (compared with an also large 43 percent in specialist treatment.

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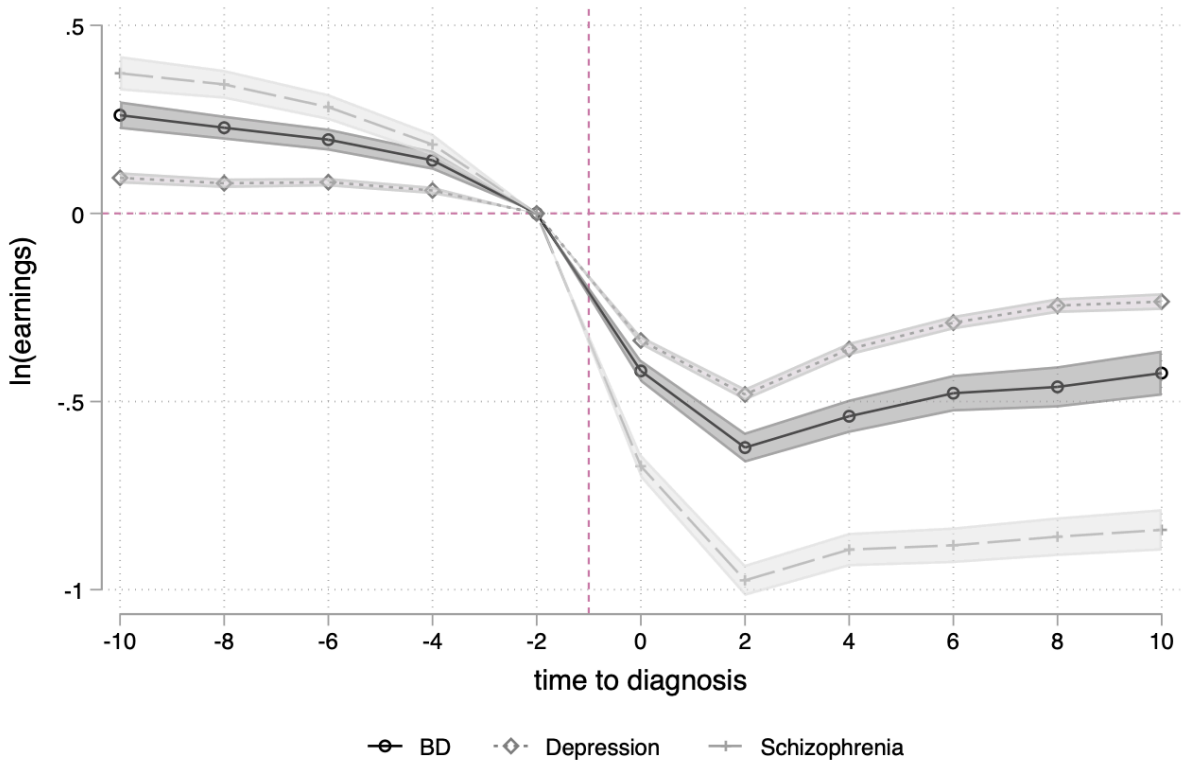
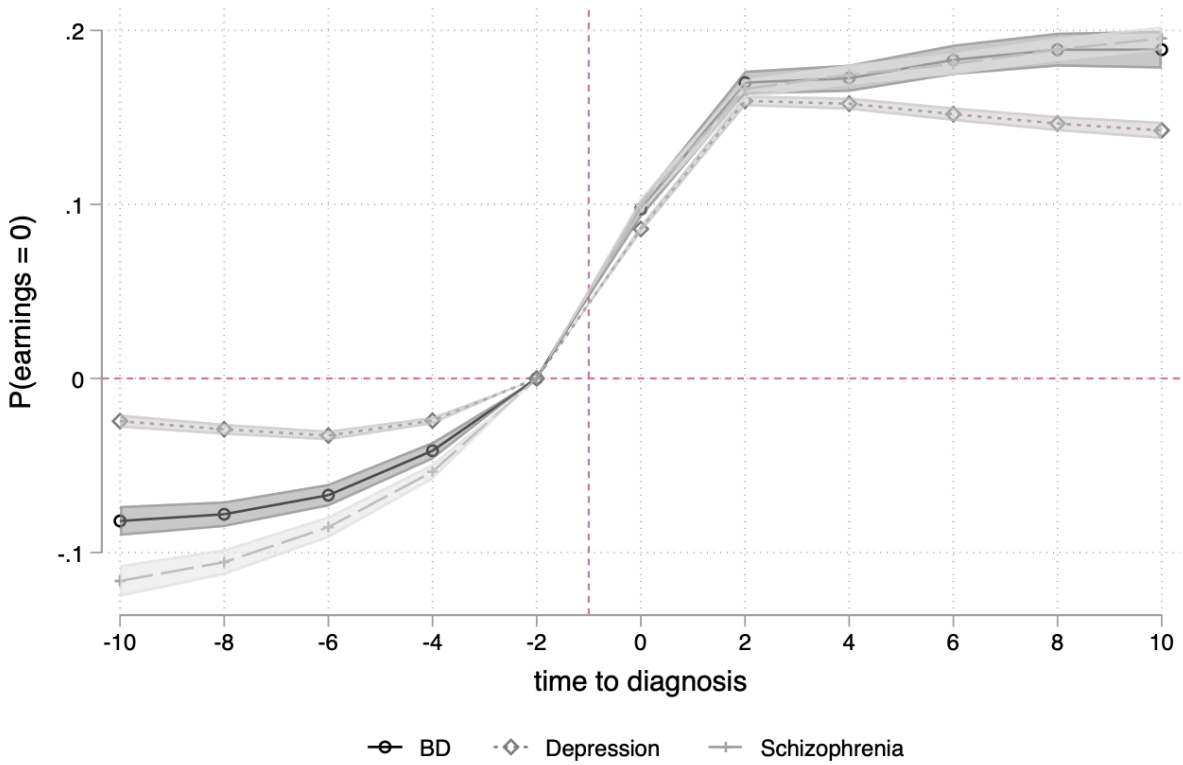
FIGURE 1– EVENT STUDY OF LN(EARNINGS) AROUND A DIAGNOSIS
BD, DEPRESSION, AND SCHIZOPHRENIA



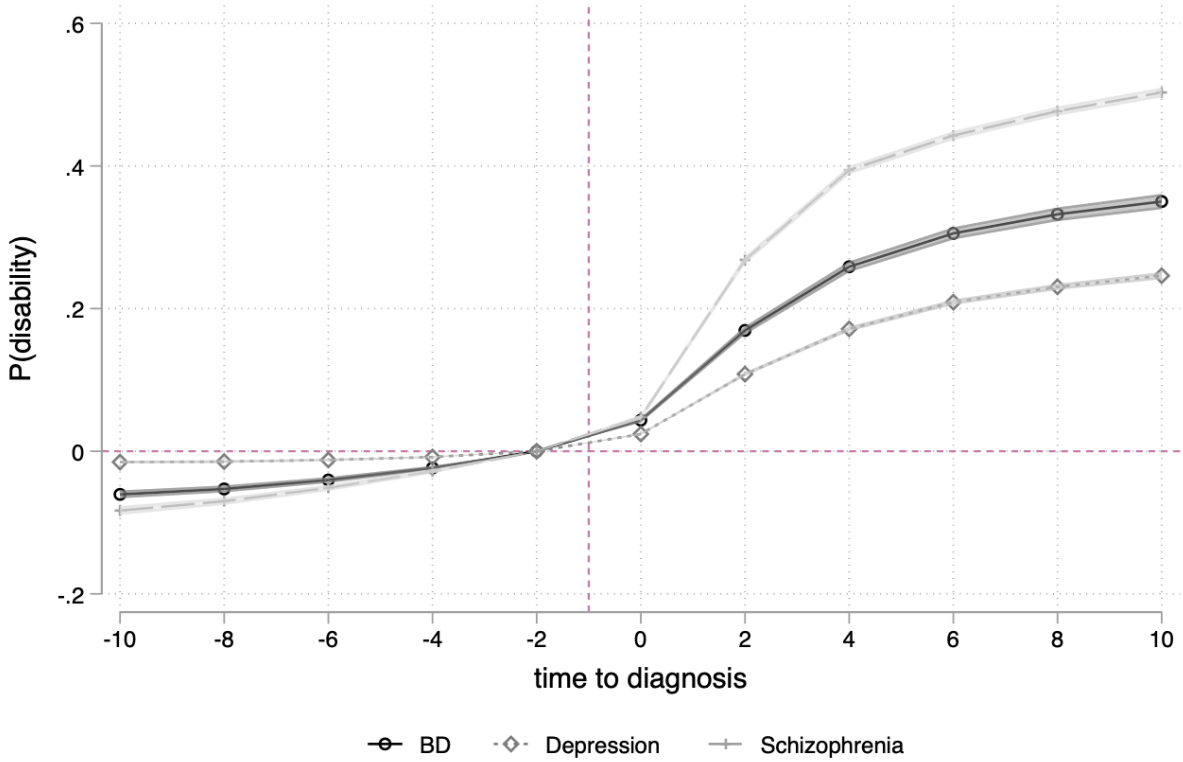
Note: Point estimates and 95 percent confidence of the parameter δ in equation $\log(earnings_{ict}) = \sum^{10}_{k=-10} \delta_k C_i I(t-Y(C)_i = k) + \beta_1 BD_i + \beta_2 Depression_i + \beta_3 Schizophrenia_i + \theta_c + \tau_t + \varepsilon_{ict}$ where the dependent variable is the natural logarithm 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 1976, and with positive earnings.

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



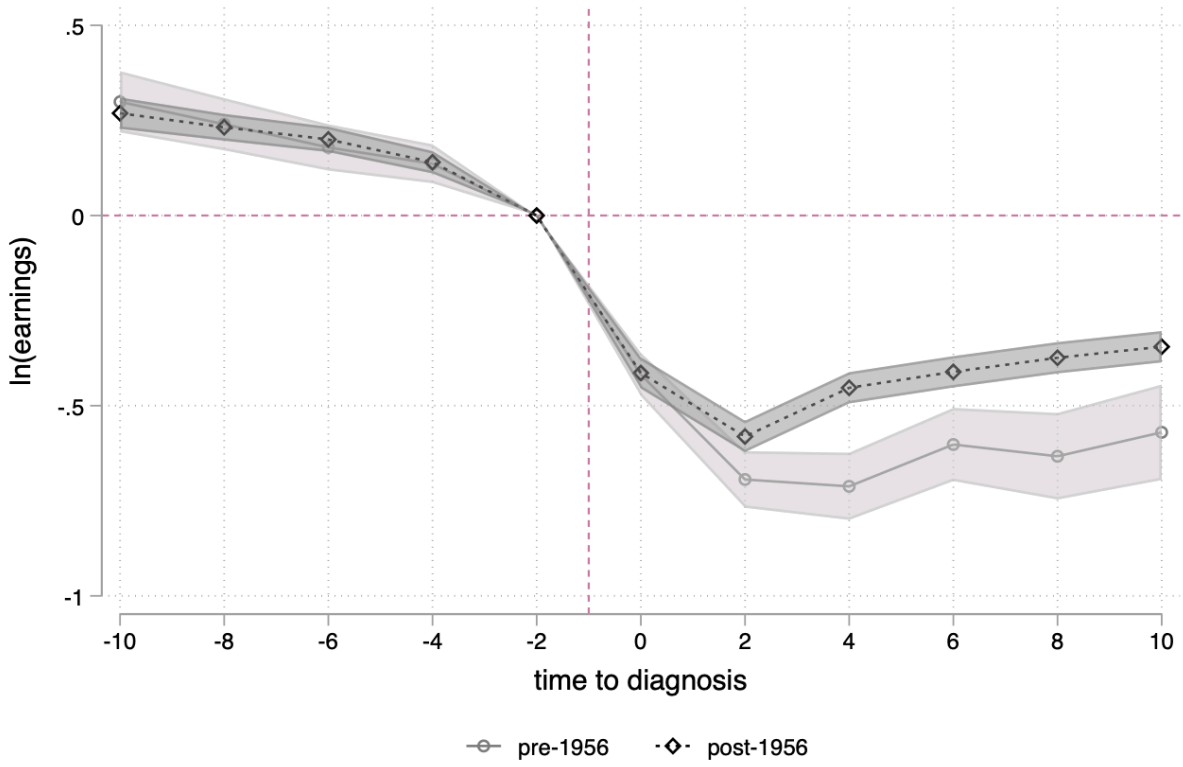
Note: Point estimates and 95 percent confidence of the parameter δ in equation $P(earnings_{ict}=0) = \sum^{10}_{k=-10} \delta_k C_i I(t-Y(C)_i = k) + \beta_1 BD_i + \beta_2 Depression_i + \beta_3 Schizophrenia_i + \theta_c + \tau_t + \varepsilon_{ict}$, where the dependent variable is an indicator for 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 1976.

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



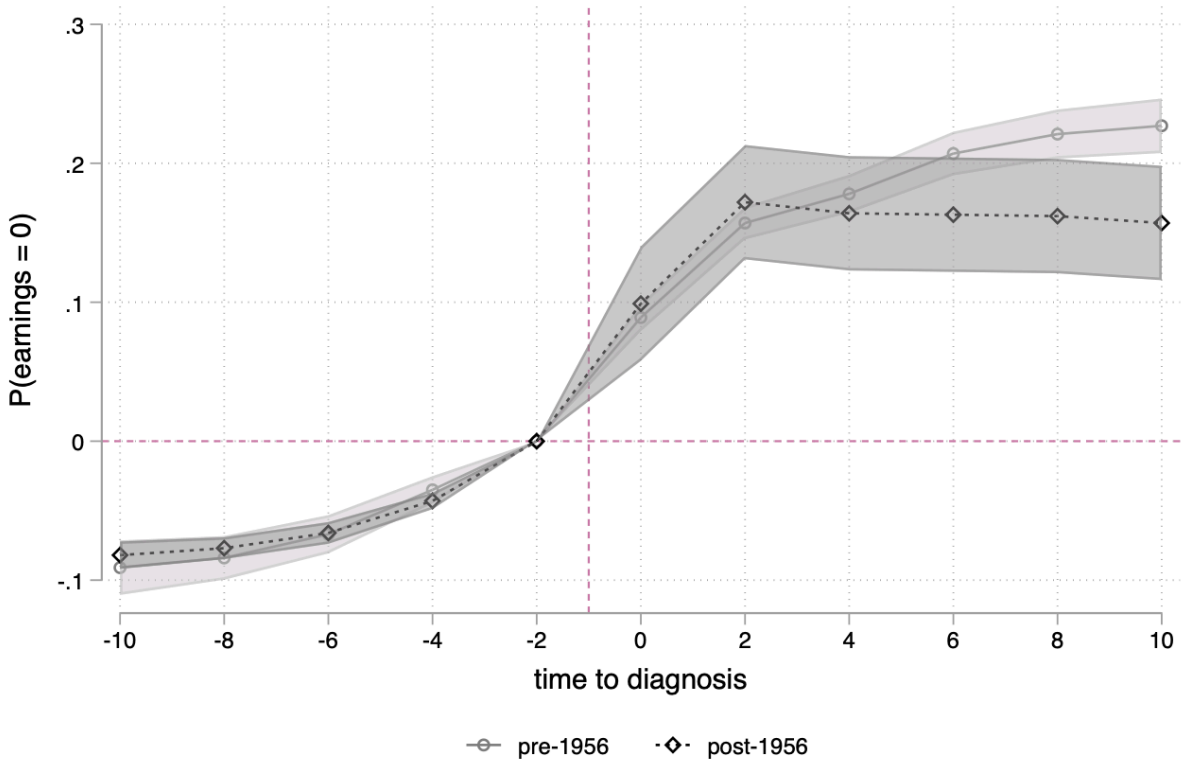
Note: Point estimates and 95 percent confidence of the parameter δ in equation $P(disability_{ict}) = \sum^{10}_{k=-10} \delta_k C_i I(t-Y(C)_i = k) + \beta_1 BD_i + \beta_2 Depression_i + \beta_3 Schizophrenia_i + \theta_c + \tau_t + \varepsilon_{ict}$, where the dependent variable is an indicator for 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 1976.

FIGURE 4– EVENT STUDY OF LN(EARNINGS)
PEOPLE WITH BD WITH AND WITHOUT ACCESS TO LITHIUM



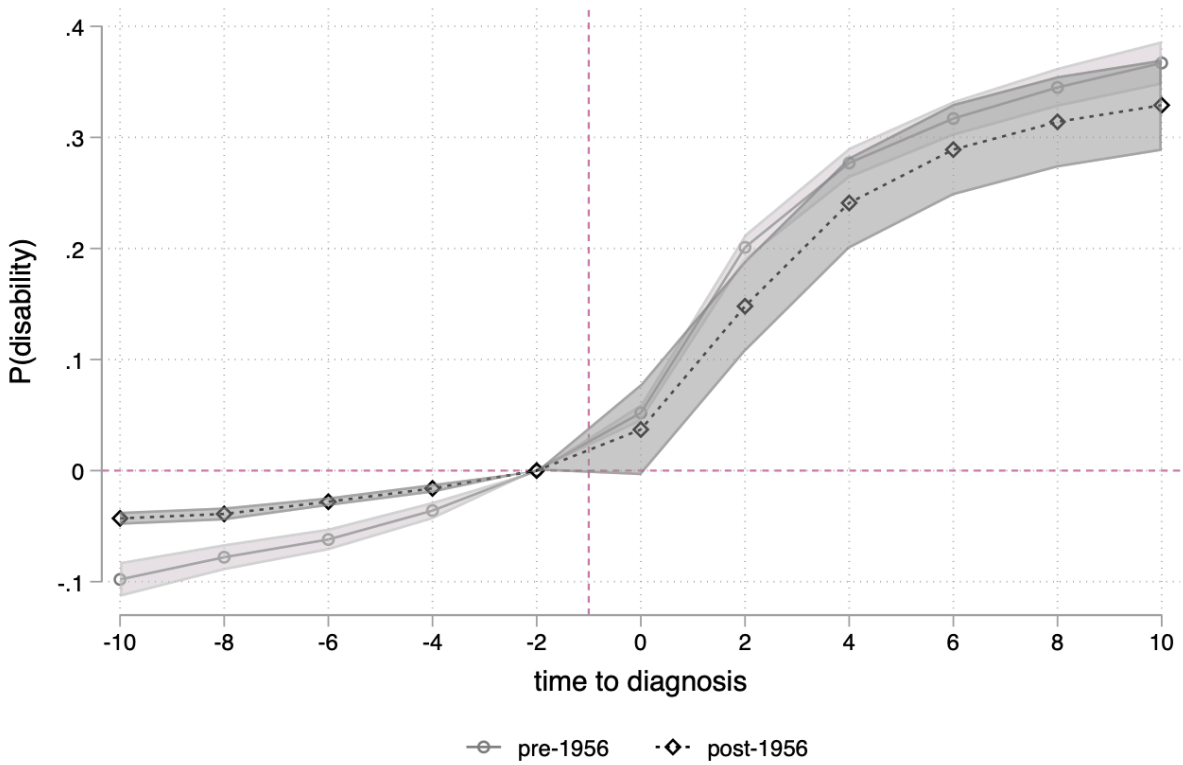
Note: Point estimates and 95 percent confidence of the parameter δ in equation $\ln(earnings_{ict}) = \sum^{10}_{k=-10} \delta_s BD_i I(t\text{-}Y(BD)_i = k) + \beta_2 Depression_i + \beta_3 Schizophrenia_i + \theta_c + \tau_t + \varepsilon_{ict}$, where the dependent variable is the natural logarithm 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 contains θ_c cohort fixed effects, and τ_t are year fixed- ffects. 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 1976.

FIGURE 5– EVENT STUDY OF P(EARNINGS = 0)
PEOPLE WITH BD WITH AND WITHOUT ACCESS TO LITHIUM



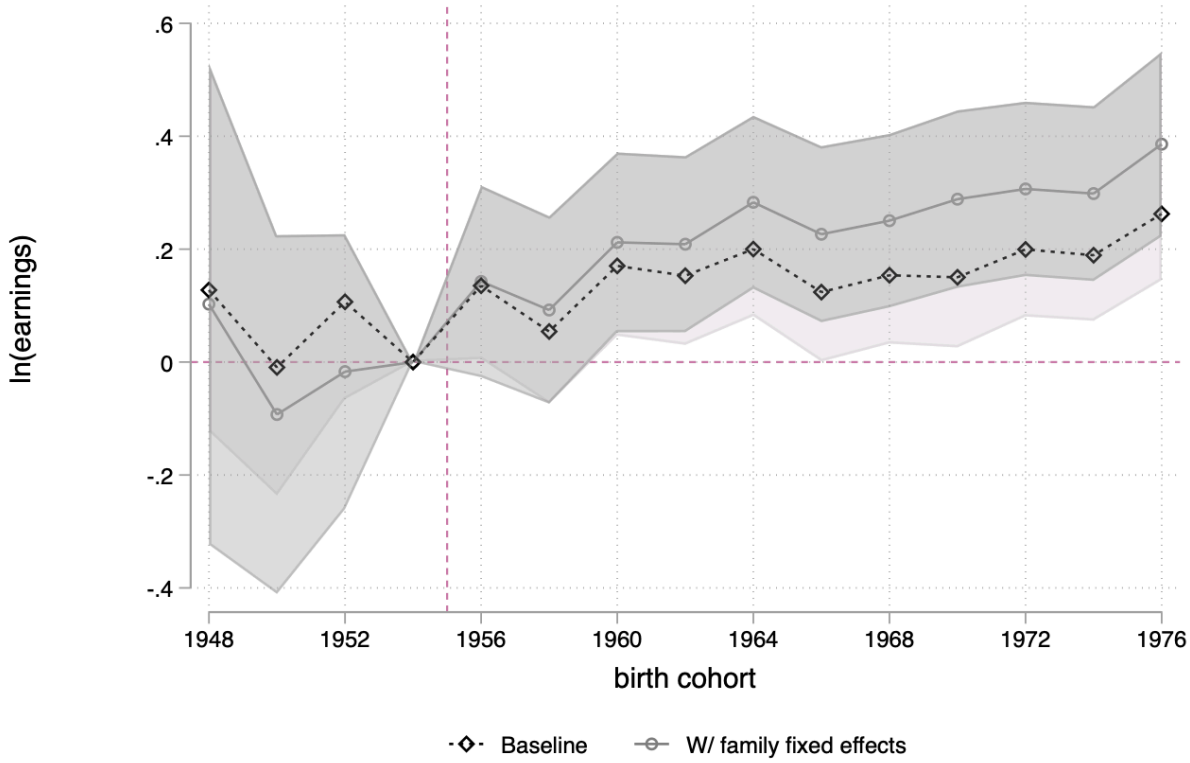
Note: Point estimates and 95 percent confidence of the parameter δ in equation $P(earnings_{ict}=0) = \sum^{10}_{k=-10} \delta_s BD_i I(t-Y(BD)_i = k) + \beta_2 Depression_i + \beta_3 Schizophrenia_i + \theta_c + \tau_t + \varepsilon_{ict}$, where the dependent variable is an indicator for having no 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 contains θ_c 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 1976.

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



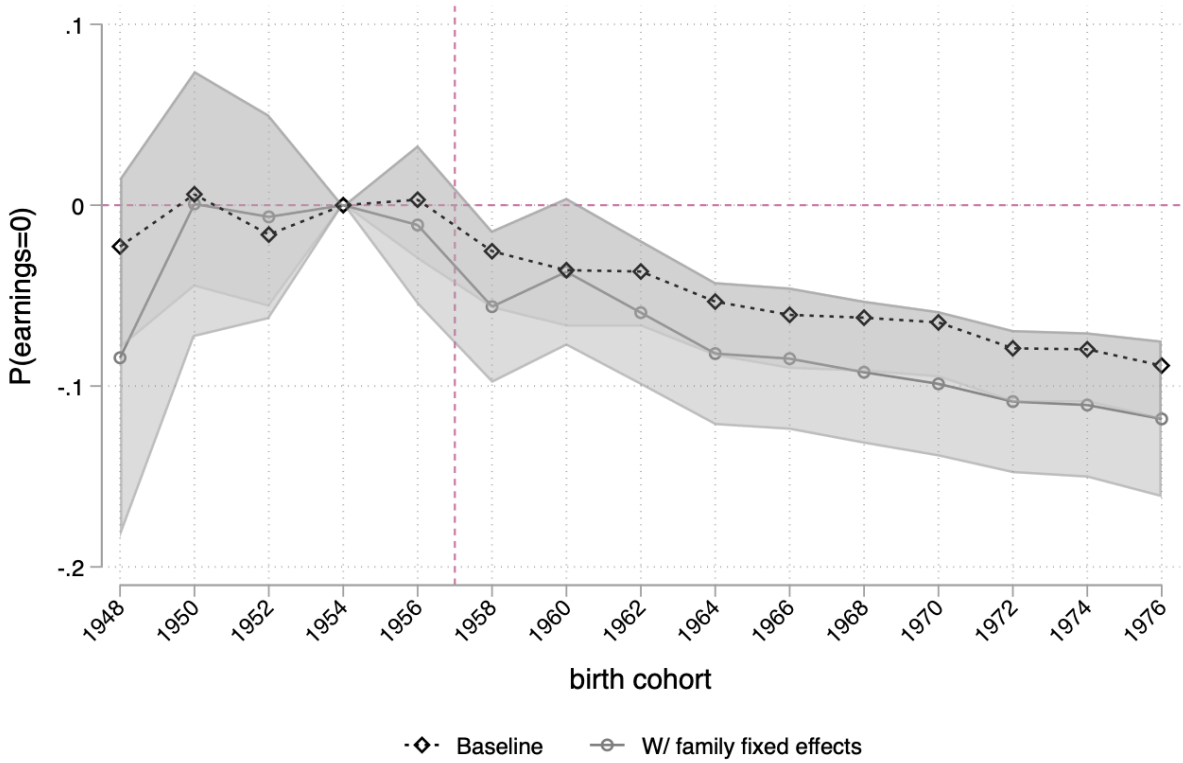
Note: Point estimates and 95 percent confidence of the parameter δ in equation $P(disability_{ict}=0) = \sum^{10}_{k=-10} \delta_s BD_i I(t-Y(BD)_i = k) + \beta_2 Depression_i + \beta_3 Schizophrenia_i + \theta_c + \tau_t + \varepsilon_{ict}$, where the dependent variable is an indicator for being on 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 contains θ_c 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 1976.

FIGURE 7– COHORT-SPECIFIC EFFECTS OF ACCESS TO LITHIUM ON LN(EARNINGS)



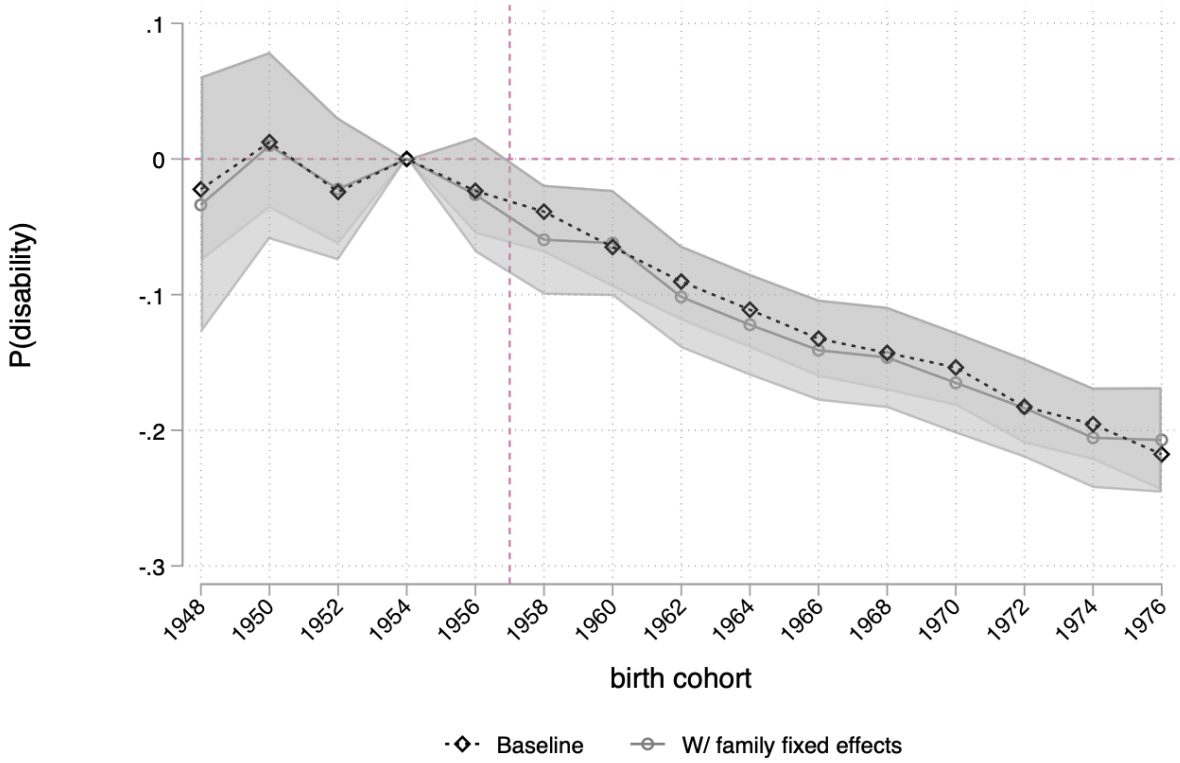
Note: OLS point estimates and 95 percent confidence intervals of the parameter β_c in the equation $ln(earnings_{ict}) = \Sigma_c\, \beta_c\, BD_i \text{ x } \theta_{c(i)} + \gamma_1\, BD_i + \gamma_2\, Depression_i + \gamma_3\, Schizophrenia_i + \delta_{f(i)} + \theta_{c(i)} + \tau_t + \varepsilon_{it}$. 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 8– 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 9– 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.

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
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 CONDITIONS, CAREER, AND EDUCATIONAL 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 1946-1975; columns 1 and 2 refer to individuals with positive earnings.

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

	Top 10%		Top 25%		Bottom 10%		Bottom 25%	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BD	-0.030***	-0.033***	-0.070***	-0.077***	0.120***	0.111***	0.152***	0.146***
	(0.001)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)
Depression	-0.052***	-0.041***	-0.112***	-0.091***	0.099***	0.086***	0.161***	0.141***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Schizophrenia	-0.058***	-0.044***	-0.137***	-0.111***	0.319***	0.309***	0.333***	0.303***
	(0.001)	(0.002)	(0.001)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
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	.10	.10	.25	.25
R-squared	0.009	0.373	0.014	0.381	0.024	0.210	0.030	0.277
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 top 10 percent (columns 1-2), top 25 percent (columns 3-4), bottom 10 percent (columns 6-7), and bottom 25 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 1946-1975.

TABLE 4 - OLS, DEPENDENT VARIABLE IS LN(EARNINGS)

	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)
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	21,541,180	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 1946-1975; in columns 1-2, we further restrict the sample to people with positive earnings.

TABLE 5 - OLS, EFFECTS ON EXTREME EARNINGS.
DEPENDENT VARIABLE IS = 1 FOR INDIVIDUALS HAVING EARNINGS IN TOP AND BOTTOM PERCENTILES

	Top 10%		Top 25%		Bottom 10%		Bottom 25%	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BD	-0.027***	-0.052***	-0.059***	-0.114***	0.133***	0.149***	0.148***	0.182***
	(0.003)	(0.008)	(0.005)	(0.010)	(0.004)	(0.008)	(0.005)	(0.010)
BD x post	-0.004	0.021***	-0.015***	0.040***	-0.017***	-0.042***	0.007	-0.039***
	(0.003)	(0.008)	(0.005)	(0.011)	(0.005)	(0.008)	(0.006)	(0.011)
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	Yes	No	No
Mean of Dep. Var.	.10	.10	.25	.25	.10	.10	.25	.24
R-squared	0.009	0.373	0.014	0.381	0.024	0.210	0.030	0.277
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 top 10 percent (columns 1-2), top 25 percent (columns 3-4), bottom 10 percent (columns 6-7), and bottom 25 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 1946-1975, with positive earnings.

TABLE 6 –OLS, DEPENDENT VARIABLE IS LN(EARNINGS), P(EARNINGS = 0), P(DISABILITY)

	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 1946-1975; in column 1, the sample is further restricted to include individuals with positive earnings.

TABLE 7 – OLS, DEPENDENT VARIABLE IS LN(EARNINGS), P(EARNINGS = 0), P(DISABILITY) – BY PARENTS' ASSETS

	Log(Earnings)	P(Earnings=0)	P(Disability)
	(1)	(2)	(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/Mania	-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***	-0.034***
	(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 1946-1975; in column 1, the sample is further restricted to include individuals with positive earnings.

TABLE 8 – OLS, DEPENDENT VARIABLE IS LN(EARNINGS), P(EARNINGS = 0), P(DISABILITY) – BY PARENTS' ASSETS

	ln(earnings)	P(earnings=0)	P(disability)
	(1)	(2)	(3)
BD/Mania	-0.561***	0.200***	0.246***
	(0.133)	(0.033)	(0.032)
BD/Mania 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 1946-1975; 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 1946-1975; columns 1-2 further restrict the sample to individuals with positive earnings.

TABLE 10 – ALTERNATIVE TREATMENT DEFINITION. OLS, DEPENDENT VARIABLE IS LN(EARNINGS), P(EARNINGS = 0), P(DISABILITY)

	ln(earnings)		P(earnings = 0)		P(disability)	
	(1)	(2)	(3)	(4)	(5)	(6)
BD/lithium	-0.482***	-0.557***	0.166***	0.175***	0.193***	0.198***
	(0.025)	(0.036)	(0.006)	(0.009)	(0.006)	(0.008)
BD/lithium x post	0.082***	0.174***	-0.041***	-0.058***	-0.101***	-0.104***
	(0.027)	(0.037)	(0.007)	(0.009)	(0.006)	(0.009)
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.	--	--	0.105	0.105	0.047	0.047
N	31,404,955	31,404,955	35,077,362	35,077,362	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 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/lithium* equals 1 for individuals who have been diagnosed with this condition or have received a lithium prescription 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. 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 1946-1975; columns 1-2 further restrict the sample to individuals with positive earnings.

DATA APPENDIX

Information on all demographic variables (age, gender, children, parents, employment and occupations) are drawn from a set of registries previously known as the Integrated Database for Labor Market Research (IDA). These registries combine high-accuracy information across more than 150 government registries.

Data on psychiatric patients are drawn from the LPSYDIAG registry. Data on prescriptions come from the LMDB registry.

Information on families, households and demographics are from the BEF, FAIN, FAM, FTDK, FTDM, UDDA and IDAP registries. Data on employment, occupations, unemployment, income and employers are drawn from the IDAN, IDAS, FIRM, IND and AKM registries. Information on start-ups is drawn from the IVPE and IVPS registries.

We link individual-level variables across these datasets using social security numbers (SSN). People born in Demark receive their SSNs at birth. Immigrants and foreign employees are assigned an SSN by the municipal office or the International Citizen Service when they receive a work permit or residence permit.

We define creative occupations using the ISCO variable in the AKS Danish registry data (variables DISCO88 and DISCO08). We link the ISCO-88 and ISCO-08 using the official correspondence table, available at http://www.ilo.org/public/english/bureau/stat/isco/.

TABLE A1: LIST OF VARIABLES

Variable	Variable name	Definition	Years available	Registry name	Registry
Prescriptions and Diagnoses					
BD		Indicator for individuals with diagnosis code ICD-10: F31	1995-2013	Landspatientregistret for Psykiatri Diagnoser	LPSYDIAG
Mania		Indicator for individuals with diagnosis code ICD-10: F30, and for which BD = 0	1995-2013	Landspatientregistret for Psykiatri Diagnoser	LPSYDIAG
Schizophrenia		Indicator for individuals with diagnosis codes ICD-10: F20-F29	1995-2013	Landspatientregistret for Psykiatri Diagnoser	LPSYDIAG
Depression		Indicator for individuals with diagnosis codes ICD-10: F32	1995-2013	Landspatientregistret for Psykiatri Diagnoser	LPSYDIAG
Lithium		Indicator for individuals with at least 1 prescription of lithium (ATC: N05AN)	1995-2013	Medicinal Product Statistics	LMDB
Labor Market Variables					
Earnings	ERHVERVSINDK + NETOVSKUD	Sum of total wages for all jobs and income from self-employment	1995-2013	Income and Employment	IND, IDAP and IDAN
Executive	STILL	Indicator for individuals with occupation, STILL = 31	1995-2013	Employment	IDAN/AKS

Self-employment	STILL, PSTILL	Indicator for individuals with occupation STILL or PSTILL = 11, 12, 13, 14, 19	1995-2013	Employment	IDAN/AKS
Creative professions	ISCO08, ISCO88	Indicator for individuals with occupation (See Table A2)	1995-2013	Employment	IDAN/AKS
Part-time work	TILKNYT	Indicator for individuals with a full-time contract	1995-2013	Employment	IDAN
Disability	PSTILL	Indicator for individuals with variable PSTILL = 93	1995-2013	Demographics	IDAP
Days of unemployment	ARLEDGR	Number of days of unemployment (based on information from the unemployment funds)	1995-2013	Demographics	IDAP
Enrollment in education	IG_VFRA	Indicator for individuals enrolled in any education program	1995-2013	Education	UDDA
Firm Characteristics					
Firm age	START_DATO	Date of establishment of each firm	1995-2013	Firm characteristics	FIRM
Firm size	GF_AARSV	Number of full-time employees	1995-2013	Firm characteristics	FIRM
Family					
Mother ID		Individual identifier of mother	1995-2013	Family information	BEF, FAIN and FAM

TABLE A2: CREATIVE PROFESSIONS IN KYAGA ET AL. (2011) AND LUDWIG ET AL. (1992)

Profession	Kyaga (2011)*	ISCO-88**/***	ISCO-08***	Kyaga	Ludwig	Kyaga + Ludwig
University teachers	051	2310 University and Higher Education Teachers	2310 University and Higher Education Teachers	X		X
Photographers	946	3131 Photographers	3431 Photographers	X		X
			3521 Broadcasting and Audiovisual Technicians	X		X
Visual artists and designers	081	2452 Visual artists (Sculptors, Painters and Related Artists)	2651 Visual artists (Sculptors, Painters and Related Artists)	X	X	X
	082		2166 Graphic and Multimedia Designers	X	X	X
Display artists and designers	083	3471 Decorators and Commercial Designers	3432 Interior Designers and Decorators	X	X	X
			3435 Other Artistic and Cultural Associate Professionals	X	X	X
			2163 Product and Garment Designers	X	X	X
			2166 Graphic and Multimedia Designers	X	X	X
			3433 Gallery, Museum and Library Technicians	X	X	X
Performing artists	086	2455 Film, Stage and Related Actors and Directors	2654 Film, Stage and Related Directors and Producers	X	X	X
			2655 Actors	X	X	X
		2454 Choreographers and Dancers	2653 Dancers and Choreographers	X	X	X

Composers and musicians	087	2453 Composers, Musicians and Singers	2652 Musicians, Singers and Composers	X	X	X
Authors	084	2451 Authors, Journalists and Other Writers	2431 Advertising and Marketing Professionals	X	X	X
			2432 Public Relations Professionals	X	X	X
			2641 Authors and Related Writers	X	X	X
			2642 Journalists	X	X	X
Other literary and artistic work	088	3474 Clowns, Magicians, Acrobats and Related Associate Professionals	3435 Other Artistic and Cultural Associate Professionals	X	X	X
Architects		2141 Architects, Town and Traffic Planners	2161 Building Architects		X	X
			2162 Landscape Architects		X	X

Note: Definition of creative professions. *) Kyaga et. al. (2011) "Creativity and mental disorder: family study of 300 000 people with severe mental disorder", The British Journal of Psychiatry, 199, 373–379. **) Kyaga (2014) "Creativity and Psychopathology", PhD Thesis, Stockholm, Sweden: Karolinska Instituttet. ***) International Standard Classification of Occupation (ISCO-08), Index correspondance with ISCO-88, International Labor Organization.

TABLE A3: DESCRIPTION OF DIAGNOSES

Variable	ICD code	ICD definitions
BD	ICD-10 30	A disorder characterized by two or more episodes in which the patient's mood and activity levels are significantly disturbed, this disturbance consisting on 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). Repeated episodes of hypomania or mania only are classified as bipolar.
Mania	ICD-10 31	A disorder which is elevated out of keeping with the patient's circumstances and may vary from carefree joviality to almost uncontrollable excitement. Elation is accompanied by increased energy, resulting in overactivity, pressure of speech, and a decreased need for sleep. Attention cannot be sustained, and there is often marked distractibility. Self-esteem is often inflated with grandiose ideas and overconfidence. Loss of normal social inhibitions may result in behavior that is reckless, foolhardy, or inappropriate to the circumstances, and out of character.
Depression	ICD-10: F32	A mental condition marked by ongoing feelings of sadness, despair, loss of energy, and difficulty dealing with normal daily life. Other symptoms of depression include feelings of worthlessness and hopelessness, loss of pleasure in activities, changes in eating or sleeping habits, and thoughts of death or suicide.
Schizophrenia	ICD-10: F20-F29	A group of severe mental disorders in which a person has trouble telling the difference between real and unreal experiences, thinking logically, having normal emotional responses to others, and behaving normally in social situations. Symptoms include seeing, hearing, feeling things that are not there, having false ideas about what is taking place or who one is, nonsense speech, unusual behavior, lack of emotion, and social withdrawal.

TABLE A4 –AVERAGE EARNINGS (IN US$)

	All	BD	Depression	Schizophrenia
All	52,307	35,359	37,642	24,661
	(83,476)	(35,319)	(335,991)	(27826)
pre-1956	54,180	38,076	26,047	26,041
	(140,099)	(41386)	(35,546)	(27,772)
post-1956	51583	34411	24,238	24,317
	(45,499)	(32887)	(28,385)	(27,829)
CEO in small/young firms	103,648	89,058	84,795	101,104
	(115763)	(136,733)	(201,603)	(218,782)
pre-1956	101,093	69,203	79,070	47,771
	(120,899)	(45,547)	(58,931)	(38537)
post-1956	104,483	94,098	86,696	121,5604
	(114,024)	(151071)	(230,200)	(253,757)
Self-employed	70,683	53,629	50,500	35,669
	(296,012)	(94,634)	(84,178)	(54469)
pre-1956	75190	57,456	59,151	39,931
	(476,117)	(106,007)	(100,946)	(56795)
post-1956	68,249	51,537	46,491	34,193
	(111,864)	(87,733)	(74,812)	(53,565)
Receiving disability pay	4,061	3,221	3,506	2,145
	(10,447)	(15,206)	(7,827)	(5,617)
pre-1956	4,763	3,452	4,158	2,112
	(13,605)	(23,766)	(10,261)	(8,943)
post-1956	3,608	3,091	3,206	2,154
	(7,727)	(6,541)	(6,384)	(4,142)

Note: Means and standard deviations (in parentheses) of annual earnings (measured in US dollars) for individuals aged 20-60 born in cohorts 1946-1976 between 1995 and 2015. Earnings are measured in 2015 US dollars and are the sum of all wages and income from self-employment. The variables *BD, Depression,* and *Schizophrenia* equal 1 for individuals who have ever been diagnosed with these conditions at least once between 1995 and 2015. Diagnoses data are available for calendar years 1995-2015.

TABLE A5– COMORBIDITY: BD AND OTHER MENTAL DISORDERS

	BD + Depression	BD + Schizophrenia	BD + Depression + Schizophrenia
All	6277	3093	1164
pre-1956	2236	1114	392
post-1956	4041	1979	772

TABLE A6 – MENTAL HEALTH CONDITIONS, CAREER, AND EDUCATIONAL OUTCOMES. SAMPLE OF PEOPLE WITH FAMILY IDENTIFIERS

	Ln(Earnings)	P(Earnings = 0)	P(Disability)
	(1)	(2)	(3)
BD	-0.470***	0.145***	0.109***
	(0.010)	(0.003)	(0.002)
Depression	-0.439***	0.137***	0.063***
	(0.004)	(0.001)	(0.001)
Schizophrenia	-1.376***	0.450***	0.428***
	(0.012)	(0.002)	(0.002)
Cohort FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Family FE	No	No	No
Mean of Dep. Var.	--	0.105	0.047
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 natural logarithm of earnings, defined as the sum of all wages and income from self-employment (column 1); an indicator for individuals receiving zero earnings in a given year (column 2); and for individuals on disability (column 3). 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, 6, 8, and 10 include family fixed effects. The sample is restricted to people aged 20-60 born in cohorts 1946-1975 for whom family identifiers are available; in column 1, we further restrict the sample to people with positive earnings.

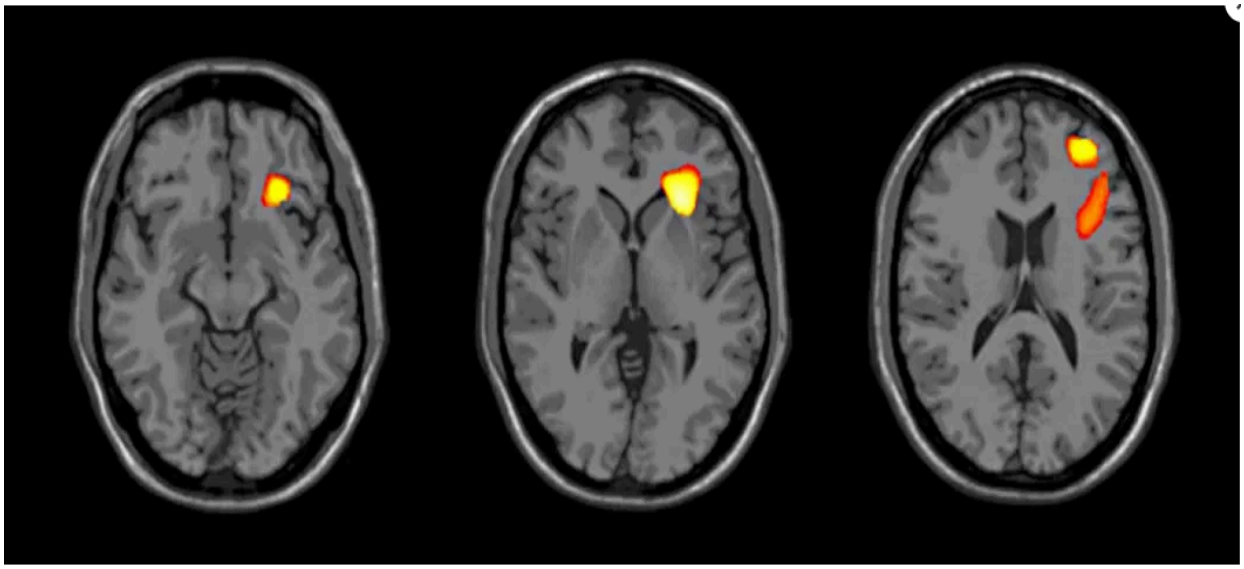
TABLE A7 - OLS, DEPENDENT VARIABLE IS LN(EARNINGS)

	Ln(Earnings)	P(Earnings = 0)	P(Disability)
	(1)	(2)	(3)
BD	-0.564***	0.188***	0.209***
	(0.031)	(0.007)	(0.007)
BD x post	0.108***	-0.050***	-0.117***
	(0.032)	(0.008)	(0.007)
Cohort FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Family FE	No	Yes	No
Mean of Dep. Var.	--	0.105	0.047
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

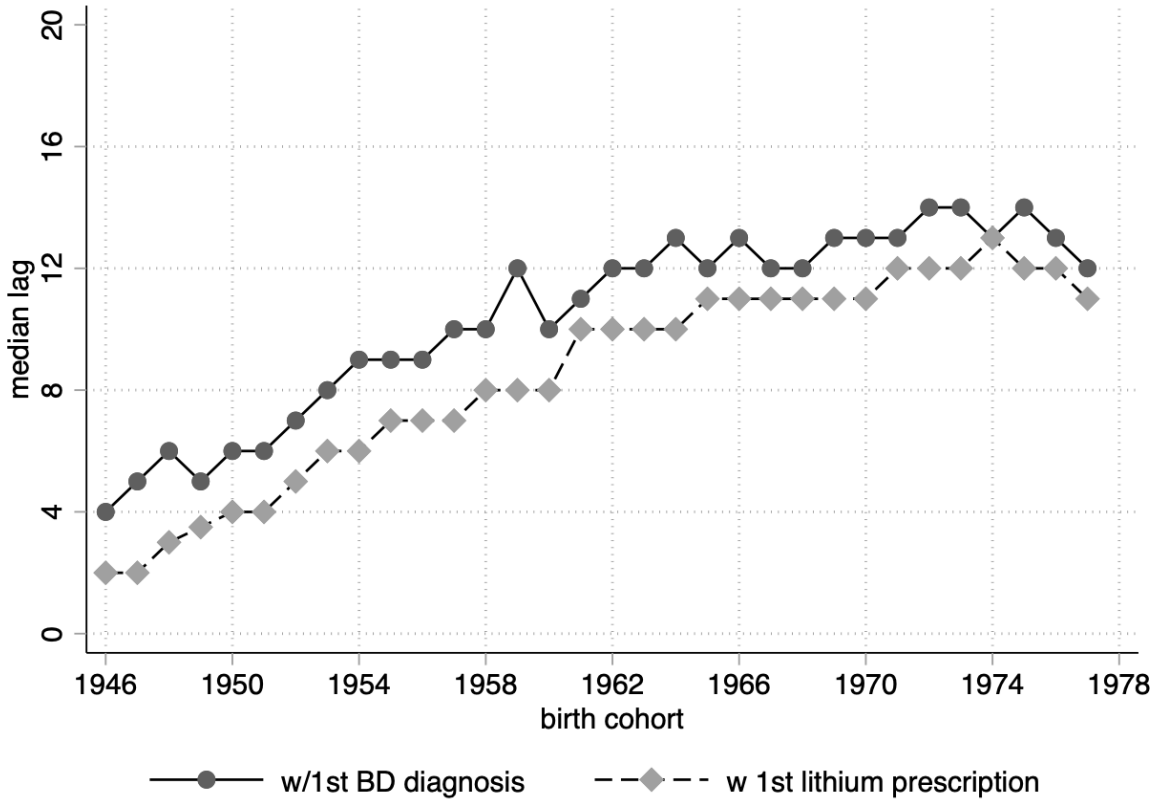
Note: The dependent variable is the natural logarithm of earnings, defined as the sum of all wages and income from self-employment (column 1); an indicator for individuals receiving zero earnings in a given year (column 2); and for individuals on disability (column 3). The variable *BD* equals 1 for 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*. 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 1946-1975 for whom family identifiers are available; in column 1, we further restrict the sample to people with positive earnings.

FIGURE A1– BIPOLAR DISORDER AND THE BRAIN



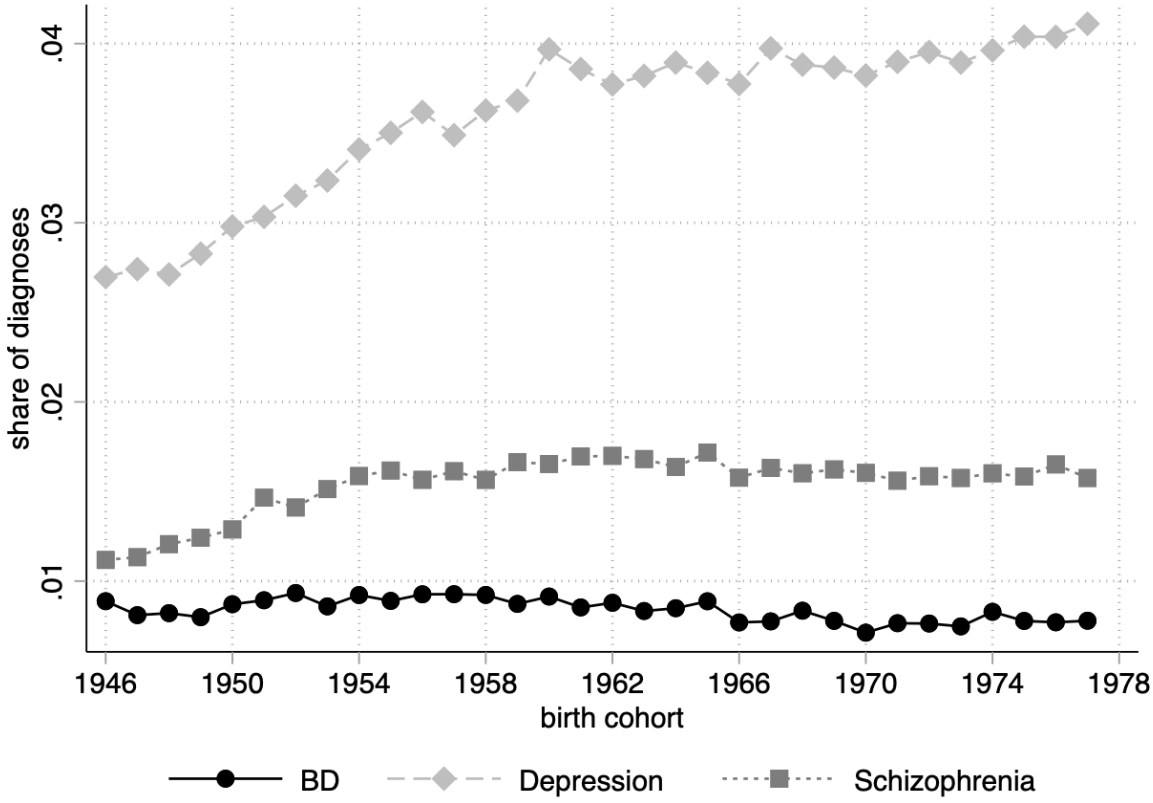
Note: The images show the brain regions (right insula and frontal cortex) where volume decreased more over approximately two years in adolescents with bipolar disorder, compared to adolescents without bipolar disorder. Image credit*: Blumberg lab* and *Biological Psychiatry*.

FIGURE A3– LAG BETWEEN FIRST YEAR IN THE SAMPLE AND FIRST BD DIAGNOSIS/LITHIUM PRESCRIPTION



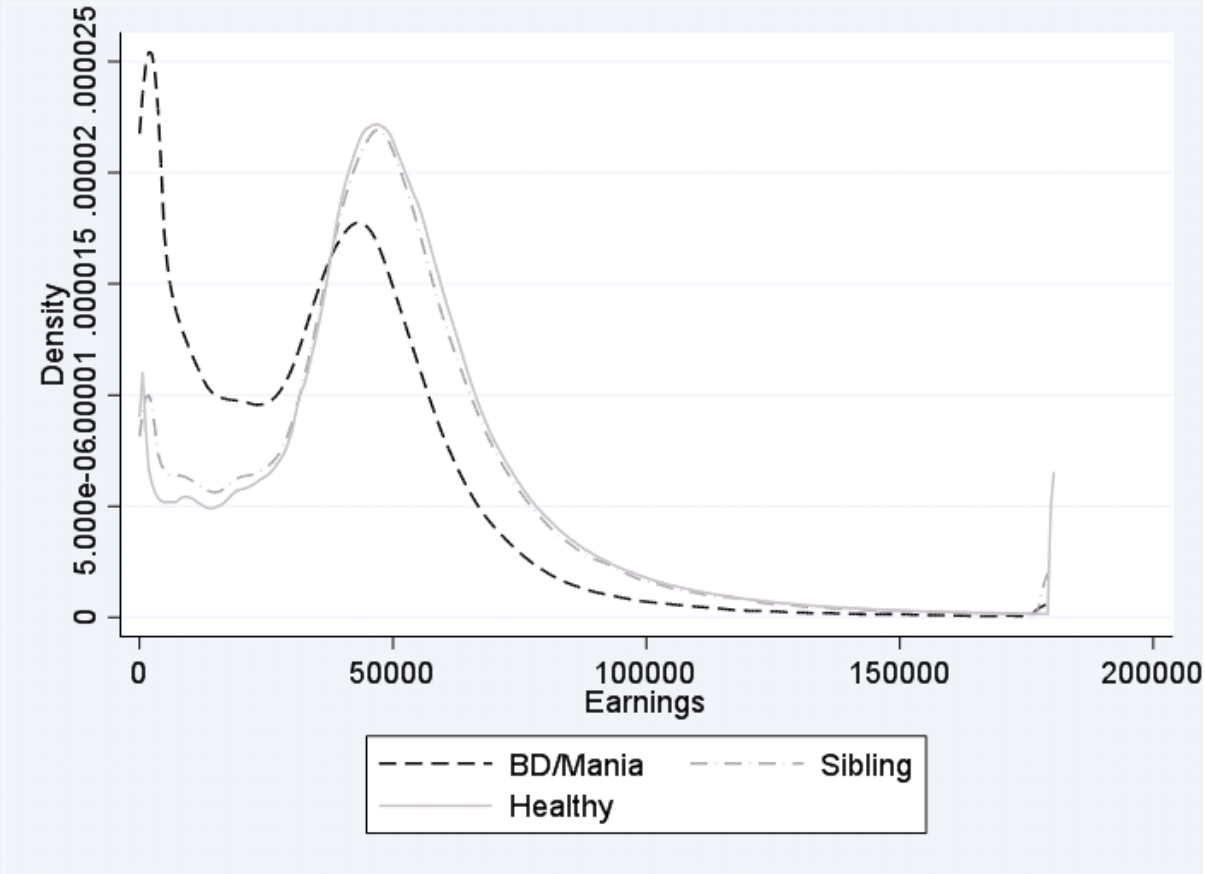
Note: Average lag between the year in which a person entered the sample between 1995 and 2015, and the year in which they received the first diagnosis of BD (solid line) or the first lithium prescription (dashed line).

FIGURE A3– COUNTS OF INDIVIDUALS DIAGNOSED, BY CONDITION AND ACROSS COHORTS



Note: Counts of individuals with at least one diagnosis of depression, BD, or schizophrenia between 1995 and 2015.

FIGURE A5 – EARNING DISTRIBUTION: INDIVIDUALS WITH BD/MANIA, THEIR SIBLINGS, AND HEALTHY INDIVIDUALS



Note: Kernel of the distribution of earnings, separately for individuals diagnosed with BD at least once, for their siblings, and for healthy individuals. The sample is restricted to individuals born between 1946 and 1976.