CAREER EFFECTS OF MENTAL HEALTH*

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One in twelve Americans is affected by a mental health disorder. This paper examines the effects of such disorders and treatment, using individual-level registry data on mental health diagnoses. We find that mental health conditions carry immense earnings penalties: Compared with the population, people with depression earn 35 percent less, people with bipolar disorder earn 38 percent less, and people with schizophrenia earn a full 74 percent less. These results hold when we compare people with a disorder to their siblings, controlling for a person's family background. People with mental health disorders also face substantially higher risks of zero earnings and disability. To investigate the causal effects of mental health, we examine the approval of lithium as a treatment for bipolar disorder (BD) in 1976. Baseline estimates compare career outcomes for people with and without access to treatment in their early 20s, the typical age of onset for BD. We find that access to treatment eliminates one third of the earnings penalty from BD. Moreover, it reduces the risk of zero earnings by more than one third, and it reduces the risk of disability by nearly two thirds. Notably, both the costs of mental health disorders and the benefits from treatments are concentrated in the bottom quantiles of earnings.

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

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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 These disorders carry enormous costs. For example, the World Health Organization (WHO, 2011) argues that mental illness is the leading cause of lost disability-adjusted life years. Yet a growing literature in clinical psychology emphasizes the upsides of mental health disorders, linking them with increased creativity and innovation (Jamison 1993, Kyaga et al 2015, Powers et al 2015, Holm-Hadulla et al 2010). This literature often points to the experiences of writers (such as Ernest Hemingway, Robert Lowell, Theodore Roethke, and Virginia Woolf), composers (Robert Schumann and Hugo Wolf), and visual artist (Jackson Pollock and Edvard Munch), who had bipolar depression (BD, Rothenberg 2001, pp. 131-2, Jamison 1993).

Systematic analyses of mental health disorders face two major empirical challenges. The first challenge stems from the paucity of individual-level data on mental health. Without such data, studies have generalized from case studies of prominent writers and artists even though their experiences may not be reflective of those of the broader population. A second challenge lies in the incidence of mental health, which is not random. For example, siblings and half-siblings of people with bipolar disorder or schizophrenia are significantly more likely have either disorder (Lichtenstein et al 2009). Moreover, access to diagnoses and treatment is likely to vary across families, especially when access to health care is unequal.

This paper systematically examines the effects of mental health on a person's earnings and their risk of disability. To resolve data constraints, we link individual-level registry data on mental health diagnoses with information on career outcomes for the population of Denmark, including 2.4 million people born between 1946 and 1975. To investigate the causal effects of changes in mental health, we exploit the approval of an effective treatment for BD.

These data show that mental health disorders are associated with large earnings penalties, especially for people in the bottom quantiles of earnings. People with depression earn 36 percent less compared with the population; people with BD earn 38 percent less, and people with schizophrenia earn 74 percent less. All results hold in regressions with controls for family fixed effects, which compare people with BD with their healthy siblings. Splitting the sample at the median of earnings shows that earnings penalties are most severe below the median. Among people whose earnings fall below the median, those with depression earn 29

[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).

percent less. People with BD earn 26 percent less, and those with schizophrenia earn 72 less. By comparison, earnings penalties are small above the median, with only 2 percent for depression, 6 percent for BD, and 6 percent for schizophrenia.

Mental health disorders may also increase the risks of extremely low earnings and reduce a person's ability to climb into the top quantiles of earnings. Earnings data confirm that people with depression are 52 percent less likely than the population to enter the top decile of earnings and 99 percent more likely to decline into the bottom decile. People with schizophrenia face an enormous risk of declining into the bottom deciles, 3.2 times more than the population.

Compared with other disorders, BD is associated with a lower reduction in the chances of entering the top echelons (30 percent less), but a larger risk of declining in the bottom deciles compared with depression (120 percent). These findings are particularly interesting in light of experimental evidence from clinical psychology, which suggest that BD is associated with a preference for risky gambles (Mason et al. 2014, Reddy et al. 2011). Citing examples of prominent executives, bipolar disorder in particular has often been called a "CEO's disease" (Cooper et al. 1988). In April 2017 Elon Musk made headlines when he described his "great highs, terrible lows," and when someone asked whether he was bipolar responded "Yeah" but then followed up with: "Maybe not medically tho."[2] Stories like these fuel a perception of a link between bipolar disease and business leadership, which we can examine systematically in our data. Contrary to popular beliefs, however, registry data show that people with BD are 12 percent *less likely* to be self-employed, 35 percent *less likely* to become an executive, and 16 percent *less likely* to serve as an executive in a start-up firm. Similarly, people with depression are 12 percent less likely to be self-employed, 55 percent less likely to become an executive, and 46 percent less likely to be a start-up executive. All results are robust to controlling for a person's family background, through fixed effects.

Instead of guiding people toward entrepreneurship, mental health disorders may reduce earnings by impairing individuals' ability to hold a full-time job and increase their risks of disability. We find that people with depression and BD are 110 percent more likely to have no earnings at all. People schizophrenia are 3.36 times more likely to have zero earnings. People with depression and BD are also 1.2 times and 2.7 times more likely to receive disability pay. People with schizophrenia are 7 times more likely to be on disability. All of these results are robust to controlling for family fixed effects.

[2] "Elon Musk admits to 'unrelenting stress,' says he may be bipolar" Mike Murphy, *Market Watch*, April 1, 2017.

While these correlations are informative, they cannot identify the causal effects of changes in mental health. For example, people with depression may earn less because they are unable to work at their full capacity. But, conversely, low earnings may also create emotional pressures that trigger depression. To address these issues, we exploit a major change in the treatment of bipolar disorder (BD). In 1976 Denmark's equivalent to the Federal Drug Administration, the *Lægemiddelstyrelsen*, approved the mood-stabilizer lithium as a maintenance treatment for BD.[3] Medical research has shown that lithium is exceptionally effective in reducing the risk of hospitalization and suicide for people with BD (Angst et al. 2005, Kessler et al 2005a).

To investigate the effects of access to treatment, we first compare career outcomes for people with and without access to treatment in their early 20s.[4] We use a person's early 20s as a cutoff point because it coincides with the typical age of onset for BD (Kessler et al 2003b). In addition, a person's early 20s are a critical period for their career path (Kahn 2010, Oreopoulos et al. 2012). We find that access to treatment eliminates nearly one third of the earnings penalty associated with BD, with a reduction from 36 to 24 percent controlling for cohort and year fixed effects. Regressions with family fixed effects yield similar results.[5]

Importantly, the benefits from treatment appear to the concentrated in the bottom quantiles of earnings. Splitting the population at the median of earnings shows that the benefits of treatment fall almost entirely in the bottom quantiles of earnings. Access to treatment reduced the risks of a person's decline in the bottom decile by 13 percent (26 percent compared with siblings). Treatment also greatly reduces the risk of zero earnings (by 33 percent compared with the population and by 36 percent compared with siblings). These benefits appear to be driven by massive reduction in the risk of disability. Access to treatment reduces the risk of disability by 59 percent compared with the population (from 369 percent to 152 percent compared with the population) and by 57 percent compared with their healthy siblings (from 363 percent to 156 percent).

Effects are significant, albeit much smaller, in the top quantiles of earnings. Access to treatment increases a person's chance of breaking into the top percentile by 21 percent

[3] Maintenance treatments aim to delay and moderate future episodes of BD, as well as reducing treatments between episodes, while acute treatments aim to mitigate an episode that is in progress already.
[4] All regressions control for cohort and time fixed effects. Cohort fixed effects control for changes in the stigmatization of mental health and other unobservable factors that may vary across birth cohorts (Crocetti et al 1974, Link et al. 1999, Phelan et al. 2000). Year fixed effects control for changes in aggregate rates of employment and other economic factors that may influence wages and employment over time.
[5] Complementary regressions estimate cohort-specific effects of access to treatment. These estimates confirm that treatment carries the largest benefits for people who have access by age twenty.

compared with siblings. Analyses of occupations suggest that treatment improves a person's chance of becoming an executive. People with BD who did not have access to lithium in their 20s are 55 percent *less likely* to become executives compared with their siblings. Access to treatment eliminates 60 percent of this gap. People with BD are also 21 percent less likely to be executives in start-ups compared with the population, and 1.2 times less likely compared with their siblings. Access to treatment eliminates this difference. Cohorts with access to treatment are only 15 percent less likely to become executives.[6] People with BD are 28 percent more likely to be self-employed compared with the population. Access to treatment reduces two thirds of this gap.

Medical research indicates that "healthy" siblings may be affected by BD, even if they are not diagnosed (Mortensen et al 2003, Kruger 2006).[7] To examine such effects we compare healthy siblings of people with BD with the population. These comparisons indicate that siblings earn only slightly (6.6 percent) less than the population, and that there is a negative, but small effect of treatment. We also exploit variation in the intensity of mental health disordered, measured as the number of diagnoses over the course of a person's career. These intensity estimates confirm the main results: Benefits from access to treatment are more pronounced for people with a more severe or persistent form of the disorder. Additional robustness checks move "treatment" to 1974, when lithium was approved in the United States. All results are robust to this change.

Compared with the United States, medical coverage is nearly uniform in Denmark; with restrictions on Obamacare this gap is expanding further.[8] 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. Expansions in Medicaid coverage have increased access to psychotropic prescriptions for mental illness by 22 percent (Maclean, Cook, Carson, and Pesko 2017). Our findings indicate that such expansions in coverage can create major welfare gains by increasing earnings and reducing the risks of disability, especially among less privileged groups.

I. Background on Mental Health Disorders

[6] Among 7,007 people with BD without access to treatment, 148 (2.1 percent) become executives, compared with 70,112 among 870,785 (8.0 percent) in the population. With access to treatment, 222 among 11,272 people (2.0 percent) with BD become executives, compared with 134,156 among 1,653,540 people in the population.
[7] 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).
[8] http://www.mentalhealthamerica.net/issues/mental-health-america-access-care-data, accessed July 2, 2018.

This section describes the three mental disorders that are the focus of this paper – depression, bipolar disorder (BD), and schizophrenia, and summarizes results from recent research that are most relevant to our analysis.

Depression (or major depressive disorder, MDD) 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 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). Among respondents with depression, the median age of onset was 32, with an interquartile range of 25 years, between ages 19 and 44.

Schizophrenia is a chronic brain disorder that affects about one percent of the populations. Possible 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 schizophrenia affects men and women about equally, men often show first signs of schizophrenia in their early 20s while women experience symptoms in their late 20s and early 30s. Rates of schizophrenia are similar in all ethnic groups around the world. Although the precise causes of schizophrenia are unknown, researchers have identified several genetic and environmental factors, as well as life events that contribute to the disorder.[9]

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. Compared with depression, BD is less prevalent but more persistent and impairing (Kessler, Merinkas, and Wang 2007). According to the WHO, bipolar disorder affects about 60 million people worldwide, with the large majority remaining untreated.[10] The American Psychiatric Association (2000) defines Bipolar I Disorder by at least one lifetime manic or mixed episode. To meet diagnostic criteria, mania must last at least one week or require hospitalization. Symptoms of mania include irritability, euphoria, a need for sleep, grandiose ideas, impulsivity, increased racing thoughts, flight of ideas, increased activity, and

[9] American Psychiatric Association, Information for Families, available at https://www.psychiatry.org/patients-families/schizophrenia/what-is-schizophrenia (accessed March 16, 2018)
[10] World Health Organization Fact Sheet, April 2017 (http://www.who.int/mediacentre/factsheets/fs396/en/).

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.[11] Suicide risks for people with BD, are extremely high. Jamison (2000) finds that one in two people with BD attempt suicide at least once. Goldberg et al (2005) find that one in three people with BD attempt to kill themselves.[12]

Although the precise causes of BD are unknown, available evidence points towards differences in the brain systems that regulate emotions and a dysregulation in the use of dopamine (Miklowitz and Johnson 2006, p. 199).[13] Imagining 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).[14] 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.[15]

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[11] "BD II is defined by at least one lifetime hypomanic episode, along with at least one episode of major depression. Hypomania is characterized by the same symptoms as mania but lasts for shorter intervals (four or more days) and, although noticeable to others, is not associated with functional impairment. Episodes of major depression are defined by two or more weeks of intense sadness or loss of interests, accompanied by symptoms such as fatigue, insomnia, psychomotor agitation or retardation, weight gain or loss, cognitive dysfunction, feelings of worthlessness, and suicidal ideation or attempts. 'Converting' from BD II to BD I is rare" (Miklowitz and Johnson 2006, pp. 200-201).

[12] Angst et al (2005) follow 406 people with BD who were admitted to a Psychiatric University Hospital in Zurich between 1959 and 1963; 11 percent of them committed suicide. Goldstein et al. 2005 find that one in three people with BD attempt suicide at least once (N=405 people with BD). 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).

[13] Dopamine is a neurotransmitter that helps regulate reward-motivating behavior. 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).

[14] Drevets et al (1997) analyze brain activity using positron emission tomographic (PET) images. In a sample of 20 family members of people with BD and unipolar depression, they localize an area of abnormally decreased activity in the pre-frontal cortex. Krueger (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 reward motivation (including the *nucleus accumbens*, the ventral tegmentum, and the striatum).

[15] They find that the *nucleus accumbens*, the pleasure center of the brain, is more strongly activated in subjects with BD. 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). Lennox et al. (2004) find that people with BD who are in an episode of mania show less of a neural response in the amygdala and subgenul anterior cingulate cortex of their brains (Lennox et al. 2004).

Twin studies suggest that BD has a strong genetic component. Aida (1997) finds concordance rates around 57 percent for identical twins, compared with only 14 percent for non-identical twins. Cordno et al (2002) show that identical twins of manic patients face an elevated risk of mania (36.4 percent), as well as schizophrenia (13.6%).[16] Yet only a small portion of the incidence rate of BD – less than 2 percent - can be explained by genes (e.g., Power et al 2015),[17] suggesting a major role for environmental factors. Some of these factors may be related to childhood trauma. Children whose mother dies before their fifth birthday have a four-fold increased risk of bipolar disorder.

The median age of onset for BD is 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. In alternative specifications, we also separately estimate age-specific effects.

New Treatments in the 1970s

On January 1974, the American FDA approved lithium, a mood stabilizer, as a maintenance therapy for BD.[18] In Denmark, the Sundhedsstyrelsen (Denmark's equivalent to the FDA) approved lithium as a maintenance treatment for BD on December 14, 1976 (Bech et al. 1976). 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.

Complementary treatments (mostly psychosocial interventions ("therapy") and drug treatments through antidepressants) also improved substantially after 1974.[19] Interest in the application of cognitive behavioral therapy (CBT) began in the early 1980s (Cochran 1984), after the introduction of lithium. Recent approaches in CBT focus on psychoeducation and

[16] BD appears to share genetic vulnerabilities with both schizophrenia and depression. Cordno et al (2002) shows that monozygotic co-twins of people with schizophrenia are at a higher risk of mania (8.2%) and schizophrenia. Berretini (2003) finds that first-degree relatives of people with BD and schizophrenia have a higher risk of schizoaffective and major depressive disorders.

[17] Using population data for Iceland (including 500 people with BD and 583 with schizophrenia) Power et al (2015) find that polygenic risk scores explain only 5.5 percent in the incidence of schizophrenia and less than 1.2 percent of the observed variance in the incidence of BD, suggesting a large role for environmental factors.

[18] *Acta Psychiatrica Scandinavia* 1976, Price and Heninger 1994, McInnis et al. 2014. It took 35 years, until 2009, for the FDA to approve lithium was not approved as a treatment for BD depression (Shorter 2009, p. 3).

[19] By 2005, treatment guidelines recommended that BD depression should only be treated with with antidepressants if other agents have failed, and then only in combination with a mood stabilizing or an atypical antipsychotic agent (Miklowitz and Johnson 2006, p. 215). 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).

cognitive restructuring to challenge overly negative or overly positive cognitions. Psychoeducation also provides patients with strategies to identify symptoms and implement procedures to prevent a relapse (mostly by taking emergency medication), promote drug adherence, minimize risk factors (such as substance abuse or interpersonal stress) and maximize protective factors (such as regular sleep/wake cycles, Miklowitz and Johnson 2006, p. 216).

Among these treatments, lithium has the strongest scientific record of controlling mania and preventing recurrences. BD goes into remission for 60-70% of people on lithium (Goldberg 2000) with BD go into remission. Summarizing the existing empirical evidence, Davis et al. 1999 concluded that "relapse rates on placebo average 74%, on lithium, 29%." (Davis et al. 1999, cited in Shorter 2009). 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).[20]

Side effects of lithium treatment include motor tremors, weight gain, feelings of sedation, stomach irritations, thirst, and kidney problems (Miklowitz and Johnson 2006, p. 214). Hand tremors affect 25 to 50 percent of patients, while abnormalities in the thyroid and parathyroid affected 10 to 20 percent (Price and Heninger 1994, McInnis et al. 2014). Cognitive impairment is more difficult to measure empirically, and, to the best of our knowledge, there is no conclusive evidence to date on the effects of lithium on creativity.

Drug treatment for lithium is typically given in stages. The first involves drugs for acute treatment of an episode that has already developed. The second consists in maintenance treatment, which aims to delay and moderate future episodes as well as reduce symptoms between episodes.

In this paper, we estimate the effects of *access to treatment*, rather than treatment per se, because many people with BD stop their medication against medical advice. This is due in part to side effects and to the feeling of missing "periods of exuberance or creativity (Goodwin and Jamison 2007; Jamison and Akiskal 1983, Aasgard and Vestergaard 1990). Only one in five patients on lithium take it continuously (Weiss et al. 1998), and up to 60 percent of people with BD stop taking their drugs regularly within a year after a manic or

[20] The mechanisms through which these improvements work is as yet unclear. Bearden et al. (2007) find that bipolar people who take lithium have more gray matter in the cingulate and paralimbic regions of the brain, which are believed to regulate the ability to maintain motivation, attention, and emotional control (N=28 adults with BD - including 18 adults who were treated with lithium - and a control group of 28 adults without BD.) Using high-resolution MRI and cortical pattern-matching methods to map differences in gray matter, Nauert (2011) shows that lithium increases the volume of the hippocampal and amygdala, two brain regions whose volume is reduced by BD.

mixed episode. People at the greatest risk for non-adherence tend to be younger, have more severe illnesses or recent hospitalizations, and are more likely to have comorbid personality disorders or alcohol and substance disorders (Colom et al 2000). The costs of stopping medications are severe, especially when done rapidly, greatly increasing the risks of relapse or suicide (Keck et a. 1998, Suppses et al. 1993, Tondo and Baldessarini (2000).

II. DATA

The main 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.[21] 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 bipolar disorder (BD, 0.7 percent).[22]

Individual-Level Registry Data on Diagnoses

Individual-level data on diagnoses data 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 Health Organization (WHO)'s International Statistical Classification of Diseases and Related Health Problems (ICD-10) to classify mental health disorders.[23] Appendix Table A3 includes a detailed description of this classification.

Baseline estimates examine people who have *ever* been affected by a mental health disorder, with and without access to treatment in their early 20s. Since diagnoses are only recorded after 1995, we can only observe people who were born after 1974 when they turn 20. If people who have BD later in life did not have it in their early 20s, this feature of the diagnosis data attenuates the estimates. If people with BD in their early 20s recover and receive no diagnosis of BD after 1995, we assign people with BD to the control group, which

[21] These data are administered by Statistics Denmark. Appendix Table A1 describes the individual registries.
[22] 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).
[23] 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)."

would further attenuate our estimates. Medical studies, however, show that virtually all people with BD experience recurrences of their illness, so that we are people who have BD in their early 20s are likely to be captured by diagnoses after 1995 (Gitlin et al 1995).[24]

We construct indicators for people with at least one diagnosis of the three most frequent mental health disorders: depression, bipolar disorder, and schizophrenia.[25]

- *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 A4).

Earnings and Disability

To calculate total *earnings,* we add income from wages and self-employment for each person (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).

[24] 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 Figures A2 and A3).

[25] 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.

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.[26] 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).[27]

An additional variable captures people who receive *any* form of welfare, including retirement pensions (received by 1.5 percent of individuals with depression, 3.4 percent with BD, and 8.0 percent with schizophrenia), unemployment insurance (received by 1.9, 1.9, and 1.7 percent, respectively), and long-term unemployment (2.6, 1.8, and 1.9 percent, respectively). Similarly, we construct indicator control variables for people who work *part-time* work or are enrolled in *education* (Appendix Table A1).

Self-Employment and Executive Jobs

To examine the potential effects of BD and treatments on occupational choice, we use information on individual occupations from the Danish employment registry. Occupations are classified according to the International Labor Organization's International Standard Classification of Occupations (ISCO, Appendix Table A2).

To examine the links between mental health, business leadership, and entrepreneurship we create variables that distinguish self-employed, executives, and executives in small and young (start-up) firms. *Executives* are people who hold top management positions, such as chief executive officer (CEO) chief operating officer (COO), chief financial officers (CFO, Appendix Table A1). Our data include 204,268 executives; 500 of them have been diagnosed with BD, including 300 who had access to treatment in their twenties. *Start-up Executives* are executives in small and young firms that are less than 5

[26] 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.
[27] 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).

years old and have fewer than 50 full-time employees.[28] Our data include 28,614 executives in start-ups (14 percent of all executives in the data). Among 28,614 executives, 67 have been diagnosed with BD (0.23 percent), and 45 executives with BDs in start-ups had access to treatment in their twenties.

Self-employed are is a separate occupational category in the Danish registry data. It covers self-proprietors who carry unlimited liability for their business (Appendix Table A2).

Family Fixed Effects

To control for unobservable factors that vary across families, we create family fixed effects using the mother's social security number. Mother's social security number is available for 1,633,106 people whose mother was alive between 1980 and 2015 (69 percent of the population). Regressions with family fixed effects compare people with mental health disorders with their siblings. Seventy-five percent of individuals in the labor force have at least one sibling. Among people with BD, the share of people with siblings is slightly larger (82 percent).

III. Cross-Sectional Population Estimates

In the first part of the analyses, we examine earnings and other career outcomes for people with the three most common mental health disorders: depression, bipolar disorder (BD) and schizophrenia.

Earnings Penalties from Mental Health

First, we investigate whether mental health disorders are associated with lower earnings. OLS regressions estimate

$$(1)\ \log(earnings_{ict}) = \beta_1\, Depression_i + \beta_2\, BD_i + \beta_3\, Schizophrenia_i + \theta_c + \tau_t + \varepsilon_{ict}$$

where the dependent variable $\log(earnings_{ict})$ 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

[28] Hurst and Pugsley (2011) show that *firm size* alone is a poor indicator of entrepreneurship, since most small firms work in established industries and provide established services (such as plumbing or legal advice). Haltiwanger, Jarmin, and Miranda (2010) find that *firm age* is an important indicator of entrepreneurship. We draw information on firm age and size from the general firm statistics registry. This data set includes the date of establishment for each firm (START_DATO), which allows us to calculate firm age, as well as the number of full-time equivalent employees (GF_AARSV), which we use as a measure of firm size.

Schizophrenia are defined accordingly. Year fixed effects τ_t control for time-varying factors that are constant across individuals, such as inflation and fluctuations in unemployment. Cohort fixed effects θ_c control for unobservable factors that vary across birth cohorts, such as changes in the stigmatization of mental health.

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).

Comparisons with Siblings

Earnings and the incidence of mental health conditions 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). In addition, a person's family background and socioeconomic status can influence the odds of diagnosis and treatment. If families with lower earnings have a higher rate of mental health disorders, population estimates may overstate the earnings penalties from mental health disorders. To address this issue we repeat the OLS regressions in equation (1) with controls for family fixed effects, constructed using mothers' social security numbers. These specifications compare people with mental health conditions with their healthy siblings.

Even with controls for a person's family background, the estimates remain substantially unchanged. Only estimates for depression are reduced significantly, from 35 percent lower earnings compared with the population to 31 percent compared with health siblings (Table 2, column 2). 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).[29] Our results suggest that these effects are small relative to the earnings penalties for people with the disorder.

Event Studies Around the Diagnosis

In this section we investigate the timing of changes in earnings: If mental health affects earnings, earnings may decline before a diagnosis, when people first experience symptoms, and it may take some time for treatments to take effect. To investigate such

[29] 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).

changes relative to the year of diagnosis, we estimate equation (1) as an event study for the 10 years before and after the diagnosis:

$$(2)\ \log(earnings_{ict}) = \sum^{10}_{k=-10} \delta_k C_i I(t-Y(C)_i = k) + \beta_1 BD_i + \beta_2 Depression_i + \beta_3 Schizophrenia_i + \theta_c + \tau_t + \varepsilon_{ict}$$

where C_i is an indicator for either *BD*, *Depression*, *or Schizophrenia,* , and *I()* is an indicator function for each of ten years before and after the diagnosis. The year immediately preceding the diagnosis is the excluded period. In this specification, the coefficient δ_k estimates the earnings difference between individual *i* with condition C_i, *k* years after his diagnosis. We normalize δ_{-1} to be 0.

Time-varying estimates show that people with BD drop earn almost one fourth less in the year of their diagnosis compared with the previous year (Figure 1). Estimates for BD are between those for depression (with a 20 percent decline), and schizophrenia (40 percent, Figure 1). The timing of the decline in earnings differs across conditions. For people with BD and schizophrenia, which have traditionally been more difficult to diagnose, earnings decline for four years before the disorder is diagnosed. For people with depression, earnings decline for only two years preceding a diagnosis.

Earnings recover after the diagnosis, but – with the notable exception of depression – they never return to pre-diagnosis levels. For people with depression, earnings recover to almost fully. For people with BD, earnings recover to 90 percent, but for people with schizophrenia, earnings only reach 40 percent of pre-diagnosis. Part of these differences may be related to differences in the persistence of these disorders. Depression is less persistent than BD or schizophrenia. Notably, these estimates may overstate recovery because people who are extremely sick may leave the labor force. We examine these effects below.

Heterogeneous Effects Across the Distribution of Earnings

Mental health disorders could have heterogeneous effects on earnings in different parts of the earnings distribution. Re-estimating equation (1) for individuals above and below the median of earnings reveals that penalties are much larger below the median. Among people who earn less than the median of $48,632, those with depression earn 29 percent less and those with BD earn 37 percent less than the population (Table 3, column 3, significant at 1 percent). People with schizophrenia earn a full 72 percent less.

Above the median, earnings penalties are small. People with depression earn 2 percent less, people with BD earn only 6 percent less, and people with schizophrenia earn only 6 percent less (Table 3, column 1, significant at 1 percent). Taken together, these estimates suggest that mental health disorders may exacerbate inequality in earnings.

People with Mental Health Disorders Are Less Likely to be Top Earners or Executives

In popular accounts, such as the story about Elon Musk above, mental health disorders - and particularly BD - are often linked with high performance, high pressure executive jobs, and BD is often called a "CEO's disease" (Cooper et al. 1988). Population data, however, show that exposure to a mental health condition lowers a person's chances of entering the top percentiles of earnings. People with depression and schizophrenia are 52 and 58 percent less likely to enter the top decile of earnings (Table 4, column 1, significant at 1 percent, respectively).

Notably, people with BD face a smaller reduction in their chances of top earnings than people with other types other mental health disorders. People with BD are 3.0 percentage points less likely to enter the top 10 percent of earnings, implying a 30 percent lower probability (Table 4, column 1, significant at 1 percent). Albeit large, this gap is substantially smaller than the equivalent reduction for people with depression and schizophrenia. The difference across disorders is consistent with recent findings in experimental psychology, which suggest that BD increases the emotional rewards of risky gambles (Mason et al. 2014, Reddy et al. 2011). An elevated preference for risk increase a person's chances the extreme ends of the earning distribution – including the top – even as if other aspects of this mental health condition lower a person's chance of high earnings.[30]

Contrary to the view of BD as a "CEO's disease" (Cooper et al. 1988), people with BD are 1.1 percentage point less likely to be executives (Table 5, column 3, significant at 1 percent). Compared with a population share of 3.67 percent, this implies that BD is associated with a 30 percent reduction in the probability of becoming an executive. People with depression are also less likely to hold executive jobs (1.8 percentage points, and 49 percent less compared with the population). People with schizophrenia are 1.9 percentage points less likely (52 percent less than the population share, Table 5, column 3, significant at 1 percent).

[30] Controlling for family fixed effects reduces these differences. Compared with their healthy siblings, people with BD are 36 percent less likely to enter the top 10 deciles of earnings, people with depression are 41 percent less likely, and people with schizophrenia are 45 percent less likely (Table 3, column 2, significant at 1 percent).

We also examine the link between mental health disorders and entrepreneurship, measured by self-employment and executive positions in small and young firms. In a survey of 242 entrepreneurs and 93 control subjects, nearly half of the entrepreneurs reported that they were concerned about their mental health, compared with only 24 percent of the control subject Freeman et al. 2015). We re-examine these correlations for population data on mental health and alternative measures of entrepreneurship.

These estimates indicate that people with BD are more likely to be self-employed than the population, even though they are more likely to be self-employed compared with people who have other mental health disorders. Compared with the population, people with BD are 0.9 percentage points less likely to be self-employed, implying a 12 percent reduction compared with a 7.2 percent population share of self-employment. By comparison, people with depression are 12 percent less likely, and people with schizophrenia are not significantly less likely to be self-employed (Table 5, column 1).

People with BD are more likely than people with other mental health disorders to be executives in small and young firms, a common indicator for entrepreneurial jobs (Haltiwanger, Jarmin, and Miranda 2010).[31] People with BD are 0.04 percentage points less likely to be executives in small and young firms. Compared with a population average of 0.23 percent, this implies a 16 percent lower probability (Table 5, column 5, significant at 1 percent). By comparison, people with depression are 46 percent less likely, and people with schizophrenia are 56 percent less likely.

All of these results are robust to controlling for family fixed effects (Table 5, column 6). Compared with their siblings, people with BD are 10 percent less likely to be employed as executives in small and young firms, although this estimate is indistinguishable from zero (Table 5, column 6, p-value equal to 0.26). People with depression are 40 less likely, and people with schizophrenia are 41 less likely to be executives in small and young firms.

People with Mental Health Disorders Face Much Higher Risks of Low Earnings, Zero Earnings, and Disability

Compared with the chance of entering the top, mental health disorders are associated with a much greater risk of descending into the bottom quantiles of earnings. People with BD

[31] An alternative indicator is incorporation. Levine and Rubinstein (2017) show that incorporated self-employed and their firms engage in activities that demand more non-routine cognitive abilities, while the unincorporated are more likely to perform manual skills. People who become incorporated later also score higher on learning aptitude tests, exhibit greater self-esteem, and engage in more illicit activities when they are teenagers. Our sample of incorporated entrepreneurs is too small to repeat their test, but detailed information in the registry data allows us to build alternative measure for entrepreneurial people.

are 12 percentage points more likely to enter the bottom 10 percent of earnings, implying a 120 percent higher risk (Table 4, column 5, significant at 1 percent). Estimates are similar for depression (with 99 percent) and much larger for schizophrenia (319 percent, Table 4, column 5, significant at 1 percent).

Moreover, mental health disorders raise the risks of having no earnings at all. People with depression are 15.3 percentage points more likely have no earnings (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. 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).

What drives the large risk of low or zero earnings for people with BD? Survey data in Kessler et al (2003 and 2004) indicate that BD and depression are associated with 65.5 and 27.2 and excess lost workdays per worker respectively.[32] According to estimates by the World Health Organization (2011), mental illnesses 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. BD itself is ranked as the sixth leading cause of disability worldwide (Murray and Lopez 1996). 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.[33]

To begin our systematic analysis of disability, we first 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,

[32] Kessler et al. (2003) use self-reported data in the World Health Organization Health and Work Performance Questionnaire (HPQ). 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.
[33] See Dean et al. 2004 for a review of existing estimates of the costs of BD.

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 controls for family fixed effects (Table 2, column 6).

People with BD are also 19.6 percentage points more likely than the population to receive any form of welfare pay, including pensions, unemployment insurance, or sick leave (98 percent more likely compared with an average probability of 19.9 percent, Table 2, column 7, significant at 1 percent). People with depression are 103 percent more likely to receive welfare pay, and people with schizophrenia are 2.5 times more likely.

Time-varying estimates show that the probability of disability increases after the diagnosis (Figure 2, based on equivalent estimates to equation 2). Two years after the diagnosis, people with depression are 12 percentage points more likely to receive disability pay compared with the year immediately before the diagnosis. Relative to a population share of 5.9 percent, this implies a 100 percent increase. People with BD are 20 percentage points more likely to be on disability and people with schizophrenia are 36 percentage point more likely. These probabilities continue to grow, albeit at a slower rate, reaching 21 percentage points for depression ten year after the diagnoses, 27 percentage points for BD, and 42 percentage points for schizophrenia.[34]

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

IV. Effects of Access to Treatment

In this section, we exploit a major change in the treatment of bipolar disorder in 1976 to identify the causal effects of access to treatment. 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.[35] If treatment improves earnings and reduces the risks of zero earnings and disability, changes in access to treatment will have major welfare effects.

Access to Treatment Greatly Increases Average Earnings

[34] Education is another channel by which mental health may affect a person's career. We find that people with depression are 19 percent less likely to complete college, and people with schizophrenia are 44 percent less likely. Only people with BD are slightly (2 percent) more likely to complete college (Table 2, column 9).

[35] 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.

Baseline estimates compare earnings penalties for people with BD with and without to treatment in their 20s, the typical age of onset for BD (Kessler et al. 2005). OLS regressions estimate:

$$(3) \qquad ln(earnings_{ict}) = \alpha\, BD_i + \beta\, BD_i \times post_c + \theta_c + \tau_t + \varepsilon_{ict}$$

where the dependent variable $ln(earnings_{ict})$ represents the natural logarithm of earnings for individual i in birth cohort c and 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 before and after 1956, the coefficient β_1 on the interaction $BD_i \times post_c$ estimates the benefits of access to treatment. Cohort fixed effects θ_c control for factors that may influence outcomes differentially for people who were born in different cohorts.[36] We first estimate these effects separately for people with positive earnings, and then investigate effects on the probability of zero earnings below.

OLS estimates indicate that access to treatment eliminates one third of the earnings penalty that is associated with BD. An estimate of 0.095 for *BD x post* implies that people with BD who had access to treatment earned almost 12 percent more than other people with BD (Table 6, column 1, significant at 1 percent).[37] Compared with an earnings penalty of 38 percent, this implies a reduction of 32 percent.

Estimates with family fixed effects confirm these results. An estimate of 0.111 for *BD x post* indicates that access to treatment closes 33 percent of the 36 percent earnings penalty from BD (Table 6, column 4, significant at 1 percent).

No Significant Effects of Treatment on Siblings

We also estimate the effects of treatments on siblings, who face an elevated risk of BD (e.g., Mortensen et al 2003), and may be affected even if they are not diagnosed (Kruger 2006).[38] 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

[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] 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).

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.

Consistent with the negative effects of mental health disorders on siblings, OLS estimates indicate that healthy siblings earn 6.5 percent less than the population (with an estimate of -0.068 for *BD sibling*, Table 7, 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).

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). These estimates show similar levels and trends in earnings for people with and without treatment before the diagnosis and large differences afterwards (Figure 3). For cohorts with and without treatment, earnings begin to decline 4 years before a diagnosis, and fall by 57 percent in the 5 years before the person is diagnosed. This pre-diagnosis decline in earnings is consistent with findings on significant delays in the diagnosis of BD.[39]

For people with and without access to treatment, earnings decline by 28 percent in the year of the diagnosis compared with the previous year. Without treatment, earnings continue to decline for the next three years. After that, earnings remain at a 30-percent lower level compared with the last year before the diagnosis (Figure 3).

Access to treatment visibly mitigates this earnings penalty, closing nearly two thirds of the decline in earnings (Figure 3). For people with access to treatment earnings recover from 28 percent less in year 1 to only 8 percent less 10 years after they diagnosis. These estimates suggest that access to treatment conveys important benefits for people with BD.

Benefits are Largest in the Bottom Quantiles of Earnings

Cross-sectional correlations in Table 4 suggest that the costs of mental health disorders fall disproportionately on people with low earnings.[40] Consistent with these findings, the effects of treatment are also much stronger below the median of earnings.

[39] 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.

[40] 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.

Among people who earn less than the median of $48,632, people with BD earn 49 percent less (*BD*, Table 8, column 1, significant at 1 percent). Access to lithium eliminates 63 percent this earnings penalty (with an estimate of 31 percent for *BD x post*, Table 8, column 1, significant at 1 percent).

Differences in pre-existing wealth may drive the disproportionate impact of mental health in the bottom quantiles of earnings. Since pre-existing wealth varies across family, family (mother) fixed-effects offer a crude way to control for such differences. Controlling for family fixed effects leaves the estimated change unchanged at 51 percent (Table 8, column 2, significant at 1 percent). Access to treatment eliminates, however, a larger 84 percent of the earnings gap between people with BD and their healthy siblings (eliminating 43 percentage points of a 51 percent gap, Table 8, column 2, significant at 1 percent).

Notably, there is no evidence for positive treatment effects for people who are above the median of earnings. In the sample of people who earn more than the median, people with BD do not earn significantly less (Table 8, column 3). Access to lithium has a small negative effect on this gap (Table 8, column 3). Estimates with controls for family fixed imply that people with BD earn 4.1 less than their siblings. Access to lithium also has no noticeable effect on this difference (Table 8, column 4).

Access to Treatment Improves Chance to Become Top Earners and Executives

Compared with the population, people with BD are 2.7 percentage points less likely to enter the top 10 percent of earnings, or 27 percent less likely compared with an average probability of 0.10 (Table 9, column 1, significant at 1 percent). Access to lithium has a small and statistically insignificant effect on this probability (*BD x post*, Table 9, column 1). Controlling for family fixed effects, however, increases the size of these estimates and yields positive effects of treatment. Compared with their siblings, people with BD are 52 percent less likely to enter the top 10 percent of earnings. Access to treatment increases this probability by 21 percent (2.1 percentage points compared with an average probability of 0.10, Table 9, column 2, significant at 1 percent).[41]

Next, we perform a series of alternative tests to check whether BD is a CEO's disease. First, we re-estimate equation (1) for the probability of executive employment. OLS estimates indicate that people with BD are 31 *percent less likely* to be executives (1.1

[41] Treatment is also associated with a 16 percent increase in the probability of entering the top 25 percent of earnings compared with siblings (with an estimate of *BD * post* equal to 0.040, Table 9, column 4, significant at 1 percent).

percentage points, Table 10, column 1, compared with an average probability of 0.0367). Access to lithium has a small and insignificant effect on this gap (with an estimate of *BD x post* equal to 0.037, Table 10, column 1). Controlling for family fixed effects increases the size of these estimates. Compared with their siblings, people with BD are 55 percent less likely to become executives (2.0 percentage points, Table 10, column 2, compared with an average probability of 0.0368). Access to lithium reduces this gap by 60 percent (or 1.2 percentage points, Table 10, column 2, significant at 10 percent).

These estimates indicate a more complex relationship between BD and executive employment than is suggested by the label of a "CEO's disease." Without treatment, people with BD are much less likely to become executives. Controlling for a person's family background makes this relationship more negative, suggesting that physical and social capital at the family level can help people with BD to reach executive jobs. Access to treatment greatly increases a person's chances of becoming an executive controlling for a person's family background but has no significant effect without family-level controls, further confirming that a person's family background mitigates the effects of mental health on executives.

We also estimate investigate effects on entrepreneurship, measured by executive roles in start-ups (with less than 5 years old and fewer than 50 employees, following Haltiwanger, Jarmin and Miranda 2011). Interviews with start-ups indicate that people who join start-ups "value the autonomy, creativity, and growth they experience in their jobs" (Bussgang 2017). All of these features may be linked to some elements of BD by giving people with BD greater freedom to work. At least on the surface, people with BD appear to share traits of entrepreneurs. Levine and Rubinstein (2017) find that incorporated US entrepreneurs (born between 1940 and 1970) were more likely to have engaged in risky and illicit behavior as young adults. Some of these entrepreneurs may have been bipolar (and have received treatment), but these effects are impossible to evaluate with US data. Tendencies towards risky and illicit behavior are also associated with BD (e.g., Swann et al. 2004).[42]

Regressions with family fixed effects indicate that people with BD are 1.25 times less likely to become an executive in a start-up than their siblings. Access to lithium almost

[42] Swann et al 2004 find that impulsivity, or the tendency to pursue rewards without awareness of negative consequences, becomes elevated in people with mania. Cooper et al (1988) show that entrepreneurs overestimate their firm's probability of survival. Landier and Thesmar (2008) find that entrepreneurs overestimate the employment expansion and sales growth of their firms. De Meza and Southey (1996) argue that individuals who start new small businesses use high collaterals and bank loans instead of equity finance because they are overly optimistic. Galasso and Simcoe (2011) find that overconfident CEOs are more innovative, measured by the rate at which CEOs exercise stock options.

eliminates this difference (Table 10, column 4, significant at 1 percent).[43] Lastly, bipolar people are 40 percent less likely to be in an executive position in large firms more than 5 years old, compared with the rest of the population. Access to lithium reduces this gap to 24 percent (Table 10, column 5, p-value equal to 0.48). Compared with their siblings, bipolar individuals are 71 percent less likely to hold managerial positions in large firms. Access to lithium eliminates 58 percent of this gap.

Access to Treatment Greatly Reduces Risks of Low or Zero Earnings

Most strikingly, people with BD are 1.3 times more likely to decline into the bottom 10th percentile of earnings (13 percentage points compared with an average of 0.1, Table 9, column 5, significant at 1 percent). Access to lithium reduces this probability by 17 percent (1.7 percentage points for *BD x post*, Table 9, column 5, significant at 1 percent). Controlling for family fixed effects further increases the size of these estimates (Table 9, column 6, significant at 1 percent).

We also estimate the effects of BD and treatments on a person's risk of having no earnings at all:

$$(4) \qquad P(zero_{ict}) = \alpha\, BD_i + \beta\, BD_i \times post_c + \gamma\, Z_{it} + \theta_c + \tau_t + \varepsilon_{ict}$$

where $zero_{ict}$ equals 1 if person i from cohort c has zero earnings in year t.

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 11, column 1, significant at 1 percent). Access to treatment removes 33 percent of a person's risk of zero earnings: 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 11, column 1, significant at 1 percent). Estimates are robust to controlling for family fixed effects: People with BD are 19.8 percentage points more likely than their siblings to have no earnings. Access to lithium reduces this risk by 7.3 percentage points (Table 11, column 2).

Event study estimates imply that risks of zero earnings increase by nearly 15 percentage points in the 10 years leading up to the diagnosis, compared with a population risk of 14 percent, plus an additional 10 percent in the two years after the diagnosis (Figure 4). After that, risks of zero earnings continue to increase for people without access to treatment.

[43] Compared with the population, estimates for *BD* and *BD x post* are not statistically significant (Table 10, column 3).

In the 10 years after the diagnosis, people without access to treatment face a 18-percentage points increase in the risk of zero earnings, implying a 1.3 fold increase, compared with the last year before the diagnosis.

Access to treatment greatly reduces the risk of zero earnings. People with access to treatment face only a 9-percentage points additional risks of zero earnings in the year after the diagnosis compared with the year before (66 percent, Figure 4).

Access to Treatment Greatly Reduces the Risks of Disability

To investigate effects on disability, we first estimate equation (1) as a linear probability regression for the probability that a person receives disability payments. OLS estimates show 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, we find that access to treatment closes 59 percent of this gap (with an estimate of *BD x post* equal to 0.128, Table 11, 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 11, 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 11, column 4, significant at 1 percent).

Event study estimates confirm the dramatic decline in disability with access to treatment. In years 4 and 3 before the diagnosis, for example, people with BD are 3 and 2 percentage points less likely to be on disability relative to the year before the diagnosis (Figure 5).[44] After the diagnosis, the risk of disability doubles. Four years after the diagnosis, people with BD are 21 percentage points more likely to receive disability pay (Figure 5).

Access to treatment eliminates half of the excess risk of disability for people with BD. Ten years after the initial diagnosis, people with BD and access to treatment are 7 percentage points less likely to be on disability compared with people with BD and access to treatment (Figure 5).

V. Treatment Effects Across Birth Cohorts

stead of earnings) as an outcome variable.

Baseline estimates calculate average effects of treatments for people who had access to lithium treatment when they turned 20. This approach yields a precise estimate if treatment became available immediately to everyone after 1976. It may, however, take several years for a new drug to reach all patients (Agha and Molitor 2017, Dickstein, King, and Saxell 2017).[45] Moreover, it is possible that lithium was used before it was approved. Errors of both types will lead the baseline estimates to understate the benefits of treatment.

Here, we estimate cohort-specific effects, allowing people who were older than 20 years to benefit from treatment. Specifically, we estimate β separately for each cohort 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 1956 is the omitted category (i.e. $\theta_{1956} = 0$).

These estimates corroborate the approach of our baseline regressions. Cohort-specific estimates show no positive effects of treatment for cohorts before 1956, 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 -0.36 for 1946 (with a p-value of 0.32) to 0.22 for 1950 (p-value 0.22).

Cohort-specific estimates first become positive for people born in 1962, with an estimate of 0.14 and an implied 14 percent increase in earnings (exp(0.14)-1, significant at 10 percent, Figure 6). This six-year delay after access to treatment is consistent with estimated delays in the diffusion of drugs (e.g. Agha and Molitor 2017). Estimates further increase to 0.24 for people born in 1972 (significant at 1 percent) and 0.31 for people born in 1976 (significant at 1 percent, Figure 6), implying a 27 and 36 percent increase, respectively.

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

Cohort-specific estimates confirm that there was no measurable effect of "treatment" for people who did not have access to treatment when they reached adulthood. For people with BD who were born before 1956 the benefits of "treatment" are close to zero and never statistically significant (Figure 7).

Treatments first become statistically significant for cohorts born in 1957-58, with a 4 percentage points (-0.04) decline in the probability of zero earnings (significant at 10 percent). Estimates decline continuously, reaching -0.09 for people born in 1966 (significant

[45] Agha and Molitor (2017) show that, within the first four years after the introduction of a new cancer drug, patients who live near the lead investigator's region are substantially more likely to be treated with that drug.

at 1 percent) and -0.11 for people born in 1974 (significant at 1 percent, Figure 7). Compared with a population share of 0.137, these estimates imply a 67 and 82 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-varying estimates indicate no significant differences in the probability of disability for people with BD in cohorts born before 1956 (Figure 8, relative to cohorts born in 1956). After 1956, estimates become significantly negative: they are equal to -0.04 for 1958 (significant at 10 percent) and reach -0.13 for the 1968 cohort (significant at 1 percent) and -0.19 for 1974 (significant at 1 percent, Figure 8). Compared with an average probability of 0.059, this correspond to a 68, 220, and 322 percent lower probability, respectively.

VI. Analyses of Severity

In this final section of the analysis we examine heterogeneous effects on people with more or less severe forms of BD. First, we measure intensity by a person's number of diagnoses with BD. On average, BD individuals experience 2.4 diagnoses between 1995 and 2015, with a median of 2 episodes. We estimate the following regression:

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

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

OLS estimates of this regression 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 12, 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 12, 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 12, 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 12, column 3, significant at 1 percent). Access to treatment eliminates 10 percent of this penalty (*BD x post* is -0.010, Table 12, 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 12, 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 13, 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.

VI. Additional Robustness Checks

In the United States, lithium was approved in 1974, two years earlier than in Denmark. If Danish people with BD were able to source lithium from the United States, our main specifications mis-measure the timing of access to treatment. To address this issue, we re-estimate the main specifications, starting access to treatment in 1974. These estimates with confirm the main specifications: People with BD earn 44 percent less than the population (Table 13, column 1, significant at 1 percent), compared with 43 percent in the main specifications (Table 6, column 1). Access to treatment eliminates 31 percent of the earnings penalty from BD (from 44 percent to 30 percent, *BD x post,* Table 13, column 1).

Relative to healthy siblings, people with BD earn 51 percent less (Table 13, column 2, significant at 1 percent), compared with 43 percent less in the main specifications (Table 6, column 4). With access to treatment more than half of this penalty disappears (with a reduction from 51 percent to 18 percent, implied by BD x post, Table 13, column 2), compared with a 27 percent reduction in the main specifications (Table 6, column 4).

People with BD are also 149 percent more likely to have zero earnings compared with the population (Table 13, column 3, significant at 1 percent), compared with 146 percent in the main specifications (Table 11, column 1). Access to treatments reduces the risk of zero earnings by 32 percent (Table 13, column 3, significant at 1 percent), compared with 33 percent in the main specifications.

Finally, people with BD are 3.8 times more likely to receive disability pay compared with the population (Table 13, column 5, significant at 1 percent), compared with 3.7 times

percent in the main specifications. Access to treatment in 1974 eliminates 56 percent of this risk, compared with 59 percent in the main specifications.

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 35 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, the 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.

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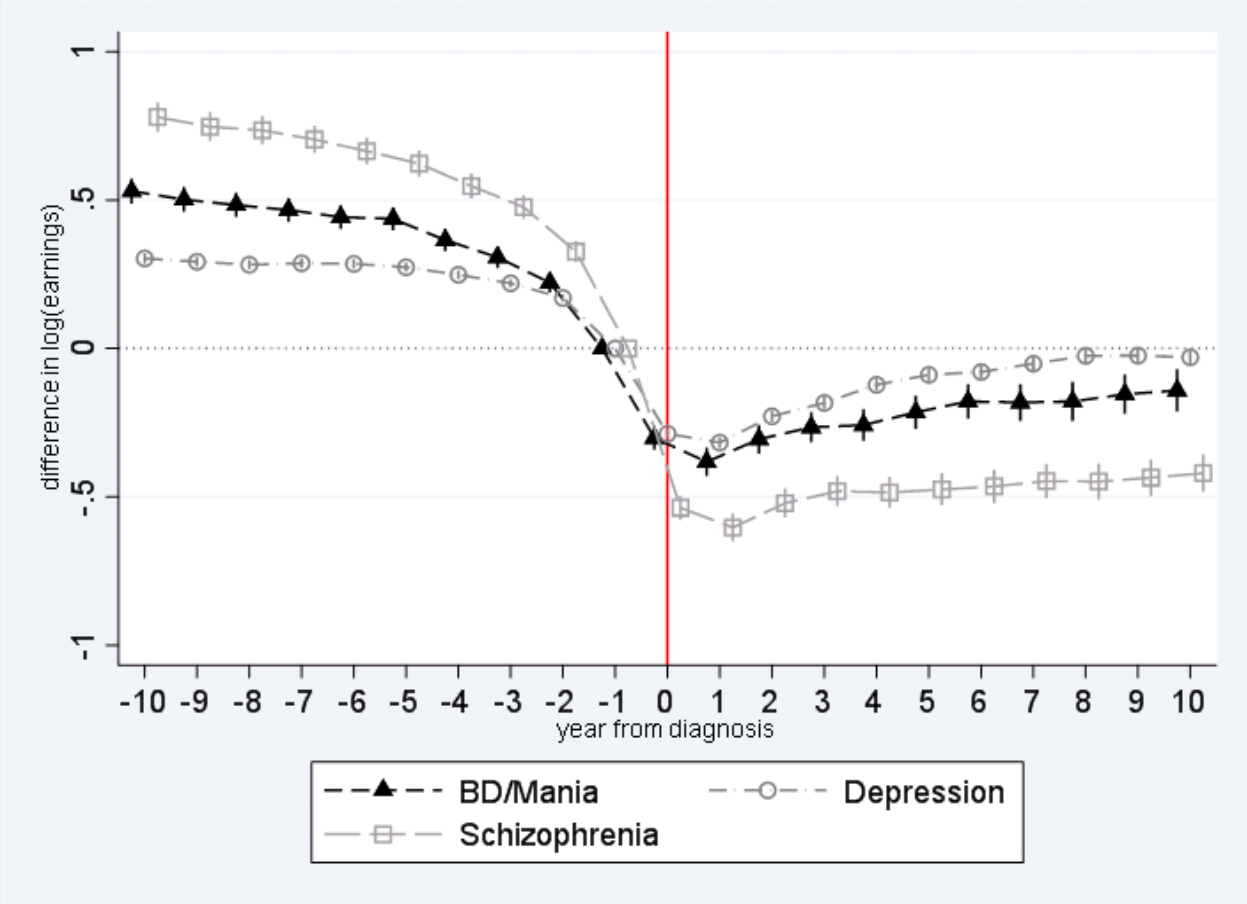
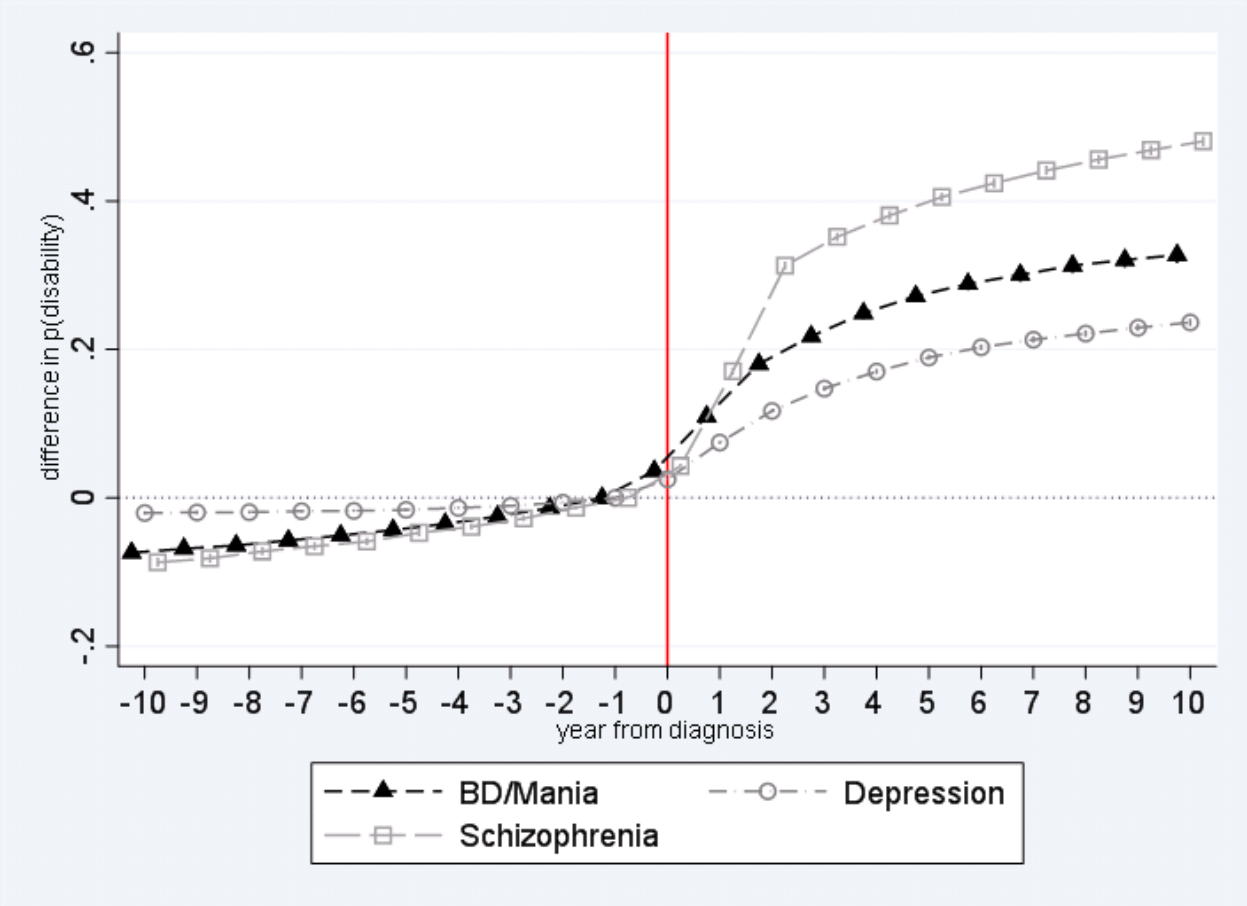
FIGURE 1– EVENT STUDY ON EARNING AROUND THE DIAGNOSIS
DEPRESSION, BD, AND SCHIZOPHRENIA



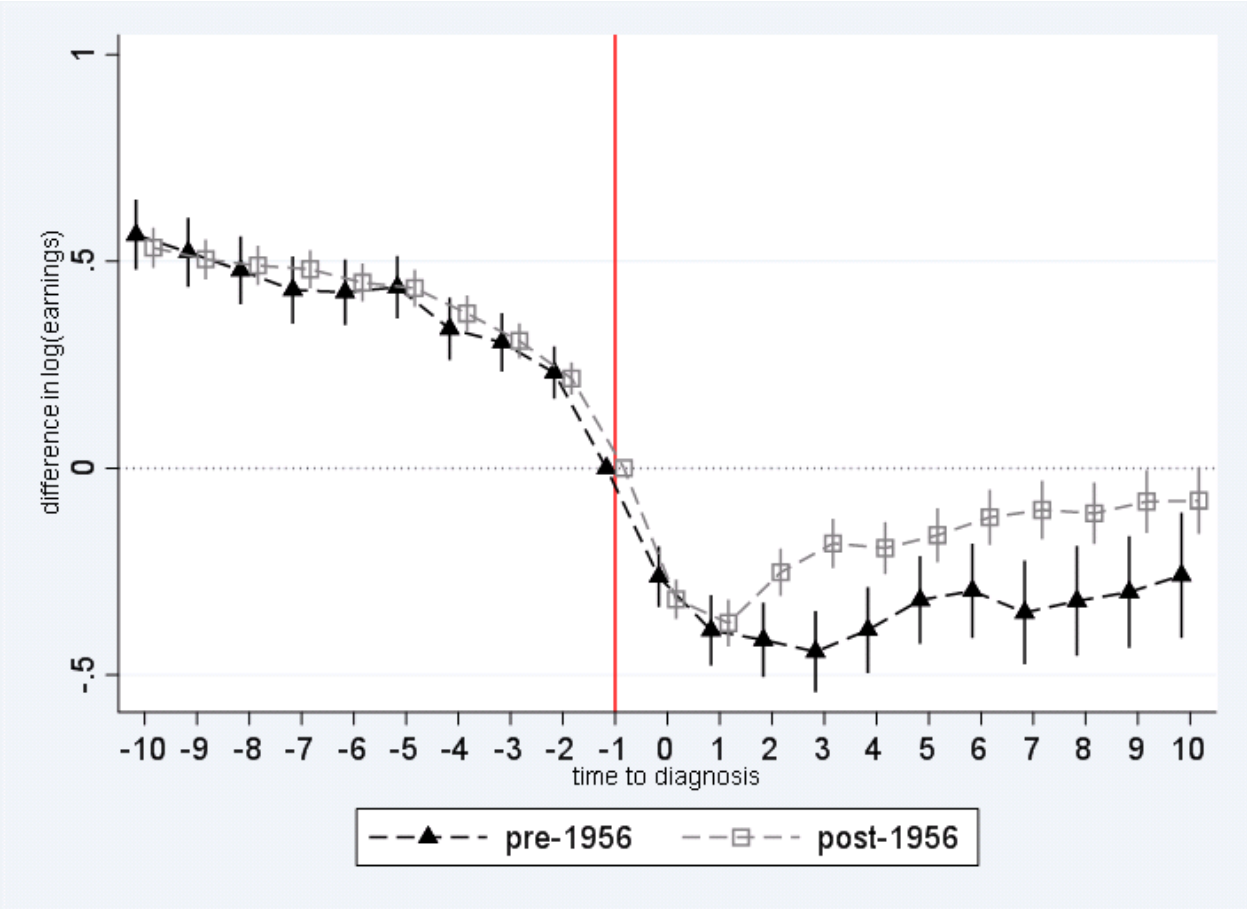
Note: Point estimates and 95 percent confidence of the parameter δ in equation $\log(earnings_{ict}) = \sum^{10}_{k=-10} \delta_k C_i I(t\text{-}Y(C)_i = k) + \beta_1 BD_i + \beta_2 Depression_i + \beta_3 Schizophrenia_i + \gamma_3 Z_{it} + \theta_c + \tau_t + \varepsilon_{ict}$ where the dependent variable 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 variable Z_{it} is a vector of controls, including the natural logarithm of the unemployment rate, an indicator for being enrolled in education, and an indicator for part-time work; 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, and with positive earnings.

FIGURE 2– EVENT STUDY ON DISABILITY AROUND THE DIAGNOSIS
BD, SCHIZOPHRENIA AND DEPRESSION



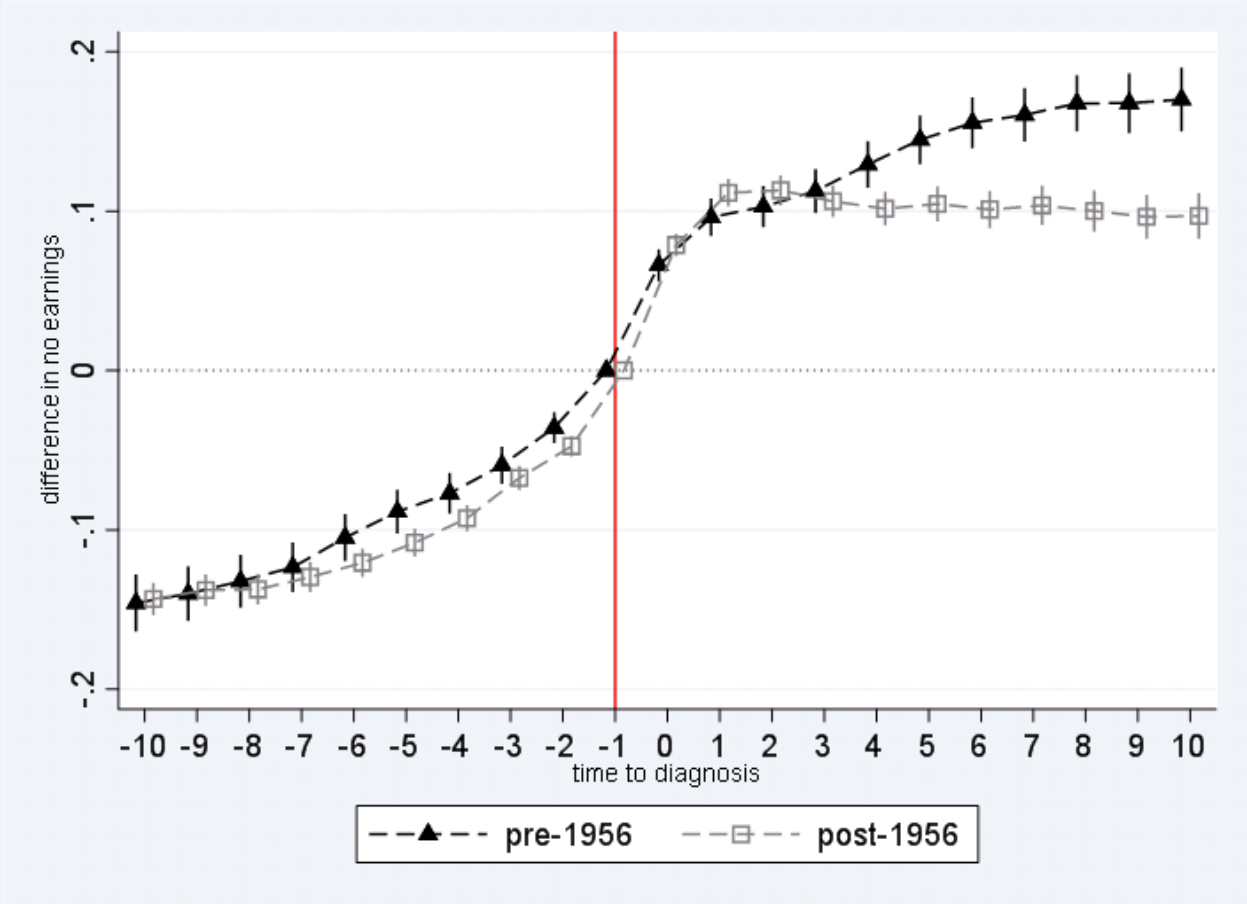
Note: Point estimates and 95 percent confidence of the parameter δ in equation $Disability_{ict}=\sum^{10}_{k=-10} \delta_k C_i I(t-Y(C)_i = k) + \beta_1 BD_i + \beta_2 Depression_i + \beta_3 Schizophrenia_i + \gamma_3 Z_{it} + \theta_c + \tau_t + \varepsilon_{ict}$ where the dependent variable is an indicator for disability payment receipts, 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 variable Z_{it} is a vector of controls, including the natural logarithm of the unemployment rate, an indicator for being enrolled in education, and an indicator for part-time work; 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 ON EARNINGS
PEOPLE WITH BD WITH AND WITHOUT ACCESS TO TREATMENT



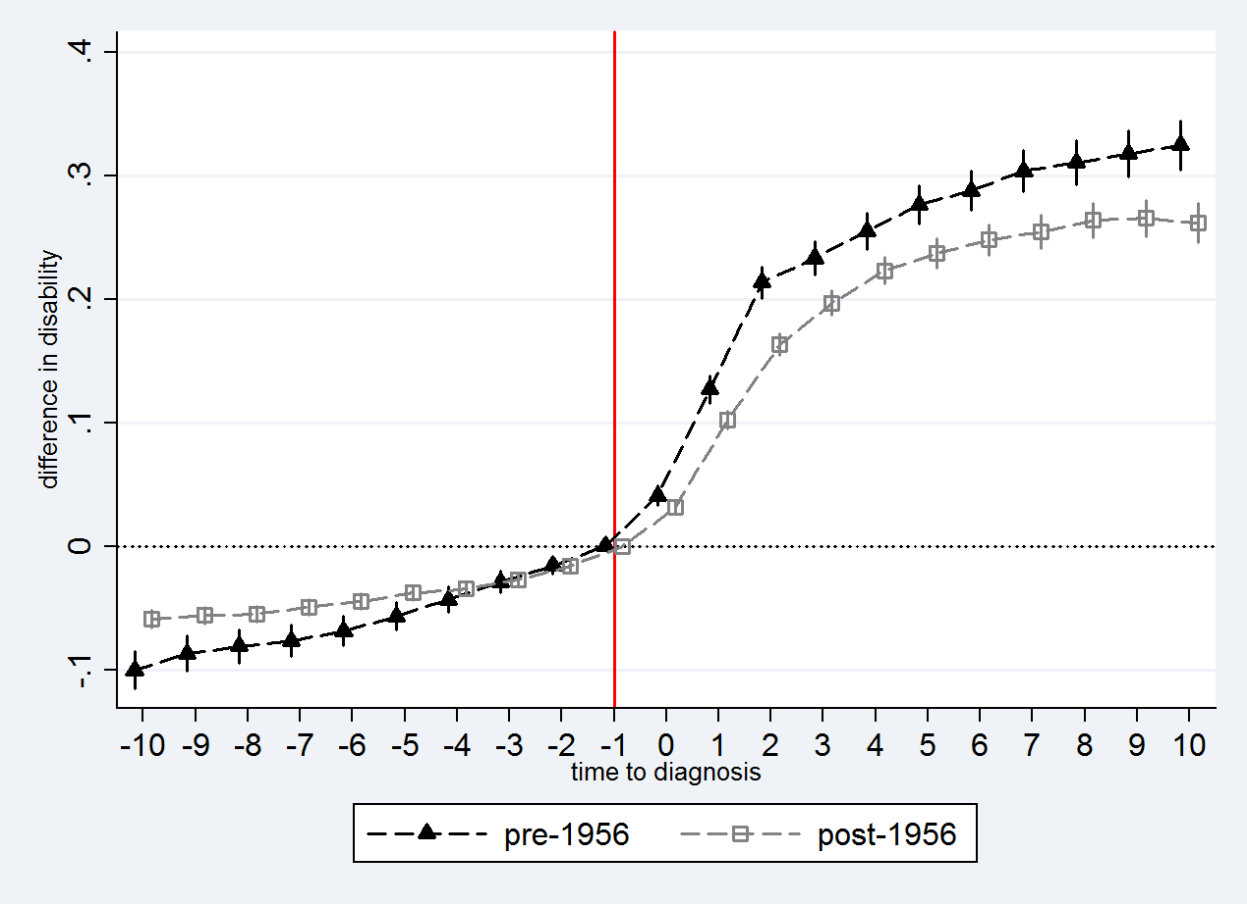
Note: Point estimates and 95 percent confidence of the parameter δ in equation $\log(earnings_{ict}) = \sum^{10}_{k=-10} \delta_s BD_i I(t\text{-}Y(BD)_i = k) + \beta_2 Depression_i + \beta_3 Schizophrenia_i + \gamma Z_{it} + \theta_c + \tau_t + \varepsilon_{ict}$, where the dependent variable is the 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 variable Z_{it} is a vector of controls, including the natural logarithm of the unemployment rate, an indicator for being enrolled in education, and an indicator for part-time work; θ_c are 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, and with positive earnings.

FIGURE 4– EVENT STUDY ON ZERO EARNINGS
PEOPLE WITH BD WITH AND WITHOUT ACCESS TO LITHIUM



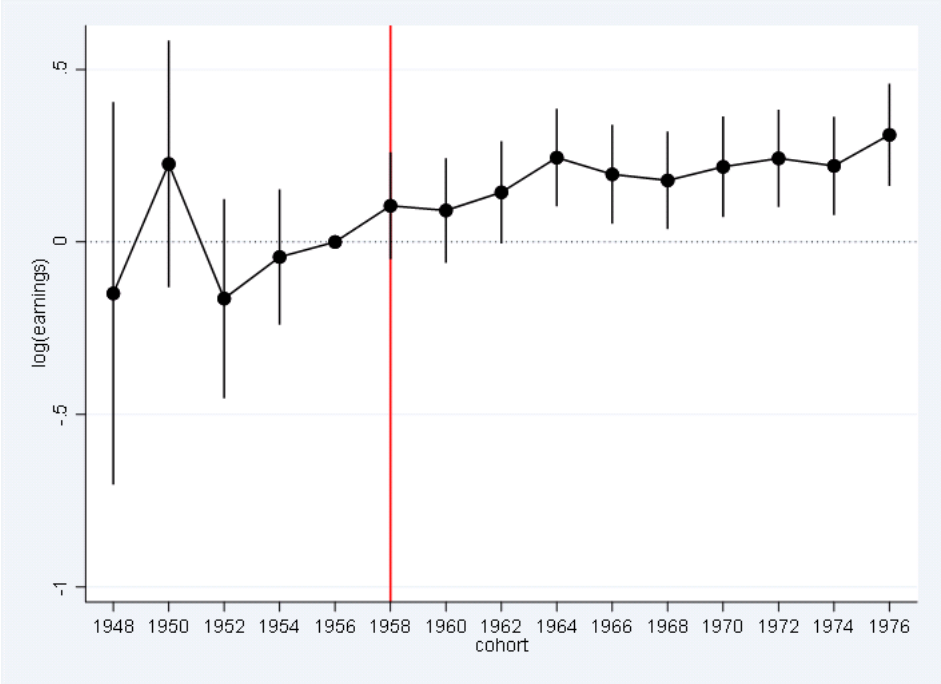
Note: Point estimates and 95 percent confidence of the parameter δ in equation $P(earnings_{ict}=0) = \sum^{10}_{k=-10} \delta_s \, BD_i \, I(t\text{-}Y(BD)_i = k) + \beta_2 \, Depression_i + \beta_3 \, Schizophrenia_i + \gamma \, Z_{it} + \theta_c + \tau_t + \varepsilon_{ict}$, where the dependent variable equals 1 if the individuals receives zero earnings in year t, 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 variable Z_{it} is a vector of controls, including the natural logarithm of the unemployment rate, an indicator for being enrolled in education, and an indicator for part-time work; θ_c are 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 5– EVENT STUDY ON DISABILITY
PEOPLE WITH BD WITH AND WITHOUT ACCESS TO LITHIUM



Note: Point estimates and 95 percent confidence of the parameter δ in equation $P(disability_{ict}=0) = \sum^{10}_{k=-10} \delta_s \, BD_i \, I(t\text{-}Y(BD)_i = k) + \beta_2 \, Depression_i + \beta_3 \, Schizophrenia_i + \gamma \, Z_{it} + \theta_c + \tau_t + \varepsilon_{ict}$, where the dependent variable equals 1for individuals on in year t, 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 variable Z_{it} is a vector of controls, including the natural logarithm of the unemployment rate, an indicator for being enrolled in education, and an indicator for part-time work; θ_c are 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– COHORT-SPECIFIC EFFECTS OF ACCESS TO LITHIUM ON EARNINGS



Note: Point estimates and 95 percent confidence intervas of the parameter β_{1c} in the equation $ln(earnings_{ict}) = \alpha_1 BD_i + \Sigma_c \beta_{1c} BD_i \times \theta_c + \gamma_1 Depression_i + \gamma_2 Schizophrenia_i + \gamma_3 Z_{it} + \delta_f + \theta_c + \tau_t + \varepsilon_{ict}$, where $ln(earnings_{ict})$ is the natural logarithm of earnings for individual i from in cohort c 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 variable Z_{it} is a vector of controls, including the natural logarithm of the unemployment rate, an indicator for being enrolled in education, and an indicator for part-time work; θ_c are cohort fixed effects, δ_f are family 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 7– COHORT-SPECIFIC EFFECTS OF ACCESS TO LITHIUM ON P(ZERO EARNINGS)

Note: Point estimates and 95 percent confidence intervas of the parameter β_{1c} in the equation $P(earnings_{ict}=0) = \alpha_1 BD_i + \Sigma_c \beta_{1c} BD_i \times \theta_c + \gamma_1 Depression_i + \gamma_2 Schizophrenia_i + \gamma_3 Z_{it} + \delta_f + \theta_c + \tau_t + \varepsilon_{ict}$, where $P(earnings_{ict}=0)$ 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 variable Z_{it} is a vector of controls, including the natural logarithm of the unemployment rate, an indicator for being enrolled in education, and an indicator for part-time work; θ_c are cohort fixed effects, δ_f are family 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 8– COHORT-SPECIFIC EFFECTS OF ACCESS TO LITHIUM ON P(DISABILITY)

Note: Point estimates and 95 percent confidence intervas of the parameter β_{1c} in the equation $P(disability_{ict}) = \alpha_1 BD_i + \Sigma_c \beta_{1c} BD_i \times \theta_c + \gamma_1 Depression_i + \gamma_2 Schizophrenia_i + \gamma_3 Z_{it} + \delta_f + \theta_c + \tau_t + \varepsilon_{ict}$, 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 variable Z_{it} is a vector of controls, including the natural logarithm of the unemployment rate, an indicator for being enrolled in education, and an indicator for part-time work; θ_c are cohort fixed effects, δ_f are family 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.

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
Executives	234,570	3,425	701	343
69,966	69,966	1,094	227	89
post-1956	164,604	2,331	474	254
Executives in small/young firms	37,963	565	137	52
9,540	9,540	147	34	13
post-1956	28,423	418	103	39
Self-employed	419,556	13,748	3,359	3,345
pre-1956	129,184	3,535	1,012	716
post-1956	290,372	10,213	2,347	2,629
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

	Log(Earnings)		P(Earnings = 0)		P(Disability)		P(Welfare)		P(College)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
BD/Mania	-0.478***	-0.446***	0.150***	0.133***	0.128***	0.105***	0.196***	0.180***	0.007**	-0.021***
	(0.009)	(0.010)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Depression	-0.438***	-0.370***	0.153***	0.106***	0.074***	0.048***	0.205***	0.154***	-0.055***	-0.025***
	(0.003)	(0.004)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Schizophrenia	-1.354***	-1.328***	0.447***	0.388***	0.411***	0.401***	0.502***	0.440***	-0.125***	-0.133***
	(0.011)	(0.012)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Mean of Dep. Var.	--	--	.134	.105	.059	.047	.199	.170	.284	.293
R-squared	0.045	0.306	0.048	0.342	0.092	0.424	0.051	0.325	0.012	0.596
N	41,619,160	31,404,955	48,071,128	35,077,362	48,071,128	35,077,362	48,071,128	35,077,362	47,028,679	34,720,113

Standard errors in parentheses are clustered at the individual level.

Note: The dependent variable the natural logarithm of earnings (columns 1-2), an indicator for individuals having zero earnings (columns 3-4), receiving disability benefits (columns 5-6), receiving any welfare payments (column 7-8), and having at least a college degree (column 9-10). 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 individuals aged 20-60 born in cohorts 1946-1975; columns 1 and 2 refer to individuals with positive earnings.

TABLE 3 – OLS ESTIMATES: MENTAL HEALTH DISORDER AND EARNINGS – ABOVE AND BELOW MEDIAN

	Above Median		Below Median	
	(1)	(2)	(3)	(4)
BD	-0.018***	-0.032***	-0.470***	-0.389***
	(0.004)	(0.005)	(0.010)	(0.012)
Depression	-0.063***	-0.055***	-0.346***	-0.305***
	(0.001)	(0.002)	(0.004)	(0.005)
Schizophrenia	-0.060***	-0.040***	-1.279***	-1.287***
	(0.004)	(0.005)	(0.011)	(0.013)
Family FE	No	Yes	No	Yes
Cohort FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R-squared	0.080	0.558	0.037	0.290
N	20,809,496	15,992,414	20,809,664	15,412,541

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

Note: The dependent variable measures the earnings of an individual *i* in year *t*, separately for individuals with earnings above the median (columns 1-2) and below the median (columns 3-4) of earnings. 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.Diagnoses data are available for calendar years 1995-2015. All regressions include cohort and year fixed effects; columns 2 and 4 include family fixed effects. The sample is restricted to individuals with positive earnings aged 20-60 and born in cohorts 1946-1975.

TABLE 4 – 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 5 – OLS. MENTAL HEALTH DISORDERS AND THE PROBABILITY OF BEING SELF-EMPLOYED OR AN EXECUTIVE

	Self-employed		Executive			
			All firms		Small and young firms	
	(1)	(2)	(3)	(4)	(5)	(6)
BD	0.882***	0.438**	-1.106***	-0.938***	-0.037**	-0.025
	(0.169)	(0.212)	(0.078)	(0.121)	(0.014)	(0.021)
Depression	-0.890***	-0.731***	-1.802***	-1.546***	-0.106***	-0.099***
	(0.070)	(0.091)	(0.036)	(0.056)	(0.006)	(0.010)
Schizophrenia	-0.213	-0.612***	-1.900***	-1.249***	-0.129***	-0.100***
	(0.145)	(0.187)	(0.053)	(0.100)	(0.010)	(0.018)
Family FE	No	Yes	No	Yes	No	Yes
Cohort	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean of Dep. Var.	7.187	6.577	3.669	3.676	.23	.246
R-squared	0.005	0.355	0.008	0.279	0.001	0.103
N	40,414,954	30,593,590	35,373,502	27,076,046	35,373,502	27,076,046
Standard errors in parentheses are clustered at the individual level.						

Note: The dependent variable is an indicator (multiplied by 100) for self-employed individuals (columns 1-2), individuals holding top managements positions, including CEOs, in all firms (column 3-4), and in small/young firms, defined as those having less than 50 employees and less than 5 years of age (column 5-6). 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 and born in cohorts 1946-1975.

TABLE 6 - OLS, DEPENDENT VARIABLE IS LN(EARNINGS)

	All	Men	Women	All	Men	Women
	(1)	(2)	(3)	(4)	(5)	(6)
BD	-0.560***	-0.556***	-0.577***	-0.662***	-0.562***	-0.653***
	(0.019)	(0.027)	(0.026)	(0.034)	(0.054)	(0.064)
BD x post	0.112***	0.111***	0.142***	0.240***	0.171**	0.239***
	(0.021)	(0.031)	(0.028)	(0.036)	(0.057)	(0.066)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Family FE	No	No	No	Yes	Yes	Yes
R-squared	0.045	0.045	0.050	0.306	0.389	0.354
N	41,619,160	21,541,180	20,077,980	31,404,955	16,638,424	14,766,531

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. 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. All regressions include cohort and year fixed effects; columns 4-6 include family fixed effects. The sample is restricted to individuals aged 20-60 born in cohorts 1946-1975, with positive earnings.

TABLE 7 - OLS, DEPENDENT VARIABLE IS LN(EARNINGS), P(EARNINGS = 0), P(DISABILITY)

	Log(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)
Controls	Yes	Yes	Yes
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 natural logarithm of earnings, defined as are the sum of all wages and income from self-employment (column 1), an indicator for zero earnings (column 2), and an indicator for being 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. *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 8 – OLS, DEPENDENT VARIABLE IS LN(EARNINGS) –INDIVIDUALS WITH EARNINGS BELOW AND ABOVE THE MINIMUM WAGE

	Below MW		Above MW	
	(1)	(2)	(3)	(4)
BD	-0.678***	-0.719***	0.004	-0.042***
	(0.023)	(0.048)	(0.007)	(0.016)
BD x post	0.272***	0.359***	-0.031***	0.011
	(0.025)	(0.050)	(0.008)	(0.016)
Controls	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Family FE	No	Yes	No	Yes
R-squared	0.037	0.290	0.080	0.558
N	20,809,664	15,412,541	20,809,496	15,992,414

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. 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. All regressions include cohort and year fixed effects; columns 2 and 4 include family fixed effects. The sample is restricted to individuals aged 20-60 born in cohorts 1946-1975, with positive earnings.

TABLE 9 - OLS, 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)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family FE	No	Yes	No	No	No	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*, 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, 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 10 - DEPENDENT VARIABLE IS EQUAL TO 1 FOR INDIVIDUALS IN MANAGERIAL POSITIONS

	All firms		Small/young firms		Large/old firms		Self-employed	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BD	-1.132***	-2.028***	-0.048**	-0.129*	-0.874***	-1.532***	2.021***	1.374
	(0.202)	(0.514)	(0.021)	(0.073)	(0.142)	(0.366)	(0.403)	(0.870)
BD x post	0.036	1.202*	0.013	0.115	0.143	0.895**	-1.526***	-1.035
	(0.216)	(0.526)	(0.028)	(0.076)	(0.150)	(0.375)	(0.439)	(0.894)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family FE	No	Yes	No	Yes	No	Yes	No	Yes
Mean of Dep. Var.	3.669	3.676	.23	.246	2.165	2.155	7.187	6.577
R-squared	0.008	0.279	0.001	0.103	0.005	0.255	0.005	0.355
N	35,373,502	27,076,046	35,373,502	27,076,046	35,373,502	27,076,046	40,414,954	30,593,590

Note: The dependent variable is an indicator for individuals holding top managements positions, including CEOs, in all firms (columns 1 and 2), in small/young firms, defined as those having less than 50 employees and less than 5 years of age (columns 3 and 4), and in large/old firms, defined as those having more than 50 employees and more than 5 years of age (columns 5 and 6), as well as an indicator for self-employed as an occupation (columns 7 and 8). 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. 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.

TABLE 11 - DEPENDENT VARIABLE IS EQUAL TO 1 FOR EARNINGS EQUAL TO 0 (COLUMNS 1 AND 2) AND FOR INDIVIDUALS ON DISABILITY (COLUMNS 3 AND 4)

	P(earnings = 0)		P(disability)	
	(1)	(2)	(3)	(4)
BD	0.196***	0.198***	0.218***	0.214***
	(0.004)	(0.008)	(0.004)	(0.008)
BD x post	-0.065***	-0.073***	-0.128***	-0.122***
	(0.005)	(0.009)	(0.005)	(0.008)
Controls	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Family FE	No	Yes	No	Yes
Mean of Dep. Var.	.134	.105	.059	.047
R-squared	0.049	0.344	0.092	0.424
N	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 an indicator for individuals receiving zero earnings in a given year (columns 1-2) or for individuals on disability (columns 3-4). 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. All regressions include cohort and year fixed effects; columns 2 and 4 include family fixed effects. The sample is restricted to individuals aged 20-60 born in cohorts 1946-1975.

TABLE 12 – 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)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
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, 6, and 8 include family fixed effects. The sample is restricted to individuals aged 20-60 born in cohorts 1946-1975; columns (1) and (2) further restrict the sample to individuals with positive earnings.

TABLE 13 – PLACEBO: INTRODUCTION OF LITHIUM IN 1974. 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	-0.580***	-0.715***	0.200***	0.197***	0.225***	0.217***
	(0.022)	(0.048)	(0.005)	(0.011)	(0.005)	(0.010)
BD x post 1954	0.128***	0.284***	-0.065***	-0.068***	-0.126***	-0.119***
	(0.024)	(0.049)	(0.006)	(0.011)	(0.005)	(0.010)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
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	0.344	0.092	0.424
N	41,619,160	31,404,955	48,071,128	35,077,362	48,071,128	35,077,362

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

Note: The dependent variable is the natural logarithm of earnings, defined as 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 1954, and turned 20 after lithium, the main treatment for bipolar disorder, was approved by Danish FDA in 1974. 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, 6, and 8 include family fixed effects. The sample is restricted to individuals aged 20-60 born in cohorts 1946-1975; columns (1) and (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$)

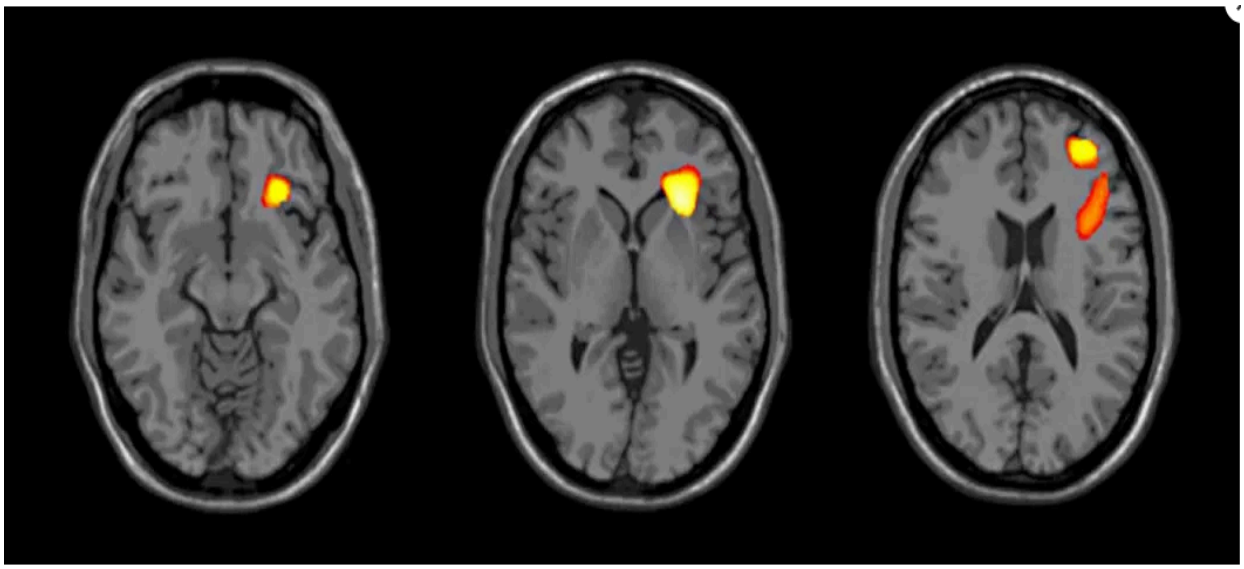
	All	BD	Depression	Schizophrenia
All	52,307	35,359	37,642	24,661
	(83,476)	(35,319)	(335,991)	(27826)
pre-1956	54,180	38,076	26,047	26,041
	(140,099)	(41386)	(35,546)	(27,772)
post-1956	51583	34411	24,238	24,317
	(45,499)	(32887)	(28,385)	(27,829)
CEO in small/young firms	103,648	89,058	84,795	101,104
	(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

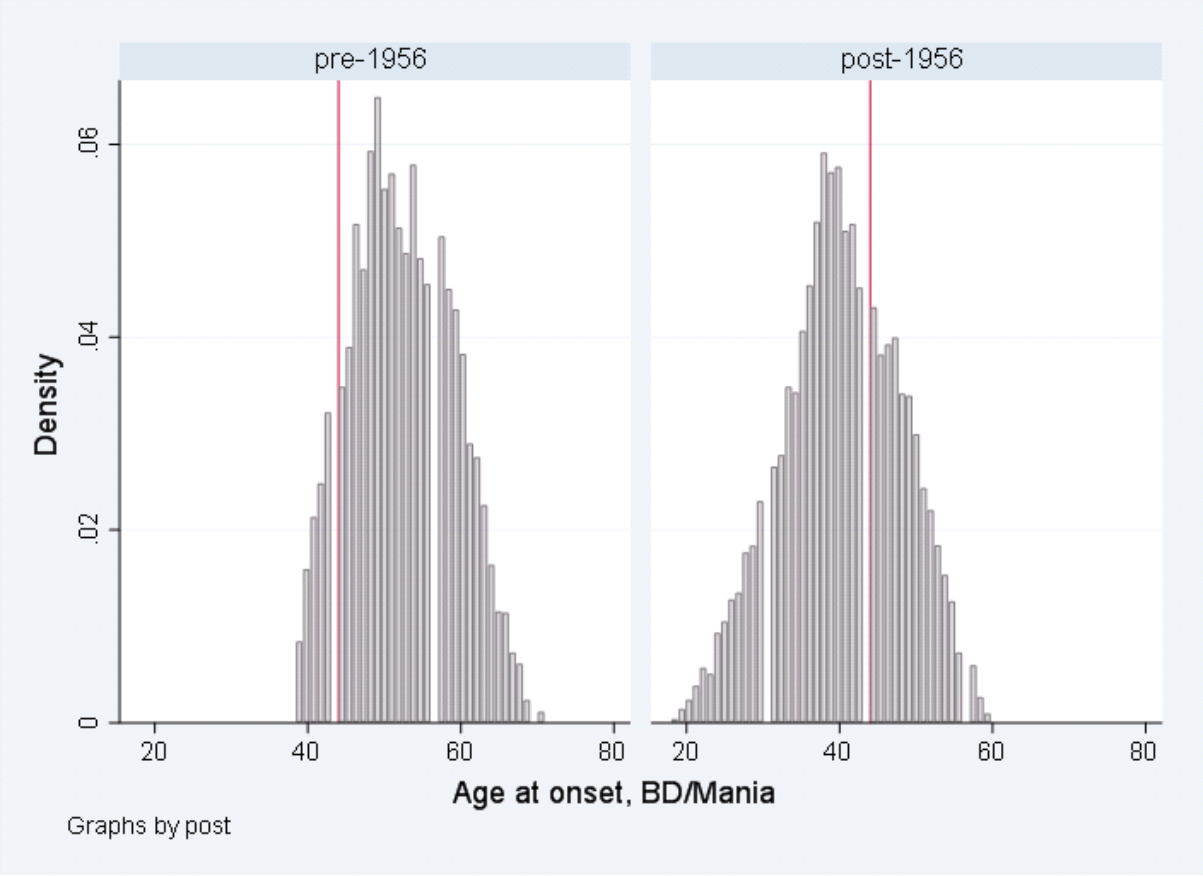
	BD + Depression	BD + Schizophrenia	BD + Depression + Schizophrenia
All	6277	3093	1164
pre-1956	2236	1114	392
post-1956	4041	1979	772

FIGURE A1– BIPOLAR DISORDER AND THE BRAIN



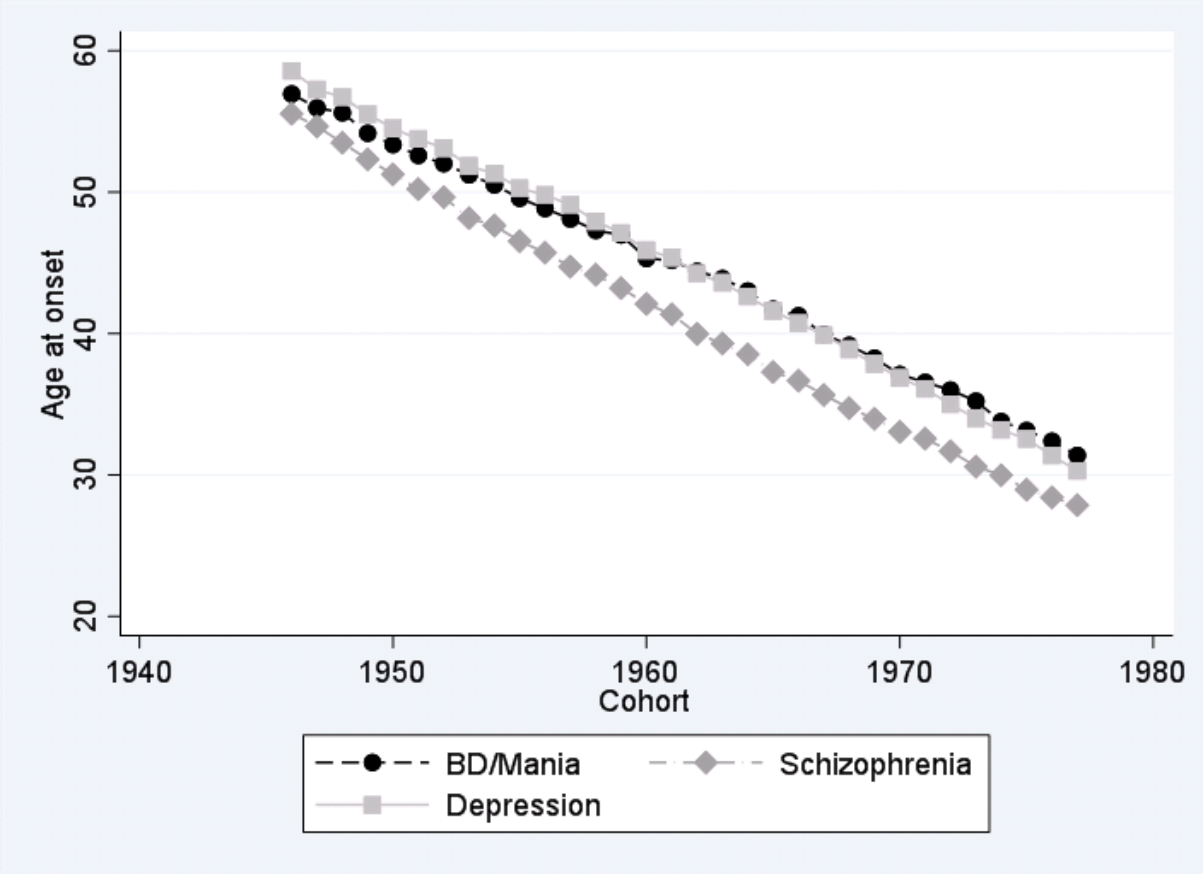
Note: The images show the brain regions (right insula and frontal cortex) where volume decreased more over approximately two years in adolescents with bipolar disorder, compared to adolescents without bipolar disorder. Image credit*: Blumberg lab* and *Biological Psychiatry*.

FIGURE A2– DISTRIBUTION OF AGE AT ONSET FOR BD/MANIA- COHORTS BORN BEFORE AND AFTER 1956



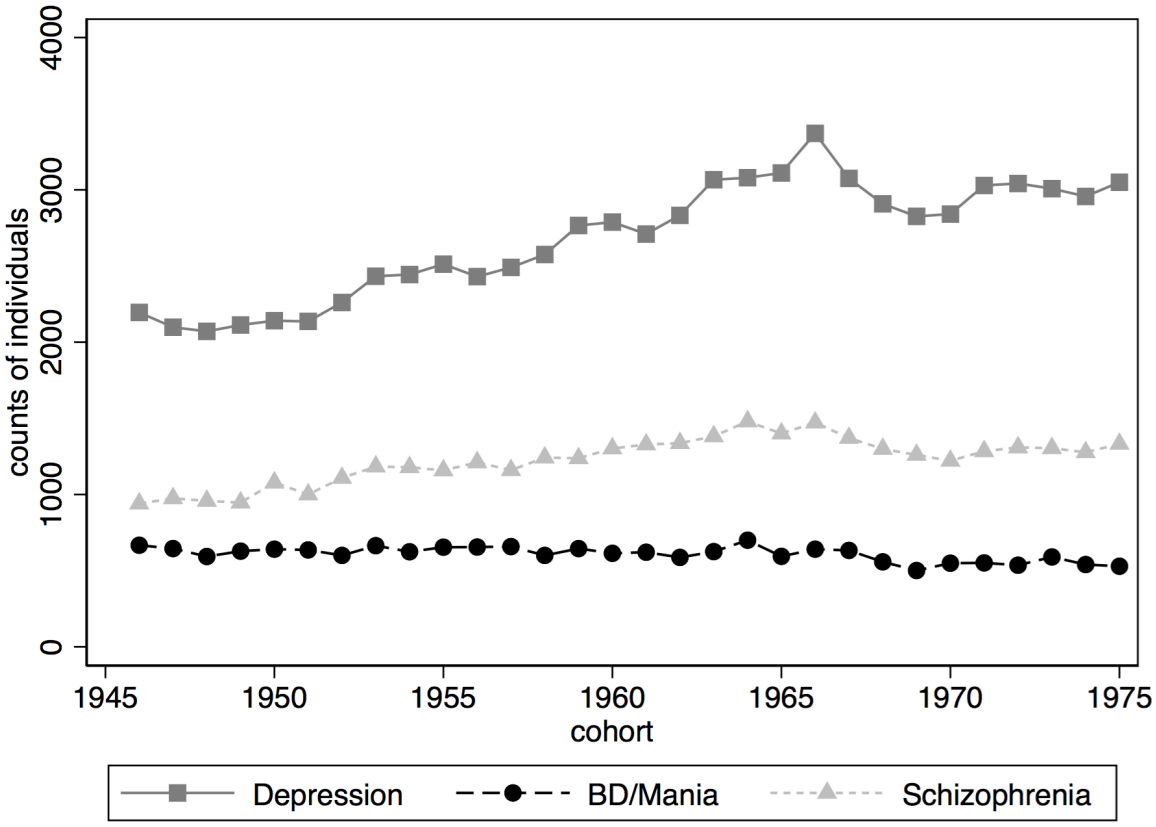
Note: Distribution of the age at which individuals received their first BD diagnosis, for cohorts born before and after 1956. The sample is restricted to individuals between 20 and 60 years of age, born between 1946 and 1976.

FIGURE A3– AVERAGE AGE AT ONSET FOR BD/MANIA, DEPRESSION, AND SCHIZOPHRENIA



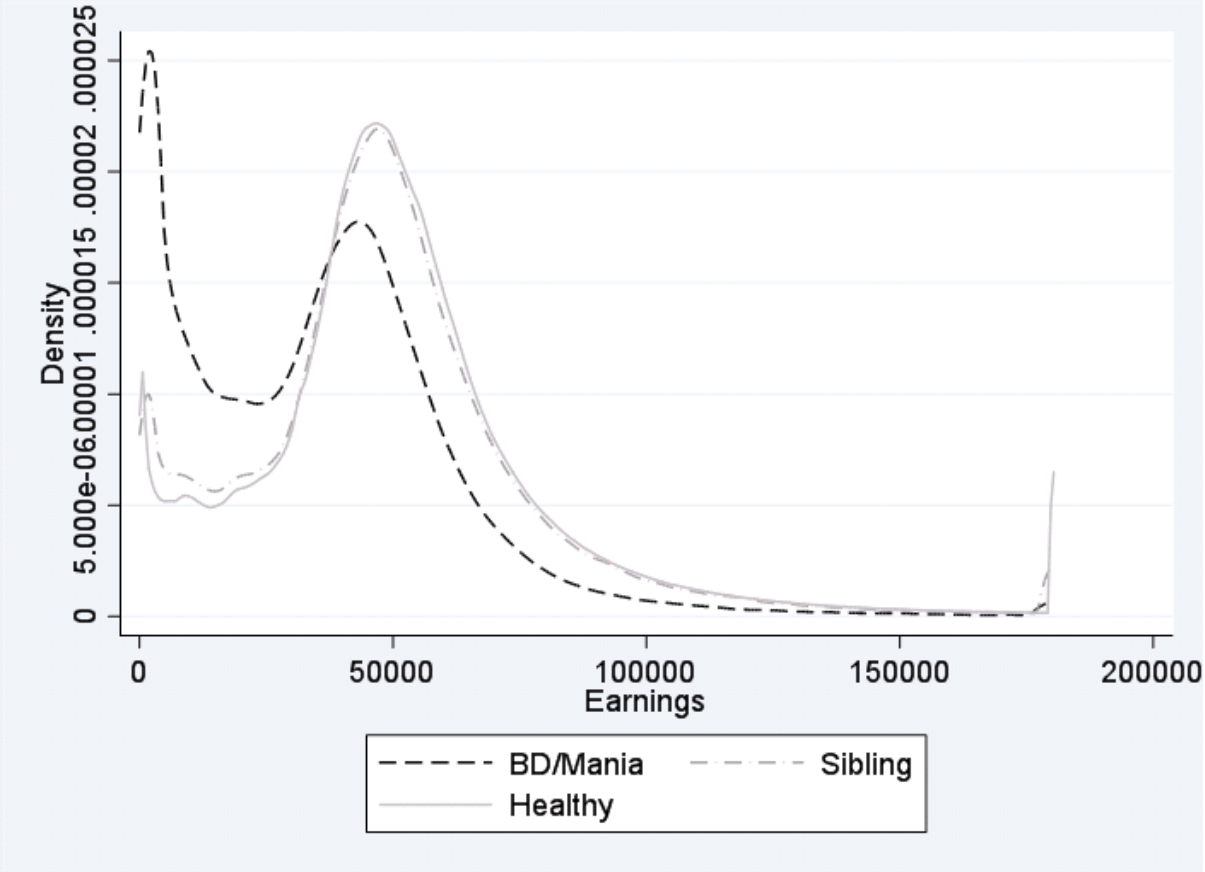
Note: Average age at which individuals received their first diagnosis, by cohort and condition. The sample is restricted to individuals between 20 and 60 years of age, born between 1946 and 1976.

FIGURE A4– SHARE 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 2013.

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.