The dynamic economic benefits of early life health interventions: the role of skills and opportunities

Evidence from Sweden and America

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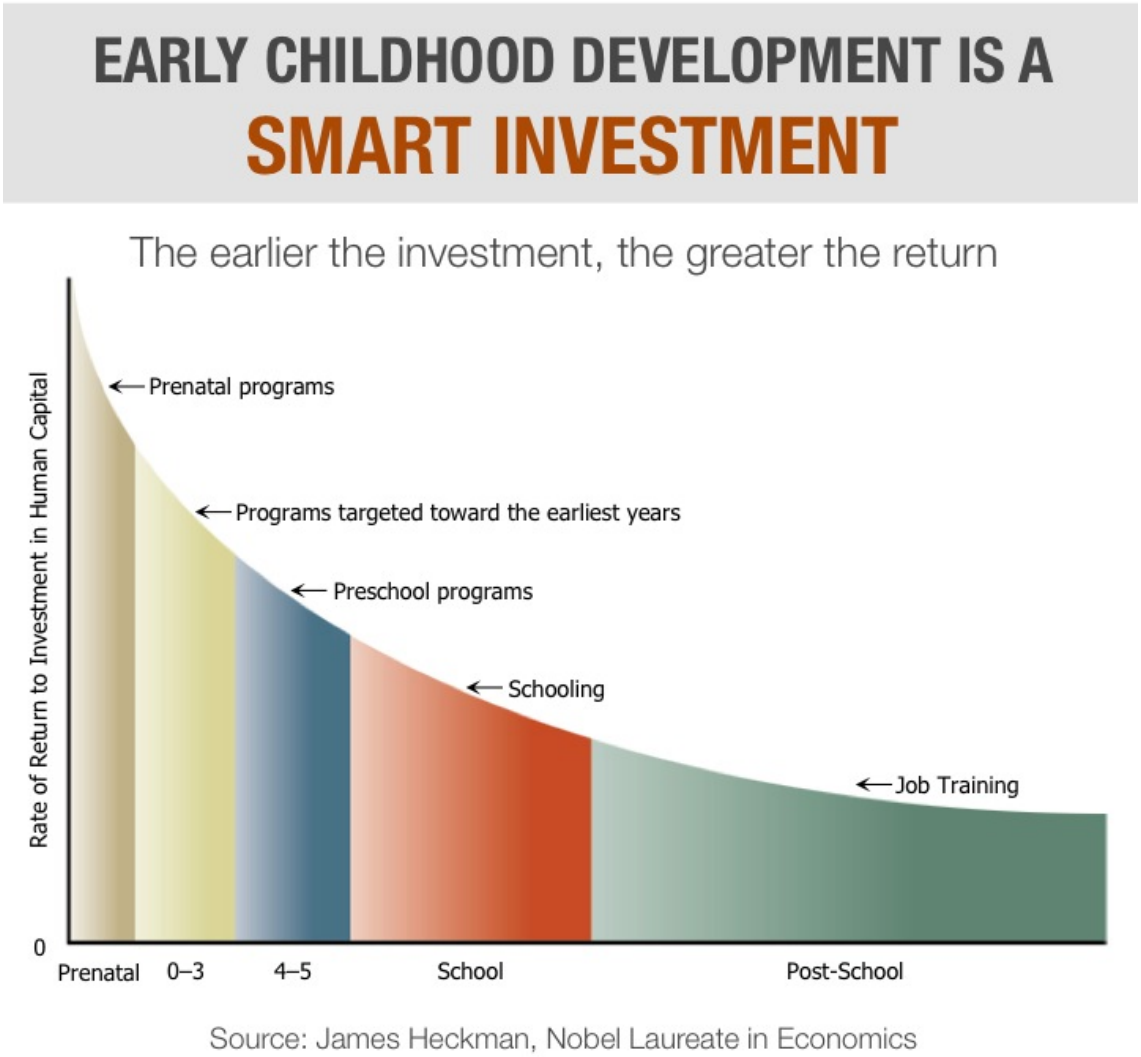
Higher returns to investments earlier in life: The Heckman curve



Higher marginal value of public funds for early life investments

(a) Category-average MVPF

(b) Net government costs per dollar of programmatic spending

Source: Hendren, N. and Sprung-Keyser, B., 2020. A unified welfare analysis of government policies. *The Quarterly Journal of Economics*, *135*(3), pp.1209-1318.

Key threads in the literature: early health

Early life **health** predicts later life **health**

- Barker hypothesis: early life exposures can permanently alter the metabolism, creating predisposition toward chronic disease
- Test: Showed area-level association of infant mortality or LBW in the UK with chronic disease a generation later

Early life **health** predicts later life **economic** outcomes

- Almond & Currie 2010 *Human Capital Development Before Age Five*
- Almond, Currie & Duque 2017 *Childhood Circumstances and Adult Outcomes: Act II*
- Mostly birth cohort designs, limited identification of mechanisms

Key threads- early inputs

- Early life **human capital** predicts later life human capital and **economic** outcomes
  - Cunha & Heckman 2007 *Technology of Human Capital Formation*
  - Within and cross domain dynamic complementarity

- New angles
  - Burst of research on early life **stimulation** building on research in psychology & education, e.g. Attanasio et al.
  - Outcomes expanded to include **socio-emotional development & economic preferences**, see Heckman and Molosso

Mechanics of the pioneering study in economics

- Is the influenza epidemic over? Almond JPE 2006
- Cross-cohort model
  - Epidemic peaked in 1918- pregnant women caught it- flu transmits across the placenta
  - Thus expect a discontinuity in future outcomes for the 1919 birth cohort exposed in the womb
  - Identifying assumption: T and C cohorts are statistically exchangeable

$$y_i = \beta_0 + \beta_1 \text{YOB} + \beta_2 \text{YOB}^2 + \beta_3 \mathbf{1}[\text{YOB} = 1919] + \epsilon_i$$

- Find disrupted outcomes for 1919-births– lower SES in adulthood along multiple dimensions
- Spurred dozens of similar studies

Results turn out to be contaminated by selection

- Parents of the 1919 cohort are significantly more likely to be low-SES– Beach et al JPE 2022
  - Positive selection into WW1
  - Identified impacts vanish upon adjusting for selection
- Also, the flu shock coincided with WW1 generating stress and food shortages which are potential mechanisms for any foetal adaptation
- A within-cohort (DiD or panel data) model mitigates but still have to worry about coincident cohort-region shocks

$$y_i = \alpha_0 + \alpha_1 \, \text{MIR}_{s,t-1} + \mu_s + \mu_t + \epsilon_{ist}$$

WW1 enlistment coincides with the flu epidemic

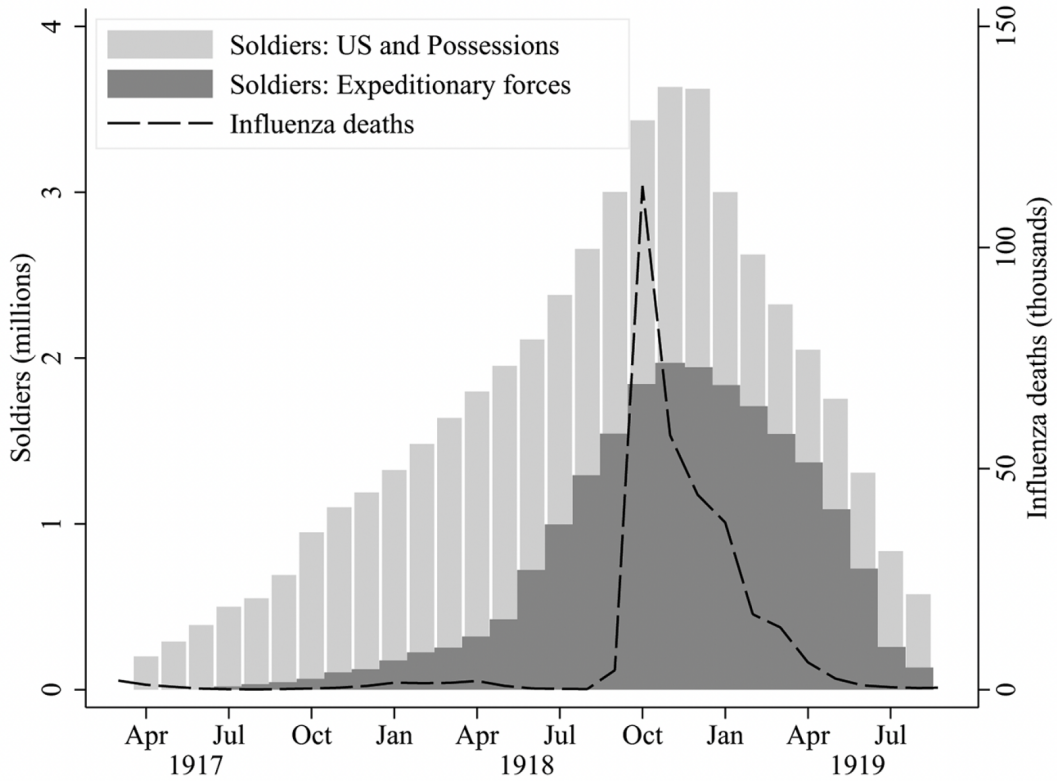


FIG. 1.—Monthly overseas troop deployments and influenza deaths in the registration area, April 1917–October 1919. Troop data from Ayers (1919); influenza deaths from Bureau of the Census (1919, 1920, 1921).

Source: Beach, B., Brown, R., Ferrie, J., Saavedra, M. and Thomas, D., 2022. Reevaluating the long-term impact of in utero exposure to the 1918 influenza pandemic. *Journal of Political Economy*, *130*(7), pp.1963-1990.

Parents of 1919 birth cohorts are negatively selected

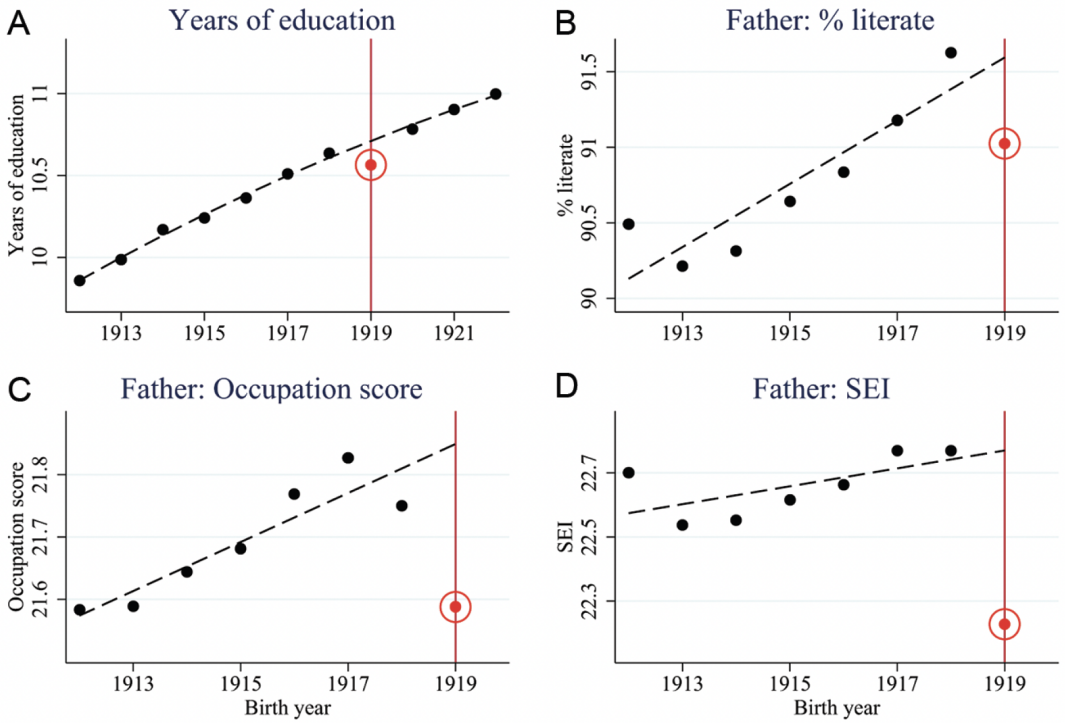


FIG. 2.—Own years of education and paternal characteristics by birth cohort. *A* uses a 1% sample of native-born US males in the 1960 census. *B–D* use fathers of children born in the United States in 1912–19, as reported in the 1920 full-count census. Estimated cohort trends are quadratic in birth year in *A* and linear in *B–D*.

Source: Beach, B., Brown, R., Ferrie, J., Saavedra, M. and Thomas, D., 2022. Reevaluating the long-term impact of in utero exposure to the 1918 influenza pandemic. *Journal of Political Economy*, *130*(7), pp.1963-1990.

Our agenda

- We study health and economic impacts of infant health interventions in Sweden and America in the 1930s
- Our main contribution is to advance analysis of mechanisms
- Sweden:
  - Individual longitudinal data from birth to death provide cleaner identification
  - Intermediate outcomes across the lifecourse illuminate mechanisms
- America:
  - Individual census microdata but limited to birth cohort-birth region identification
  - Interact birth health shock with labour market shock in early adulthood

Evidence from a pioneering postnatal care intervention in Sweden

The research I will discuss is in two publications:

Infant health – chronic disease – life expectancy
Journal of the European Economic Association 2017

Infant health – cognitive attainment – earnings
Review of Economics and Statistics 2022

The long arm of early childhood- mechanisms?

- **Why** do returns to early investments exceed returns to later interventions?
  - Developmental plasticity in the early years of life
  - Investment begets investment (self-productivity dynamic)
- **How** do early life health investments translate into future economic outcomes?
  - Why exactly does a healthy child grow up to earn more or live longer than a less healthy child?
  - We do not yet fully understand the mechanisms or key levers

Why infant health might improve **cognition**

- Infancy is a period of rapid neurological development
  - In infancy, 85% calorie intake goes toward brain development
  - The brain doubles in size in infancy (by age 3, 80% of adult volume)
  - Infection diverts nutrients away from neurological growth, inflammation affects gene expression

- We show that simple infant health interventions can raise school test scores as much as an educational intervention like reducing class size

Animation: Clean water in childhood improves cognitive development

- See policy brief at:
  Bhalotra, Brown, Venkataramani 2023

Why infant health might lead to higher **employment and earnings**

- Neurological health- improved cognitive endowment
- Potentially reinforced by investments:
  - *Own* investments in education- lower cost of effort
  - Attract *parental* investments
  - **Compete more effectively for *state* investments in education**
- **We show human capital may *not* lead to earnings if**
  - Institutional constraints - school capacity
  - Demand constraints - demand for skilled women vs men
  - Discrimination- unequal access to good schools or jobs

Why infant health might lower **chronic disease risk in adulthood**

- In a fight to survive, infants challenged by infection and under-nutrition may become programmed with (latent) metabolic traits predictive of chronic disease in late adulthood
  - Barker 1990; Drake and Walker 2004; Petronis 2010
  - e.g. Famine survivors [thrify gene] are obesity-prone
- Chronic disease accounted for 68% of global deaths in 2012.
- Implication: Policy resources in low-cost preventive care in infancy can avoid expensive treatments for chronic disease later
- Scarcely any causal evidence

The intervention and its contemporary relevance

- Pioneering universal no-fee program for newborn health
  - Pillar of emerging welfare state- led to national rollout across Scandinavia
  - Home visits and clinics- information, support, monitoring
  - Emphasis on breastfeeding, sanitation, diet
  - All of this limits infections & catches other problems early
- Contemporary relevance
  - UHC maternal-child health at top of health agenda- Lancet, 2015
  - Surge in funds for such programs in LMICs, no evaluation- Engle 2007
  - Relevant also to Family Nurse Partnership in UK, US

Data and Linkage

Administrative individual longitudinal data: birth, schooling, labour market, death

- Birth records, school registers, census, tax registers, death certificates
  - Match using full name, exact birth date and place of birth
  - Data at age 0, 10, 39, 71
  - We digitised church birth records for 1930-1934, all 25000 births
  - We digitised test scores from primary school catalogs
  - Education, employment, occupation, earnings in 1970 census
  - Pension income in tax register
- Match rates are similar by gender, attrition adjustments by gender
  - Attrition differential by treatment only in school data

School data from paper archives

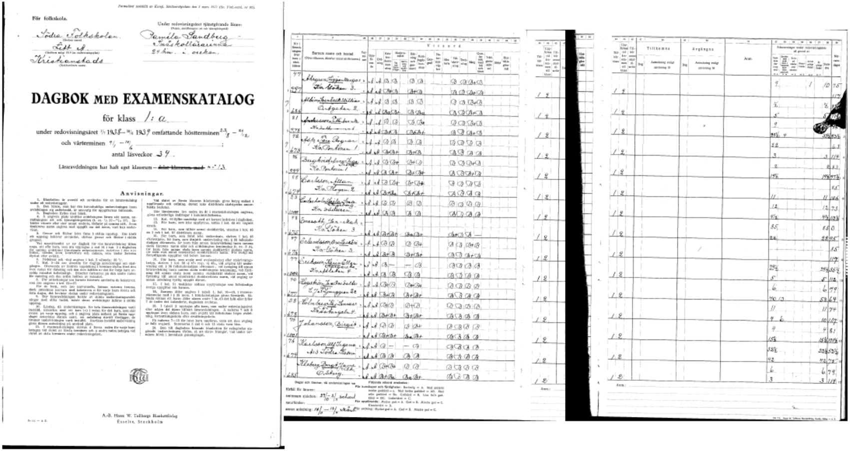


Figure 3. Exam catalogue in *Folkskola*

Identification

Identifying cohort variation- eligibility by birth date

- Every child age 0 to 12 months was eligible
- Define exposure duration as treatment

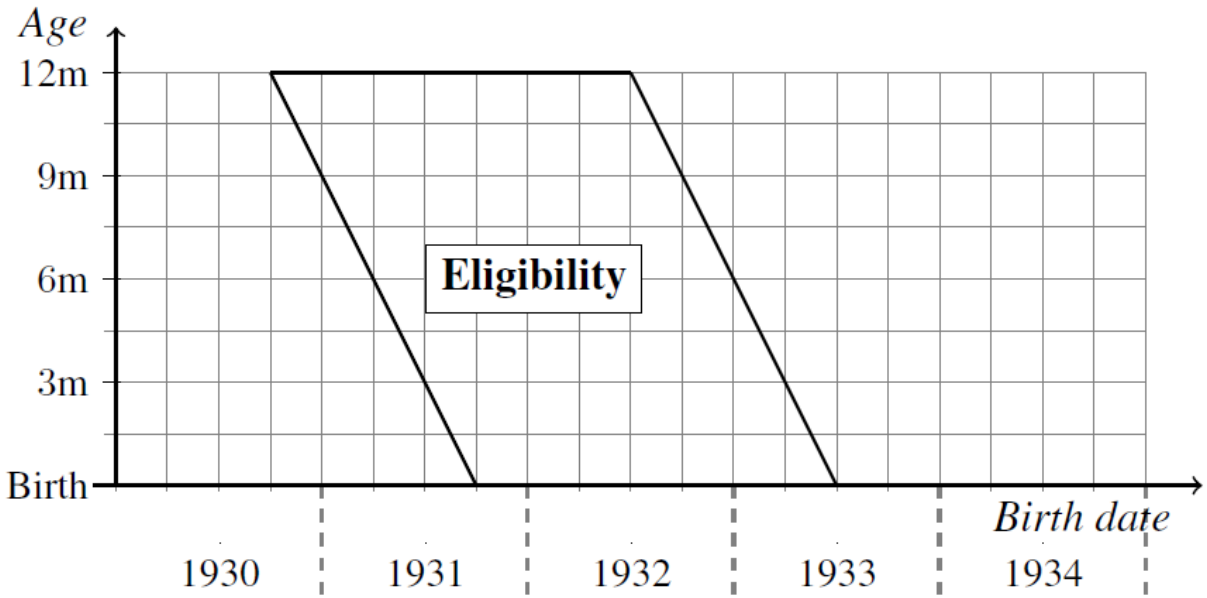


Figure 4. Eligibility by birth date

Matched controls

- 57 rural parishes and 2 cities were treated
- Identify 57 control parishes and 2 control cities w/ Mahalanobis matching

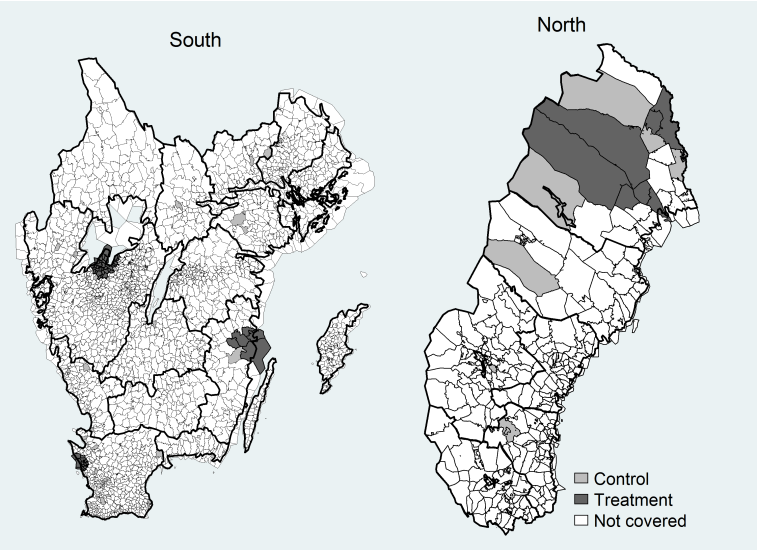


Figure 5. Municipalities containing treated and control districts

Match Quality

Empirical strategy

$$y_{ipt} = \alpha + \beta T_t + \gamma_p + \delta T_t D_p + \sigma_t + \lambda X + u_{ipt}$$

y_{ipt} Outcome y for child i born in parish p on day t

$T_t D_p$ Duration of eligibility x treated parish

γ_p Parish fixed effects

σ_t Quarter of birth $\times$ year of birth FE

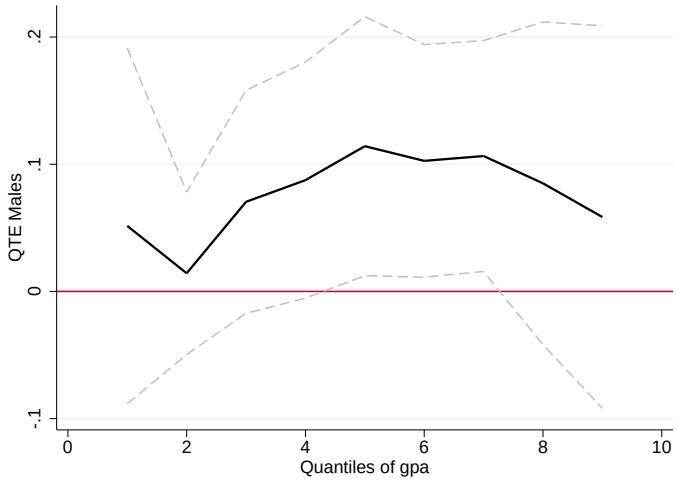
X Covariates

- Bhalotra, et al (2017) present numerous tests to establish that the variation in exposure that we leverage is quasi-experimental: pre-trends, selection into uptake, fertility responses

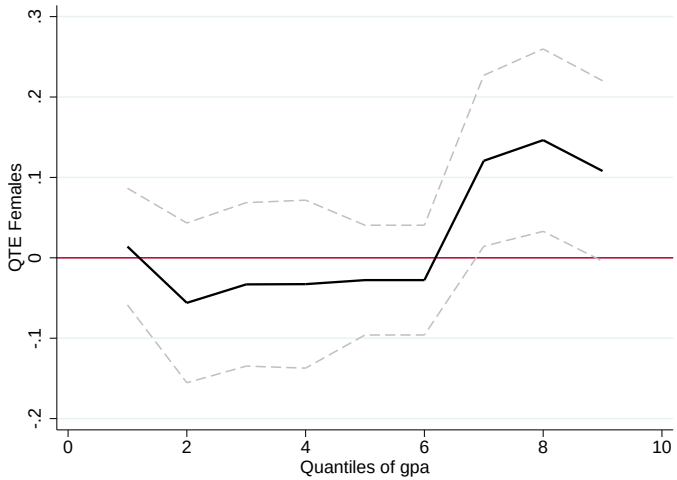
Results- Test Scores and Higher Education

Primary school test scores

- Treatment effects on the distribution are uniform for boys
- For girls the top 40% of the distribution is higher after treatment
- note: Girls had higher test scores in the control group

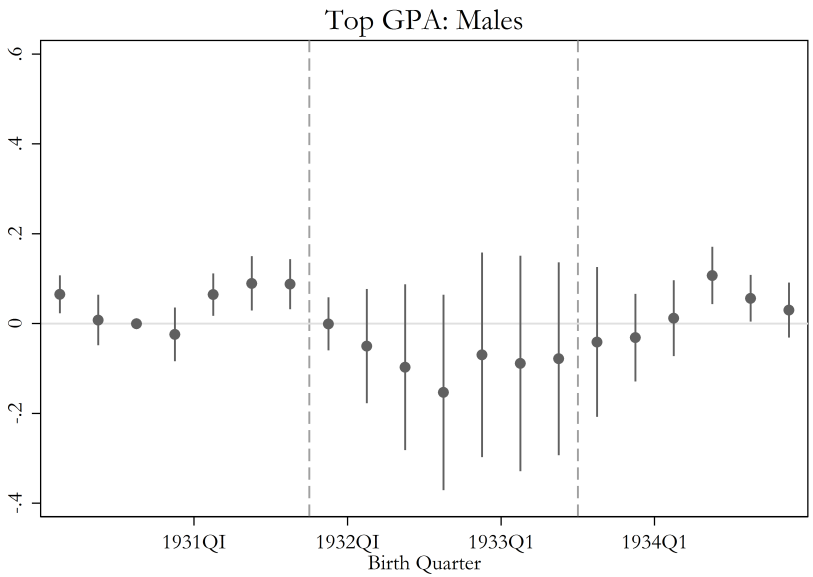


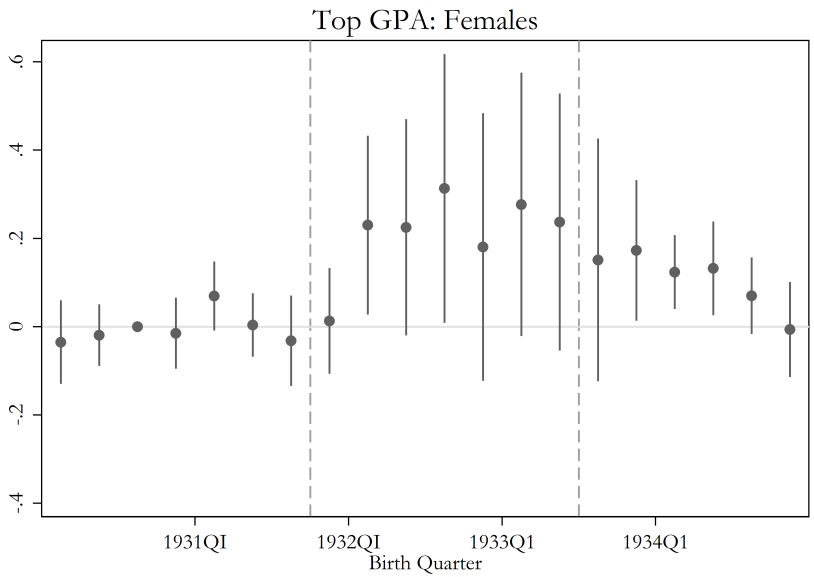
(a) Boys



(b) Girls

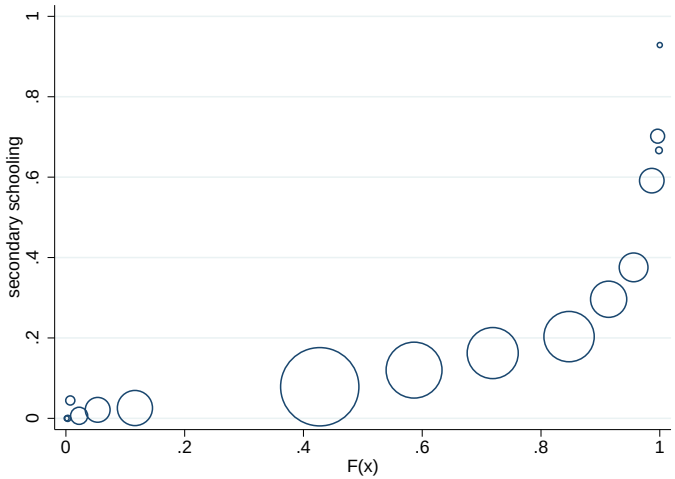
Event Study: Indicator for Top Quintile GPA



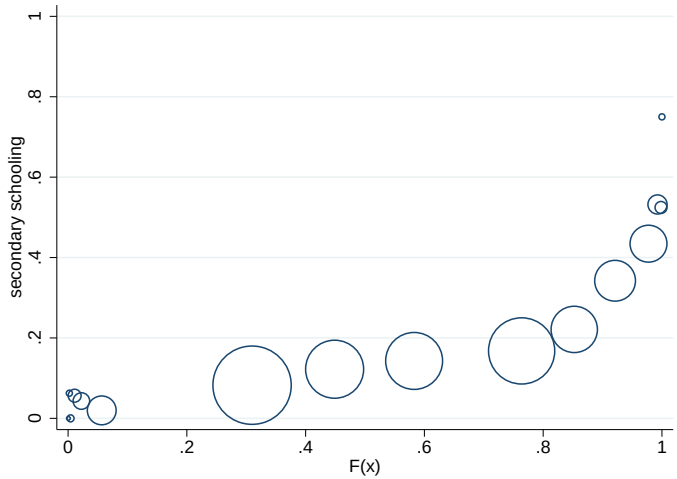


Secondary school entry as a function of primary school GPA

- Primary school was universal but only 20% progressed to secondary
- Secondary school places were limited, and entry competitive

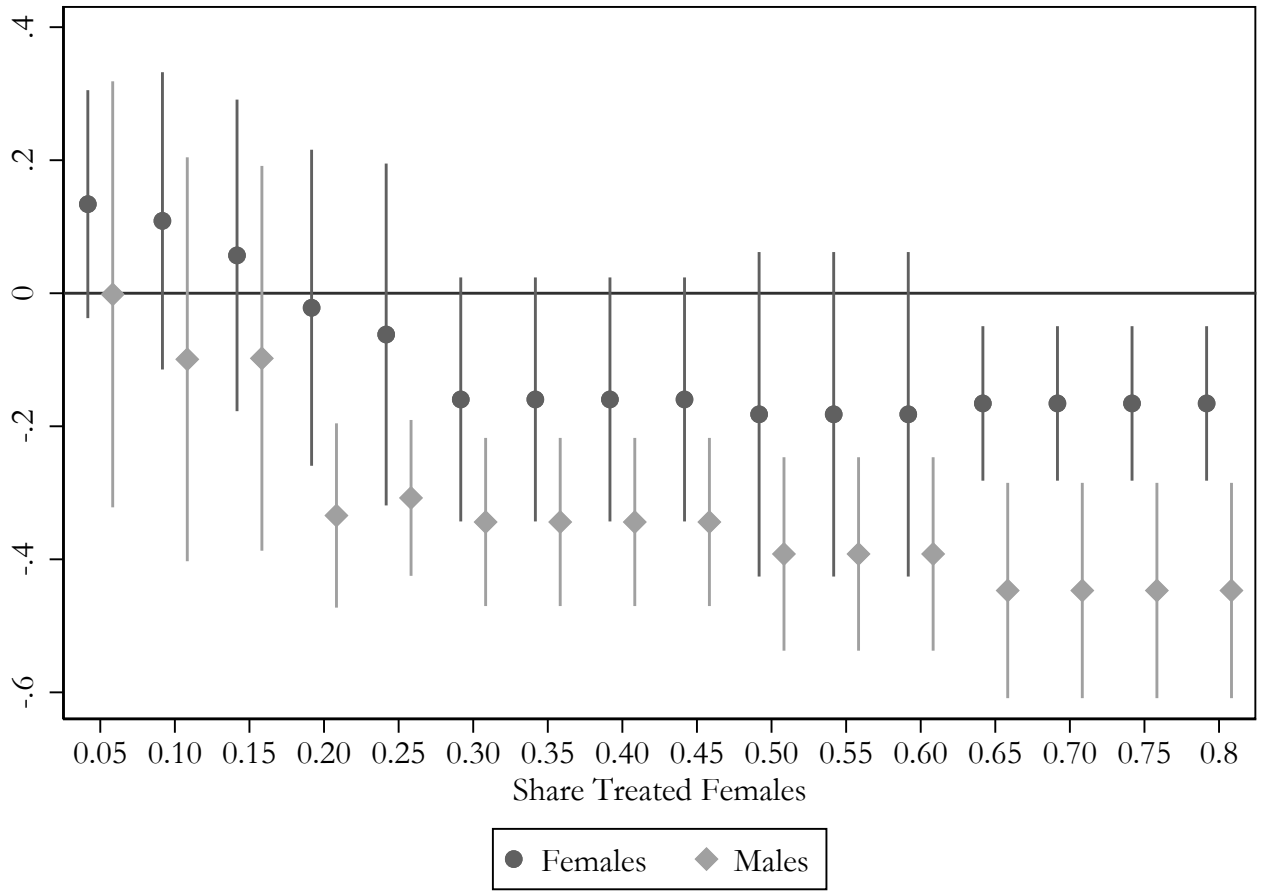


(a) Boys



(b) Girls

Testing displacement of boys by girls in entry to secondary school



Exposure to Treated Children among Treated and Control Males

Results Summary- Schooling

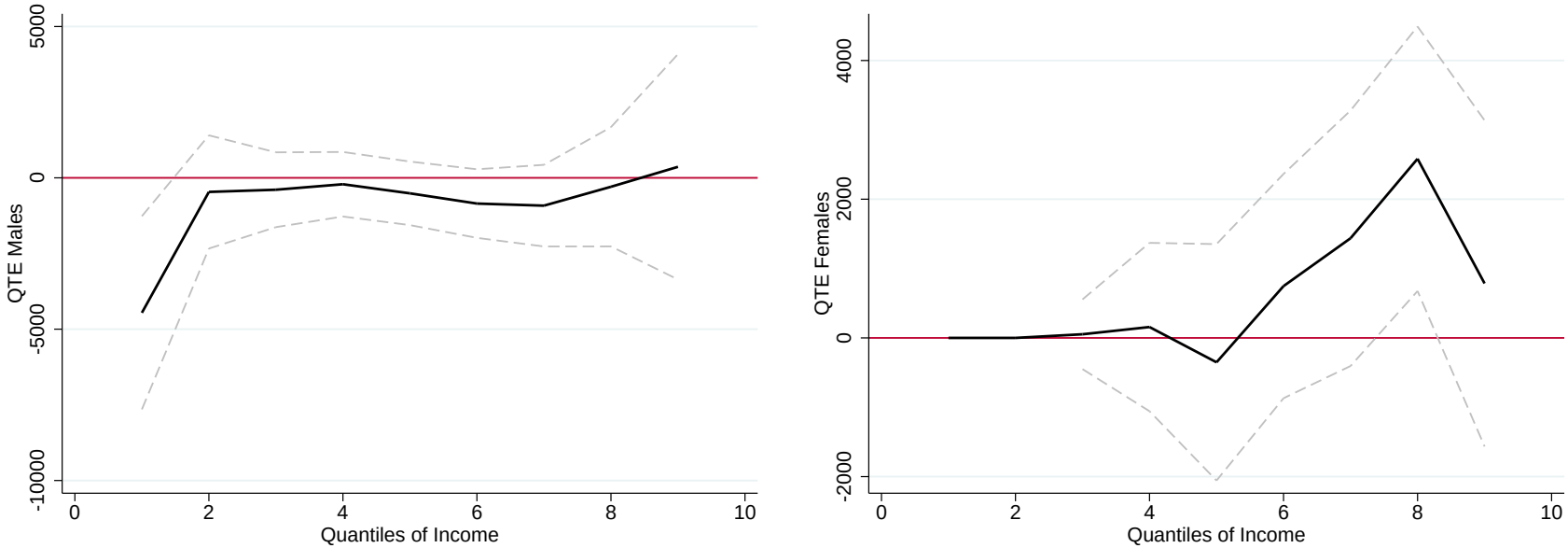
- Treatment effects for boys across distribution, mean 0.10 SD
- Girls 12.4 pp more likely to score in top quintile
- A 3.5 pp increase in secondary school completion for girls

- Insight on mechanisms
  - Under competition, *distributional* effects determined size of economic gains
  - *Capacity constraints* hampered boys' realisation of the full potential of infant health gains

Results- Labour Market Outcomes

Individual earnings

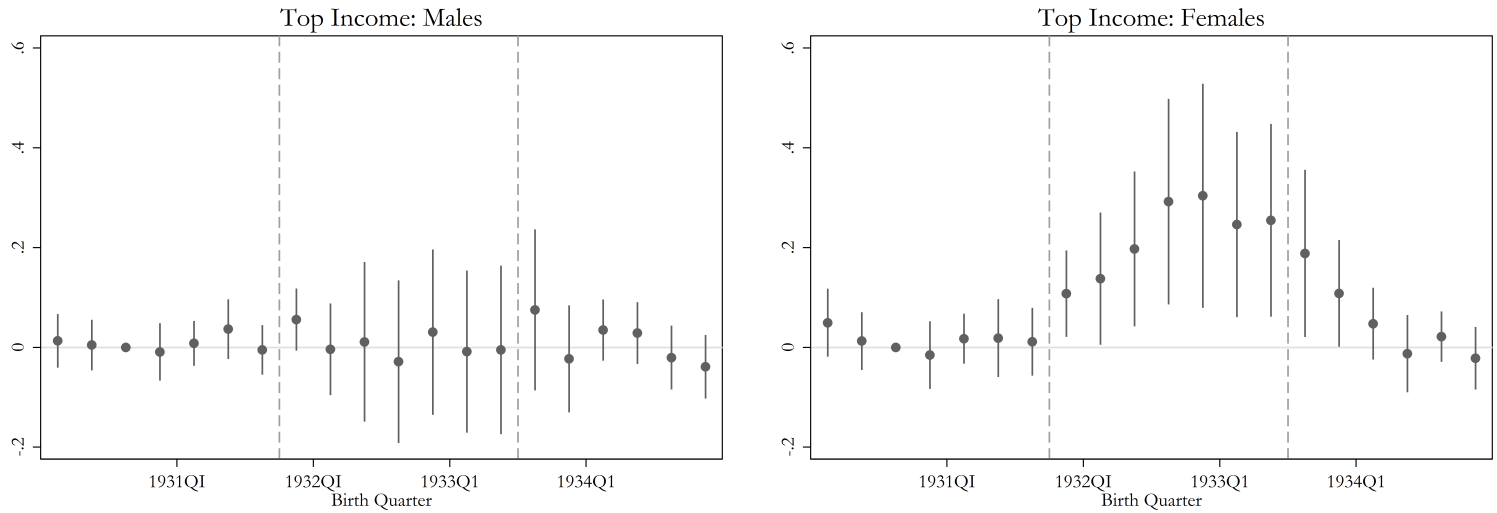
- For women the top 40% of the distribution is higher after treatment
- Pattern bears striking similarity to that for school test scores



(a) Men (b) Women

Figure 9. Treatment effects on the earnings distribution

Event study: Indicator for top quintile earnings



(a) Males (b) Females

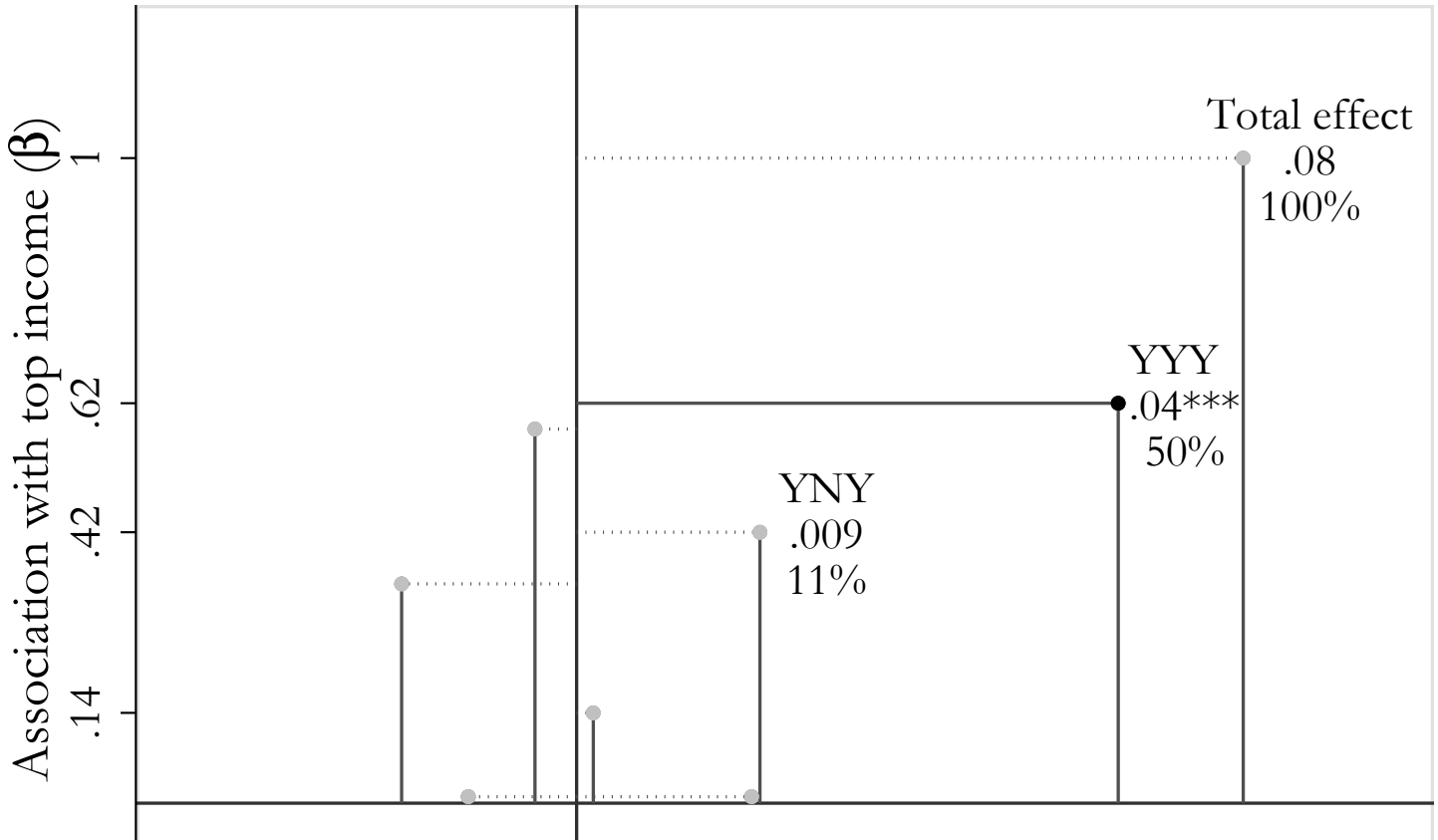
Note: The vertical dashed lines signify the eligibility period.

Results- Labour Market Outcomes

- Large increase in women's earnings reflects:
  - Increase in demand for women's work (extensive margin)
  - Using regional variation we demonstrate that the demand for women workers was driven by welfare state expansion at a time when women with higher skills were emerging on the labour market
  - Women joined the labour force in skilled occupations, as teachers, health workers, managers
- We find no evidence that childcare expansion or evolving gender norms played a role

How much do test scores, secondary school and occupational choice contribute to the increase in women's earnings?

- 50% TE explained by top-GPA, secondary, high occ; 11% if no secondary school
- TopGPA critical lever, explains 70% TE on secondary



Results Summary

- This low cost intervention transformed the lives of post-intervention cohorts and contributed to longevity & economic growth decades later

- Immediate and lasting impact on health
  - Infant death rate fell 24%
  - Life expectancy increased 2.56% points (7.0%)
  - Longevity driven by reduction in mortality from cancer, CVD and infections
  - Similar for men and women
  - **First causal evidence that infection and diet in childhood contribute to chronic disease**

- School performance improved
  - Primary school test scores improved for boys and girls
  - Only girls became more likely to score in top quintile
  - Only girls were more likely to complete secondary school

Results Summary contd.

- Unequal gains (girls win over boys) arise because of capacity constraints- not enough secondary schools in the 1930s
- **New evidence of impacts of infant health on distribution of test scores**

- Labour market outcomes improved
  - Employment, occupation, earnings improved
  - But only for women (gender gaps narrowed)
  - Unequal gains (women vs men) arise because of women's skill acquisition, and demand conditions that favoured women
  - **First evidence that welfare state expansion favours skilled jobs for women**

Conclusions

Conclusions

- Recent policy emphasis on pre-school stimulation
- We show that pre-school health can have similarly large effects

- We illuminate mechanisms linking infant health to earnings
- Potentially large effects, but dependent upon institutional capacity and market demand

- Realising the full potential of early life health investments requires building institutions (that enable skill acquisition) and creating opportunities (demand for skilled workers)

Main Message for Contemporary Policy

- A publicly funded programme targeting infant health produced benefits over and above its target
- Benefits include education, productivity and longevity, emerging over the life course

- Thus the return to investing in infant health is much higher than is commonly recognized, e.g. Copenhagen Consensus
- We estimate a high internal rate of return of 0.22

Thank you for listening!

Backtracking-Why were girls more likely to score high in the first place?

- No gender difference in intervention impact on infant health
- No gender difference in program utilisation
- Hypotheses –
  - Comparative advantage of boys in brawny (non-cog) tasks, Pitt et al2012
  - We show occupational sorting by gender consistent with this
  - Returns to education were higher for girls ▸ Female Returns
  - Cognitive growth curve differs by gender
  - Non-cognitive skills enhance girl effort
  - Lower LFP of women might have led girls to work harder to succeed

Control Group I

- As intended by implementers treated parishes mirrored Sweden at large.
- Balancing tests indicate that treated and matched controls are balanced on observable characteristics.

	All (1)	Treated (2)	Control (3)	Std. Dif. (2) vs. (3)	Matched (5)	Std. Dif. (2) vs. (5)
Panel A: Matching Characteristics from the 1930 Census.						
Agriculture	0.340	0.324	0.340	-0.040	0.302	0.054
Manufacturing	0.318	0.340	0.318	0.096	0.345	-0.018
Fertile Women	0.121	0.101	0.121	-0.135	0.100	0.060
Income	811	839	810	0.042	847	-0.013
Wealth	2,525	2,703	2,521	0.080	2,655	0.022
Urban	0.334	0.439	0.331	0.158	0.437	0.003
Population	6,271,266	258,418	6,004,052		160,987	

Table 1. Characteristics of matched and control districts from the 1930 Census.

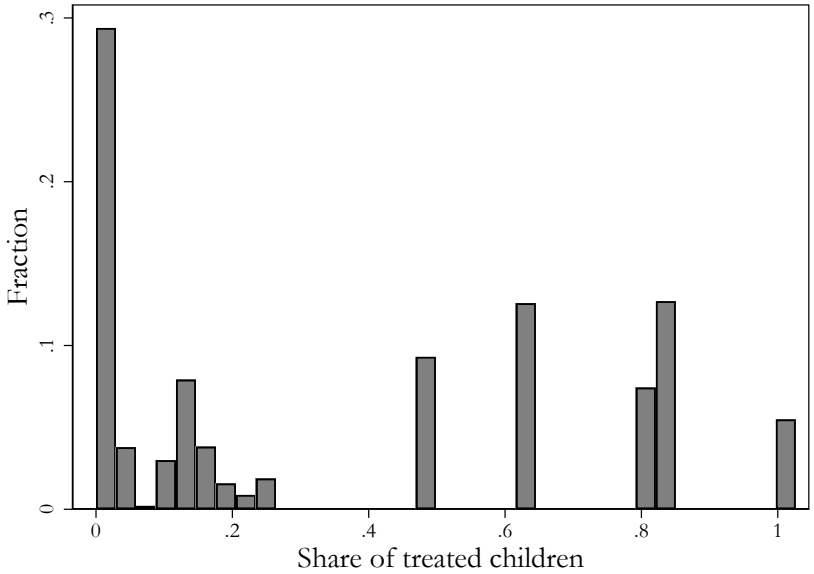
Control Group II

	All (1)	Treated (2)	Control (3)	Std. Dif. (2) vs. (3)	Matched (5)	Std. Dif. (2) vs. (5)
Panel B: Other Pre-Intervention Characteristics.						
Live Birth	0.973	0.974			0.979	-0.024
Wedlock	0.836	0.888			0.884	0.008
Infant Mortality	0.055	0.063			0.064	-0.002
Perinatal Mortality	0.030*	0.017			0.021	-0.017
Infectious Disease	0.005*	0.005			0.006	-0.004
Other Causes	0.020*	0.041			0.038	0.011
Maternal Mortality	348.1	417.275			381.785	0.004
Mother's Age	29.45	29.455			29.610	-0.017
Professional, technical		0.049			0.038	0.037
Administrative, managerial		0.025			0.016	0.046
Clerical		0.016			0.025	-0.045
Sales worker		0.029			0.023	0.031
Service worker		0.022			0.010	0.071
Agricultural		0.297			0.307	-0.015
Production worker		0.426			0.460	-0.048
Institutional Delivery	0.242	0.335	0.239	0.151	0.273	0.096
Weeks Compulsory Schooling	226.2	223.8	226.3	-0.244	223.7	0.012
Seven Years Compulsory	0.606	0.838	0.598	0.392	0.666	0.287

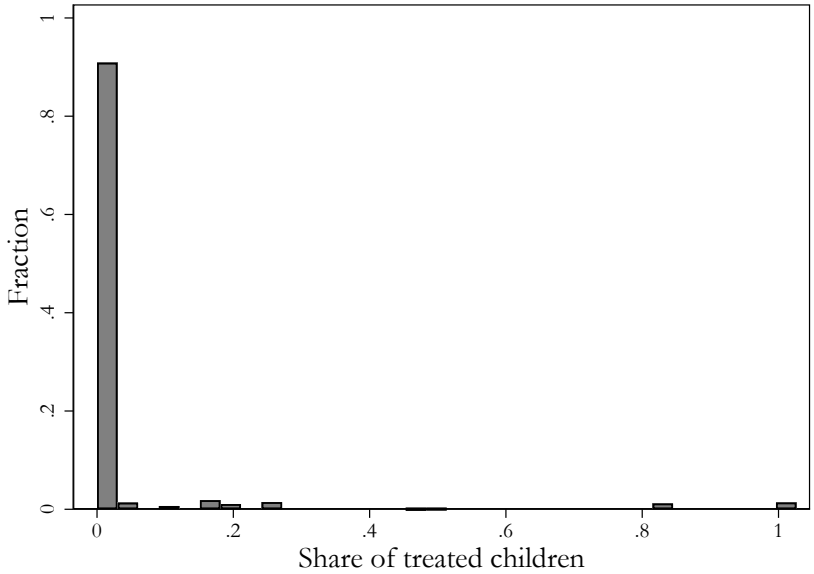
Table 2. Characteristics 1930 from annual medical district reports.

Return

Exposure to Treated Children



(a) Exposure to Treated Children among Treated Males



(b) Exposure to Treated Children among Control Males

Back to Results

Male vs Females Returns to Education

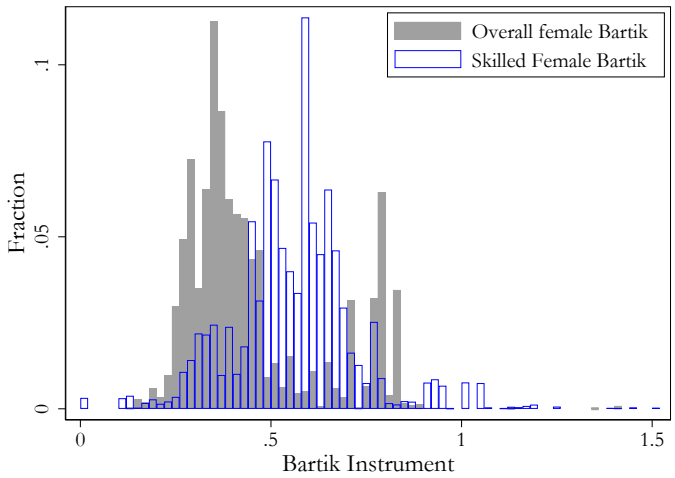
Table 3. Determinants of 1970 earnings.

	Males & Females	Females	Males
Standardised grade 4 GPA	0.0835***	0.0886***	0.0806***
	(0.012)	(0.021)	(0.011)
higher education	0.4684***	0.5531***	0.3746***
	(0.025)	(0.043)	(0.023)
Female child	-1.3725***		
	(0.017)		
Born to younger mother	0.0267	0.0230	0.0282
	(0.042)	(0.073)	(0.040)
Born to older mother	-0.0507***	-0.0332	-0.0690***
	(0.019)	(0.035)	(0.018)
Twin birth	-0.0736	-0.0951	-0.0351
	(0.055)	(0.096)	(0.052)
In-wedlock birth	0.0006	-0.0203	0.0214
	(0.035)	(0.062)	(0.032)
N	11,937	5,957	5,980
r2	0.386	0.048	0.099

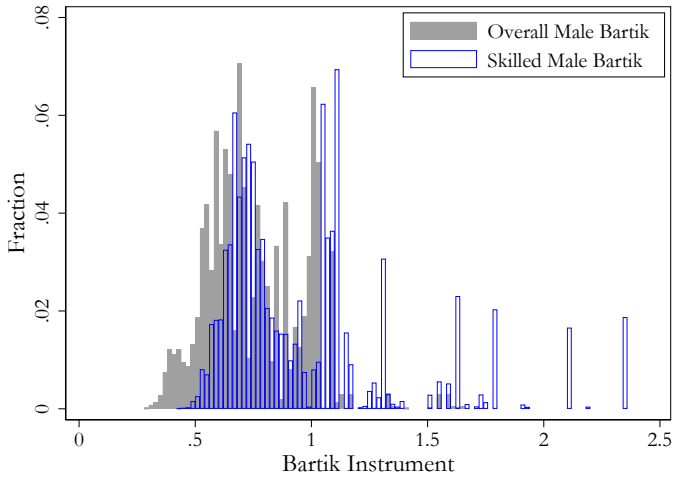
Return

Distribution of the Bartik Instrument

Figure 13. Bartik Instrument for Skilled and Unskilled: Distributions in Sample



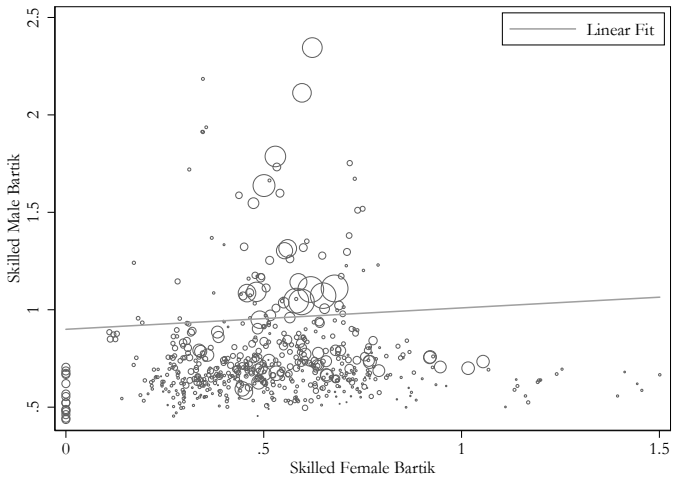
(a) Females



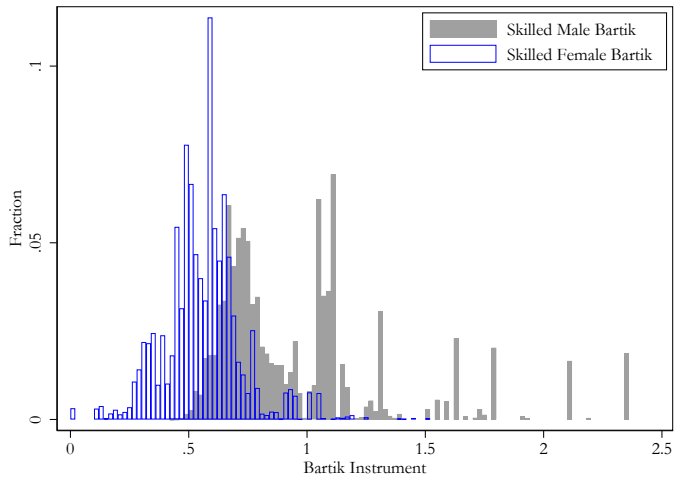
(b) Males

Distribution of the Bartik Instrument

Figure 15. Bartik Instrument for Skilled and Unskilled: Distributions in Sample



(a) Index



(b) Distribution

Distribution of share of treated children that a treated individual is exposed to

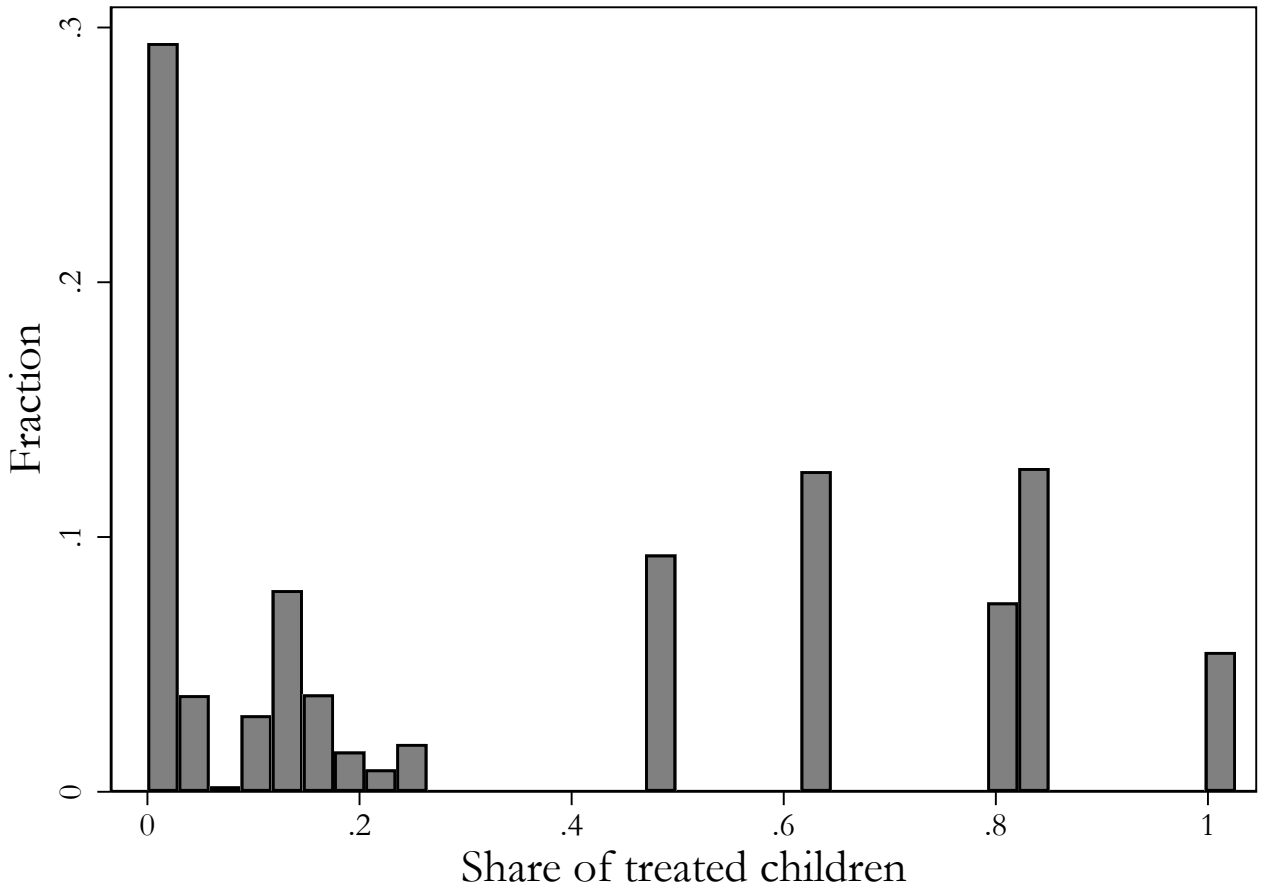


Figure 17. Share of treated children that the index treated child is exposed to

Heterogeneity in intervention effects by share of treated children

Table 4. Share Treated Children, 50km Radius.

	Girls		Boys	
	(1)	(2)	(3)	(4)
Share treated children	< 0.5	> 0.5	< 0.5	> 0.5
Top Income				
DIDI	0.0895**	0.3807***	-0.0253	-0.1179
	(0.036)	(0.081)	(0.030)	(0.220)
Log Income				
DIDI	0.2503***	0.7850**	-0.0544	-0.3546**
	(0.083)	(0.351)	(0.042)	(0.145)
Log Pensions				
DIDI	0.0401	-0.0024	-0.0466*	-0.6169***
	(0.025)	(0.157)	(0.025)	(0.154)
Fulltime				
DIDI	0.1094**	0.2770	-0.0169	-0.2171***
	(0.044)	(0.181)	(0.018)	(0.044)

Distribution of raw test scores at age 10- boys vs girls

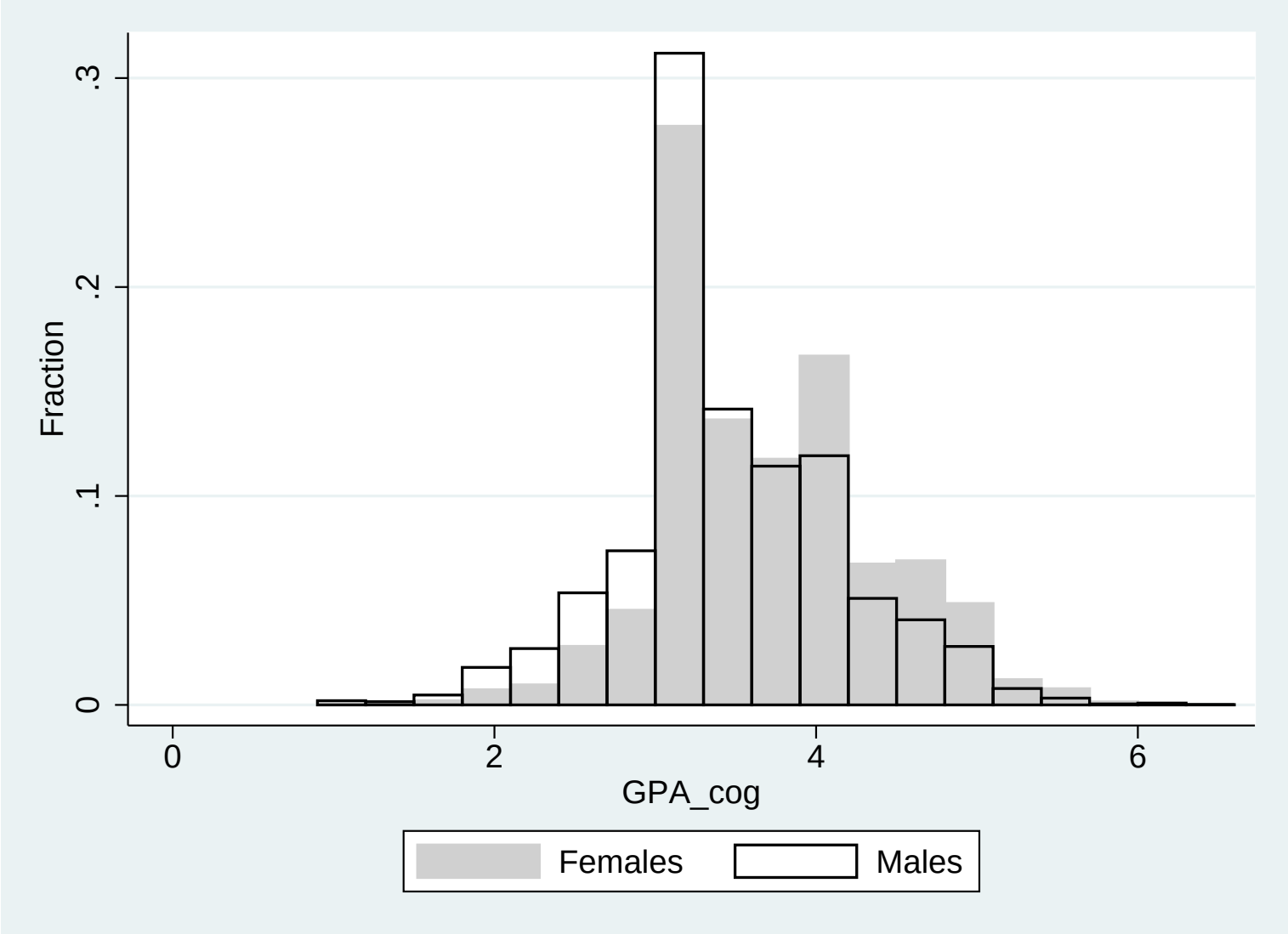


Figure 18. Distribution of test scores: Girls vs. Boys

Results: Linking Effects

Table 5. Correlated Treatment Effects – Females

Outcome 1 / Outcome 2	(1) τ_1	(2) τ_2	(3) τ_Y^{uc}	(4) τ_Y	(5)	(6) corr (τ_{1i}, τ_{2i})	(7)
Top GPA (Primary)							
Secondary	0.1055*	0.0519*	0.0337	0.0664***		0.7738	
	(0.062)	(0.027)		(0.024)	[0.5332	–	0.8426]
High Occ	0.1044*	0.0631	0.0485	0.0856**		0.9848	
	(0.063)	(0.056)		(0.039)	[0.9524	–	0.996]
Top Income	0.1044*	0.0837*	0.0465	0.0704*		0.5420	
	(0.063)	(0.050)		(0.041)	[0.1697	–	0.6484]
Secondary Schooling							
High Occ	0.0396**	0.0815**	0.0276	0.0458***		0.6121	
	(0.017)	(0.038)		(0.014)	[0.2426	–	0.7177]
Top Income	0.0396**	0.0649**	0.0212	0.0392***		0.5825	
	(0.017)	(0.033)		(0.013)	[0.2213	–	0.6857]
High Occupation							
Top Income	0.0817**	0.0650**	0.0376	0.0568**		0.6005	
	(0.038)	(0.033)		(0.024)	[0.2748	–	0.6936]

Related studies in Scandinavia

- The trial was a significant pillar in emergence of the welfare state in Scandinavia
- It motivated rollout of nationwide programmes in Sweden, Denmark and Norway
  - Hjort et al. 2017 analyses health effects of the Danish rollout, similar to our JEEA paper
  - Butifoker et al. 2018 analyses education and earnings effects of the Norwegian rollout, similar to this paper.

Related studies in Scandinavia

- Distinguishing features of our study:
  - Data on cognitive performance, rare that this is linked backwards and forward
  - Outcomes include sectoral employment and occupation, illuminating mechanisms further
  - Distributional effects on test scores and income
  - Different impacts on men and women-which we illuminate

Table 6. Employment

	Women (N=10,256)			Men (N=10,466)		
	Mean	(3)	(4)	Mean	(5)	(6)
Working Parttime	0.265	-0.0325	-0.0244	0.019	-0.0077	-0.0049
		(0.030)	(0.033)		(0.007)	(0.007)
Working Fulltime	0.370	0.0607*	0.0760**	0.925	-0.0052	-0.0061
		(0.031)	(0.037)		(0.014)	(0.015)
Municipal	0.238	0.0377*	0.0488**	0.092	0.0012	0.0102
		(0.020)	(0.020)		(0.014)	(0.016)
Governmental	0.051	0.0306***	0.0339**	0.111	-0.0053	-0.0077
		(0.012)	(0.014)		(0.019)	(0.019)
Parish FE		✓	✓		✓	✓
QOB×YOB FE		✓	✓		✓	✓
SES Effects		✓	✓		✓	✓
School Reforms		✓	✓		✓	✓
Parish Trends			✓			✓

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Table 7. Occupational Sorting

	Women (N=10,301)				Men (N=10,619)			
	Mean				Mean			
	Outc.	*Earn.*	(3)	(4)	*Outc.*	*Earn.*	(5)	(6)
A. Managers, Professionals	0.176	23,909	0.0427**	0.0495***	0.224	44,196	-0.0229	-0.0373**
			(0.019)	(0.019)			(0.021)	(0.019)
B. Accounting, Admin.	0.124	18,825	0.0388	0.0443*	0.036	32,997	-0.0141	-0.0210
			(0.027)	(0.025)			(0.016)	(0.017)
C. Sales	0.083	13,063	-0.0245	-0.0226	0.083	33,742	-0.0052	0.0191*
			(0.018)	(0.017)			(0.014)	(0.011)
D. Agricultural	0.026	3,260	0.0099	0.0070	0.093	21,976	0.0081	0.0085
			(0.007)	(0.007)			(0.012)	(0.014)
E. Mining	0.001	24,678	0.0007	0.0003	0.036	29,266	0.0047	0.0024
			(0.001)	(0.001)			(0.008)	(0.009)
F. Transport, Comm.	0.031	17,346	-0.0081	-0.0062	0.079	27,522	-0.0002	0.0141
			(0.012)	(0.011)			(0.013)	(0.015)
G. Crafts	0.006	31,335	-0.0206	-0.0161	0.335	26,632	-0.0131	-0.0286
			(0.019)	(0.018)			(0.020)	(0.021)
H. Service	0.130	11,288	-0.0087	-0.0033	0.041	29,953	0.0278	0.0238
			(0.015)	(0.016)			(0.019)	(0.020)
I. Out of LF	0.370	2,282	-0.0301	-0.0528**	0.072	9,665	0.0149	0.0190
			(0.024)	(0.026)			(0.014)	(0.015)
Parish FE			✓	✓			✓	✓
QOB×YOB FE			✓	✓			✓	✓
SES Effects			✓	✓			✓	✓
School Reforms			✓	✓			✓	✓
Parish Trends				✓				✓

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Table 8. Descriptive Statistics: Skills and Task Content by Occupation

	Share		Occupational Tasks					Grades
	Occ. Group	Sec. Educ.	Nonr. Manual	Routine Manual	Nonr. Cogn. Interactive	Routine Cog.	Nonr. Cogn. Analytic	GPA
Men and Women								
All	0.76	0.20	1.568	3.889	1.772	4.488	3.488	-0.009
SD	0.42	0.40	1.375	1.087	2.596	3.714	1.950	(0.769)
Managers & Professionals	0.20	0.47	1.400	4.224	3.029	3.555	5.301	0.304
Accounting, Admin.	0.07	0.32	0.114	4.841	0.632	7.798	3.273	0.318
Sales	0.07	0.17	0.595	3.511	2.669	0.945	4.580	0.091
Agricultural	0.06	0.05	2.418	2.935	4.189	2.284	3.006	-0.166
Transport, Comm.	0.06	0.09	2.882	3.257	1.191	2.267	2.162	-0.154
Crafts	0.20	0.02	1.856	4.287	0.425	7.988	2.759	-0.321
Service	0.09	0.08	1.511	2.902	0.990	1.329	1.798	-0.066

Notes: Descriptive Statistics for Tasks. **Columns:** (2) Share in Occ. Group 1970 (3) Share with Secondary Education Within Occupational Group (4)-(8) Average Tasks for Occupational Group (9) GPA in Primary School. *Source:* Linked 1970 Census. Own calculations. Occupational Tasks based on Autor et al. (2003).

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Extensive margin contributes to large increase in earnings

Suppose that prior to the intervention, n_2 individuals work full-time, n_1 individuals work part-time and $1 - n_1 - n_2$ individuals do not work. Their log earnings are y_2, y_1 and y_0, respectively. After the intervention, n_2^1 individuals work full-time and n_1^1 individuals work part-time. The extensive margin effect on earnings may then be calculated as

$$\frac{\Delta y}{y_0} = \frac{\left(n_2^1 - n_2\right)\left[\exp\left(y_2\right) - \exp\left(y_0\right)\right] + \left(n_1^1 - n_1\right)\left[\exp\left(y_1\right) - \exp\left(y_0\right)\right]}{n_2 \exp\left(y_2\right) + n_1 \exp\left(y_1\right) + n_0 \exp\left(y_0\right)} \tag{1}$$

In our case, $n_1^1 - n_1 = 0$, $n_2^1 - n_2 = 0.076$, $y_2 = 9.89$, $y_1 = 9.18$, $y_0 = 7.93$. Hence, we get:

$$\frac{\Delta y}{y_0} = \frac{0.076 \cdot 16,953}{8,022} = \frac{1,288}{8,022} = 16\% \tag{2}$$

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Table 9. Top-8 Occupations by Sex and Earnings Quintile

	Females					Males				
	Top Income			**Others**		**Top Income**			**Others**	
A. Analysis Sample										
1	Class teacher	0.125	1	Not working	0.505	1	Architecht, engineer in construction	0.069	1	Not working	0.084
2	Medical assistant	0.104	2	Store personnel, other	0.067	2	Engineer, mechanical	0.068	2	Driver	0.064
3	Specialised office worker	0.088	3	Cleaner	0.051	3	Subject teacher	0.057	3	Lumberer	0.041
4	Secretary, stenographer	0.052	4	Medical assistant	0.046	4	Other company managers	0.055	4	Farmer	0.040
5	Nurse	0.051	5	Specialised office worker	0.036	5	Purchasing clerk	0.052	5	Machine repairman	0.036
6	Office clerk	0.045	6	Home carer	0.028	6	Engineer in electricity/telecom	0.038	6	Shop mechanic	0.030
7	Subject teacher	0.044	7	Agricultural worker	0.021	7	Driver	0.031	7	Concrete worker	0.025
8	Store personnel, other	0.032	8	Kitchen-maid	0.016	8	Executive	0.030	8	Engineer, mechanical	0.023
	All other	0.458		All other	0.231		All other	0.601		All other	0.657
B. Entire Population, Cohorts 1930–34										
1	Specialised office worker	0.109	1	Not working	0.467	1	Engineer, mechanical	0.085	1	Not working	0.074
2	Class teacher	0.075	2	Store personnel, other	0.079	2	Purchasing clerk	0.071	2	Farmer	0.060
3	Medical assistant	0.074	3	Cleaner	0.050	3	Architecht, engineer in construction	0.064	3	Driver	0.054
4	Secretary, stenographer	0.071	4	Specialised office worker	0.040	4	Other company managers	0.057	4	Shop mechanic	0.035
5	Office clerk	0.067	5	Medical assistant	0.034	5	Executive	0.054	5	Machine repairman	0.034
6	Store personnel, other	0.043	6	Home carer	0.032	6	Engineer in electricity/telecom	0.042	6	Engineer, mechanical	0.029
7	Nurse	0.039	7	Agricultural worker	0.029	7	Subject teacher	0.042	7	Concrete worker	0.025
8	Not working	0.030	8	Kitchen-maid	0.018	8	Public sector managerial	0.026	8	Woodworker	0.025
	All other	0.494		All other	0.251		All other	0.559		All other	0.664

The table reports the most common occupations within the top income quintile and the bottom four income quintiles in 1970, for our sample (panel A) and the entire population of the same cohorts (panel B), respectively. For example 0.125 for class teachers in row 1, panel A, means that 12.5% of all women who were in the top-quintile of the female earnings distribution were class teachers.

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Top Female Occupations in the Male Earnings Distribution

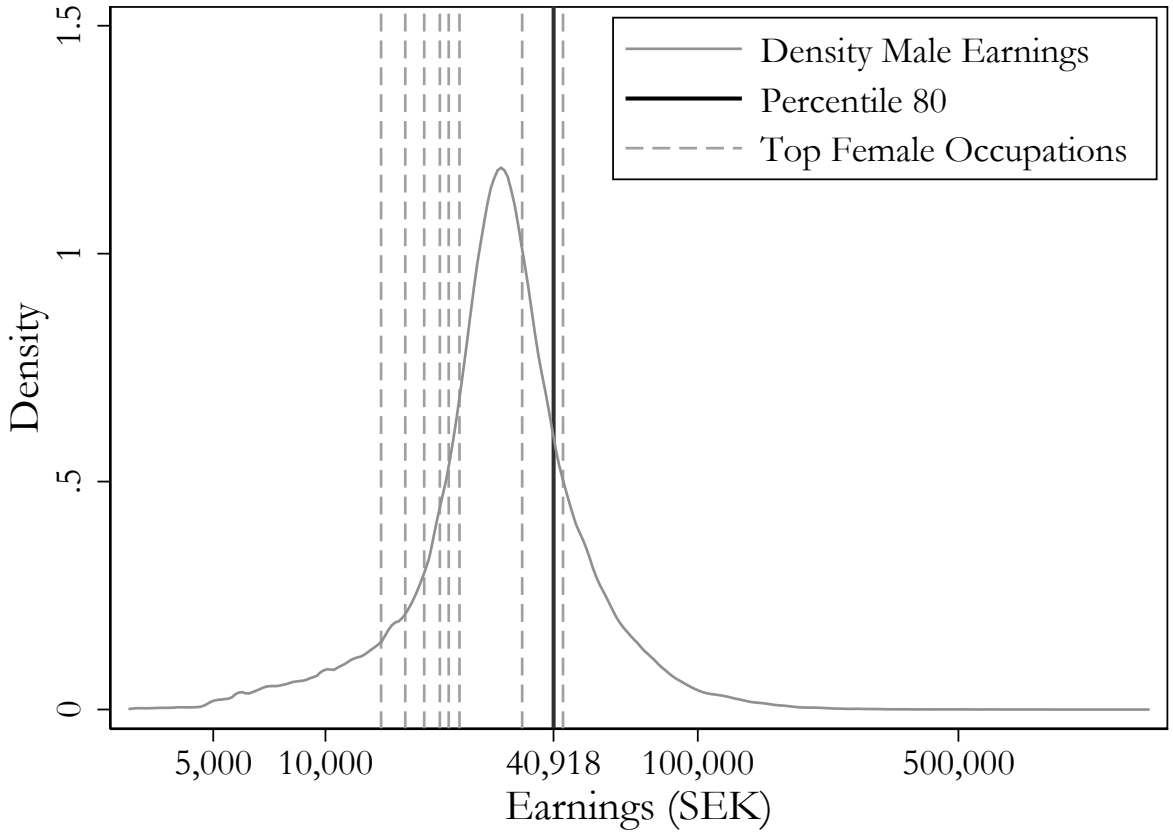

Figure 19. Top Female Occupations in the Male Earnings Distribution

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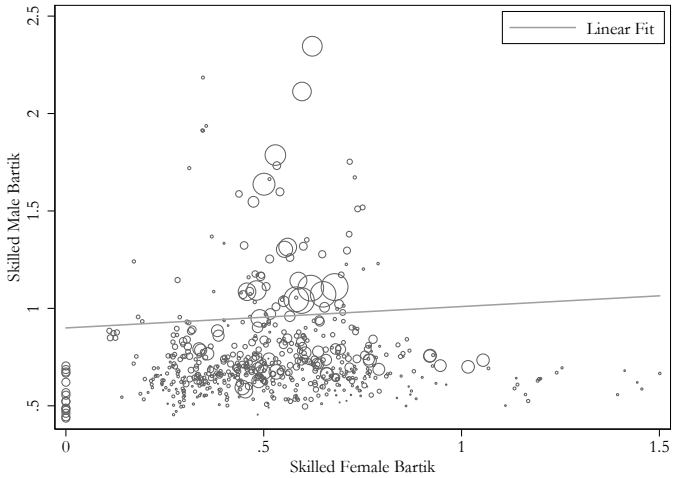
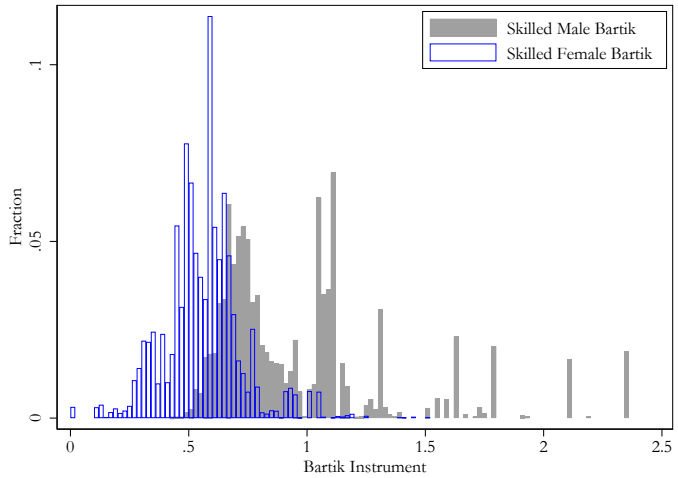
Distribution of the Bartik Instrument

Figure 20. Bartik Instrument for Skilled and Unskilled: Distributions in Sample



(a) Index



(b) Distribution

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Table 10. Effects of the Bartik Index on Labour Market Outcomes

	Index	Working	Top Income	ln(Earnings)	ln(Pensions)	Municipal	Federal
A. Labour Market Outcomes, All Females							
Skilled Female Bartik	0.0576*	0.0792**	0.0091	0.1356*	0.1334	0.0502	0.0199
	(0.031)	(0.035)	(0.038)	(0.076)	(0.100)	(0.031)	(0.022)
F Value	3.560	5.250	0.059	3.155	1.762	2.655	0.809
Baseline	-0.139	0.517	0.216	8.901	10.905	0.234	0.049
N	10,301	10,256	10,301	10,301	8,483	10,256	10,256
B. Labour Market Outcomes, Females with Secondary Schooling							
Skilled Female Bartik	0.0960	0.1823**	0.0710	0.4010	0.1825	0.0985	0.0244
	(0.094)	(0.080)	(0.100)	(0.257)	(0.233)	(0.061)	(0.076)
F Value	1.036	5.154	0.500	2.442	0.614	2.591	0.104
Baseline	0.217	0.737	0.494	9.441	11.660	0.393	0.097
N	1,938	1,935	1,938	1,938	1,656	1,935	1,935
C. Labour Market Outcomes, All Males							
Skilled Male Bartik	0.0013	0.0202***	0.0201*	0.0299	0.0075	-0.0143	-0.0039
	(0.016)	(0.005)	(0.011)	(0.022)	(0.031)	(0.013)	(0.018)
F Value	0.007	17.657	3.178	1.914	0.060	1.290	0.046
Baseline	-0.032	0.777	0.204	10.214	11.885	0.089	0.111
N	10,619	10,466	10,619	10,619	7,710	10,466	10,466
D. Labour Market Outcomes, Males with Secondary Schooling							
Skilled Male Bartik	0.0318*	0.0299*	0.0760**	0.0098	0.0794***	-0.0238	0.0199
	(0.017)	(0.017)	(0.033)	(0.076)	(0.028)	(0.034)	(0.019)
F Value	3.345	3.118	5.218	0.017	7.764	0.481	1.158
Baseline	0.318	0.972	0.639	10.666	12.312	0.221	0.127
N	1,864	1,849	1,864	1,864	1,443	1,849	1,849

*** p <0,01; ** p <0,05; * p <0,1, Standard errors are clustered at the parish level. Working refers to working fulltime or patime. Covariates included in all specifications are a dummy indicating twin births, dummies capturing old (>35 years) and young (<20) mothers, a dummy for married women, a dummy indicating a hospital birth and the treatment effect of the maternal intervention. *Pre-mean* refers to the mean value of the outcome variable before the intervention. *QOB×YOB effects* include quarter-of-birth dummies for each of the 20 quarters. *Parish FE* are fixed effects for the parish the individual lived in at the time of birth. *SES effects* are fixed effects for the professional group of the household head. *Length of schoolyear* are fixed effects controlling for the reforms concerning the length of the school year.

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Rotemberg Weights- Top 5 weight industries

Table 11. Top 5 Rotemberg weight industries

Industry	α_k	g_k	Share (%)
Panel A: Females			
Machinery manufacturing	0.150	0.073	11.362
Elementary school	**0.142**	**0.584**	**11.475**
Grocery stores	0.123	0.316	3.447
Health care	**0.101**	**1.507**	**9.509**
Agriculture	0.093	1.441	3.317
Panel B: Males			
Agriculture	0.805	0.543	7.485
Iron Mining	0.531	3.810	0.126
Fishing	0.135	0.383	0.125
Gardening	0.096	0.323	0.826
Excavation	0.071	50.056	0.004

Note: For definitions, see text and Goldsmith-Pinkham et al (2019). The industry shares are based on the 1950 census, coded according to the 1970 three-digit classification of industries. Growth rates are based on the change at the national level between 1950 and 1970. Sources: Censuses 1950, 1970, own calculations.

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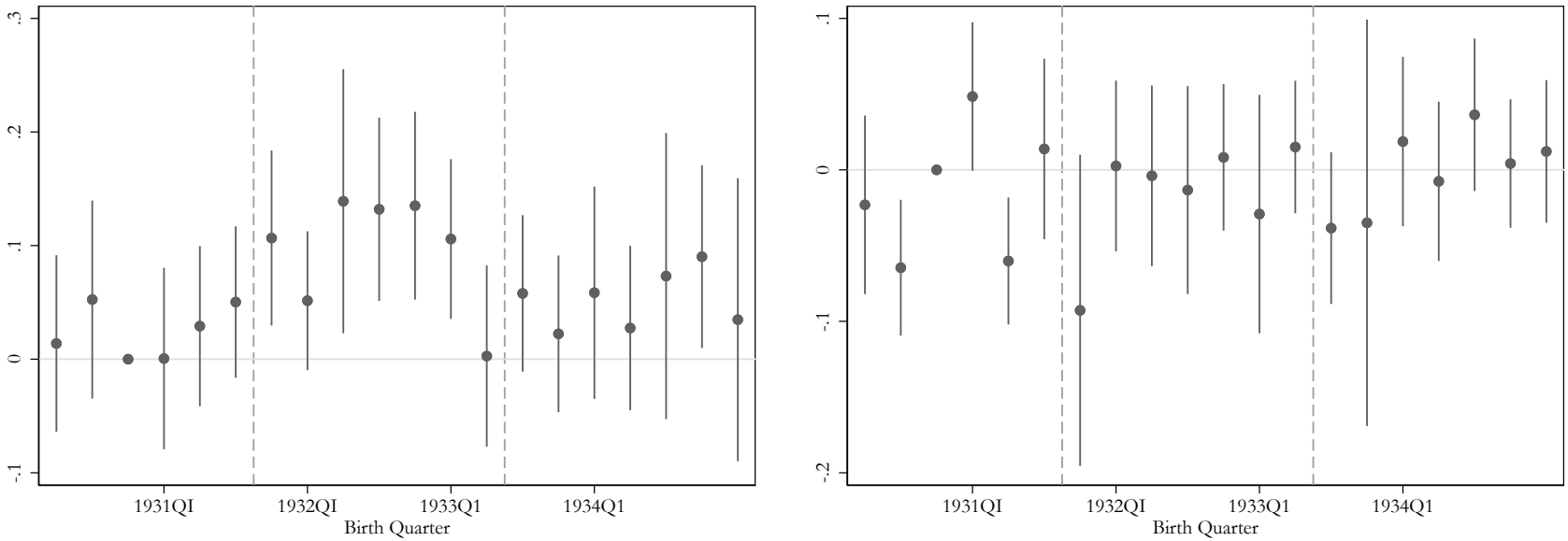
Multiple Hypothesis Testing Concern- Event study for Anderson index of adult outcomes

full-time work, high-ranking occupation, public sector work, earnings, pensions



(a) B (Females)

(b) B (Males)

Figure 22. Adult Outcomes – Index

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Table 12. Lee Bounds for School Test Scores

	Females				Males			
	N	Mean	(1)	(2)	N	Mean	(3)	(4)
A. Top GPA								
Upper Bound	6,378	0.229	0.1029*	0.1255*	6,444	0.119	0.0514	0.0374
			(0.056)	(0.068)			(0.035)	(0.029)
Estimate	6,465	0.227	0.1000*	0.1243*	6,607	0.116	0.0400	0.0275
			(0.058)	(0.070)			(0.033)	(0.028)
Lower Bound	6,363	0.214	0.0824	0.1093	6,462	0.108	0.0211	0.0132
			(0.054)	(0.068)			(0.027)	(0.025)
B. GPA								
Upper Bound	6,397	0.118	0.1315**	0.1535**	6,464	-0.179	0.1434**	0.1232*
			(0.065)	(0.071)			(0.056)	(0.070)
Estimate	6,465	0.098	0.0410	0.0617	6,607	-0.200	0.1213**	0.1084
			(0.048)	(0.053)			(0.056)	(0.070)
Lower Bound	6,342	0.073	-0.0022	0.0217	6,381	-0.240	0.0643	0.0485
			(0.036)	(0.042)			(0.052)	(0.072)
Parish FE			✓	✓			✓	✓
QOB×YOB FE			✓	✓			✓	✓
School FE			✓	✓			✓	✓
SES Effects			✓	✓			✓	✓
Length of Schoolyear			✓	✓			✓	✓
Schoolform			✓	✓			✓	✓
Parish Trends				✓				✓

*** p <0,01; ** p <0,05; * p <0,1. The specifications used in this table correspond to those used in Table 2 in Section 4. Upper and lower bounds are estimated using Lee's method (Lee, 2009). The trimming was carried out conditioning on child gender, and SES and marital status of the household head.

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Table 13. Lee Bounds for Education and Labour Market Outcomes

	Women				Men			
	N	Mean	(1)	(2)	N	Mean	(3)	(4)
A. Secondary Schooling								
Upper Bound	10,244	0.193	0.0513***	0.0508***	10,562	0.161	-0.0542*	-0.0409
			(0.016)	(0.015)			(0.032)	(0.028)
Estimate	10,295	0.198	0.0350**	0.0347**	10,613	0.172	-0.0468	-0.0289
			(0.016)	(0.014)			(0.029)	(0.021)
Lower Bound	10,255	0.200	0.0338**	0.0335**	10,567	0.172	-0.0483	-0.0306
			(0.016)	(0.014)			(0.029)	(0.021)
B. Top Income								
Upper Bound	10,261	0.241	0.0740***	0.0860***	10,566	0.207	-0.0467	-0.0389
			(0.022)	(0.028)			(0.032)	(0.027)
Estimate	0.0653***	0.0787***	10,619	0.210	-0.0445	-0.0361		
			(0.022)	(0.028)			(0.034)	(0.028)
Lower Bound	10,256	0.246	0.0625***	0.0752***	10,563	0.211	-0.0450	-0.0355
			(0.022)	(0.028)			(0.033)	(0.028)
C. Log Income								
Upper Bound	10,245	8.976	0.1547**	0.2285***	10,558	10.216	-0.0571	-0.0453
			(0.060)	(0.065)			(0.036)	(0.036)
Estimate	10,299	8.990	0.1199*	0.1943***	10,619	10.222	-0.0596	-0.0464
			(0.063)	(0.066)			(0.037)	(0.036)
Lower Bound	10,260	9.005	0.0853	0.1635**	10,565	10.230	-0.0721**	-0.0624*
			(0.062)	(0.067)			(0.035)	(0.034)
D. Pensions								
Upper Bound	8,210	11.599	0.0456**	0.0802***	7,577	11.979	-0.0212	-0.0290*
			(0.018)	(0.015)			(0.016)	(0.017)
Estimate	8,283	11.609	0.0293	0.0712***	7,680	11.995	-0.0400**	-0.0400*
			(0.019)	(0.015)			(0.017)	(0.020)
Lower Bound	8,214	11.627	0.0244	0.0667***	7,575	12.014	-0.0630***	-0.0618***
			(0.017)	(0.017)			(0.016)	(0.019)
Parish FE			✓	✓			✓	✓
QOB×YOB FE			✓	✓			✓	✓
SES Effects			✓	✓			✓	✓
School Reforms			✓	✓			✓	✓
Parish Trends				✓				✓

*** p <0,01; ** p <0,05; * p <0,1. The specifications used in this table correspond to those used in Tables **??** and **??** in Section **??**. Upper and lower bounds are estimated using Lee's method (Lee, 2009). The trimming was carried out conditioning on child gender, and SES and marital status of the household head.

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Table 14. Alternative Treatment Indicators

	Log Income	Working Parttime	Working Fulltime	Secondary Schooling	Top Income	Top GPA
	(1)	(2)	(3)	(4)	(5)	(6)
Binary Any Exposure	0.0808	-0.0264	0.0397*	0.0192	0.0337	0.1103**
	(0.075)	(0.029)	(0.023)	(0.015)	(0.021)	(0.050)
Binary Min 3 Months	0.1752***	-0.0394	0.0650*	0.0340*	0.0726***	0.1203**
	(0.053)	(0.037)	(0.033)	(0.019)	(0.027)	(0.058)
Binary at Least First 3 Months Complete	0.1408*	-0.0702	0.0966**	0.0341	0.0645**	0.1909*
	(0.078)	(0.052)	(0.040)	(0.021)	(0.031)	(0.106)
Binary other Treated	0.0481	-0.0032	0.0090	0.0117	0.0169	0.0699**
	(0.088)	(0.022)	(0.022)	(0.019)	(0.025)	(0.032)
Binary 12 Months/Full Eligibility	0.0972	-0.0506	0.0874**	0.0364*	0.0462	0.1434*
	(0.090)	(0.036)	(0.037)	(0.020)	(0.031)	(0.078)
Binary other Treated	0.0741	-0.0177	0.0220	0.0133	0.0287	0.0991**
	(0.076)	(0.028)	(0.021)	(0.018)	(0.022)	(0.043)
Binary Eligible From Birth	0.1388	-0.0498	0.0956***	0.0241	0.0689**	0.1570*
	(0.090)	(0.045)	(0.033)	(0.022)	(0.033)	(0.086)
Binary other Treated	0.0412	-0.0108	0.0018	0.0164	0.0097	0.0806**
	(0.089)	(0.025)	(0.027)	(0.023)	(0.029)	(0.037)
Parish FE	✓	✓	✓	✓	✓	✓
QOB×YOB FE	✓	✓	✓	✓	✓	✓
SES Effects	✓	✓	✓	✓	✓	✓
School Reforms	✓	✓	✓	✓	✓	✓
Parish Trends	✓	✓	✓	✓	✓	✓

*** p <0,01; ** p <0,05; * p <0,1. Standard errors are clustered at the parish level. See Appendix Section **??** for definitions of treatment indicators. Covariates included in all specifications are a dummy indicating twin births, dummies capturing old (>35 years) and young (<20) mothers, a dummy for married women, a dummy indicating a hospital birth and the treatment effect of the maternal intervention. *Mean* refers to the mean value of the outcome variable before the intervention. *QOB×YOB effects* include quarter-of-birth dummies for each of the 20 quarters. *Parish FE* are fixed effects for the parish the individual lived in at the time of birth. *SES effects* are fixed effects for the professional group of the parental household head. *School reforms* refers to the extension of compulsory schooling and length of school year reforms and *Parish trends* allows for parish specific time trends.

Back to robustness checks

Randomisation Inference, Outcomes for Women

- Randomly assign treatment status within each T-C parish pair using 5,000 permutations
- Plot distribution of placebo treatment effects

Figure 23. Randomisation Inference, Women

Back to robustness checks

Randomisation Inference, Outcomes for Men

Figure 24. Randomisation Inference, Men

Back to robustness checks

Table 15. Gelbach Mediation Females.

	Secondary Schooling			High Occupation			Earnings		
Treatment Effect			0.0484*			0.0605			0.1861**
SE			(0.027)			(0.057)			(0.091)
N			6,105			6,105			6,105
Pre-mean			0.189			0.318			9.036
Unexplained = Treatment Effect - $\hat{\delta}$			0.0164			0.0392			0.0854
	$\hat{\Gamma}$	$\hat{\beta}$	$\hat{\delta} = \hat{\Gamma} \times \hat{\beta}$	$\hat{\Gamma}$	$\hat{\beta}$	$\hat{\delta} = \hat{\Gamma} \times \hat{\beta}$	$\hat{\Gamma}$	$\hat{\beta}$	$\hat{\delta} = \hat{\Gamma} \times \hat{\beta}$
Top GPA	0.1073*	0.2951***	0.0320*						
	(0.063)	(0.016)	(0.018)						
Secondary Schooling				0.0484*	0.3652***	0.0177*	0.0484*	-0.0118	-0.0006
				(0.027)	(0.036)	(0.011)	(0.027)	(0.099)	(0.005)
Top GPA & Secondary				0.0662***	-0.0030	-0.0002	0.0662***	0.1540***	0.0102**
				(0.024)	(0.039)	(0.003)	(0.024)	(0.034)	(0.005)
Top GPA & No Secondary				0.0422	0.0910***	0.0038	0.0422	0.0016	0.0001
				(0.046)	(0.018)	(0.004)	(0.046)	(0.039)	(0.002)
High Occ & Secondary							0.0596**	1.5088***	0.0899**
							(0.029)	(0.091)	(0.041)
High Occ & No Secondary							0.0009	1.2271***	0.0011
							(0.043)	(0.038)	(0.052)

Note: $\hat{\beta}$ refers to estimates from full model of interest (dependent variable see columns); $\hat{\Gamma}$ refers to estimates from auxiliary models with each possible mediator acting as dependent variable; $\hat{\delta}$ is component of omitted variable bias estimated to be due to each variable (see Gelbach, 2016).

Return to Mediation

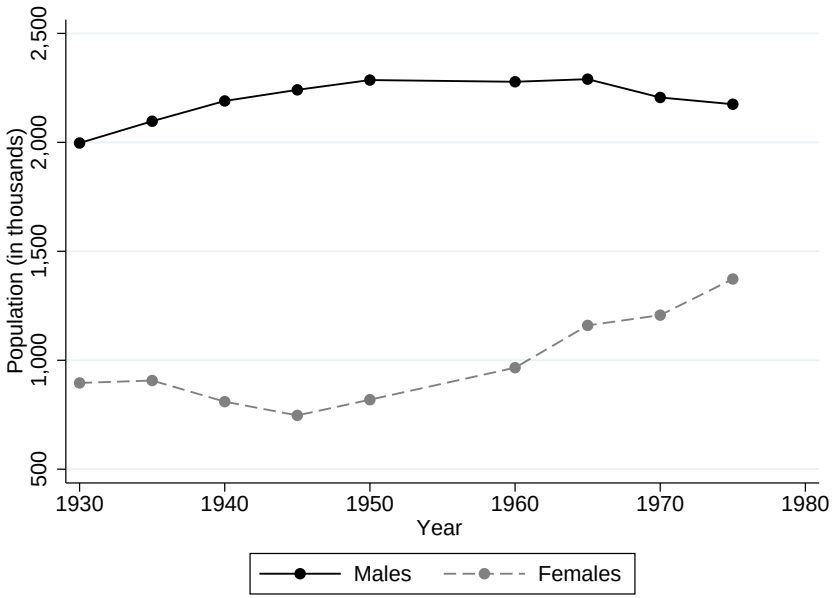

Figure 25. Working Population by Gender

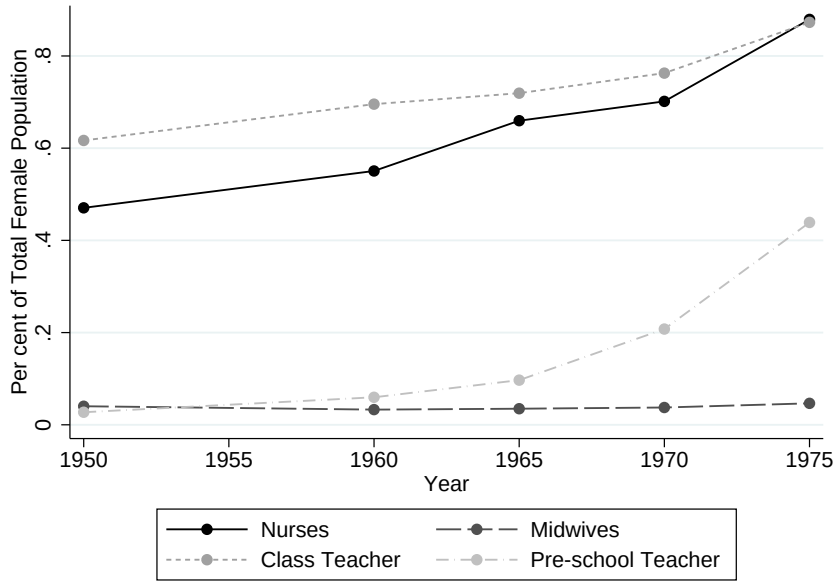

Figure 26. Females working in public sector jobs.

Return to slides

Heterogeneity in Treatment Effects by Local Area Growth- Each Adult Outcome

Table 16. Interacted Estimates, Various Outcomes

	Index	Working	Top Income	ln(Earnings)	ln(Pensions)	Municipal	Federal
Panel A: Labour Market Outcomes – Females							
Treated × Duration Eligibility	0.0721***	0.0413*	0.0808***	0.1843***	0.0788	0.0465**	0.0302**
	(0.022)	(0.024)	(0.028)	(0.058)	(0.201)	(0.019)	(0.015)
Treated × Skilled Female Bartik	0.0070	-0.0077	0.0800	0.2120*	-0.0729	0.0208	-0.0484
	(0.051)	(0.065)	(0.064)	(0.122)	(0.184)	(0.058)	(0.035)
Skilled Female Bartik	0.0409	0.0756*	-0.0471	-0.0085	0.2069	0.0228	0.0381
	(0.039)	(0.045)	(0.046)	(0.083)	(0.127)	(0.040)	(0.032)
Duration Eligibility × Skilled Female Bartik	-0.0309**	-0.0234	-0.0002	-0.0311	-0.2286***	-0.0089	-0.0105*
	(0.013)	(0.017)	(0.013)	(0.026)	(0.079)	(0.014)	(0.006)
Treated × Duration Eligibility × Skilled Female Bartik	0.0581***	0.0411*	0.0100	0.0830*	0.3067***	0.0458**	0.0081
	(0.018)	(0.025)	(0.019)	(0.047)	(0.109)	(0.019)	(0.009)
Baseline	-0.139	0.517	0.216	8.901	10.905	0.234	0.049
N	10,301	10,256	10,301	10,301	8,483	10,256	10,256
Panel B: Labour Market Outcomes– Males							
Treated × Duration Eligibility	-0.0147	-0.0112	-0.0352	-0.0549*	-0.0612	0.0069	-0.0117
	(0.016)	(0.012)	(0.030)	(0.032)	(0.057)	(0.014)	(0.019)
Treated × Skilled Male Bartik	0.0366**	-0.0047	-0.0140	-0.0959**	0.0275	-0.0027	0.0682***
	(0.018)	(0.008)	(0.020)	(0.041)	(0.037)	(0.015)	(0.020)
Skilled Male Bartik	-0.0003	0.0211***	0.0211*	0.0699***	0.0341	-0.0066	-0.0174
	(0.009)	(0.005)	(0.013)	(0.018)	(0.021)	(0.006)	(0.016)
Duration Eligibility × Skilled Male Bartik	-0.0216*	-0.0021	0.0007	-0.0488***	-0.0757**	-0.0203	-0.0084
	(0.012)	(0.004)	(0.009)	(0.016)	(0.033)	(0.020)	(0.007)
Treated × Duration Eligibility × Skilled Male Bartik	0.0169	-0.0020	0.0001	0.0701**	0.0698	0.0363*	-0.0155
	(0.017)	(0.012)	(0.016)	(0.028)	(0.061)	(0.021)	(0.016)
Baseline	-0.032	0.777	0.204	10.214	11.885	0.089	0.111
N	10,619	10,466	10,619	10,619	7,710	10,466	10,466

Note: *** p <0,01; ** p <0,05; * p <0,1, Standard errors are clustered at the parish level. Covariates which are included in all specifications are a dummy indicating twin births, a dummy for being female, dummies capturing old (>35 years) and young (<20) mothers, a dummy for married women, a dummy indicating a hospital birth and the treatment effect of the maternal intervention. *Pre-mean* refers to the mean value of the outcome variable before the intervention took place. *QOB×YOB effects* include quarter-of-birth dummies for each of the 20 quarters. *Parish FE* are fixed effects for the parish the individual lived in at the time of the birth. *SES effects* are fixed effects for the professional group of the household head. *Length of schoolyear* are fixed effects controlling for the reforms concerning the length of the school year.

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Table 17. Heterogeneity in Infant Intervention Effects By Predicted Employment - Skilled Workers

	Index	Working	Top Income	ln(Earnings)	ln(Pensions)	Municipal	Federal
A. Labour Market Outcomes, Women							
Treated × Duration Eligibility	0.0721***	0.0413*	0.0808***	0.1843***	0.0788	0.0465**	0.0302**
	(0.022)	(0.024)	(0.028)	(0.058)	(0.201)	(0.019)	(0.015)
Treated × Skilled Female Bartik	0.0070	-0.0077	0.0800	0.2120*	-0.0729	0.0208	-0.0484
	(0.051)	(0.065)	(0.064)	(0.122)	(0.184)	(0.058)	(0.035)
Skilled Female Bartik	0.0409	0.0756*	-0.0471	-0.0085	0.2069	0.0228	0.0381
	(0.039)	(0.045)	(0.046)	(0.083)	(0.127)	(0.040)	(0.032)
Duration Eligibility × Skilled Female Bartik	-0.0309**	-0.0234	-0.0002	-0.0311	-0.2286***	-0.0089	-0.0105*
	(0.013)	(0.017)	(0.013)	(0.026)	(0.079)	(0.014)	(0.006)
Treated × Duration Eligibility × Skilled Female Bartik	**0.0581*** **	**0.0411***	**0.0100**	**0.0830***	**0.3067*** **	**0.0458** **	**0.0081**
	(0.018)	(0.025)	(0.019)	(0.047)	(0.109)	(0.019)	(0.009)
Baseline	-0.139	0.517	0.216	8.901	10.905	0.234	0.049
N	10,301	10,256	10,301	10,301	8,483	10,256	10,256
B. Labour Market Outcomes, Men							
Treated × Duration Eligibility	-0.0147	-0.0112	-0.0352	-0.0549*	-0.0612	0.0069	-0.0117
	(0.016)	(0.012)	(0.030)	(0.032)	(0.057)	(0.014)	(0.019)
Treated × Skilled Male Bartik	0.0366**	-0.0047	-0.0140	-0.0959**	0.0275	-0.0027	0.0682***
	(0.018)	(0.008)	(0.020)	(0.041)	(0.037)	(0.015)	(0.020)
Skilled Male Bartik	-0.0003	0.0211***	0.0211*	0.0699***	0.0341	-0.0066	-0.0174
	(0.009)	(0.005)	(0.013)	(0.018)	(0.021)	(0.006)	(0.016)
Duration Eligibility × Skilled Male Bartik	-0.0216*	-0.0021	0.0007	-0.0488***	-0.0757**	-0.0203	-0.0084
	(0.012)	(0.004)	(0.009)	(0.016)	(0.033)	(0.020)	(0.007)
Treated × Duration Eligibility × Skilled Male Bartik	**0.0169**	**-0.0020**	**0.0001**	**0.0701** **	**0.0698**	**0.0363***	**-0.0155**
	(0.017)	(0.012)	(0.016)	(0.028)	(0.061)	(0.021)	(0.016)
Baseline	-0.032	0.777	0.204	10.214	11.885	0.089	0.111
N	10,619	10,466	10,619	10,619	7,710	10,466	10,466

*** p <0,01; ** p <0,05; * p <0,1, Standard errors are clustered at the parish level. Covariates included in all specifications are a dummy indicating twin births, dummies capturing old (>35 years) and young (<20) mothers, a dummy for married women, a dummy indicating a hospital birth and the treatment effect of the maternal intervention. *Pre-mean* refers to the mean value of the outcome variable before the intervention. *QOB×YOB effects* include quarter-of-birth dummies for each of the 20 quarters. *Parish FE* are fixed effects for the parish the individual lived in at the time of birth. *SES effects* are fixed effects for the professional group of the household head. *Length of schoolyear* are fixed effects controlling for the reforms concerning the length of the school year.

Table 18. "First-Stage" Estimates- Bartik Instrument Predicts Employment in 1970

	Index	Working	Top Income	ln(Earnings)	ln(Pensions)	Municipal	Federal
Panel A: Labour Market Outcomes, All Females							
Skilled Female Bartik	0.0576*	0.0792**	0.0091	0.1356*	0.1334	0.0502	0.0199
	(0.031)	(0.035)	(0.038)	(0.076)	(0.100)	(0.031)	(0.022)
F Value	3.560	5.250	0.059	3.155	1.762	2.655	0.809
Baseline	-0.139	0.517	0.216	8.901	10.905	0.234	0.049
N	10,301	10,256	10,301	10,301	8,483	10,256	10,256
Panel B: Labour Market Outcomes, Females with Secondary Schooling							
Skilled Female Bartik	0.0960	0.1823**	0.0710	0.4010	0.1825	0.0985	0.0244
	(0.094)	(0.080)	(0.100)	(0.257)	(0.233)	(0.061)	(0.076)
F Value	1.036	5.154	0.500	2.442	0.614	2.591	0.104
Baseline	0.217	0.737	0.494	9.441	11.660	0.393	0.097
N	1,938	1,935	1,938	1,938	1,656	1,935	1,935
Panel C: Labour Market Outcomes, All Males							
Skilled Male Bartik	0.0013	0.0202***	0.0201*	0.0299	0.0075	-0.0143	-0.0039
	(0.016)	(0.005)	(0.011)	(0.022)	(0.031)	(0.013)	(0.018)
F Value	0.007	17.657	3.178	1.914	0.060	1.290	0.046
Baseline	-0.032	0.777	0.204	10.214	11.885	0.089	0.111
N	10,619	10,466	10,619	10,619	7,710	10,466	10,466
Panel D: Labour Market Outcomes, Males with Secondary Schooling							
Skilled Male Bartik	0.0318*	0.0299*	0.0760**	0.0098	0.0794***	-0.0238	0.0199
	(0.017)	(0.017)	(0.033)	(0.076)	(0.028)	(0.034)	(0.019)
F Value	3.345	3.118	5.218	0.017	7.764	0.481	1.158
Baseline	0.318	0.972	0.639	10.666	12.312	0.221	0.127
N	1,864	1,849	1,864	1,864	1,443	1,849	1,849

Note: *** p <0,01; ** p <0,05; * p <0,1, Standard errors are clustered at the parish level. Covariates which are included in all specifications are a dummy indicating twin births, a dummy for being female, dummies capturing old (>35 years) and young (<20) mothers, a dummy for married women, a dummy indicating a hospital birth and the treatment effect of the maternal intervention. *Pre-mean* refers to the mean value of the outcome variable before the intervention took place. *QOB×YOB effects* include quarter-of-birth dummies for each of the 20 quarters. *Parish FE* are fixed effects for the parish the individual lived in at the time of the birth. *SES effects* are fixed effects for the professional group of the household head. *Length of schoolyear* are fixed effects controlling for the reforms concerning the length of the school year.

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Table 19. Heterogeneity in intervention effects by predicted employment– All Workers – Adult Index

	Males & Females		Females		Males
Treated × Duration Eligibility	0.0816***	0.0818***	-0.0157	-0.0114	
	(0.025)	(0.024)	(0.015)	(0.015)	
Treated × Own Overall Bartik	0.0499	0.0623	0.0755*	0.0963**	
	(0.063)	(0.074)	(0.044)	(0.048)	
Own Overall Bartik	-0.0122	-0.0277	-0.0079	-0.0124	
	(0.031)	(0.040)	(0.012)	(0.017)	
Duration Eligibility × Own Overall Bartik	0.0104	0.0219	-0.0284***	-0.0279	
	(0.016)	(0.043)	(0.007)	(0.022)	
Treated × Duration Eligibility × Own Overall Bartik	-0.0038	-0.0137	0.0140	0.0340	
	(0.021)	(0.049)	(0.014)	(0.029)	
Treated × Other Overall Bartik		0.0695		-0.0500	
		(0.045)		(0.058)	
Other Overall Bartik		-0.0285		-0.0246	
		(0.022)		(0.033)	
Duration Eligibility × Other Overall Bartik		-0.0083		0.0017	
		(0.033)		(0.033)	
Treated × Duration Eligibility × Other Overall Bartik		-0.0004		-0.0219	
		(0.047)		(0.036)	

Note: *** p <0,01; ** p <0,05; * p <0,1, Standard errors are clustered at the parish level. Covariates which are included in all specifications are a dummy indicating twin births, a dummy for being female, dummies capturing old (>35 years) and young (<20) mothers, a dummy for married women, a dummy indicating a hospital birth and the treatment effect of the maternal intervention. *Pre-mean* refers to the mean value of the outcome variable before the intervention took place. *QOB×YOB effects* include quarter-of-birth dummies for each of the 20 quarters. *Parish FE* are fixed effects for the parish the individual lived in at the time of the birth. *SES effects* are fixed effects for the professional group of the household head. *Length of schoolyear* are fixed effects controlling for the reforms concerning the length of the school year.

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Table 20. Labour Market Outcomes as a Function of Share of Treated Children in Secondary School Catchment

	Girls		Boys	
	(1)	(2)	(3)	(4)
Share treated children	< 0.5	> 0.5	< 0.5	> 0.5
Top Income				
DIDI	0.0895**	0.3807***	-0.0253	-0.1179
	(0.036)	(0.081)	(0.030)	(0.220)
Log Income				
DIDI	0.2503***	0.7850**	-0.0544	-0.3546**
	(0.083)	(0.351)	(0.042)	(0.145)
Log Pensions				
DIDI	0.0401	-0.0024	-0.0466*	-0.6169***
	(0.025)	(0.157)	(0.025)	(0.154)
Fulltime				
DIDI	0.1094**	0.2770	-0.0169	-0.2171***
	(0.044)	(0.181)	(0.018)	(0.044)

Table 21. Top-8 Occupations by Sex and Earnings Quintile

	Females				Males			
	Top Income		**Others**		**Top Income**		**Others**	
A. Analysis Sample								
1	Class teacher	0.125	Not working	0.505	Architecht, engineer in construction	0.069	Not working	0.084
2	Medical assistant	0.104	Store personnel, other	0.067	Engineer, mechanical	0.068	Driver	0.064
3	Specialised office worker	0.088	Cleaner	0.051	Subject teacher	0.057	Lumberer	0.041
4	Secretary, stenographer	0.052	Medical assistant	0.046	Other company managers	0.055	Farmer	0.040
5	Nurse	0.051	Specialised office worker	0.036	Purchasing clerk	0.052	Machine repairman	0.036
6	Office clerk	0.045	Home carer	0.028	Engineer in electricity/telecom	0.038	Shop mechanic	0.030
7	Subject teacher	0.044	Agricultural worker	0.021	Driver	0.031	Concrete worker	0.025
8	Store personnel, other	0.032	Kitchen-maid	0.016	Executive	0.030	Engineer, mechanical	0.023
	All other	0.458	All other	0.231	All other	0.601	All other	0.657
B. Entire Population, Cohorts 1930–34								
1	Specialised office worker	0.109	Not working	0.467	Engineer, mechanical	0.085	Not working	0.074
2	Class teacher	0.075	Store personnel, other	0.079	Purchasing clerk	0.071	Farmer	0.060
3	Medical assistant	0.074	Cleaner	0.050	Architect, engineer in construction	0.064	Driver	0.054
4	Secretary, stenographer	0.071	Specialised office worker	0.040	Other company managers	0.057	Shop mechanic	0.035
5	Office clerk	0.067	Medical assistant	0.034	Executive	0.054	Machine repairman	0.034
6	Store personnel, other	0.043	Home carer	0.032	Engineer in electricity/telecom	0.042	Engineer, mechanical	0.029
7	Nurse	0.039	Agricultural worker	0.029	Subject teacher	0.042	Concrete worker	0.025
8	Not working	0.030	Kitchen-maid	0.018	Public sector managerial	0.026	Woodworker	0.025
	All other	0.494	All other	0.251	All other	0.559	All other	0.664

The table reports the most common occupations within the top income quintile and the bottom four income quintiles in 1970, for our sample (panel A) and the entire population of the same cohorts (panel B), respectively. For example 0.125 for class teachers in row 1, panel A, means that 12.5% of all women who were in the top-quintile of the female earnings distribution were class teachers.

Top Female Occupations in the Male Earnings Distribution

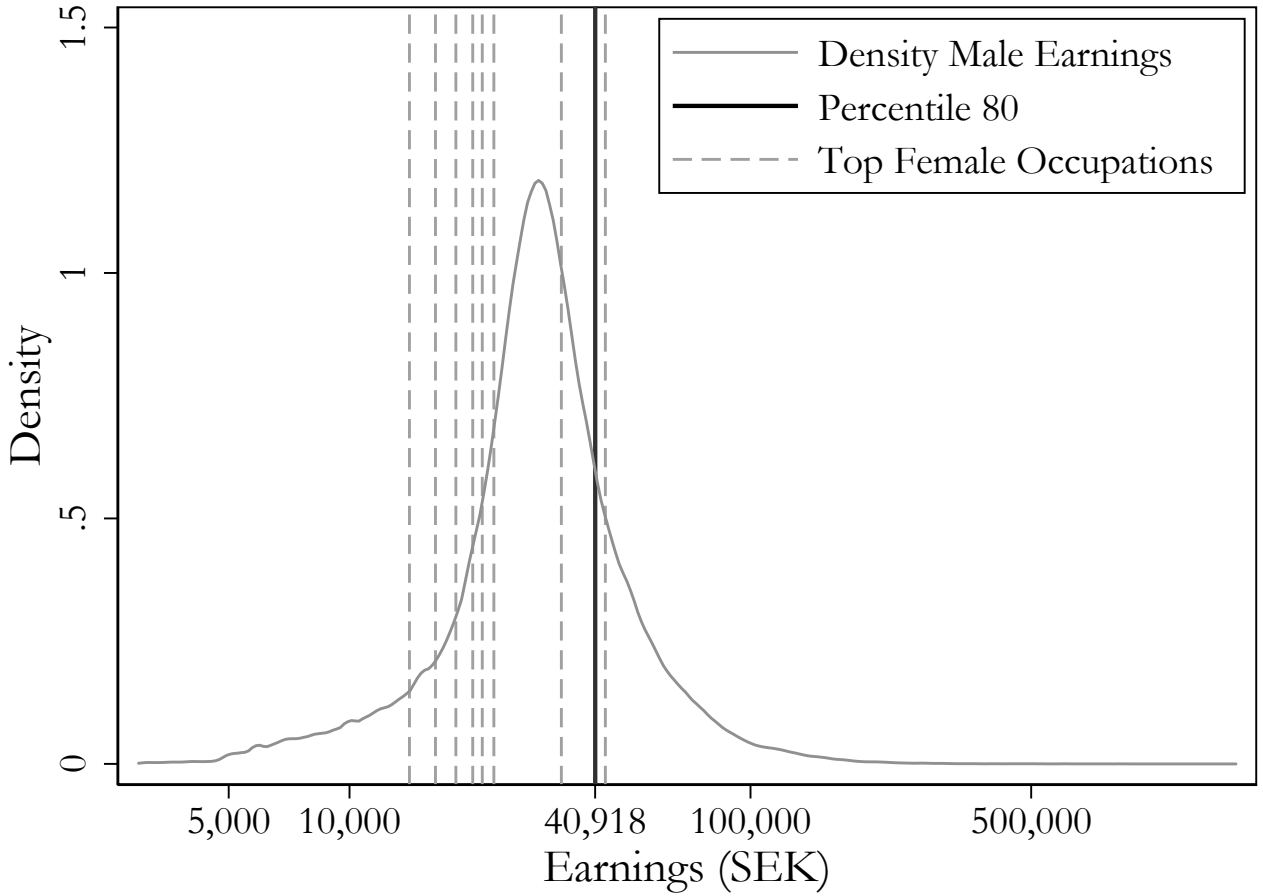


Figure 27. Top Female Occupations in the Male Earnings Distribution

Table 22. Effects of the Bartik Index on Labour Market Outcomes

	Index	Working	Top Income	ln(Earnings)	ln(Pensions)	Municipal	Federal
A. Labour Market Outcomes, All Females							
Skilled Female Bartik	0.0576*	0.0792**	0.0091	0.1356*	0.1334	0.0502	0.0199
	(0.031)	(0.035)	(0.038)	(0.076)	(0.100)	(0.031)	(0.022)
F Value	3.560	5.250	0.059	3.155	1.762	2.655	0.809
Baseline	-0.139	0.517	0.216	8.901	10.905	0.234	0.049
N	10,301	10,256	10,301	10,301	8,483	10,256	10,256
B. Labour Market Outcomes, Females with Secondary Schooling							
Skilled Female Bartik	0.0960	0.1823**	0.0710	0.4010	0.1825	0.0985	0.0244
	(0.094)	(0.080)	(0.100)	(0.257)	(0.233)	(0.061)	(0.076)
F Value	1.036	5.154	0.500	2.442	0.614	2.591	0.104
Baseline	0.217	0.737	0.494	9.441	11.660	0.393	0.097
N	1,938	1,935	1,938	1,938	1,656	1,935	1,935
C. Labour Market Outcomes, All Males							
Skilled Male Bartik	0.0013	0.0202***	0.0201*	0.0299	0.0075	-0.0143	-0.0039
	(0.016)	(0.005)	(0.011)	(0.022)	(0.031)	(0.013)	(0.018)
F Value	0.007	17.657	3.178	1.914	0.060	1.290	0.046
Baseline	-0.032	0.777	0.204	10.214	11.885	0.089	0.111
N	10,619	10,466	10,619	10,619	7,710	10,466	10,466
D. Labour Market Outcomes, Males with Secondary Schooling							
Skilled Male Bartik	0.0318*	0.0299*	0.0760**	0.0098	0.0794***	-0.0238	0.0199
	(0.017)	(0.017)	(0.033)	(0.076)	(0.028)	(0.034)	(0.019)
F Value	3.345	3.118	5.218	0.017	7.764	0.481	1.158
Baseline	0.318	0.972	0.639	10.666	12.312	0.221	0.127
N	1,864	1,849	1,864	1,864	1,443	1,849	1,849

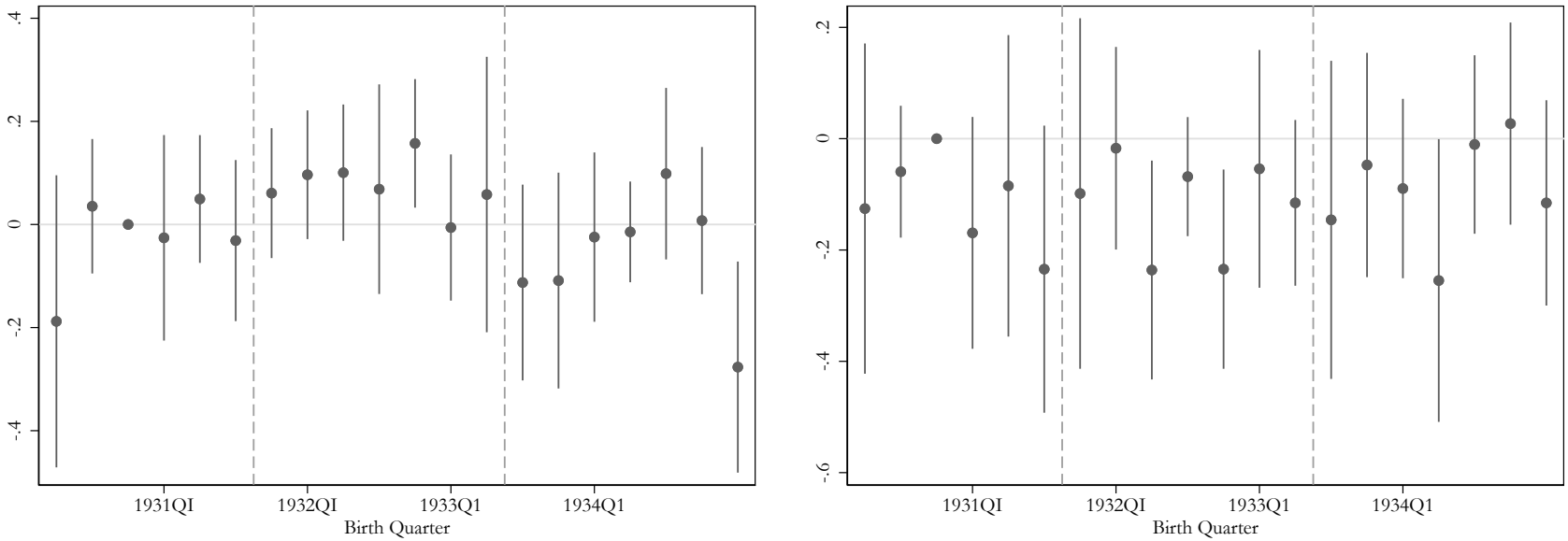
*** p <0,01; ** p <0,05; * p <0,1, Standard errors are clustered at the parish level. Working refers to working fulltime or patime. Covariates included in all specifications are a dummy indicating twin births, dummies capturing old (>35 years) and young (<20) mothers, a dummy for married women, a dummy indicating a hospital birth and the treatment effect of the maternal intervention. *Pre-mean* refers to the mean value of the outcome variable before the intervention. *QOB×YOB effects* include quarter-of-birth dummies for each of the 20 quarters. *Parish FE* are fixed effects for the parish the individual lived in at the time of birth. *SES effects* are fixed effects for the professional group of the household head. *Length of schoolyear* are fixed effects controlling for the reforms concerning the length of the school year.

Table 23. Correlations

	α_k	g_k	$Var\,(z_k)$
A. Women			
α_k	1.000	-0.149	0.895
g_k	-0.149	1.000	-0.151
Var(z_k)	0.895	-0.151	1.000
B. Men			
α_k	1.000	0.019	0.367
g_k	0.019	1.000	-0.093
Var(z_k)	0.367	-0.093	1.000

For definitions, see text and Goldsmith-Pinkham et al. (2019). The industry shares are based on the 1950 census, coded according to the 1970 three-digit classification of industries. Growth rates are based on the change at the national level between 1950 and 1970. Sources: Censuses 1950, 1970, own calculations.

Event study for Anderson school index including top-GPA and secondary school



(a) B (Females)

(b) B (Males)

Figure 28. Age 10 Outcomes – Index

The Educational System

- Schooling in Sweden started in the **year a child turned 7**.
- Compulsory for **6 years**.
- Majority of pupils attended school full time.
- Different **school forms**: *Main forms* and *Exception forms*.
- Beginning of 1940s: 90% of pupils went to school assigned to main forms.
- Reforms concerning compulsory schooling from 1936 onwards (Fischer et al., 2015) $\rightarrow$ **can control for all these changes and school form**.

Return

The Marking System

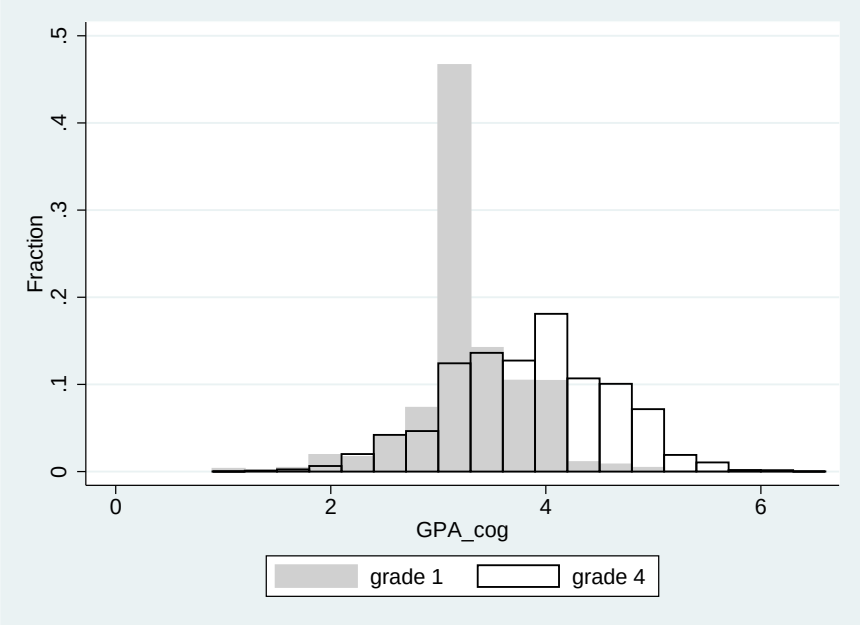
- Grading scale from 1897.
- + and - signs to express strength or weakness of marks.
- *Ba* defined as "normal" mark (1/3 of pupil's cohort).
- *A and C* only in really exceptional cases.
- Translated into **7-point grading scale** (A=7; C=1)

Mark	Meaning
A	Passed with great distinction
a	Passed with distinction
AB	Passed with great credit
Ba	Passed with credit
B	Passed
BC	Not entirely passable
C	Fail

Table 24. Grading scale

Return

School Data



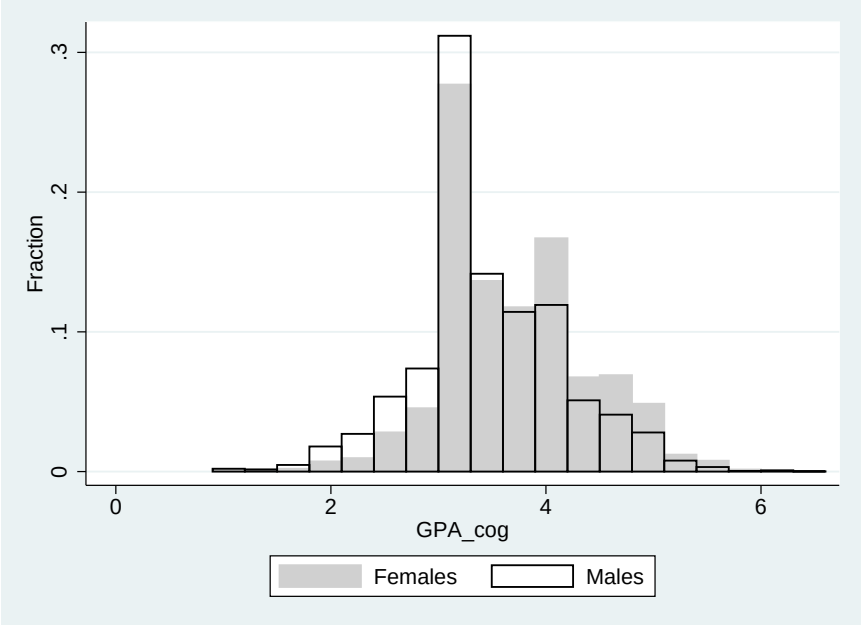


Figure 29. Fraction of GPA by grade and gender.

Return

Complementary Investments over the Lifecourse and the Racial Earnings Gap

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[1]Warwick University, [2]Universities of Chile and Exeter, [3]University of Pennsylvania

May 15, 2023

Papers: The Antibiotic Revolution

S.Bhalotra, D. Clarke, A. Venkataramani. 2022. Shadows of the Captain of the Men of Death. *RR, Journal of Political Economy*

S.Bhalotra, D. Clarke, A. Venkataramani. 2022. The black-white earnings Gap-Complementary policy investments over the life course. *Mimeo*.

S.Bhalotra, A. Venkataramani, S Walther. 2022. Women's labor market and fertility responses to a health innovation. *Journal of the European Economic Association 2023*

Pneumonia: the Captain of the Men of Death

- In 1930s America, pneumonia accounted for 1 in 10 deaths, and was the leading cause of infant mortality, barring premature birth
- Morbidity scales with mortality [proxy]
- In the 1930s, pneumonia in children resulted in an average of 39 days of disability (Britten, 1942), and some children suffered multiple episodes. There is thus a medical basis for long run developmental consequences

The policy shock

- Antibiotic innovation in 1937 provided the first treatment for pneumonia
  - Antibiotic properties of sulfanomides [sulfa drugs] were identified in a German textile lab.
  - Following clinical trials in London and NT, they became widely available in America in 1937
- Sharp drop in infant mortality from pneumonia [*trend break*]
- Larger drop in states with higher baseline pneumonia [*convergence*]
- We identify long run impacts of treatment leveraging these cohort and state patterns
  - Acemoglu and Johnson 2007, Bleakley 2007, 2010

Main results

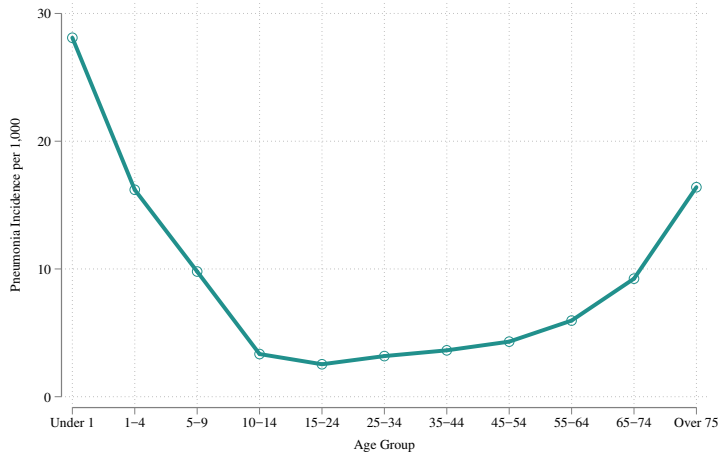
- Children born after the antibiotic revolution grow up to have higher employment and earnings and lower work-related disability
- Economic gains are larger for men than for women, consistent with more limited labour market opportunities for women (Coles and Francesconi 2019; Bhalotra et al. 2022)
- Economic gains for black men are decreasing in segregation, being large in the North and close to zero in the South

Relevance of results

- Pneumonia is still the leading cause of child death, killing 800,000 children p.a. worldwide - more than malaria, tuberculosis and AIDS combined
- Only 20% of children who need antibiotics access them
- Child mortality is a policy target but governments under-estimate the long run benefits of intervention for **survivors**
- Our findings demonstrate that realizing the potential economic benefits of early life health interventions depends upon [unequal] labour market opportunities

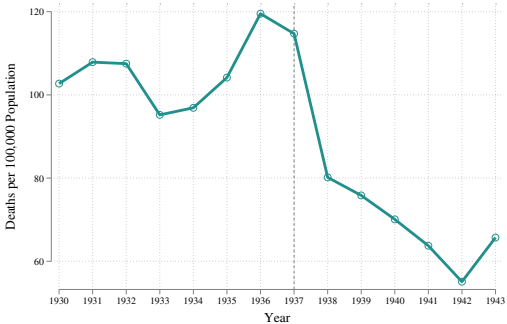
First Stage:Trend break and state convergence in (infant) mortality

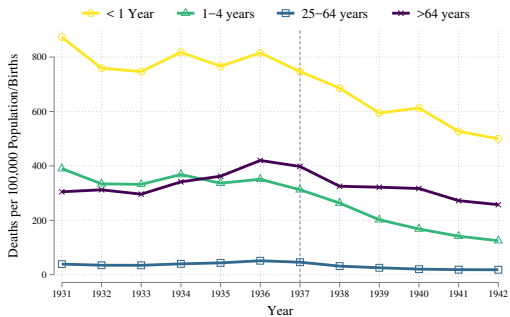
Figure 1: Pneumonia was much more likely to affect infants than adults



Notes: Deaths per 1,000 population from pneumonia in 1935-1937 by age group. Source: Britten 1942.

Figure 2: Antibiotic availability from 1937 led to a sharp drop in pneumonia mortality, esp among infants

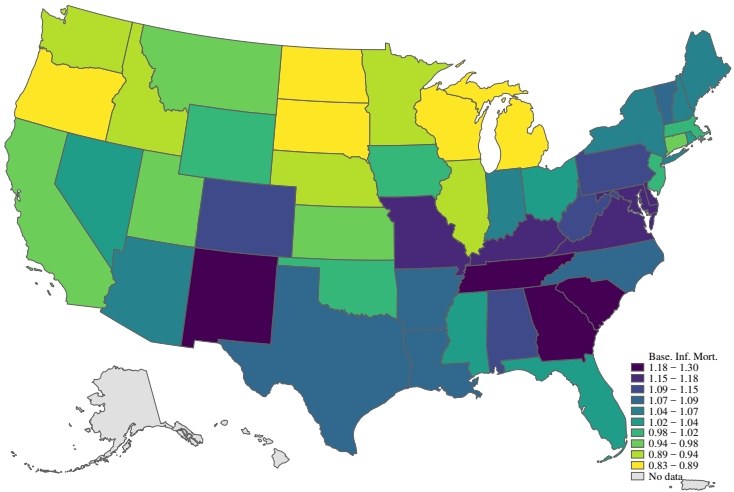




Notes: U.S. Vital Statistics.

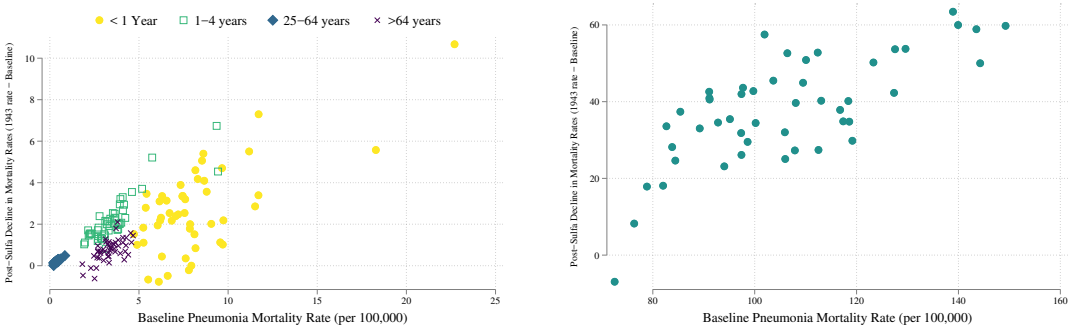
trend breaks table

Figure 3: There was considerable variation in the pneumonia burden across states in the pre-antibiotic era



Notes: Deaths per 1,000 population from pneumonia and influenza over 1930-1936. Source: U.S. Vital Statistics.

Figure 4: The drop in pneumonia was larger in states with higher pre-antibiotic burdens, driving convergence in pneumonia across the states

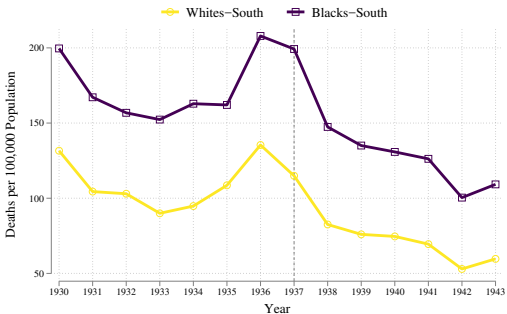


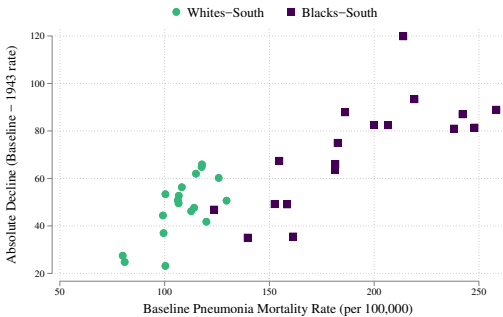
(a) All age

(b) By age group

Notes: Base pneumonia (and influenza) mortality is the 1930-36 average. It varies from 80 per 100,000 deaths (Oregon, Washington, California) to 150 (Colorado, Nevada, Arizona). Every dot is a state. Source: US Vital Statistics.

Figure 5: The trend break and convergence were evident among Blacks and Whites in the North and South





Notes: Panel B plots the difference between mortality rates post and pre-sulfa by race. Trend breaks among blacks are larger in absolute magnitude.

convergence table

Empirical strategy

Base Specification

- We expect that the arrival of antibiotics in 1937 drove convergence of pneumonia mortality across states and that this is mirrored in convergence in long run outcomes
  - Continuous DiD event study: Adult outcome regressed on interaction of 1(post-1937) with pre-1937 pneumonia burden in birth state
  - Condition on FE for birth state birth year, census year, all by race and gender
  - Cohorts 1930-1943. This avoids the influenza epidemic of 1928-9 and the penetration of penicillin after 1943
- Identification rests on a strong parallel trends assumption that we investigate (Callaway et al 2021)
- We investigate heterogeneity by a measure of diffusion and by gender and race

Average causal responses

- Single adoption date i.e. a block treatment design (Athey & Imbens 2020)
  - We can estimate dynamic effects without the concern that heterogeneity in TE contaminates 2×2 comparisons, leading to undesired weights in TWFE models (Goodman Bacon 2021; de Chaisemartin D'Haultfoeuille 2020)

- Continuous DD with varying treatment intensity
- Motivates estimation of average causal responses of exposure (ACR)
  - ACR captures av change in the outcome owing to marginal changes in exposure
  - Under a *strong parallel trends* assumption, TWFE are a weighted average of ACR (Callaway et al., 2021)

Scrutinizing the strong parallel trends assumption

- Trends in outcomes for states with a baseline dosage p are a good counterfactual for trends that all other states would have followed, had they been assigned p.
  - Generalization of standard assumption that trends in outcomes for untreated units are a good counterfactual for trends in outcomes of treated units, had they not been treated

- Tests:
  - Examine dose responses by decile
  - Avoid the assumption by discretization at the median

Scrutinizing weights

- Even if TWFE estimate a weighted average of dose-specific ACR, the weighting may not be the desired weighting- e.g. it may give more weight to ACR for doses which are rare in the data

- Tests:
  - Examine the weighting functions- how do the weights implicitly generated by TWFE compare to the frequency of true doses observed in the population
  - Re-estimate TWFE, reweighting with the analytical distribution of observed doses rather than the naive weighting function.

Specification checks

- Even if we cannot reject parallel trends, this may be because we are under powered
- Main concern is omitted var correlated with base-pneumonia - though to act as confounders they will have had to induced convergence in the outcomes from 1937 onwards
- Control for these var as (baseline times post-1937)
  - Mortality from placebo diseases- diarrhea (under the age of 2), malaria, heart disease, tuberculosis, and cancer
  - Mortality from other diseases treatable with sulfa- scarlet fever, erysipelas, meningitis and puerperal sepsis (MMR)
  - State income p.c., illiteracy, urbanization rates, schools, health spending
  - Census division or region times cohort FE, state trends

Results: Long run causal effects on economic outcomes

Table 1: Antibiotic exposure in infancy drives improvements in adult education, employment, earnings and disability- Total Population

	Schooling	log(Family Income)	Cognitive Disability	Work Limiting Disability
Post × Base Pneumonia Influenza	0.310***	0.0489***	-0.00682	-0.00796**
	(0.0991)	(0.0115)	(0.00593)	(0.00387)
FWER p-value	[0.059]	[0.008]	[0.475]	[0.192]
Effect Size	0.0590 years	0.929 %	-0.129 pp	-0.151 pp
N	1,458,665	4,134,467	1,328,396	4,215,361

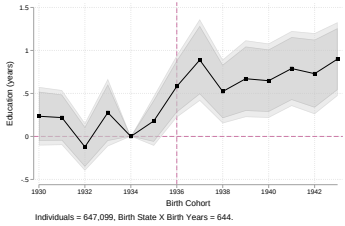
Notes: Sample: 1930-1943 birth cohorts. Controls: birth state and birth year fixed effects, census division X year FE ; post×baseline control diseases; post*baseline state income, literacy, urbanization, school and hospital infrastructure, physicians and pharmacists p.c, controls for ME. **Effect sizes are for a 1 s.d. decline in pneumonia mortality (0.19 deaths per 1000)**

Table 2: White Men

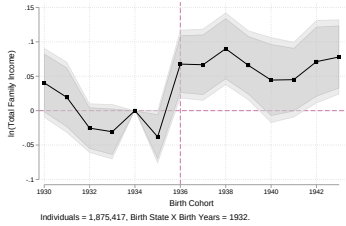
	Schooling	log(Family Income)	Cognitive Disability	Work Limiting Disability
Post × Base Pneumonia Influenza	0.593***	0.0721***	-0.000357	-0.0140***
	(0.130)	(0.0176)	(0.00908)	(0.00357)
FWER p-value	[0.002]	[0.004]	[0.969]	[0.005]
Effect Size	0.113 years	1.37 %	-0.00679 pp	-0.266 pp
N	647,099	1,841,454	590,738	1,875,417

Notes: See Notes to previous table.

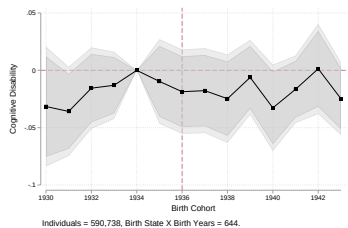
Figure 6: Event study – White men



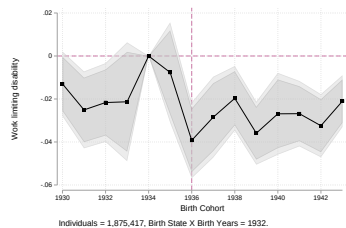
(a) Education



(b) log(Family Income)



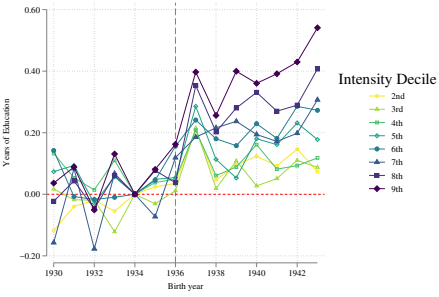
(c) Cognitive Disability



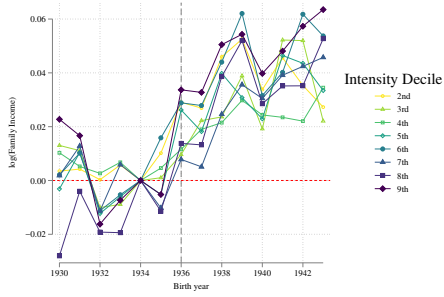
(d) Work Limiting Disability

Notes:.

Figure 7: The strong parallel trends assumption and the average causal response function- White men



(a) Education



(b) log(Family Income)

Notes:.

Figure 8: Estimand weights: TWFE weights vs actual treatment distribution weights

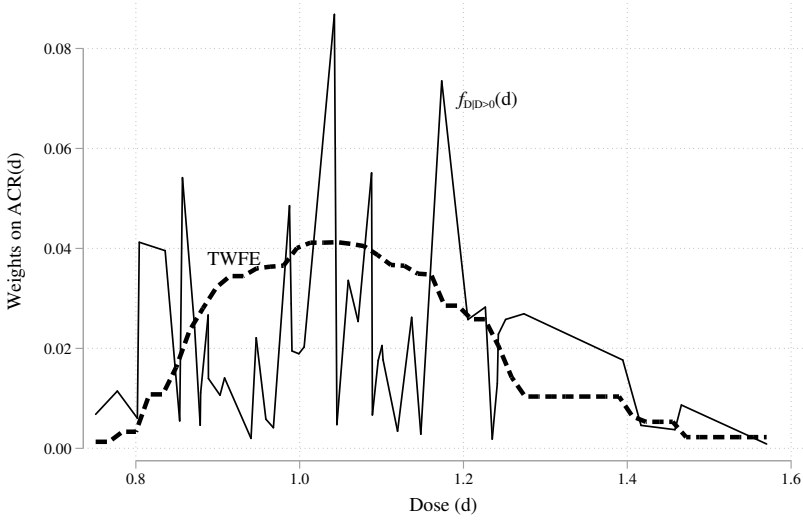


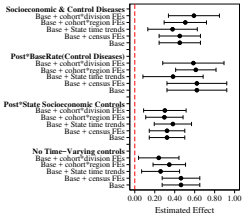
Table 3: Two-way Fixed Effects, Average Causal Responses and Binary Treatments – White Men

	Schooling	log(Family Income)	Cognitive Disability	Work Limiting Disability
Panel A - Baseline Model				
Post × Base Pneumonia Influenze	0.593***	0.0721***	-0.000357	-0.0140***
	(0.130)	(0.0176)	(0.00908)	(0.00357)
Effect Size	0.113 years	0.0137 %	-0.00679 pp	-0.266 pp
N	647,099	1,841,454	590,738	1,875,417
Panel B - Reweighting based on ACR function				
Post × Base Pneumonia Influenza	0.675***	0.0717***	0.00793	-0.0131***
	(0.132)	(0.0222)	(0.0108)	(0.00420)
Effect Size	0.128 years	0.0136 %	0.151 pp	-0.249 pp
N	647,099	1,841,454	590,738	1,875,417
Panel C - Binary Treatment Measure				
Post × High Base Pneumonia Influenza	0.136***	0.0188***	0.000559	-0.000893
	(0.0440)	(0.00502)	(0.00252)	(0.00115)
N	647,099	1,841,454	590,738	1,875,417

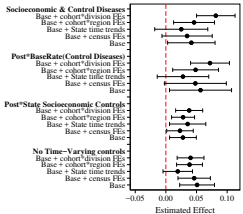
Notes: Each column represents a separate regression. Estimates are for white men. Coefficient reported is on Post×Baseline Pneumonia (panels A and B) or Post×Highly Exposed, where Post identifies cohorts born after 1936 and Baseline Pneumonia Influenza is the average pneumonia+influenza mortality rate between 1930 1936. Highly exposed refers to states with a baseline mortality rate above the median. Sample definitions and controls follow those defined in Table 2. Panel A presents identical models as in Table 2 for comparison. Panel B reweights observations so that estimates can be considered to be representative of doses in the sample. In this procedure, units are reweighted by the ratio of analytic weights to TWFE weights documented in Figure 8. In panels A and B where a continuous treatment measure is used, estimated effect of a 1 s.d. decline in pneumonia mortality (0.19 deaths per 1000) is provided in panel footers as *Effect Size*. *** p<0.01, ** p<0.05, * p<0.10.

Robustness checks- White men

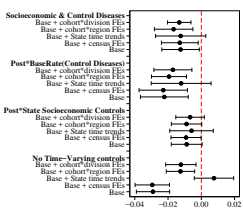
Figure 9: Robustness to alternative controls – White men



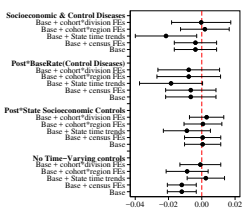
(a) Education



(b) log(Family Income)



(c) Work-limiting Disability

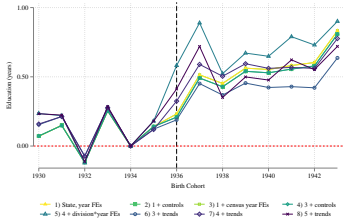


(d) Cognitive Disability

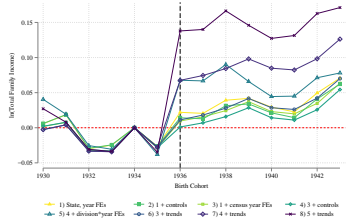
Notes:.

other groups

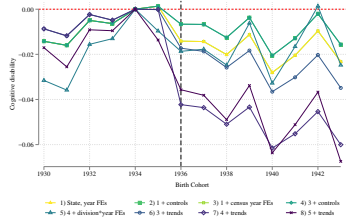
Figure 10: White men – sensitivity to controls



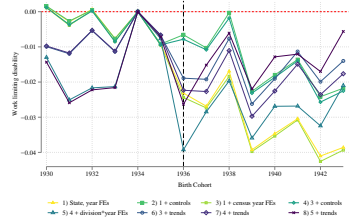
(a) Education



(b) log(Family Income)



(c) Cognitive Disability



(d) Work Limiting Disability

Notes: The event is antibiotic availability in 1937

Table 4: Other robustness checks

	Schooling	log(Family Income)	Cognitive Disability	Work Limiting Disability
Panel A - Alternate Base Measures				
Post × Base 1935 Pneumonia	0.518***	0.0678***	0.0106	-0.0105**
	(0.158)	(0.0207)	(0.00891)	(0.00419)
FWER p-value	[0.026]	[0.026]	[0.243]	[0.075]
Effect Size	0.0880 years	1.15 %	0.180 pp	-0.178 pp
N	610,968	1,740,938	558,210	1,772,641
Panel B - Infant Pneumonia Measure				
Post × Base Infant Pneumonia	0.0354**	0.00332*	-0.000859	-0.000238
	(0.0172)	(0.00196)	(0.000918)	(0.000369)
FWER p-value	[0.210]	[0.308]	[0.584]	[0.528]
Effect Size	0.0626 years	0.587 %	-0.152 pp	-0.0420 pp
N	647,099	1,841,454	590,738	1,875,417
Panel C - Excluding WW II Cohorts				
Post × Base Pneumonia Influenza	0.501***	0.0599***	-0.00936	-0.0201***
	(0.109)	(0.0161)	(0.00767)	(0.00420)
FWER p-value	[0.002]	[0.006]	[0.225]	[0.001]
Effect Size	0.0951 years	1.14 %	-0.178 pp	-0.381 pp
N	481,417	1,364,213	433,233	1,389,301
Panel D - Measurement Error Controls				
Post × Base Pneumonia Influenza	0.526***	0.0780***	-0.00632	-0.0144***
	(0.135)	(0.0174)	(0.00744)	(0.00363)
FWER p-value	[0.002]	[0.004]	[0.969]	[0.005]
Effect Size	0.0999 years	1.48 %	-0.120 pp	-0.273 pp
N	647,099	1,841,454	590,738	1,875,417
Panel E - Measurement Error, 2SLS				
Pneumonia-Influenza Mortality Rate	-1.324***	-0.159**	0.000881	0.0355***
	(0.464)	(0.0620)	(0.0205)	(0.0111)
Effect Size	0.126 years	1.51 %	-0.00837 pp	-0.337 pp
N	642,424	1,828,844	586,988	1,862,523

Notes: Estimated effect sizes are for a 1 s.d. change in the exposure variable.

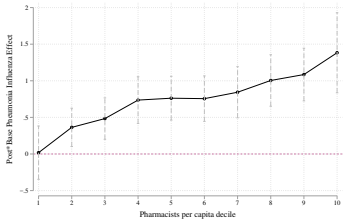
Other robustness checks and extensions

- Fertility selection table
- Migratory responses table
- New Deal (WW2 above)
- Measurement of black vs white mortality

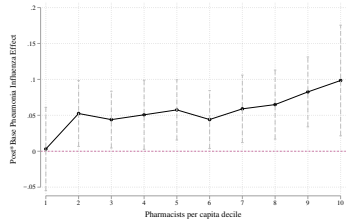
- Treatment effects (TE) on the distribution of income
- TE by a proxy for antibiotic diffusion (pharmacists per capita)
- TE by race and gender

The diffusion curve

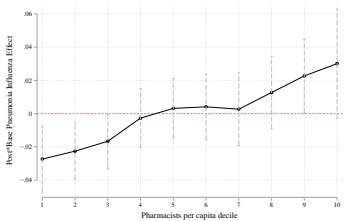
Figure 11: Heterogeneity in TE by baseline pharmacist coverage



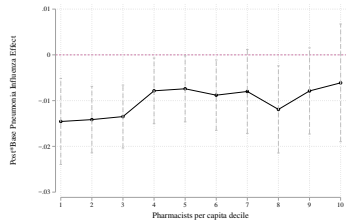
(a) Education



(b) log(Family Income)



(c) Cognitive Disability



(d) Work Limiting Disability

Notes:.

Table 5: Diffusion gradient

	Schooling	log(Family Income)	Cognitive Disability	Work Limiting Disability
Post × Base Pneumonia Influenza	0.0655	0.0171	-0.0257*	-0.0111**
	(0.141)	(0.0198)	(0.0134)	(0.00441)
FWER p-value	[0.876]	[0.766]	[0.358]	[0.160]
Post × Base Pneumonia Influenza				
× Pharmacists p.c.	1.275***	0.134***	0.0614***	-0.00697
	(0.260)	(0.0401)	(0.0195)	(0.0106)
FWER p-value	[0.000]	[0.026]	[0.034]	[0.533]
Effect size at bottom decile of pharmacists p.c.	0.107 years	1.32 %	0.450 pp	-0.0538 pp
Effect size at top decile of pharmacists p.c.	0.301 years	3.35 %	1.383 pp	-0.160 pp
N	647,099	1,841,454	590,738	1,875,417

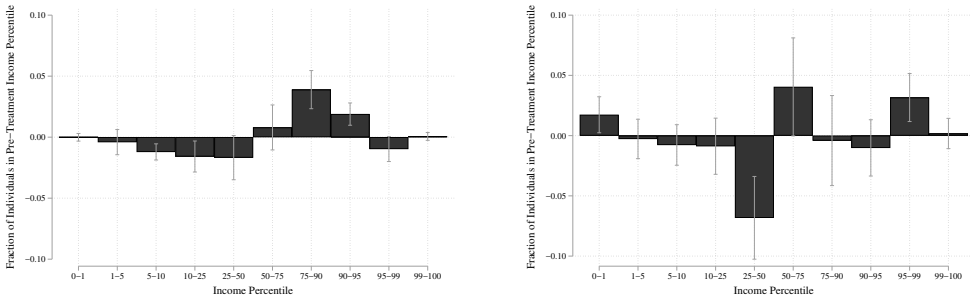
Notes: Triple difference, allowing TE to vary with the 1930 share of pharmacists per capita in the birth state.

Race X gender X state differences in treatment effects

Gender and race differences in average treatment effects

- White women: significant gains but smaller than men table
- Black men: significant gains, on average, similar to white men table
- Sharp gradient for black men (and women) in (slave fraction 1860 in birth state)
- The economic returns to sulfa diverged sharply between blacks in the North vs South (vs deep South), mirroring the force of the Jim Crow laws (Margo, 1990; Donohue and Heckman, 1991; Card and Krueger, 1992)

Figure 12: Gender and race specific heterogeneity in effects across the income distribution



(a) White Men

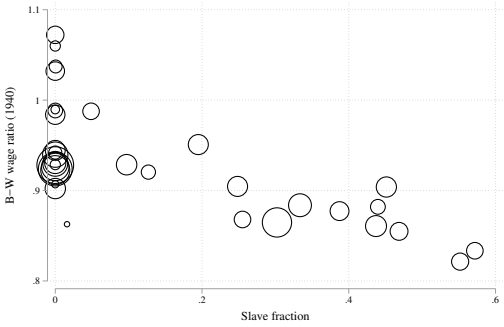
(b) Black Men

Notes: Group-specific baseline distributions. The plot shows how the distribution changes after treatment

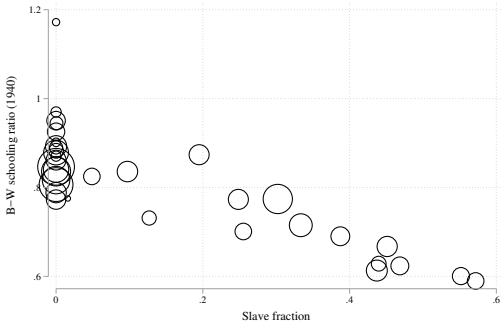
Investigate place-based race discrimination

- We proxy discrimination with the share of slaves in the birth state in 1860 (Nunn 2008)
- This share is zero in the North and largest in the deep South, range 0.01 to 0.57
- It is correlated with racial schooling and earnings gaps in the 1930s, and predictive of racially biased institutions decades later (black school quality, productivity, suffrage)
- (Engerman and Sokoloff, 2005; Mariscal and Sokoloff, 2000; Bertocchi and Dimico, 2010; Sacerdote, 2005; Mitchener and MacLean, 2003, Acharya et al 2018).

Figure 13: Historical slave share and wage and schooling differentials in 1930



(a) Slave share and W/B wage ratio



(b) Slave share and W/B schooling ratio

Table 6: Gradients – black men

	Schooling	log(Family Income)	Cognitive Disability	Work Limiting Disability
Black Men				
Post × Base Pneumonia Influenza	1.005***	0.494***	-0.0858	-0.168***
	(0.267)	(0.0910)	(0.0649)	(0.0256)
FWER p-value	[0.176]	[0.054]	[0.448]	[0.024]
Post × Base Pneumonia Influenza				
× Slave Fraction	-1.978***	-0.877***	0.0686	0.368***
	(0.619)	(0.207)	(0.123)	(0.0615)
FWER p-value	[0.153]	[0.079]	[0.817]	[0.025]
Post × Slave Fraction	1.111**	0.285*	-0.168**	-0.250***
	(0.474)	(0.162)	(0.0819)	(0.0500)
Effect size at slave fraction = 0	0.191 years	9.38 %	-1.630 pp	-3.196 pp
Effect size at slave fraction = 0.2 (Median)	0.116 years	6.05 %	-1.369 pp	-1.799 pp
Effect size at slave fraction = 0.5 (Max)	0.00299 years	1.05 %	-0.978 pp	0.297 pp
N	66,533	162,696	51,486	171,865

Notes:

black women

Table 7: No gradient- white men

	Schooling	log(Family Income)	Cognitive Disability	Work Limiting Disability
White Men				
Post × Base Pneumonia Influenza	0.664***	0.0559*	0.00513	-0.0161***
	(0.218)	(0.0295)	(0.0131)	(0.00486)
FWER p-value	[0.349]	[0.737]	[0.713]	[0.298]
Post × Base Pneumonia Influenza				
× Slave Fraction	0.0371	-0.0265	0.0474	0.0195
	(0.582)	(0.0652)	(0.0327)	(0.0119)
FWER p-value	[0.998]	[0.972]	[0.750]	[0.693]
Post × Slave Fraction	0.135	0.166**	-0.0831**	-0.0369**
	(0.721)	(0.0767)	(0.0394)	(0.0159)
Effect size at slave fraction = 0	0.126 years	1.06 %	0.0975 pp	-0.306 pp
Effect size at slave fraction = 0.2 (Median)	0.128 years	0.961 %	0.278 pp	-0.232 pp
Effect size at slave fraction = 0.5 (Max)	0.130 years	0.811 %	0.548 pp	-0.121 pp
N	594,322	1,693,737	542,931	1,724,779

Notes:

white women nonmarket outcomes

Discrimination weakened the link between early life health and earnings

- The potential of a generation of black children born in the post-sulfa era went underutilized at a time when America was experiencing rapid, inclusive growth as a result of the expansion of state-financed education and skill-biased technological change (Goldin and Katz, 2008)

Women- and race

- White Women:
  - In the 1930s, pre-sulfa, participation constrained by gender norms (Goldin 1977; Boustan and Collins 2014)
  - LFP of (married) white women trebled by the 1950s (Goldin 2006). Explained by the pill and norms. We provide the first suggestion that early life health (sulfa) contributed

- Black Women:
  - 1930s: Black LFP higher than white, esp South, because of poverty & slave legacy. But mostly household workers
  - In the 1950s, black women remained constrained by limited school and market opportunities (Bailey and Collins 2006; Collins and Moody 2017)
  - They show no economic gains from sulfa on average, instead higher fertility, both margins

table

Table 8: Nonmarket outcomes- women

	Ever Married	Age at Marriage	# Children Ever Born	Any Child	# Children | Any Child
Panel A: White Women					
Post × Base Pneumonia Influenza	0.00970*	-0.00808	-0.145*	0.00646	-0.162**
	(0.00549)	(0.108)	(0.0801)	(0.00876)	(0.0741)
FWER p-value	[0.287]	[0.947]	[0.337]	[0.726]	[0.198]
Effect Size	0.00184 pp	-0.00154 years	-0.0276 children	0.00123 pp	-0.0308 children
N	665,908	629,203	595,340	595,340	531,715
Panel B: Black Women					
Post × Base Pneumonia Influenza	0.0409	0.127	1.537***	0.197***	0.957***
	(0.0312)	(0.294)	(0.250)	(0.0292)	(0.229)
FWER p-value	[0.470]	[0.683]	[0.001]	[0.001]	[0.007]
Effect Size	0.00777 pp	0.0242 years	0.292 children	0.0375 pp	0.182 children
N	70,087	74,605	62,284	62,284	53,146

event study

Conclusions

Unequal economic gains

- Our findings demonstrate causal effects of medical innovation [treating pneumonia, investing in early life health] on economic mobility
- The gains are pervasive, *except* for blacks in the South (& BW widely)
  - Southern blacks **did** experience a sharp drop in pneumonia mortality, so it is not about access to antibiotics
  - Instead it is driven by barriers to quality schools and jobs. Racial discrimination prevented blacks from consolidating the dynamic benefits of reduced infectious disease in infancy
  - New light on legacies of racial discrimination (Card and Krueger 1993; Donohue and Heckman, 1991)
  - Highlights importance of a favourable social and economic environment in realizing the full potential of a healthy start (also see Bhalotra et al 2022 on Sweden x gender)

Complementary Investments Over the Life Course and the Black-White Earnings Gap

The civil rights movement

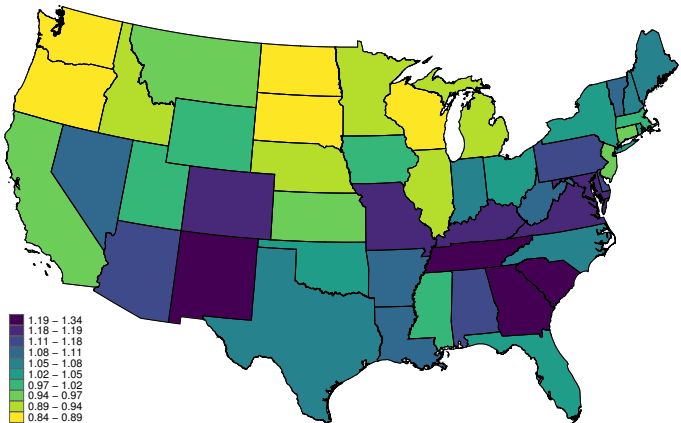
Racial earnings inequality

- Antibiotic innovation generated a universal improvement in health at birth, narrowing the race gap in infant health
- Theory leads us to expect this to lead to a narrowing of race earnings gaps for these cohorts. (Heckman and Mosso 2015; Currie et al. 2012)
- Instead, antibiotics initially led to racial earnings inequality widening– in the South
- Was there any scope for remediation?

Lightning strikes twice: Cohorts exposed to the antibiotic at birth are exposed to a minimum wage law in adulthood

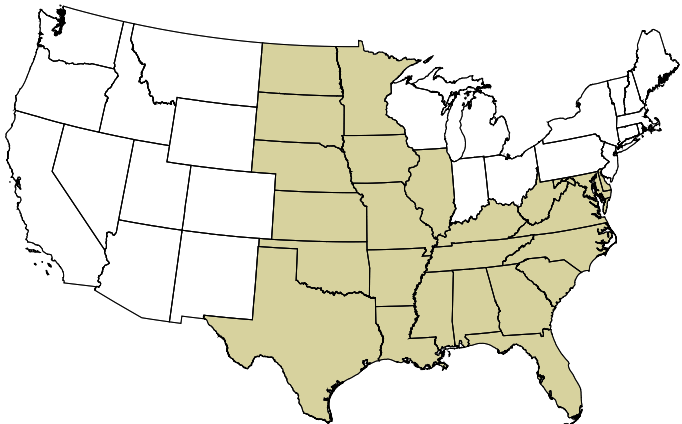
- We examine mitigation with a policy that strikes in early adulthood
- This is the FLSA, that raised the minimum wage for all workers in certain industries and states from 1967
- We interact exposure to the minimum wage with exposure to antibiotics in infancy

Figure 14: Baseline (1930–1934) pneumonia mortality rates



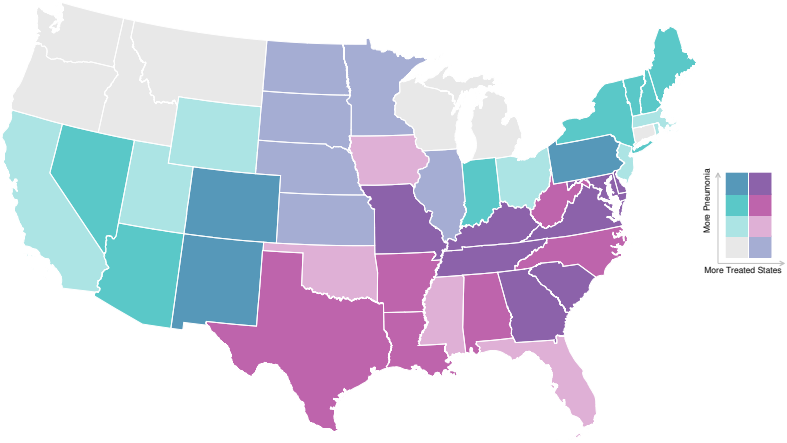
Notes: US Vital Statistics. Mortality rates per 1,000 individuals owing to pneumonia and influenza. State populations from the 1930 census.

Figure 15: State exposure to the 1967 FLSA minimum wage law



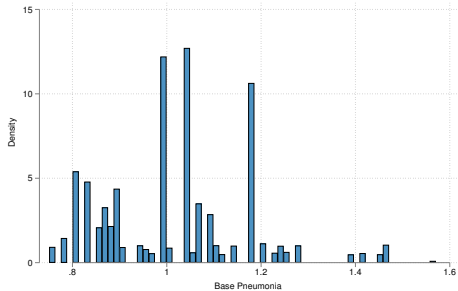
Notes: Treated states are shaded ?. Control states had minimum wage laws earlier in time.

Figure 16: Bivariate map of baseline pneumonia burden and minimum wage treatment

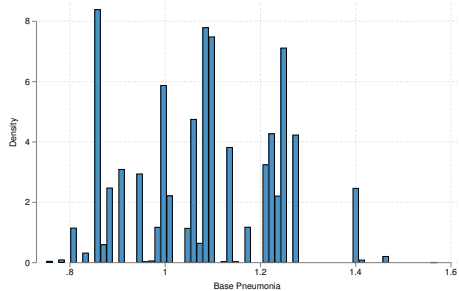


Source of data and state layers: IPUMS and United States Census Bureau.

Figure 17: Exposure to sulfa drugs in states with and without the minimum wage law



(a) Untreated by the minimum wage



(b) Treated by the minimum wage

Notes: Histograms display density of baseline pneumonia mortality in the **birth state** by FLSA minimum wage law exposure which depends on **state of residence** in 1960. Microdata from samples of the 1960 and 1970 census.

Table 9: Earnings effects of each policy shock

	log(Wage Income)		Poverty Threshold	
	Black	White	Black	White
	(1)	(2)	(3)	(4)
Panel A: Sulfa				
Post Sulfa × Base Pneumonia	0.0508	0.118***	0.00173	-0.00694
	(0.0760)	(0.0352)	(0.0259)	(0.0106)
Mean of Dep. Var.	9.25	9.73	0.32	0.22
Scaled effect size	0.008	0.018	0.000	-0.001
Observations	74,235	756,981	74,235	756,981
R-Squared	0.369	0.506	0.268	0.397
Panel B: FLSA				
Strongly Treated Stata × Post FLSA	0.205***	0.0359**	-0.159***	-0.0368***
	(0.0606)	(0.0165)	(0.0309)	(0.0100)
Mean of Dep. Var.	9.25	9.73	0.32	0.22
Observations	74,244	757,199	74,244	757,199
R-Squared	0.256	0.209	0.169	0.089

Notes: Sulfa is the antibiotic and FLSA is the minimum wage. Pooled 1960 and 1970 census.

Table 10: Participation and employment effects of each policy shock

	Labour Market Participation		Employed		Hours worked	
	Black (1)	White (2)	Black (3)	White (4)	Black (5)	White (6)
Panel A: Sulfa						
Post Sulfa × Base Pneumonia	0.0269	-0.0202	0.00745	-0.0169	1.059*	2.726***
	(0.0259)	(0.0139)	(0.0267)	(0.0134)	(0.597)	(0.433)
Mean of Dep. Var.	0.80	0.87	0.73	0.83	40.10	42.40
Scaled effect size	0.004	-0.003	0.001	-0.003	0.164	0.422
Observations	93,609	875,526	93,609	875,526	66,464	706,945
R-Squared	0.157	0.192	0.139	0.173	0.054	0.125
Panel B: FLSA						
Strongly Treated Stata × Post FLSA	0.0438***	0.00205	0.0248	-0.00194	0.746***	-0.150
	(0.0129)	(0.00947)	(0.0185)	(0.0122)	(0.222)	(0.225)
Mean of Dep. Var.	0.80	0.87	0.73	0.83	40.10	42.40
Observations	93,616	875,767	93,616	875,767	66,472	707,117
R-Squared	0.027	0.032	0.035	0.038	0.010	0.020

Notes:

Table 11: Interacting the early life and adult labour market policy shocks

	Income	
	ln(Wage Income)	Wage < Poverty
	(1)	(2)
Panel A: Black Men		
Reform 1	0.0797	-0.0148
	(0.0575)	(0.0259)
Reform 2	0.0526	-0.109***
	(0.0542)	(0.0231)
Reform 1 × Reform 2	0.0577**	-0.0156**
	(0.0247)	(0.00755)
Mean of Dep. Var.	9.25	0.32
Observations	74,235	74,235
R-Squared	0.414	0.305
Panel B: White Men		
Reform 1	0.115***	-0.00638
	(0.0337)	(0.00657)
Reform 2	0.0465	-0.0340***
	(0.0285)	(0.0124)
Reform 1 × Reform 2	0.0215**	-0.00521*
	(0.00932)	(0.00280)
Mean of Dep. Var.	9.73	0.22
Observations	756,981	756,981
R-Squared	0.511	0.400

Notes: Wage incomes standardized in 1999 USD.

Interaction effects

- Reform-1 raised earnings by more for white men (0.12) than for black men (0.08)
- Among men *also* exposed to reform-2, the earnings increase was equalized at 0.14 for black and white men
- FLSA closed the earnings gap associated with antibiotic arrival

- The FLSA raised earnings for black men unexposed to sulfa more than for white men (0.053 vs 0.047)
- The gap was wider in favour of blacks among men exposed to antibiotics at birth (0.11 vs 0.67)

Table 12: Interacting the early life and adult labour market policy shocks

	Employment		
	Labour Particip. (1)	Employment (2)	Hours Worked (3)
Panel A: Black Men			
Reform 1	0.0307	0.00545	1.144*
	(0.0299)	(0.0261)	(0.672)
Reform 2	0.0141	-0.0105	0.165
	(0.0132)	(0.0194)	(0.358)
Reform 1 × Reform 2	0.00271	0.00759	0.0681
	(0.00731)	(0.00754)	(0.165)
Mean of Dep. Var.	0.80	0.73	40.10
Observations	93,609	93,609	66,464
R-Squared	0.161	0.146	0.058
Panel B: White Men			
Reform 1	-0.0220	-0.0199	2.854***
	(0.0133)	(0.0128)	(0.372)
Reform 2	0.00134	-0.00578	-0.0491
	(0.0154)	(0.0197)	(0.691)
Reform 1 × Reform 2	0.00963***	0.0119***	-0.310***
	(0.00225)	(0.00204)	(0.110)
Mean of Dep. Var.	0.87	0.83	42.40
Observations	875,526	875,526	706,945
R-Squared	0.196	0.178	0.131

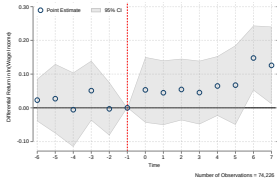
Notes: Wage incomes standardized in 1999 USD.

Table 13: Reform Impacts with Industry and Occupational Controls

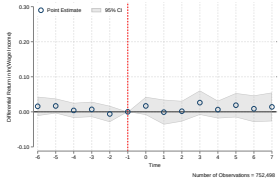
	log(Wage Income)		Poverty Threshold	
	Black	White	Black	White
Panel A: Sulfa Effects				
Post Sulfa × Base Pneumonia	0.0857	0.0857***	-0.0139	-0.000447
	(0.0714)	(0.0301)	(0.0221)	(0.00914)
Mean of Dep. Var.	9.25	9.73	0.32	0.22
Scaled effect size	0.013	0.013	-0.002	-0.000
Observations	74,235	756,981	74,235	756,981
R-Squared	0.443	0.555	0.327	0.428
Panel B: FLSA Effects				
Strongly Treated State × Post FLSA	0.105**	0.0140	-0.111***	-0.0244***
	(0.0459)	(0.0172)	(0.0243)	(0.00731)
Mean of Dep. Var.	9.25	9.73	0.32	0.22
Observations	74,244	757,199	74,244	757,199
R-Squared	0.353	0.360	0.248	0.211
Panel C: Sulfa × FLSA Effects				
Reform 1	0.108*	0.0839***	-0.0289	-0.000146
	(0.0566)	(0.0299)	(0.0245)	(0.00457)
Reform 2	0.0238	0.0220	-0.0894***	-0.0236**
	(0.0510)	(0.0201)	(0.0208)	(0.00954)
Reform 1 × Reform 2	0.0476**	0.0204***	-0.0118	-0.00499**
	(0.0229)	(0.00741)	(0.00714)	(0.00246)
Mean of Dep. Var.	9.25	9.73	0.32	0.22
Observations	74,235	756,981	74,235	756,981
R-Squared	0.469	0.559	0.348	0.430

Notes: Results replicate those in Tables 9-10 (panels A and B) and 12 (panel C), however additionally including industry by census wave and occupation by census wave fixed effects. All other details are identical to those in Tables 9-12.

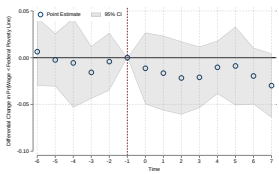
Figure 18: Event study for double policy shock- earnings



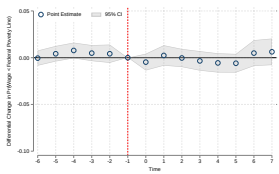
(a) Black men: ln(Wage Income)



(b) White men: ln(Wage Income)



(c) Black men: Wage $<$ Poverty Threshold



(d) White men: Wage $<$ Poverty Threshold

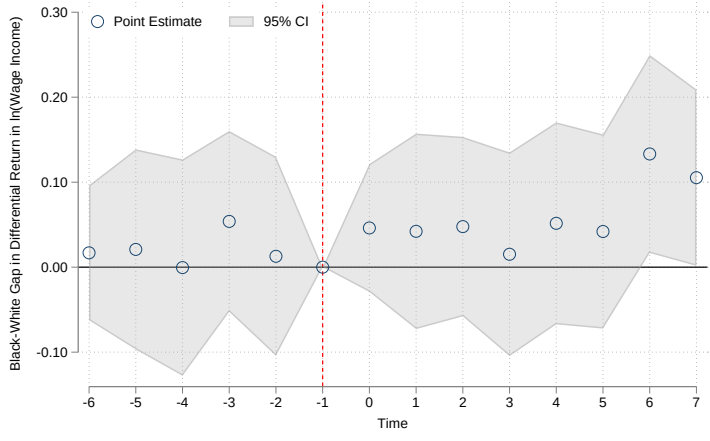
Notes: Plots show coefficient on the interaction terms τ_j. Poverty is an indicator for whether an individual's wage income is above the equivalent of earning the minimum wage and working 40 hours per week (an annual salary of \$2,080).

Table 14: Intervention Impacts and the Black-White Earnings Gap

	Sulfa Arrival (1)	FLSA Reform (2)	Interactive Reform (3)
Reform	0.118***	0.0359**	0.0215**
	(0.0352)	(0.0165)	(0.00932)
Reform × Black	-0.0677	0.169***	0.0362
	(0.0743)	(0.0555)	(0.0217)
Observations	831,216	831,443	831,216
R-Squared	0.500	0.224	0.509
White (control)	10.53	10.54	10.57
Black (control)	10.04	10.20	10.21
Δ WB (control)	0.491	0.348	0.355
Scaled Estimate	-0.138	0.487	0.102

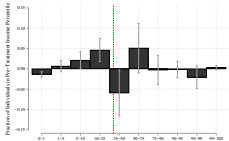
Notes: Each column presents the baseline estimate of the indicated exposure for all males (as Reform), and the differential effect for Black men (as Reform×Black. These are formal tests for differences of effects reported in Table 9 (columns 1–4), and Table 12 (columns 5–6). At the base of each column, mean outcomes are indicated for White and Black males in the sample of individuals not exposed to the reform, and ΔWB gives the log wage or income differential between these two groups. The scaled estimate refers to the proportional change which Reform×Black implies compared to this baseline wage differential, with negative values implying a proportional increase in the White-Black wage differential, and positive values indicative of a decreases in the White-Black wage differential. * p< 0.10, ** p< 0.05, *** p< 0.01.

Figure 19: Intervention Impacts and the Black-White Earnings Gap – Event Study Evidence

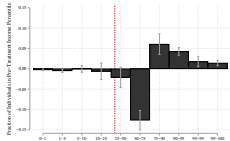


Notes: Plots show black versus White differentials in interactive terms τ_j from the fully interacted event study specification **??**. Model is estimated as described in equation **??**, fully interacted with an indicator for whether the individual is Black, so plotted terms document the differential impacts of reform interaction for Black males over those of White males *once the FLSA wage change becomes binding*.

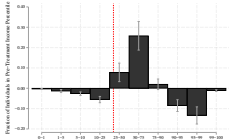
Figure 20: Sulfa, FLSA and Interactive Impacts Across Wage Distributions



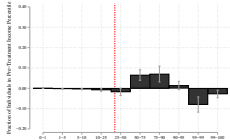
(a) Sulfa (Black Men)



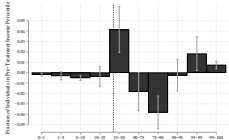
(b) Sulfa (White Men)



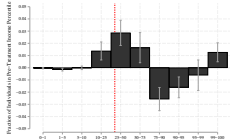
(c) FLSA (Black Men)



(d) FLSA (White Men)

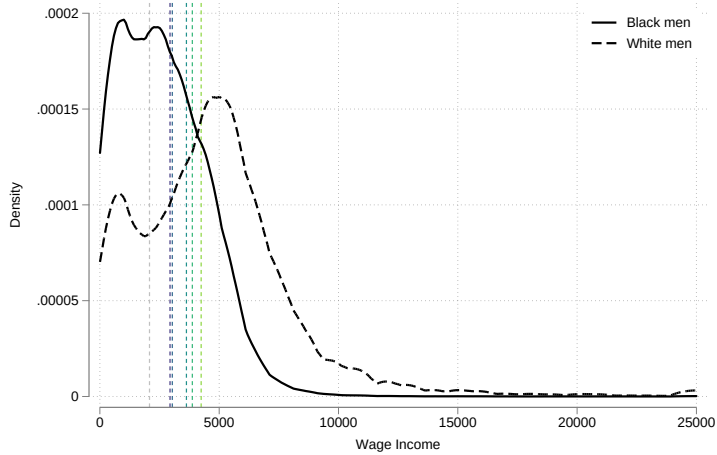


(e) Sulfa×FLSA (Black Men)



(f) Sulfa×FLSA (White Men)

Figure 21: Wage Distributions and Mean Occupational Wages (Black Men)



Notes: Kernel densities (bandwidth=500) are displayed for black men (solid line) and white men (dashed line). Dashed vertical lines display mean wages in the 5 highest wage occupations for black men (listed in Table **??**). The vertical grey line at $2080 denotes the annual equivalent minimum wage. All wages and figures are calculated from 1960 census microdata.

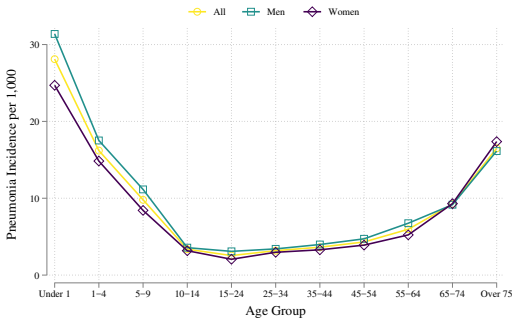
Antibiotic revolution: impacts on women of childbearing age

- S.Bhalotra, A. Venkataramani, S Walther. 2022. Women's labor market and fertility responses to a health innovation. *Forthcoming, Journal of the European Economic Association*

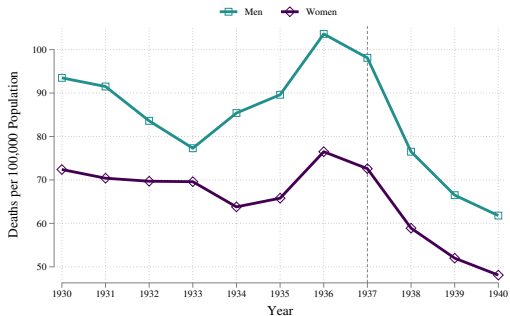
  - Study responses of women of child bearing age when antibiotics arrived
  - Decline in number of children- expected - QQ
  - Increase in childlessness - unexpected
  - Increase in (high skilled) LFP - untested
  - Decline in marriage- untested

  - We extend the QQ model to allow for fertility timing and LFP
  - Takeaway: Early life health interventions liberate women into the labour market by allowing them to start fertility later, lowering desired fertility & lowering replacement fertility

Figure 22: Pneumonia by Gender



(a) Age Profile of Pneumonia Morbidity

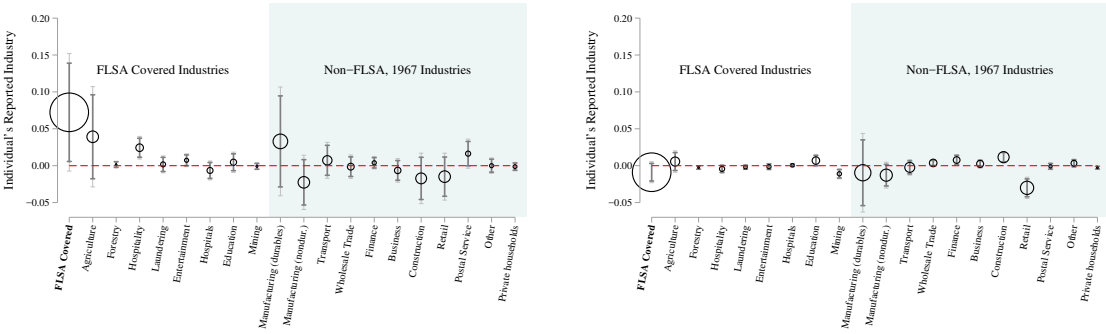


(b) Trends in Pneumonia Mortality

Notes: Panel A plots nationwide, sex specific pneumonia incidence rates from 1934-1936 as reported by Britten (1942). Panel B plots national trends in all-age pneumonia mortality by sex from 1930-1940 (source: Linder and Grove, 1947). The higher-level lines are the lines for men.

Appendix

Figure 23: Exposure to Sulfa and Industry Choice



(a) Black men

(b) White men

Notes: Each point estimate and CI (90 and 95%) is generated from a regression of whether an individual reports working in a particular industry on their sulfa exposure in a 2 way FE specification. FLSA Covered refers to all industries which were covered by the 1966 FLSA expansion. These are then presented industry-by-industry in alternative models, for each of the industries newly recorded as covered by the minimum wage following **?** (no shaded background) and not newly covered by the minimum wage (shaded background).

Table 15: Extensive Margin Single Treatment Considerations (Women)

	log(Wage Income)		Poverty Threshold	
	Black (1)	White (2)	Black (3)	White (4)
Panel A: Sulfa				
Post Sulfa × Base Pneumonia	0.170*	-0.0708	-0.0862**	0.0197
	(0.0854)	(0.0857)	(0.0372)	(0.0237)
Mean of Dep. Var.	8.48	8.78	0.58	0.47
Scaled effect size	0.026	-0.011	-0.013	0.003
Observations	59,213	449,750	59,213	449,750
R-Squared	0.247	0.165	0.205	0.132
Panel B: FLSA				
Strongly Treated Stata × Post FLSA	0.362***	0.111**	-0.122***	-0.0500***
	(0.0660)	(0.0453)	(0.0174)	(0.0162)
Mean of Dep. Var.	8.48	8.78	0.58	0.47
Observations	59,222	449,918	59,222	449,918
R-Squared	0.254	0.061	0.236	0.039

Notes: Refer to notes to Table 9. Identical models are estimated, however now for women. * $p< 0.10$, ** $p< 0.05$, *** $p< 0.01$.

Table 16: Intensive Margin Single Treatment Considerations (Women)

	Labour Market Participation		Employed		Hours worked	
	Black (1)	White (2)	Black (3)	White (4)	Black (5)	White (6)
Panel A: Sulfa						
Post Sulfa × Base Pneumonia	-0.0293	-0.106***	-0.0295	-0.0968***	1.671***	0.591
	(0.0292)	(0.0360)	(0.0315)	(0.0354)	(0.531)	(0.555)
Mean of Dep. Var.	0.47	0.40	0.42	0.38	35.67	35.44
Scaled effect size	-0.005	-0.016	-0.005	-0.015	0.259	0.092
Observations	109,492	895,318	109,492	895,318	44,509	329,531
R-Squared	0.051	0.027	0.056	0.025	0.032	0.083
Panel B: FLSA						
Strongly Treated Stata × Post FLSA	0.0970**	0.0438**	0.0784**	0.0411**	2.044***	0.799**
	(0.0381)	(0.0172)	(0.0354)	(0.0170)	(0.636)	(0.376)
Mean of Dep. Var.	0.47	0.40	0.42	0.38	35.67	35.44
Observations	109,506	895,622	109,506	895,622	44,517	329,639
R-Squared	0.031	0.007	0.034	0.007	0.024	0.011

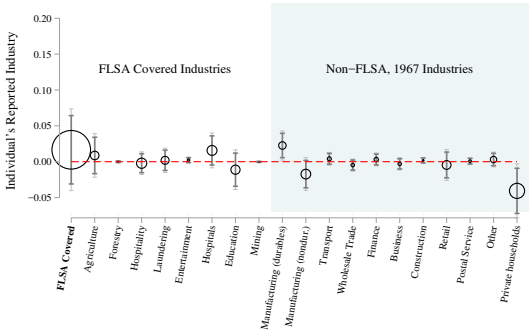
Notes: Refer to notes to Table 10. Identical models are estimated, however now for women. * p< 0.10, ** p< 0.05, *** p< 0.01.

Table 17: FLSA, Sulfa and Labour Markets – Effects by Race (Women only)

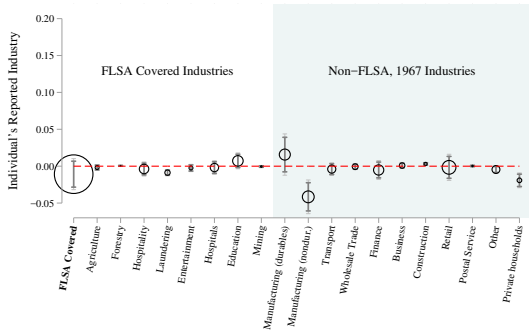
	Extensive Margin		Intensive Margin		
	ln(Wage Income) (1)	Wage < Poverty (2)	Labour Particip. (3)	Employ-ment (4)	Hours Worked (5)
Panel A: Black Men					
Reform 1	0.201**	-0.0988**	-0.0241	-0.0255	1.809***
	(0.0865)	(0.0395)	(0.0267)	(0.0302)	(0.544)
Reform 2	0.280***	-0.0971***	0.0669*	0.0509	2.212***
	(0.0710)	(0.0186)	(0.0355)	(0.0318)	(0.798)
Reform 1 × Reform 2	0.00898	0.00251	0.00581	0.00248	-0.265
	(0.0262)	(0.0113)	(0.0131)	(0.0126)	(0.209)
Mean of Dep. Var.	8.48	0.58	0.47	0.42	35.67
Observations	59,213	59,213	109,492	109,492	44,508
R-Squared	0.308	0.263	0.056	0.060	0.045
Panel B: White Men					
Reform 1	-0.0837	0.0258	-0.113***	-0.104**	0.507
	(0.0933)	(0.0269)	(0.0419)	(0.0405)	(0.585)
Reform 2	0.0217	-0.0129	-0.00805	-0.0104	0.382
	(0.0458)	(0.0152)	(0.0116)	(0.0113)	(0.260)
Reform 1 × Reform 2	0.00700	-0.00401	0.0177*	0.0172*	-0.102
	(0.0241)	(0.00845)	(0.0100)	(0.00949)	(0.131)
Mean of Dep. Var.	8.78	0.47	0.40	0.38	35.44
Observations	449,750	449,750	895,318	895,318	329,531
R-Squared	0.169	0.136	0.028	0.027	0.086

Notes: Refer to notes to Table 12. Identical models are estimated, now for women.

Figure 24: Exposure to Sulfa and Industry Choice (Women)



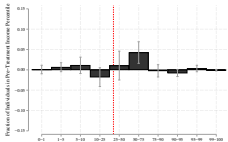
(a) Black women



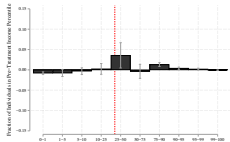
(b) White women

Notes: Each point estimate and confidence interval (90 and 95%) is generated from a regression of whether an individual reports working in a particular industry on their sulfa exposure in a 2 way FE specification. FLSA Covered refers to all industries which were covered by the 1967 FLSA expansion. These are then presented industry-by-industry in alternative models, for each of the industries newly recorded as covered by the minimum wage following **?** (no shaded background) and not newly covered by the minimum wage (shaded background).

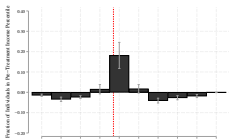
Figure 25: Sulfa, FLSA and Interactive Impacts Across Wage Distributions (Women)



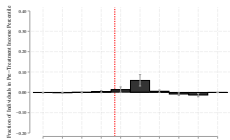
(a) Sulfa (Black Women)



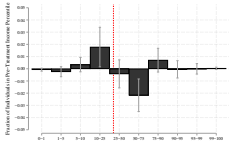
(b) Sulfa (White Women)



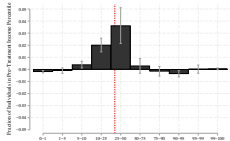
(c) FLSA (Black Women)



(d) FLSA (White Women)



(e) Sulfa×FLSA (Black Women)



(f) Sulfa×FLSA (White Women)

Table 18: Trend Breaks in 1937 in Infant and All-Age Mortality Rates from Pneumonia and Influenza

	Levels		Logs	
	All-age Mortality (per 1,000 population)	Infant Mortality (per 1000 births)	All-age Mortality (per 1,000 population)	Infant Mortality (per 1000 births)
Post 1937	-0.112***	-0.421***	-0.114***	-0.0518***
	(0.0162)	(0.123)	(0.0135)	(0.0158)
Year	0.00725	-0.0717	0.00427	-0.00611
	(0.00683)	(0.0747)	(0.00610)	(0.00933)
(Post 1937) × Year	-0.0794***	-0.416***	-0.0952***	-0.0813***
	(0.00962)	(0.0640)	(0.00774)	(0.00826)

Notes: Each column represents a separate regression, regressing the level or log of the dependent variable denoted in the column header on a Post-1937 indicator, year, Post×Year, and state fixed effects. The level and log allow us to assess absolute and relative trend breaks, respectively. The sample includes observations for 48 states over the period 1930-1943 (N = 672). See Appendix 1 for data sources. Standard errors are clustered by state. *** - p<0.01, ** - p<0.05, * - p<0.10.

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Table 19: Convergence in rates of pneumonia mortality

	Influenza Mortality (post-1937)			
	(1)	(2)	(3)	(4)
Panel A: All Races				
Post × Base Pneumonia Influenza	-0.404***	-0.359***	-0.399***	-0.401***
	(0.0429)	(0.0587)	(0.0726)	(0.0719)
Observations	805	805	792	792
Panel B: White Only				
Post × Base Pneumonia Influenza	-0.206*	-0.359**	-0.376***	-0.626*
	(0.103)	(0.159)	(0.109)	(0.318)
Observations	282	248	248	248
Panel C: Black Only				
Post × Base Pneumonia Influenza	-0.566***	-0.555***	-0.571***	-0.484***
	(0.0821)	(0.114)	(0.0993)	(0.0972)
Observations	282	248	248	248
Controls				
State & Year FEs	Y	Y	Y	Y
Census Div-Year FEs		Y	Y	Y
Disease Controls			Y	Y
SES Controls				Y

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Table 20: Testing for Fertility Selection

	Mother's Education	Mother's Age	Mother's Working	Household Income	Black
Post × Base Pneumonia Influenza	-0.00421	0.737	0.00993	-186.3	0.0148
	(0.0710)	(0.582)	(0.0126)	(114.3)	(0.0103)
N	439,168	439,168	439,168	85,248	485,766

Notes:

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Table 21: Testing for Migratory Responses

	All (1)	White (2)	Black (3)	Black (4)
Panel A: Men				
Post × Base Pneumonia Influenza	-0.00926	-0.00112	-0.0667	-0.0540
	(0.0159)	(0.0141)	(0.0418)	(0.0414)
Post × Base Pneumonia Influenza × Slave Fraction				-0.0397
				(0.0250)
Observations	2,116,337	1,925,288	191,049	187,868
Panel B: Women				
Post × Base Pneumonia Influenza	-0.0185	-0.0111	-0.0553	-0.0684**
	(0.0133)	(0.0122)	(0.0343)	(0.0281)
Post × Base Pneumonia Influenza × Slave Fraction				0.0187
				(0.0232)
Observations	2,237,843	1,996,634	241,209	237,342

Notes: The depedent variable is migration, which is = 1 if the individual reporting living in a different state than the birth state at the time of census enumeration. For black men, we control for access and measurement error .

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Table 22: Black men

	Schooling	log(Family Income)	Cognitive Disability	Work Limiting Disability
Post × Base Pneumonia Influenza	0.346*	0.106**	-0.0545**	0.00378
	(0.176)	(0.0467)	(0.0207)	(0.0185)
FWER p-value	[0.309]	[0.232]	[0.164]	[0.874]
Effect Size	0.0657 years	2.01 %	-1.036 pp	0.0717 pp
N	67,906	165,646	52,394	175,024

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Table 23: White women

	Schooling	log(Family Income)	Cognitive Disability	Work Limiting Disability
Post × Base Pneumonia Influenza	0.235**	0.0281**	-0.00785	-0.00713
	(0.109)	(0.0119)	(0.00570)	(0.00570)
FWER p-value	[0.216]	[0.187]	[0.490]	[0.427]
Effect Size	0.0447 years	0.535 %	-0.149 pp	-0.135 pp
N	659,851	1,913,841	618,646	1,944,405

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Table 24: Black women

	Schooling	log(Family Income)	Cognitive Disability	Work Limiting Disability
Post × Base Pneumonia Influenza	-0.583***	-0.0944**	-0.0364	-0.00759
	(0.189)	(0.0461)	(0.0268)	(0.0148)
FWER p-value	[0.072]	[0.285]	[0.512]	[0.867]
Effect Size	-0.111 years	-1.79 %	-0.692 pp	-0.144 pp
N	83,809	213,526	66,618	220,515

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Table 25: Gradients – black women

	Schooling	log(Family Income)	Cognitive Disability	Work Limiting Disability
Black Women				
Post × Base Pneumonia Influenza	1.038***	-0.0466	-0.101***	-0.155***
	(0.306)	(0.127)	(0.0340)	(0.0472)
FWER p-value	[0.152]	[0.893]	[0.114]	[0.085]
Post × Base Pneumonia Influenza × Slave Fraction	-3.073***	-0.106	0.181**	0.341**
	(0.823)	(0.272)	(0.0752)	(0.127)
FWER p-value	[0.123]	[0.899]	[0.168]	[0.118]
Post × Slave Fraction	1.780***	0.139	-0.0502	-0.128
	(0.600)	(0.206)	(0.0577)	(0.0891)
Effect size at slave fraction = 0	0.197 years	-0.886 %	-1.920 pp	-2.954 pp
Effect size at slave fraction = 0.2 (Median)	0.0805 years	-1.29 %	-1.233 pp	-1.657 pp
Effect size at slave fraction = 0.5 (Max)	-0.0947 years	-1.89 %	-0.202 pp	0.289 pp
N	82,224	209,799	65,568	216,673

Notes:

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Table 26: No gradient- white women

	Schooling	log(Family Income)	Cognitive Disability	Work Limiting Disability
White Women				
Post × Base Pneumonia Influenza	0.344**	0.0371***	-0.0391***	-0.0122
	(0.133)	(0.0113)	(0.00883)	(0.00778)
FWER p-value	[0.292]	[0.203]	[0.095]	[0.333]
Post × Base Pneumonia Influenza × Slave Fraction	-0.545	0.0135	0.0783***	0.0101
	(0.336)	(0.0313)	(0.0201)	(0.0227)
FWER p-value	[0.564]	[0.665]	[0.019]	[0.885]
Post × Slave Fraction	0.720*	-0.0280	-0.0293	0.0254
	(0.379)	(0.0394)	(0.0198)	(0.0295)
Effect size at slave fraction = 0	0.0653 years	0.705 %	-0.742 pp	-0.232 pp
Effect size at slave fraction = 0.2 (Median)	0.0446 years	0.756 %	-0.445 pp	-0.194 pp
Effect size at slave fraction = 0.5 (Max)	0.0135 years	0.833 %	0.00174 pp	-0.136 pp
N	606,160	1,760,608	569,227	1,788,694

Notes:

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Table 27: Gradients in Long Run Impacts of Infant Pneumonia Exposure by Indices of Discrimination on Nonmarket Outcomes

	Ever Married	Age at Marriage	# Children Ever Born	Any Child	# Children | Any Child
Panel A: White Women					
Post × Base Pneumonia Influenza	0.0147	-0.335**	-0.266**	0.0111	-0.244**
	(0.00962)	(0.144)	(0.100)	(0.00851)	(0.0964)
FWER p-value	[0.206]	[0.192]	[0.168]	[0.222]	[0.193]
Post × Base Pneumonia Influenza × Slave Fraction	-0.0434*	0.806**	-0.463**	-0.0120	-0.582***
	(0.0224)	(0.333)	(0.209)	(0.0263)	(0.206)
FWER p-value	[0.173]	[0.206]	[0.188]	[0.668]	[0.119]
Post × Slave Fraction	0.0618***	-1.078**	0.485*	-0.0146	0.724***
	(0.0208)	(0.413)	(0.277)	(0.0367)	(0.254)
Effect size at slave fraction = 0	0.280 pp	-0.0637 years	-0.0505 children	0.211 pp	-0.0464 children
Effect size at slave fraction = 0.2 (Median)	0.115 pp	-0.0331 years	-0.0681 children	0.166 pp	-0.0685 children
Effect size at slave fraction = 0.5 (Max)	-0.133 pp	0.0129 years	-0.0945 children	0.0975 pp	-0.102 children
N	613,307	577,140	547,143	547,143	487,766
Panel B: Black Women					
Post × Base Pneumonia Influenza	0.165***	0.516	0.124	0.271***	-0.809*
	(0.0455)	(0.887)	(0.476)	(0.0589)	(0.460)
FWER p-value	[0.066]	[0.845]	[0.834]	[0.093]	[0.312]
Post × Base Pneumonia Influenza × Slave Fraction	-0.246	2.344	4.750***	0.175	4.587***
	(0.149)	(2.455)	(1.085)	(0.109)	(1.196)
FWER p-value	[0.277]	[0.472]	[0.035]	[0.183]	[0.032]
Post × Slave Fraction	-0.00669	-1.445	-2.678***	-0.0496	-2.661***
	(0.0997)	(1.777)	(0.716)	(0.0768)	(0.868)
Effect size at slave fraction = 0	3.127 pp	0.0981 years	0.0235 children	5.148 pp	-0.154 children
Effect size at slave fraction = 0.2 (Median)	2.191 pp	0.187 years	0.204 children	5.814 pp	0.0205 children
Effect size at slave fraction = 0.5 (Max)	0.786 pp	0.321 years	0.475 children	6.813 pp	0.282 children
N	68,872	73,166	61,189	61,189	52,184

Notes:

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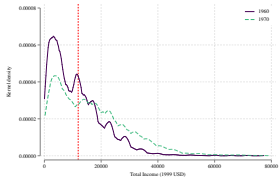
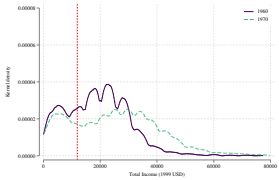
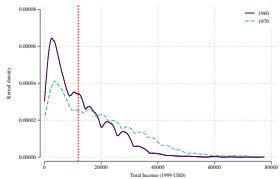
Figure 26: Total Income Across Census Waves by FLSA State (Black Males)



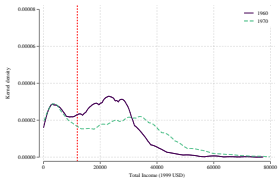
(a) Strongly treated state, Pneumonia above median



(b) Less affected state, Pneumonia above median



(c) Strongly treated state, Pneumonia below median



(d) Less affected state, Pneumonia below median

Notes: Plots show kernel densities of total income, standardized in terms of 1999 USD. Subplots are separated by whether states are highly exposed to FLSA (left hand side column) or not (right hand side column), and whether they were highly exposed to the sulfa reform (top row) or not (bottom row). All plots are based on the 5% sample of the 1960 census, and a 2% sample of the 1970 census for Black men who report a non-zero income. Plots are truncated at $80,000 USD (1999) for ease of visualization, axes are standardized for comparability across plots, and the red vertical line represents the yearly equivalent minimum wage if an individual worked 40 hours per week for 52 weeks.

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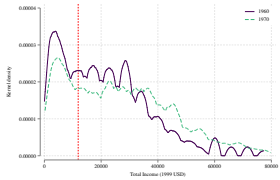
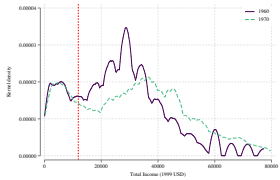
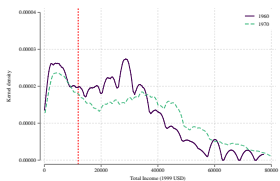
Figure 27: Total Income Across Census Waves by FLSA State (White Males)



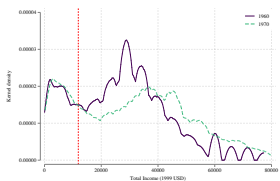
(a) Strongly treated state, Pneumonia above median



(b) Less affected state, Pneumonia above median



(c) Strongly treated state, Pneumonia below median



(d) Less affected state, Pneumonia below median

Notes: Plots show kernel densities of total income, standardized in terms of 1999 USD. Subplots are separated by whether states are highly exposed to FLSA (left hand side column) or not (right hand side column), and whether they were highly exposued to the sulfa reform (top row) or not (bottom row). All plots are based on the 5% sample of the 1960 census, and a 2% sample of the 1970 census for White men who report a non-zero income. Plots are truncated at $80,000 USD (1999) for ease of visualization, axes are standardized for comparability across plots, and the red vertical line represents the yearly equivalent minimum wage if an individual worked 40 hours per week for 52 weeks.

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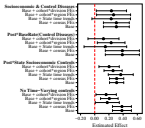
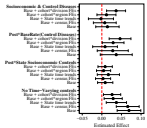
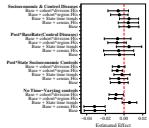
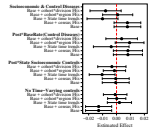
Figure 28: Robustness of estimates to alternative controls – Other Groups

Panel A: White Women

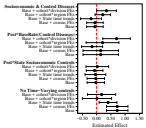

(a) Education

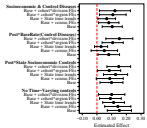

(b) log(Family Income)

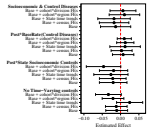

(c) Work-limiting Disability

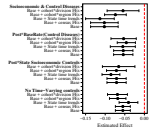

(d) Cognitive Disability

Panel B: Black Men

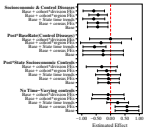

(e) Education

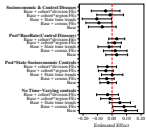

(f) log(Family Income)

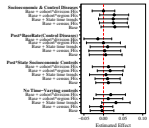

(g) Work-limiting Disability


(h) Cognitive Disability

Panel C: Black Women


(i) Education


(j) log(Family Income)


(k) Work-limiting Disability

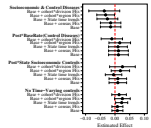

(l) Cognitive Disability

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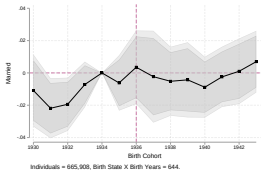
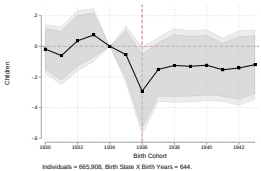
Figure 29: Event Study Estimates of Pneumonia Exposure in Infancy on non-Market Outcomes

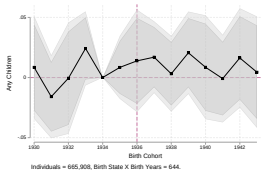
White Women



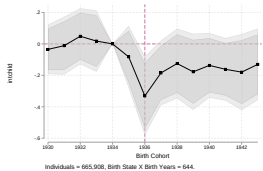
(a) Ever married



(b) Total Children

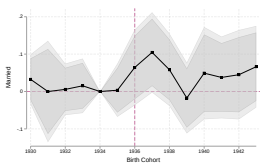


(c) Any Child

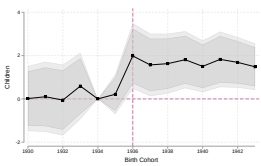


(d) Child|Any Child

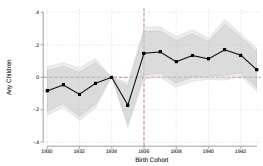
Black Women



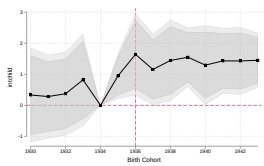
(e) Ever married



(f) Total Children



(g) Any Child



(h) Child|Any Child

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