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

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ONLINE APPENDIX

Information on all demographic variables (age, gender, children, parents, employment, and occupations) is 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 is from the BEF, FAIN, and FAM registries. Data on employment, unemployment, and earnings are drawn from the IDAN, IND, and IDAP 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.

TABLE A1: LIST OF VARIABLES

Variable	Variable name	Definition	Years available	Registry name	Registry
Prescriptions and Diagnoses					
BD		Indicator for individuals with diagnosis codes ICD-10: F31 and ICD-10: F30	1995-2015	Landspatientregistret for Psykiatri Diagnoser	LPSYDIAG
Schizophrenia		Indicator for individuals with diagnosis codes ICD-10: F20-F29	1995-2015	Landspatientregistret for Psykiatri Diagnoser	LPSYDIAG
Depression		Indicator for individuals with diagnosis code ICD-10: F32	1995-2015	Landspatientregistret for Psykiatri Diagnoser	LPSYDIAG
Lithium		Indicator for individuals with at least 1 prescription of lithium (ATC: N05AN)	1995-2015	Medicinal Product Statistics	LMDB
Labor Market Variables					
Earnings	ERHVERVSINDK + NETOVSKUD	Sum of total wages for all jobs and income from self-employment	1995-2015	Income and Employment	IND, IDAP, and IDAN
Disability	PSTILL	Indicator for individuals with variable PSTILL = 93	1995-2015	Demographics	IDAP
Days of unemployment	ARLEDGR	Number of days of unemployment (based on information from the unemployment funds)	1995-2015	Demographics	IDAP
Family					
Mother ID		Individual identifier of mother	1995-2015	Family information	BEF, FAIN, and FAM

TABLE A2: DESCRIPTION OF DIAGNOSES

Variable	ICD code	ICD definitions
BD	ICD-10: F30	A disorder characterized by two or more episodes in which the patient's mood and activity levels are significantly disturbed, this disturbance consisting in 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: F31	A disorder that 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 A3: DEFINITION OF OCCUPATION DIMENSIONS FROM O*NET

	O*NET Variables				
Dimension	Skills	Content	Work Activity	Work Style	Interest
Management	Mgmt of financial, material, personnel resources, time; complex problem-solving; critical thinking; monitoring; negotiation; persuasion	Responsibility for outcomes and results; impact of decisions on company results; frequency of decision-making	Making decisions and solving problems; developing objectives and strategies; coordinating the work and activities of others; guiding, directing, and motivating subordinates	Leadership	
Decision-making	Complex problem-solving; critical thinking; troubleshooting	Consequence of error; frequency of decision-making; importance of unstructured work	Analyzing data or info; making decisions and solving problems; updating and using relevant knowledge		
Pressure	Level of competition; time pressure; importance of being accurate; consequence of error			Stress tolerance	
Artistic	Critical thinking		Thinking creatively	Innovation	Artistic
Social	Social perceptiveness; persuasion; negotiation; instruction; active listening	Coordinate or lead others; deal w/external customers; work w/groups or teams; contact w/others; face-to-face discussions; public speaking	Providing advice to others; coaching and developing others; guiding, directing subordinates; working directly w/public; resolving conflict and negotiating w/others; selling or influencing others; assisting and caring for others; establishing/maintaining personal relations; communicating w/people outside organization; communicating w/supervisors, peers, subordinates	Social orientation	Social

TABLE A4 – OLS: BD, ACCESS TO TREATMENT, AND LABOR MARKET OUTCOMES
FULL SAMPLE (INCLUDING PEOPLE W/OUT FAMILY FE)

	P(Earnings=0)		ln(Earnings)			
	(1)	(2)	(3)	(4)	(5)	(6)
BD	0.169***	0.192***	-0.526***	-0.600***	-0.528***	-0.603***
	(0.004)	(0.004)	(0.017)	(0.017)	(0.017)	(0.017)
BD * access	-0.078***	-0.132***	0.181***	0.361***	0.182***	0.364***
	(0.005)	(0.005)	(0.019)	(0.020)	(0.020)	(0.020)
D, A, S	✓	✓	✓	✓	✓	✓
D/A/S * access		✓		✓		✓
Gender * cohort FE	✓	✓	✓	✓	✓	✓
Gender * year FE	✓	✓	✓	✓	✓	✓
R-squared	0.066	0.066	0.067	0.068	0.951	0. 951
Mean of Dep. Var.	0.14	0.14	--	--	--	--
N	51,488,394	51,488,394	44,156,899	44,156,899	51,488,394	51,488,394
Sample	Full	Full	Earnings>0	Earnings>0	Full	Full

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

Note: The dependent variable is an indicator for zero earnings (columns 1-2) or the natural logarithm of earnings, defined as the sum of wages and income from self-employment (columns 3-6). *BD* equals 1 for people who have been diagnosed with this condition at least once between 1995 and 2015. *Access* equals 1 for individuals born after 1956, who had access to lithium when they entered their 20s. *D*, *A*, and *S* are indicators for people who have ever received a diagnosis of depression, anxiety, and schizophrenia, respectively; *D/A/S* indicates people with at least one diagnosis of one of these conditions. All regressions include gender-by-cohort and y gender-by-ear fixed effects. Columns 5-6 further control for interactions of *BD* and *BD * access* with an indicator for zero earnings. Data are available for calendar years 1995-2015. The sample is restricted to people between the ages of 20 and 60 in cohorts between 1940 and 1977, with family identifiers. Columns 3-4 report results for people with positive earnings.

TABLE A5 – OLS: BD, ACCESS TO TREATMENT, AND LABOR MARKET OUTCOMES. SAMPLE W/MOTHER ID

	P(Earnings=0)		ln(Earnings)			
	(1)	(2)	(3)	(4)	(5)	(6)
BD	0.163***	0.207***	-0.608***	-0.726***	-0.492***	-0.740***
	(0.007)	(0.007)	(0.042)	(0.042)	(0.030)	(0.037)
BD * access	-0.045***	-0.144***	0.271***	0.499***	0.135***	0.512***
	(0.007)	(0.007)	(0.044)	(0.044)	(0.031)	(0.039)
D, A, S	✓	✓	✓	✓	✓	✓
D/A/S * access		✓		✓		✓
Gender * cohort FE	✓	✓	✓	✓	✓	✓
Gender * year FE	✓	✓	✓	✓	✓	✓
R-squared	0.076	0.068	0.322	0.322	0.943	0. 955
Mean of Dep. Var.	0.14	0.14	--	--	--	--
N	35,371,167	35,371,167	31,628,529	31,628,529	35,371,167	35,371,167
Sample	Full	Full	Earnings>0	Earnings>0	Full	Full

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

Note: The dependent variable is an indicator for zero earnings (columns 1-2) or the natural logarithm of earnings, defined as the sum of wages and income from self-employment (columns 3-6). *BD* equals 1 for people who have been diagnosed with this condition at least once between 1995 and 2015. *Access* equals 1 for individuals born after 1956, who had access to lithium when they entered their 20s. *D/A/S* equals 1 for people who received at least one diagnosis of depression, anxiety, or schizophrenia. All regressions include gender-by-cohort and gender-by-year fixed effects. Columns 5-6 further control for interactions of *BD* and *BD * access* with an indicator for zero earnings. Data are available for calendar years 1995-2015. The sample is restricted to people between the ages of 20 and 60 in cohorts between 1940 and 1977, with family identifiers. Columns 3-4 report results for people with positive earnings.

TABLE A6 – OLS: BD, ACCESS TO TREATMENT, AND LABOR MARKET OUTCOMES.
SAMPLE OF COHORTS OBSERVED FOR THE SAME NUMBER OF YEARS

	P(Earnings=0)		ln(Earnings)	
	(1)	(2)	(3)	(4)
BD	0.094***	0.089***	-0.508***	-0.505***
	(0.017)	(0.018)	(0.084)	(0.084)
BD * access	-0.050***	-0.045***	0.313***	0.310***
	(0.018)	(0.019)	(0.088)	(0.089)
D, A, S	✓	✓	✓	✓
D/A/S * access		✓		✓
Gender * cohort FE	✓	✓	✓	✓
Gender * year FE	✓	✓	✓	✓
R-squared	0.602	0.602	0.654	0.654
Mean of Dep. Var.	0.11	0.11	--	--
N	1,687,422	1,687,422	1,535,800	1,535,800

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

Note: The dependent variable is an indicator for zero earnings (columns 1-2) or the natural logarithm of earnings, defined as the sum of wages and income from self-employment (columns 3-4). *BD* equals 1 for people who have been diagnosed with this condition at least once between 1995 and 2015. *Access* equals 1 for individuals born after 1956, who had access to lithium when they entered their 20s. *D/A/S* equals 1 for people who received at least one diagnosis of depression, anxiety, or schizophrenia. All regressions include gender-by-cohort and gender-by-year fixed effects. Data are available for calendar years 1995-2015. The sample is restricted to people between the ages of 20 and 60 in cohorts between 1940 and 1977, with family identifiers; we only retain observations for the first 15 years in which a cohort is observed. Columns 3-4 report results for people with positive earnings.

TABLE A7 – OLS: BD, ACCESS TO TREATMENT, AND OCCUPATIONAL SORTING

	ln(median earnings)	Management	Decision making	Pressure	Artistic	Social	ln(earnings)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BD	-0.019***	-0.050**	-0.041**	-0.007	-0.026	-0.029	-0.535***	-0.525***
	(0.002)	(0.021)	(0.017)	(0.016)	(0.022)	(0.018)	(0.032)	0.031
BD * access	-0.006	-0.006	-0.008	-0.018	-0.012	-0.008	0.183***	0.171***
	(0.002)	(0.022)	(0.019)	(0.017)	(0.023)	(0.019)	(0.033)	(0.033)
D, A, S	✓	✓	✓	✓	✓	✓	✓	✓
D/A/S * access		✓		✓		✓		✓
Cohort/year FE	✓	✓	✓	✓	✓	✓	✓	✓
Family FE	✓	✓	✓	✓	✓	✓	✓	✓
Occupation FE							✓	
Occupation*year FE								✓
R-squared	0.365	0.448	0.497	0.422	0.499	0. 504	0.337	0.361
N	23,892,538	23,892,538	23,892,538	23,892,538	23,892,538	23,892,538	31,622,529	31,622,529

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

Note: The dependent variable is the natural logarithm of median earnings for each individual's occupation, calculated separately for each year (column 1); and measures of various job components, as classified within the O*NET database and standardized to have mean zero and variance 1 (columns 2-6); and the natural logarithm of individual earnings (columns 7-8). *BD* equals 1 for people who have been diagnosed with this condition at least once between 1995 and 2015. *Access* equals 1 for individuals born after 1956, who had access to lithium when they entered their 20s. *D/A/S* equals 1 for people who received at least one diagnosis of depression, anxiety, or schizophrenia. All regressions include cohort, year, and family fixed effects. Data are available for calendar years 1995-2015. The sample is restricted to people between the ages of 20 and 60 in cohorts between 1940 and 1977, with family identifiers; in columns 1-6, it is further restricted to individuals in occupations with an assigned ISCO code.

TABLE A8 – OLS: BD, ACCESS TO TREATMENT, AND EDUCATION

	P(College=0)	
	(1)	(2)
BD	0.014	0.008
	(0.011)	(0.011)
BD * access	-0.035***	-0.027***
	(0.012)	(0.012)
D, A, S	✓	✓
D/A/S * access		✓
Cohort/year FE	✓	✓
Family FE	✓	✓
R-squared	0.607	0.607
Mean of Dep. Var.	0.25	0.25
N	35,008,690	35,008,690

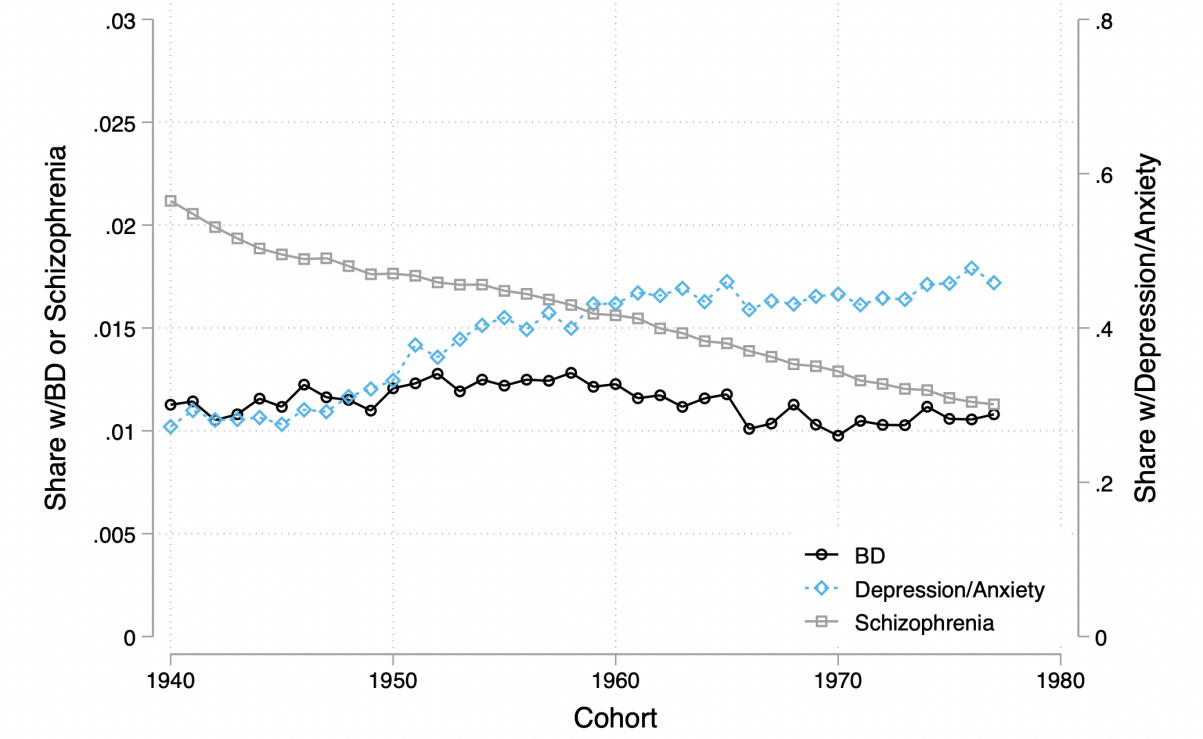
Note: The dependent variable is an indicator for having a college degree. *BD* equals 1 for people who have been diagnosed with this condition at least once between 1995 and 2015. *Access* equals 1 for individuals born after 1956, who had access to lithium when they entered their 20s. *D*, *A*, and *S* are indicators for people who have ever received a diagnosis of depression, anxiety, and schizophrenia, respectively; *D/A/S* indicates people with at least one diagnosis of one of these conditions. All regressions include cohort, year, and family fixed effects. Data are available for calendar years 1995-2015. The sample is restricted to people between the ages of 20 and 60 in cohorts between 1940 and 1977, with family identifiers.

TABLE A9 – OLS: MENTAL HEALTH CONDITIONS AND CAREER OUTCOMES

	Baseline penalty (%)	Earnings (w/out access)	Increase in earnings associated w/treatment		N	Total	
			% [(1) * 0.26]	$ [(2) * (3))]		$ [(4) * (5))]	% [(6)/$4.86bn]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
BD	33	40,369	8.6	3,464	34,315	118,855,500	2
Depression/Anxiety	22	50,128	5.7	2,867	1,257,412	3,605,404,588	74
Schizophrenia	73	26,010	19.0	4,937	46,148	277,818,739	5
Total						3,952,078,827	81

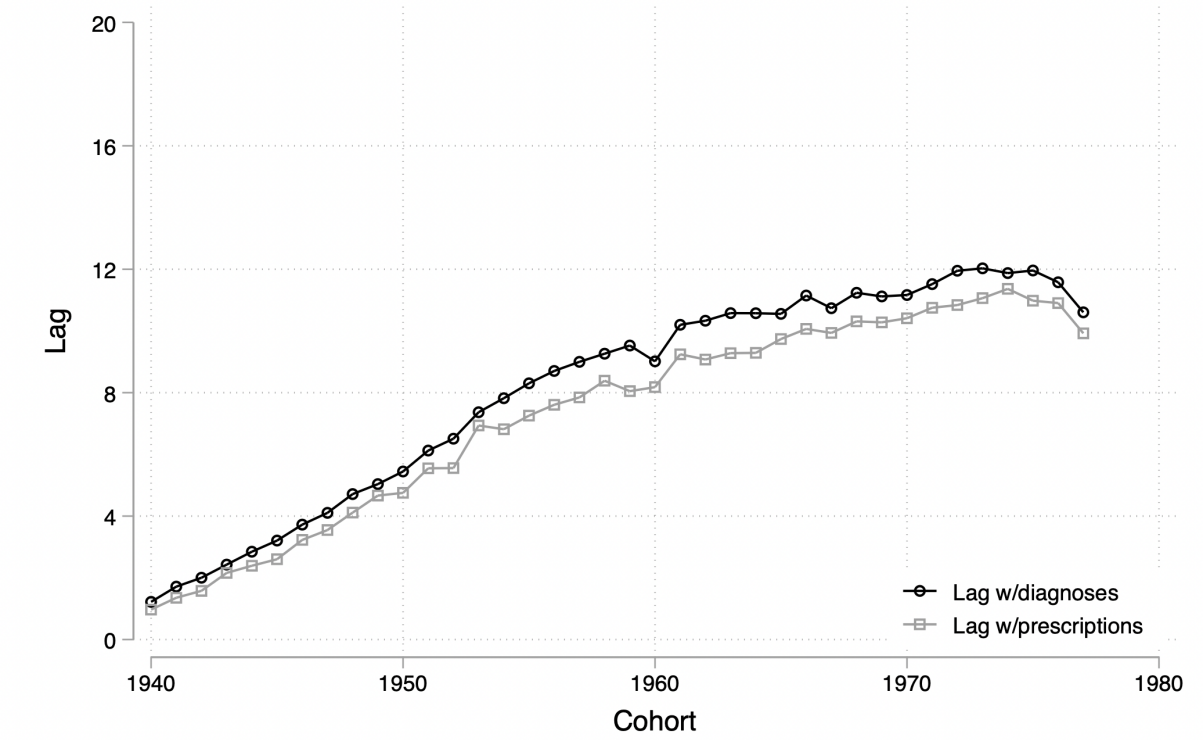
Note: *Baseline penalty* (column 1) is obtained from estimates in column 2 of Table 9. *Earnings (w/out access)* correspond to average earnings for cohorts born before 1956 (as shown in Table 1). *Increase in earnings associated w/treatment* is constructed as 26% of the penalties in column 1 and it is shown in percent (column 3) and in dollars (column 4). Column 5 shows the counts of individuals with each condition, as shown in Table 1. Column 7 shows totals in column 6 divided by the estimated total healthcare costs associated with mental health in Denmark, as estimated by Santini et al. (2021).

FIGURE A1– COUNTS OF INDIVIDUALS DIAGNOSED, BY CONDITION AND ACROSS COHORTS



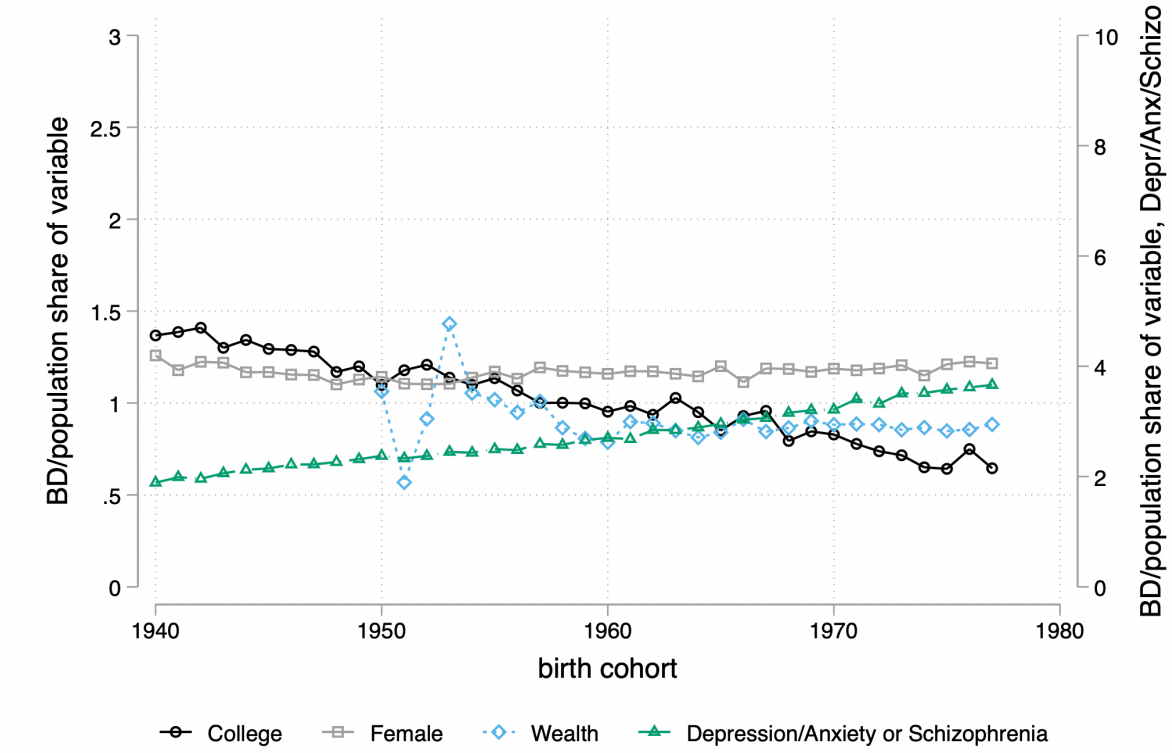
Note: Counts of individuals with at least one diagnosis of depression, BD, or schizophrenia between 1995 and 2015.

FIGURE A2– LAG BETWEEN FIRST YEAR IN THE SAMPLE AND FIRST BD DIAGNOSIS/LITHIUM PRESCRIPTION



Note: Average lag between the year in which a person entered the sample between 1995 and 2015, and the year in which they received the first diagnosis of BD (the darker series, w/ circles) or the first lithium prescription (the lighter series, w/ squares).

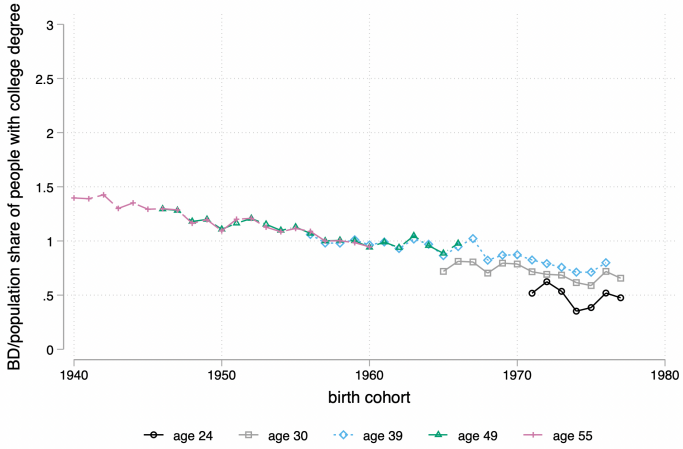
FIGURE A3– CHARACTERISTICS OF PEOPLE WITH BD, BY COHORT



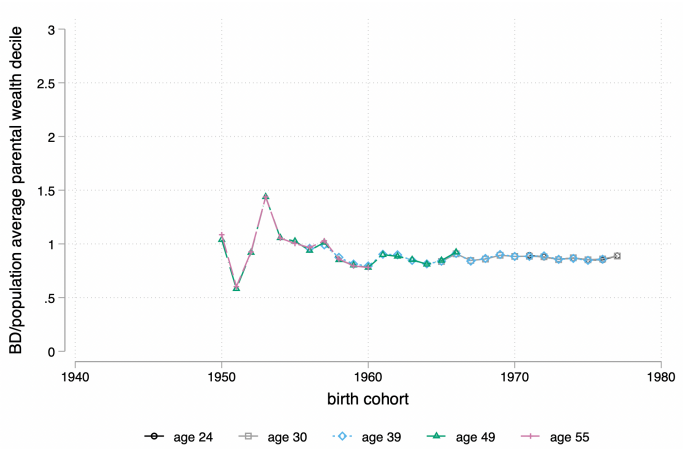
Note: The figure shows ratios of the mean of each variable among people with BD and the mean among the population, separately for each cohort. *Female* equals one for women. *College* equals one for people with at least one college degree. *Depression/Anxiety* and *Schizophrenia* equal one for people with at least one diagnosis of each of these conditions. *Wealth* represents the quantile of a person's parental wealth. The right vertical axis shows the scale for the *Depression/Anxiety*/*Schizophrenia* variables; the left vertical axis shows the scale for all other variables.

FIGURE A4– CHARACTERISTICS OF PEOPLE WITH BD, BY COHORT AND AGE

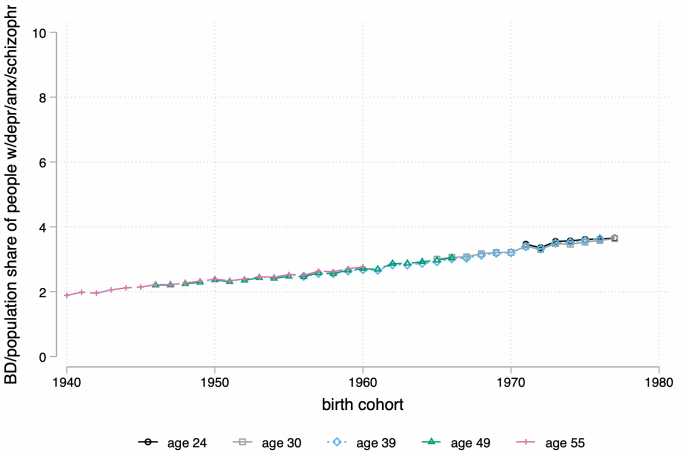
PANEL (A): COLLEGE



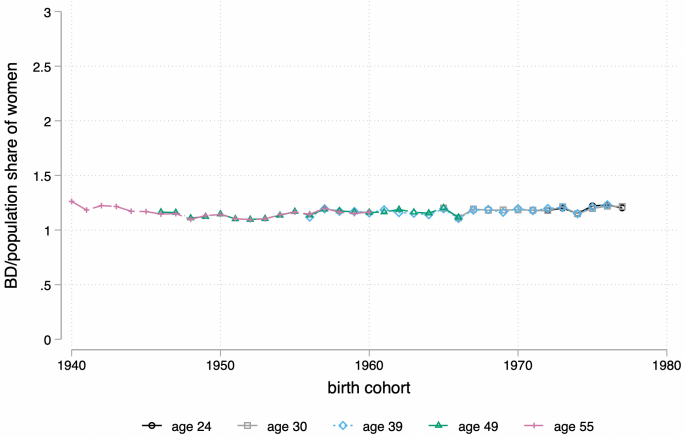
PANEL (B): WEALTH



PANEL (C): DEPRESSION/ANXIETY/ SCHIZOPHRENIA

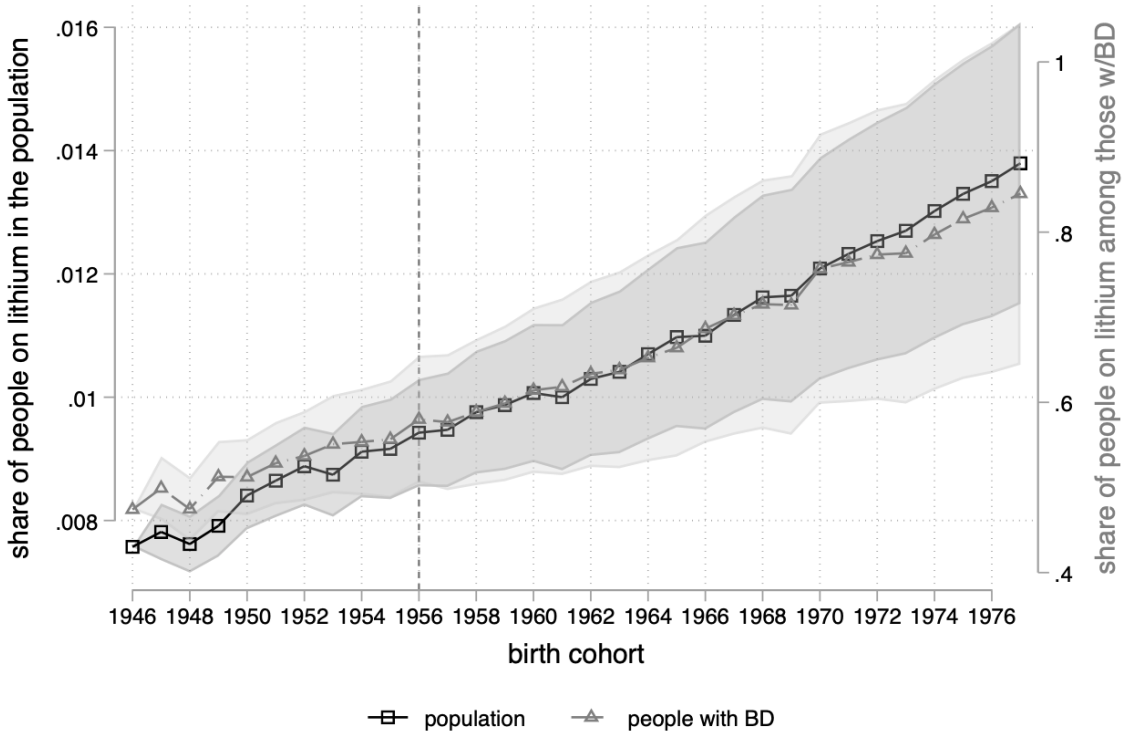


PANEL (D): WOMEN



Note: The figure shows ratios of the mean of each variable among people diagnosed with BD at each age and the mean among the population for people of the same age, separately for each cohort. Panel (a) plots the ratio for *College,* an indicator for people with at least one college degree. Panel (b) plots the ratio for *Wealth,* quantile of a person's parental wealth. Panel (c) plots the ratio for *Depression/Anxiety/Schizophrenia,* which equals one for people with at least one diagnosis of each of these conditions. Panel (d) plots the average share of *Women*.

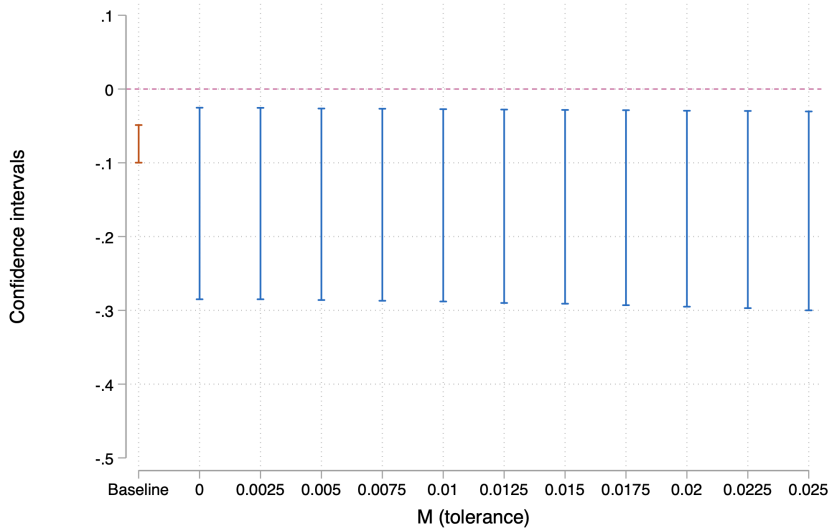
FIGURE A5 – RATES OF LITHIUM PRESCRIPTIONS, BY COHORT



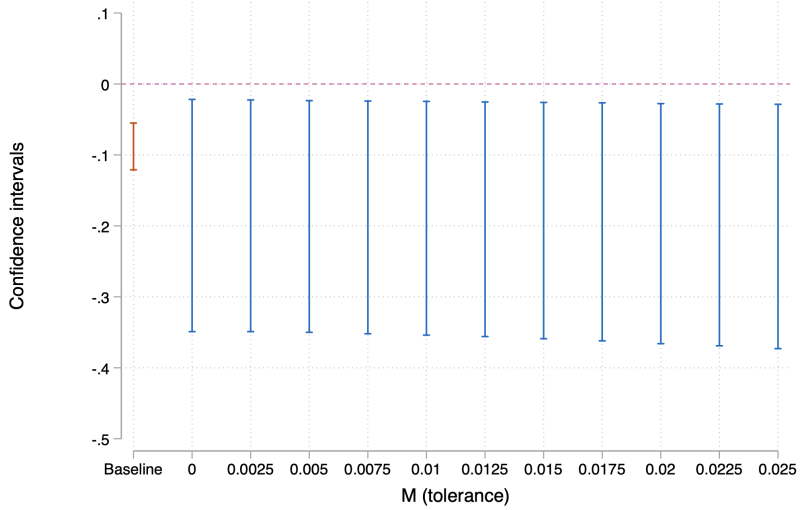
Note: OLS estimates and 95 percent confidence intervals of the parameters δ (cohort fixed effects) in the equation $L_{it} = \alpha_1 a_{it} + \alpha_2 a_{it}^2 + \alpha_3 a_{it}^3 + \delta_{c(i)} + \tau_t + \varepsilon_{it}$, where L_{it} equals one if person i has a lithium diagnosis in year t, a_{it} denotes age, and τ_t are year fixed effects. The darker series (squares) is estimated on the population. The lighter series (triangles) is estimated on people with a BD diagnosis. Standard errors are clustered at the individual level.

FIGURE A6– SENSITIVITY ANALYSIS TO PARALLEL TRENDS ASSUMPTION VIOLATION IN COHORT STUDIES, USING RAMBACHAN AND ROTH (2021) APPROACH

PANEL (A): 1970-75



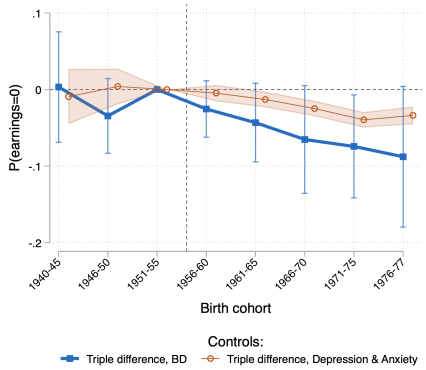
PANEL (B): 1976-77



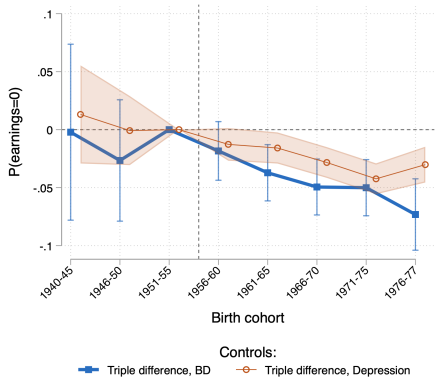
Note: Sensitivity plots of the confidence intervals of β_k in equation (4) for k=1971-75 (panel a) and k=1976-77 (panel b), constructed following the approach of Rambachan and Roth (2021). The approach tests for violations of the parallel trend assumption and studies their impacts on the point estimates and confidence intervals of interest. Specifically, their proposed test consists in (a) constructing a set of possible deviations from the parallel trends assumption, and (b) constructing the confidence intervals associated with these deviations. We adopt Rambachan and Roth (2021)'s main robustness test, which involves constructing confidence intervals that allow for deviations from linearity up to a tolerance parameter M: defining δ as the trend, $\Delta^{SDD}(M) \coloneqq \{\delta: |(\delta_{t+1} - \delta_t) - (\delta_t - \delta_{t-1})| \leq M, \forall t\}$, and we assume the trends to be increasing. The orange series represent baseline OLS confidence intervals; the blue series show confidence intervals as M grows. We allow M to range from zero (linear pre-trends) to the standard error of the coefficient of interest.

FIGURE A7– OLS COHORT ESTIMATES USING DIFFERENT CONDITIONS AS CONTROLS

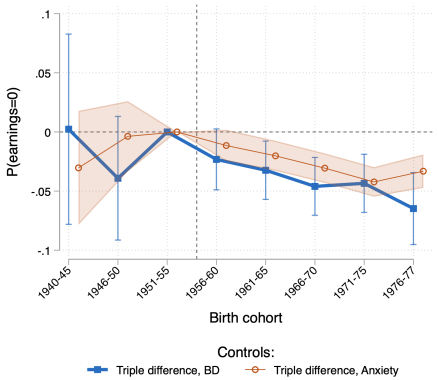
PANEL (A): P(EARNINGS = 0), USING DEPRESSION AND ANXIETY AS CONTROLS



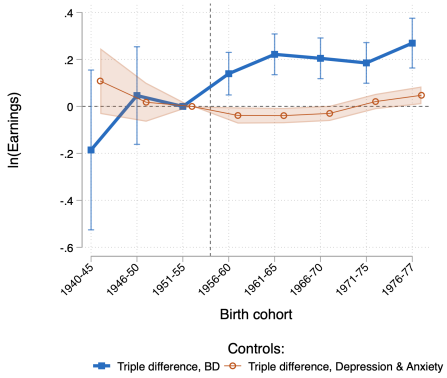
PANEL (B): P(EARNINGS = 0), USING DEPRESSION AS CONTROL



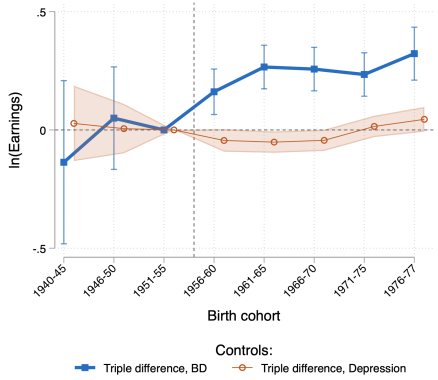
PANEL (C): P(EARNINGS = 0), USING ANXIETY AS CONTROL



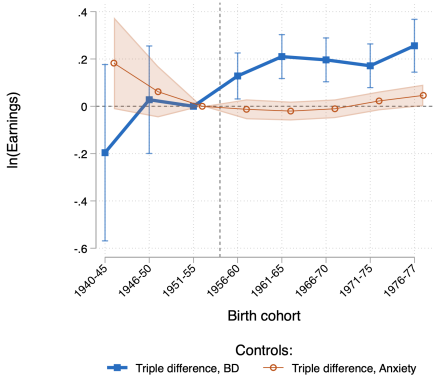
PANEL (A): LN(EARNINGS), USING DEPRESSION AND ANXIETY AS CONTROLS



PANEL (B): LN(EARNINGS), USING DEPRESSION AS CONTROL



PANEL (C): LN(EARNINGS), USING ANXIETY AS CONTROL



Note: OLS point estimates and 95 percent confidence intervals of the parameters β_k and $\beta_{M,k}$ in equation (4), obtained using an indicator for zero earnings (panels a, b, c) and the natural logarithm of earnings (panels d, e, f) as the dependent variables. Estimates are obtained using as control groups the conditions listed in the figure subtitles. Standard errors are clustered at the family level. The sample is restricted to individuals between 20 and 60 years of age, born between 1940 and 1977.