Maternal Education and Offspring's Mental Health

Daniel Graeber
DIW Berlin, SOEP Group
University of Potsdam

Daniel D. Schnitzlein
Leibniz University Hannover
DIW Berlin, SOEP Group

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We acknowledge funding from the Federal Ministry of Education and Research under the title "Nicht-monetäre Erträge von Bildung in den Bereichen Gesundheit, nicht-kognitive Fähigkeiten sowie gesellschaftliche und politiche Partizipation" (FKZ: NIMOERT2/Kassenzeichen: 8103036999784/#30857).

The societal and economic burden of mental illness is high

- **199 million disability adjusted life years** or 37 percent of healthy life years lost from non-communicable diseases stem from mental illnesses (Bloom et al. 2011).
- The sum of direct and indirect costs of mental illness are estimated to increase from 2.5 trillion US Dollar to **6 trillion US Dollar in 2030** (Bloom et al. 2011).
- In Germany, **one out of three** persons suffer from symptoms of clinical relevant mental illnesses (Jachertz 2013).

The paper in a nutshell

- **Contribution**: We estimate the causal effect of maternal years of schooling on the offspring's mental health in adolescence and adulthood.
- We exploit a **compulsory schooling law (CSL) reform** by means of a 2SLS strategy.
- As outcomes we use the Mental Component Summary (MCS) score, life satisfaction, and an indicator for being at risk of a depression from the **Socio-Economic Panel (SOEP)**.
- Our estimates show that one additional year of maternal schooling decreases daughters' MCS score by about **0.26 of a stdv.** and increases the risk of being diagnosed having mental illnesses by about **11 percentage points**.
- We argue that the empirical evidence is consistent with a substitution effect **dominating the income effect**.

Theory is ambiguous about the direction of an effect

The mother is the primary caregiver and the literature has shown that transmission of mental health is particular strong along the mother daughter line (Johnston et al., JHE, 2013).

Indirect effects:

- Maternal years of schooling could influence offspring's mental health through enhanced labor market opportunities (e.g. higher income, less financial worries).
- But higher labor market attachment may translate into more absence from home.

Direct effects:

- Behavioral responses to enhanced education (e.g. Grossman, JPE; 1972; Becker and Lewis, JPE, 1973; Lefgren and McIntyre, JOLE, 2006).

Timing and relevance of the compulsory schooling law reform in Germany

Table 1: The timing of the CSL reform in Germany across federal states

	First school year with compulsory 9 years	First birth cohort with compulsory 9 years
Hamburg	1946	1931
Schleswig-Holstein	1947	1932
Bremen	1959	1944
Lower Saxony	1962	1947
Saarland	1958	1943
North Rhine-Westphalia	1967	1953
Hesse	1967	1953
Rhineland-Palatinate	1967	1953
Baden-Wurttemberg	1967	1953
Bavaria	1969	1955
Source: Leschinsky and Roeder, 1980		

Visiting the basic track was standard during that time (about 49 percent in our sample).

Timing of the CSL reform by birth cohort

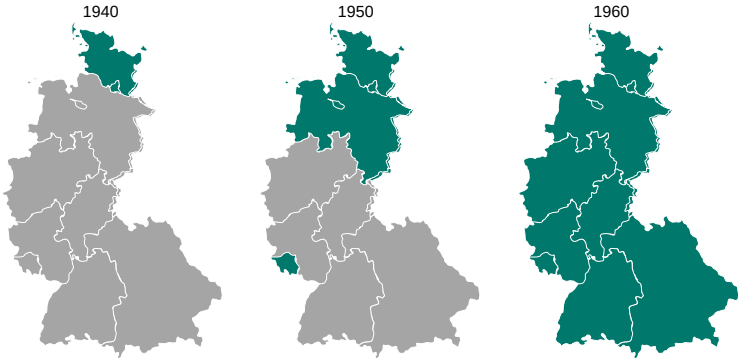

Figure 1: Timing of CSL reform

2SLS strategy

Second stage:

$$MH_{it} = \beta_1 + \beta_2 ED_i + \beta_3 \text{age}_{it}^2 + \beta_4 \text{syear} + \beta_5(\text{state FE}) + \beta_6(\text{cohort FE}) + \beta_7(\text{state-time trend}) + \epsilon_{it}. \quad (1)$$

First stage:

$$ED_i = \gamma_1 + \gamma_2 \text{reform}_i + \gamma_3 \text{age}_{it}^2 + \gamma_4 \text{syear} + \gamma_5(\text{state FE}) + \gamma_6(\text{cohort FE }) + \gamma_7(\text{state-time trend}) + \eta_{it}. \quad (2)$$

Identification:

$$\mathbb{E}(\text{reform}_i \mid \text{cohort FE}, \text{state FE}, \text{state-time trend}, \epsilon_{it}) = 0. \quad (3)$$

- MH_{it} = Mental health outcomes of offspring i at time point t.
- ED_i = Maternal years of schooling.
- age_{it}^2 = Second order polynomial in age of the offspring.
- reform_i = Indicator for maternal reform exposure.

Graphical representation of first stage

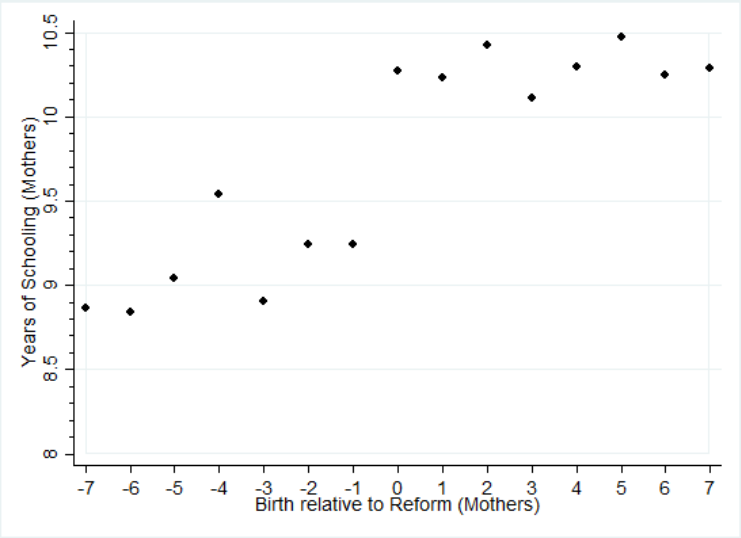

Figure 2: Graphical representation of first stage

We use the Socio Economic Panel

SOEP:

- Annual survey since 1984,
- Includes 11.000 households and about 30.000 persons in Germany,
- as well as information on household composition, occupational biographies, health, etc.
- Offspring surveyed first at age of 17 and followed thereafter.

The MCS score as mental health measure

MCS score:

- Based on SF-12 questionnaire. ▸ SF-12 questionnaire
- Extracted by means of factor analysis.
- Continuous measure ranging from 0 to 100.
- Standardized to have mean 50 and standard deviation 10 in the 2004 population of SOEP (Andersen et al., JCE, 2007).

The MCS score has been widely used among economists in recent years (e.g. Cygan Rehm et al. 2017, HE; Eibich, 2015, JHE; Marcus, 2013, JHE).

Life satisfaction and indicator for depression as additional mental health measures

Life satisfaction:

- "How satisfied are you at present with your life as a whole?"
- Answers range from 0 "completely dissatisfied" to 10 "completely satisfied".

Indicator for being at risk of a depression:

- Vilagut et al. (Value Health, 2013): MCS score below 45.6 has high predictive power for a thirty day depression.
- $I(MCS < 45.6)$ indicates a thirty day depression.
  Similar procedure as Roy and Schurer (2013, HE) and Adhvaryu et al. (forthcoming, JPE). Distribution of the MCS score

Sample selection and summary statistics

Mothers restricted to be born between 1930 and 1960. Observational period: 2002-2015.

Variable	Mean	Std. Dev.	N
LS	7.25	1.64	24550
MCS	49.49	9.63	12312
Depression (MCS)	0.29	0.46	12312
Female	0.47	0.5	25055
Age	29.72	9.14	25055
Education	11.07	1.67	20909
Maternal Educ.	9.75	1.71	25055
Paternal Educ.	10.06	2.02	21770
Mat. Reform Exp.	0.5	0.5	25055
Pat. Reform Exp.	0.36	0.48	21767
Year of birth	1978.09	8.91	25055
Mat. Year of Birth	1949.66	8.09	25055
Pat. Year of Birth	1946.77	8.77	21838

Notes: SOEPv32.1; Life satisfaction available on annual basis. MCS score is available on biannual basis.

Causal effect of maternal years of schooling on offspring's mental health

Table 2: Results, full sample

	OLS			2SLS		
	LS	MCS	Depr.	LS	MCS	Depr.
Maternal years of schooling	.029	-.014**	.004	-.034	-.078	.021
	(.00)	(.01)	(.00)	(.07)	(.08)	(.03)
FS F-test				48.71	46.9	46.9
FS coefficient				.88	.86	.86
Individual-time observations	24550	12312	12312	24550	12312	12312

Notes: SOEPv32 waves 2002 to 2015. Maternal state of schooling and maternal year of birth indicators as well as linear maternal state of schooling trends are included. Robust standard errors clustered on the maternal state of schooling level are in parentheses.
* $p < .1$, ** $p < .05$, *** $p < .01$.

Table 3: Results for sons and daughters

	OLS			2SLS		
	LS	MCS	Depr.	LS	MCS	Depr.
Block 1: Daughters						
Maternal years of schooling	.032***	-.031***	.016***	-.093	-.258***	.113**
	(.01)	(.01)	(.01)	(.15)	(.12)	(.06)
FS F-test				50.62	50.50	50.50
N	1540	1540	1540	1540	1540	1540
Individual-time observations	11594	5789	5789	11594	5789	5789
Block 2: Sons						
Maternal years of schooling	.028***	-.000	-.050	-.028	.074	-.049
	(.01)	(.01)	(.00)	(.06)	(.12)	(.04)
FS F-test				35.05	32.39	32.39
N	1786	1786	1786	1786	1786	1786
Individual-time observations	12956	6523	6523	12956	6523	6523

Notes: SOEPv32 waves 2002 to 2015. Maternal state of schooling and maternal year of birth indicators as well as linear maternal state of schooling trends are included. Robust standard errors clustered on the maternal state of schooling level are in parentheses.
* $p < .1$, ** $p < .05$, *** $p < .01$.

Sensitivity analysis

- ✓ The Results on disaggregated measures are consistent. ▸ Subscales
- ✓ Results sustain drop of first states. ▸ Drop of HH and SH
- ✓ Results robust to restricting observations to parents born after 1945. ▸ Trauma
- ✓ Exclusion of offspring which could have been affected by the CSL reform themselves. ▸ Treated
- ✓ Centering seven years around pivotal cohort. ▸ Seven years window
- ✓ Calculation of different standard errors. ▸ Different s.e.s

Maternal home environment improves as a result of the CSL reform

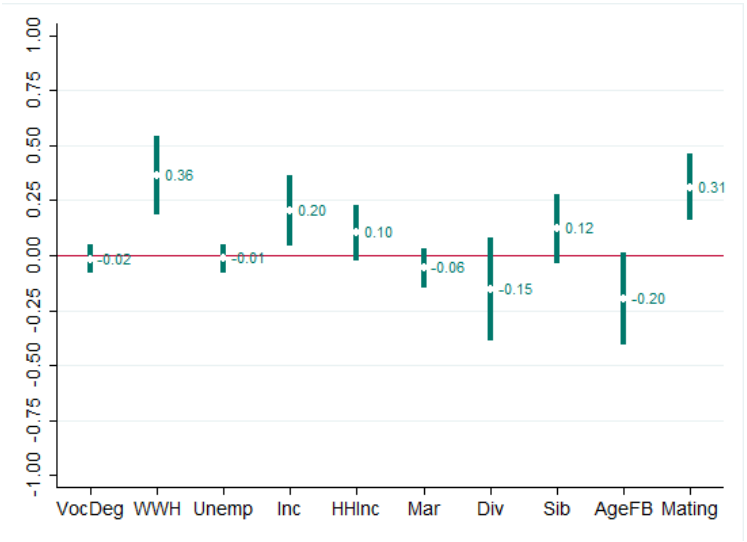

Figure 3: Effect of the CSL reform on maternal outcomes

Conclusion

- We estimated the causal effect of maternal education on the offspring's mental health in adolescence and adulthood.
- We exploited exogenous variation in maternal years of schooling by means of a 2SLS strategy.
- Maternal years of schooling decreases daughter's MCS score by about 0.26 of a standard deviation and the risk of having a depression by about 11 p.p.s.
- We attribute the negative effect to a substitution effect dominating the income effect.

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The SF-12 questionnaire

Table 4: Items of the SF-12 and the corresponding subscales

Question	Subscale
(+) How would you describe your current health?	General health
During the last for weeks, how often did you feel that due to physical health problems... ...you achieved less than you wanted to at work or in everyday activities? ...you were limited in some way at work or in everyday activities?	Role physical
When you have to climb several flights of stairs on foot, does your health limit you greatly, somewhat, or not at all? And what about other demanding everyday activities, such as when you have to lift something heavy or do something requiring physical mobility: Does your health limit you greatly, somewhat, or not at all?	Physical functioning
During the last four weeks, how often did you have severe physical pain?	Bodily pain
(+) During the last four weeks, how often did you feel energetic?	Vitality
During the last four weeks, how often did you feel down and gloomy? (+) During the last four weeks, how often did you feel calm and relaxed?	Mental health
During the last four weeks, how often did you feel that due to physical or mental health problems you were limited socially, that is, in contact with friends, acquaintances, or relatives?	Social functioning
During the last four weeks, how often did you... ...feel that due to mental health or emotional problems you achieved less than you wanted to at work or in everyday activities? ...feel that due to mental health or emotional problems you carried out your work or everyday tasks less thoroughly than usual?	Role emotional

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Distribution of the MCS score

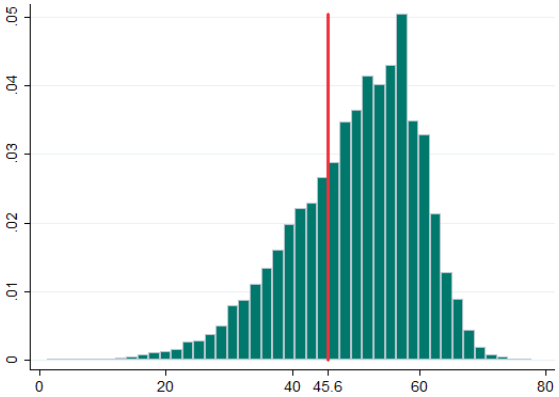

Figure 4: Source: SOEP v32.1. Distribution of the MCS score in the SOEP population in 2004.

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Subscales - Mother-offspring sample

Table 5: Maternal years of schooling and the offspring's SF-12 subscales, mother sample & mental subscales

	Mental health			
	Ment. health	Role emot.	Soc. funct.	Vitality
Panel A: Daughters and sons				
Maternal years of schooling	-0.136**	0.056	0.068	-0.035
	(0.07)	(0.09)	(0.09)	(0.05)
Panel B: Daughters				
Maternal years of schooling	-0.298**	-0.042	-0.127	-0.128
	(0.13)	(0.11)	(0.10)	(0.10)
Panel C: Sons				
Maternal years of schooling	-0.011	0.143	0.224*	0.052
	(0.08)	(0.10)	(0.12)	(0.14)

Notes: SOEPv32 waves 2002 to 2015. 2SLS regressions. Maternal state of schooling and maternal year of birth indicators as well as linear maternal state of schooling trends are included. Robust standard errors clustered on the maternal state of schooling level are in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

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Subscales - Mother-offspring sample

Table 6: Maternal years of schooling and the offspring's SF-12 subscales, mother sample & physical subscales

	Physical health			
	Gen. health	Bodily pain	Role phys.	Phys. func.
Panel A: Daughters and sons				
Maternal years of schooling	-0.073	0.089	0.064	0.212***
	(0.05)	(0.09)	(0.09)	(0.05)
Panel B: Daughters				
Maternal years of schooling	-0.055	0.056	-0.001	0.109
	(0.07)	(0.07)	(0.10)	(0.08)
Panel C: Sons				
Maternal years of schooling	0.055	0.108	0.139	0.284***
	(0.08)	(0.15)	(0.11)	(0.06)

Notes: SOEPv32 waves 2002 to 2015. 2SLS regressions. Maternal state of schooling and maternal year of birth indicators as well as linear maternal state of schooling trends are included. Robust standard errors clustered on the maternal state of schooling level are in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

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Dropping first states - Mother-offspring sample

Table 7: Dropping observations from Hamburg and Schleswig-Holstein, Mother sample

	All	Daughters	Sons
Panel A: Life satisfaction			
Maternal years of schooling	-0.057	-0.083	-0.056
	(0.08)	(0.14)	(0.06)
Panel B: MCS score			
Maternal years of schooling	-0.073	-0.239**	0.084
	(0.07)	(0.10)	(0.10)
Panel C: Being at risk of a depression			
Maternal years of schooling	0.020	0.098**	-0.050
	(0.00)	(0.04)	(0.03)

Notes: SOEPv32 waves 2002 to 2015. 2SLS regressions. Maternal state of schooling and maternal year of birth indicators as well as linear maternal state of schooling trends are included. Robust standard errors clustered on the maternal state of schooling level are in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

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Dropping observations born prior 1945 - Mother-offspring sample

Table 8: Dropping all individuals born before 1945, mother sample

	All	Daughters	Sons
Panel A: Life satisfaction			
Maternal years of schooling	-0.200**	-0.210**	–0.217*
	(0.09)	(0.10)	(0.13)
Panel B: MCS score			
Maternal years of schooling	-0.172**	-0.199***	-0.117
	(0.08)	(0.07)	(0.13)
Panel C: Being at risk of a depression			
Maternal years of schooling	0.050*	0.079**	0.014
	(0.03)	(0.04)	(0.04)

Notes: SOEPv32 waves 2002 to 2015. 2SLS regressions. Maternal state of schooling and maternal year of birth indicators as well as linear maternal state of schooling trends are included. Robust standard errors clustered on the maternal state of schooling level are in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

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Dropping non-treated individuals

Table 9: Dropping non-treated individuals

	All	Daughters	Sons
Panel A: Life satisfaction			
Maternal years of schooling	-0.034	-0.078	0.021
	(0.07)	(0.08)	(0.03)
Panel B: MCS score			
Maternal years of schooling	-0.095	-0.259**	0.113**
	(0.15)	(0.12)	(0.06)
Panel C: Being at risk of a depression			
Maternal years of schooling	-0.027	0.074	-0.050
	(0.06)	(0.12)	(0.04)

Notes: SOEPv32 waves 2002 to 2015. 2SLS regressions. Maternal state of schooling and maternal year of birth indicators as well as linear maternal state of schooling trends are included. Robust standard errors clustered on the maternal state of schooling level are in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

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Centering seven years around reform - Mother-offspring sample

Table 10: Centering seven years around reform, mother sample

	All	Daughters	Sons
Panel A: Life satisfaction			
Maternal years of schooling	-0.180***	-0.222***	-0.197***
	(0.02)	(0.06)	(0.05)
Panel B: MCS score			
Maternal years of schooling	-0.127***	-0.175***	-0.047
	(0.05)	(0.06)	(0.08)
Panel C: Being at risk of a depression			
Maternal years of schooling	-0.034*	0.062*	-0.003
	(0.02)	(0.03)	(0.03)

Notes: SOEPv32 waves 2002 to 2015. 2SLS regressions. Maternal state of schooling and maternal year of birth indicators as well as linear maternal state of schooling trends are included. Robust standard errors clustered on the maternal state of schooling level are in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

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Different standard errors

Table 11: Calculation of different standard errors, mother sample

	All	Daughters	Sons
Panel A: Life satisfaction			
Maternal years of schooling	-0.034	-0.093	-0.028
State of schooling-cohort	(.09)	(.16)	(.07)
Wild cluster bootstrap-t (p-value)	0.65	0.31	0.42
Panel B: MCS score			
Maternal years of schooling	-0.078	-0.258*	0.074
State of schooling-cohort	(.07)	(.11)	(.10)
Wild cluster bootstrap-t (p-value)	0.51	0.07	0.72
Panel C: Being at risk of a depression			
Maternal years of schooling	-0.078	0.113*	-0.049
State of schooling-cohort	(.03)	(.10)	(.04)
Wild cluster bootstrap-t (p-value)	0.60	0.05	0.56

Notes: SOEPv32 waves 2002 to 2015. 2SLS regressions. Maternal state of schooling and maternal year of birth indicators as well as linear maternal state of schooling trends are included. Robust standard errors clustered on the maternal state of schooling level are in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

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