Boys Left Behind? A Historical Perspective on the Gender Gaps in High School Graduation*

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Abstract

This paper investigates whether boys are more vulnerable than girls to adverse early-life shocks, leading to divergent trajectories in skill accumulation and persistent gender gaps in educational attainment. I document that girls have consistently outperformed boys in high school graduation rates throughout the 20th century in the United States, which challenges the notion that the gender gap in education is a recent development. Exploiting World War II military drafts as exogenous shocks to family composition, I find that boys exposed to paternal absence between ages 0 and 8 experienced significantly larger declines in high school graduation rates than girls. These empirical findings inform an overlapping generations model featuring gender-specific human capital accumulation. I use the model to evaluate the role of postwar education policies, particularly the G.I. Bill and similar programs that expanded college access for male veterans. Without these policies in place, the college gender gap favoring women may have emerged much earlier.

Keywords: Child Development, Human Capital Accumulation, Gender Education Gaps

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1 Introduction

This paper investigates the hypothesis that boys experience slower cognitive development or are more vulnerable to adverse shocks during childhood compared to girls, leading to gender-specific trajectories of skill accumulation that result in gender gaps in schooling outcomes. To do so, I document that the trend of girls outperforming boys in education has persisted throughout the 20th century in the United States and is by no means a recent phenomenon as current policy debates may suggest (Tyre, 2008; Farrell and Gray, 2018). Using war drafts as exogenous shocks to family composition, I show that the high school graduation rates of boys who were of ages 0 to 8 during World War II were much more negatively affected than those of girls. These findings inform an overlapping generations model with gender-specific human capital accumulation. The model is used to assess whether policies in the second half of the century, which primarily granted male veterans after World War II and the Vietnam war free college access, shifted the gender balance in college attendance in favor of men, and whether the current college gender gap favoring women would have emerged much earlier without these policies.

Over the last few decades, macroeconomic research has acknowledged that modeling the family, particularly women's life-cycle choices, is crucial for understanding gender gaps in labor force participation (Greenwood et al., 2005; Attanasio et al., 2008; Guner et al., 2012, 2020; Bick and Fuchs-Schündeln, 2018; Hannusch, 2024; Doepke et al., 2024), hours and occupational sorting (Goldin, 2014; Bick et al., 2022; Erosa et al., 2022; Ngai et al., 2024a), and financial investments (Bacher, 2024). The typical concern is that women, on average, lag behind men in the labor market, and considerable progress is still needed to achieve full gender equality.

At the same time, an increasing share of men has fallen behind women in recent years, and this particular trend, along with its causes, has received far less attention in macroeconomic models of the family. For example, the rate at which young men

drop out of the labor force has steadily risen, while no comparable trend is observed among women (Krueger, 2017; Binder and Bound, 2019). Today, women are more likely to persist in college, obtain degrees, and enroll in graduate school (Goldin et al., 2006; DiPrete and Buchmann, 2013). Wage growth for men without a college education has stagnated or declined, in contrast to the rising wages of similarly educated women (Autor et al., 2008). Additionally, men account for the majority of "deaths of despair", i.e. deaths caused by suicide, drug overdoses, and alcohol abuse (Case and Deaton, 2021; Mulligan, 2021; Greenwood et al., 2022). Despite these striking trends, macroeconomic family research has mainly focused on women's life-cycle choices and neglected the fact that gender differences already occur at early stages of children's development.

The hypothesis that boys' slower cognitive development or higher vulnerability to adverse shocks during childhood contributes to their falling behind in educational and economic outcomes has been recently emphasized by Reeves (2022). Research from neuroscience (Hines, 2011), education (Shayer et al., 2007), and psychology (Satterthwaite et al., 2014; Schore, 2017) shows that girls outperform boys in school from an early age (Brandlistuen et al., 2021), a pattern that has persisted over time (Goldin and Katz, 2009). This is a significant insight for economists. If cognitive development differs by gender, it can shift the allocation of talent in the economy, especially as barriers to education and in the labor market for women over the past 70 years declined. Current family models fail to consider the idea of gender-specific developmental processes, despite their potentially profound implications for the skill distribution in the economy.

This paper provides new evidence in support of the hypothesis that the human capital accumulation of boys and girls follows different trajectories, and that this divergence can be traced back to the early 20th century, when high school attendance became mandatory in the United States. To investigate this, I construct a novel dataset to estimate how parental absences differentially affect boys and girls. Specifically, I exploit variation in family composition induced by World War II military drafts in the United

States, which serve as an exogenous source of paternal absence. Building on the empirical findings, I develop an overlapping generations model of the family in which the human capital accumulation profiles of boys and girls can be separately identified. The empirical estimates serve to discipline key parameters of the model, which is then used to examine whether the observed gap in high school completion rates in favor of girls can be explained by differences in how early-life shocks affect human capital formation. Finally, the model is used to assess the impact of the G.I. Bill (formally, the Servicemen's Readjustment Act of 1944), which provided returning veterans with free access to college, on male and female college attendance.

Related Literature Macroeconomic models of the family have gained increasing attention in recent years. One strand of the literature is focused on modeling the labor supply of couples by explicitly incorporating mechanisms that shape female labor supply relative to men's. These mechanisms include the availability of household technology (Greenwood et al., 2005), the cost of childcare (Attanasio et al., 2008), labor income taxes (Guner et al., 2012; Bick and Fuchs-Schündeln, 2018), and government transfers to families with children (Guner et al., 2020; Hannusch, 2024). While these models enriched the labor supply problem that parents face, children are not explicitly incorporated in these frameworks. In particular, labor supply choices of parents do not impact children and their development in any way. Instead, children are typically modeled as an exogenous cost either in terms of time or in terms of money (childcare expenses).

Another area of macroeconomic research has focused on developing overlapping generations models with parental investments, where children's skills accumulate endogenously. Notable examples include Schoellman (2016), Daruich (2021), Bolt et al. (2023), and Yum (2023). These studies examine how parental time allocation and money investments influence children's development. This literature has also investigated various aspects of skill accumulation in children in more depth. For example, skill develop-

ment is positively associated with parental resources—both time and money (Lochner and Monge-Naranjo, 2011; Blandin and Herrington, 2022). Parental time, particularly during early childhood, is critical for skill formation, which occurs in stages (Caucutt and Lochner, 2020). Time and money investments are dynamic complements, underscoring the importance of early-life investments (Caucutt et al., 2023; Adamopoulou et al., 2024). The interaction between parental and government investments, such as public schooling, has also been explored (Abbott et al., 2019; Fuchs-Schündeln et al., 2022; Bellue and Mahler, 2024; Krueger et al., 2024). Finally, these models have linked parental and public investments to trends in inequality and intergenerational mobility (Lee and Seshadri, 2019; Jang and Yum, 2024).

In all of these studies, one critical factor remains overlooked: the differences in skill accumulation between boys and girls that emerge early in life. This omission is surprising, given that research from other disciplines has documented these differences as far back as the early 20th century (Lincoln, 1927; Stroud and Lindquist, 1942; Jones, 1957; Kolb, 1965). This project aims to fill that gap by examining how gender differences in cognitive development interact with both parental and schooling investments.

2 Empirical Evidence

Testing whether family composition changes affect boys and girls differently, and whether these effects translate into gender gaps in high school completion rates, is challenging for at least two reasons. The first issue is related to data availability for the time period under consideration. Unlike current data sets that follow families over time, representative panel data on children and their parents do not exist prior to 1965. The second challenge is related to endogeneity issues that could bias the estimation: Parental separations are not exogenously determined and often related to unobserved parental characteristics that can affect children's educational achievement, which introduces estima-

tion bias.

I address these two challenges in the following way. First, I create a new data set by combining three historical sources that allow me to analyze family composition changes and gender-specific high school graduation rates at the state level. Second, I exploit variation in military drafts and enlistments during World War II in the United States as an exogenous shock to family structure. The U.S. provides a particularly suitable context for this analysis: unlike many other countries involved in the war, the United States did not experience widespread destruction of physical capital, such as housing, schools, factories, or infrastructure, which could have independently affected child outcomes. This relative absence of physical devastation allows for a cleaner identification of the effects of family disruption on children's human capital and schooling outcomes.

The empirical analysis combines data from three main sources at the state level: (i) the Biennial Survey of Education, (ii) World War II Army Enlistment Records, and (iii) the 1940 and 1960 U.S. Census (Ruggles et al., 2024). The Biennial Survey of Education, produced by the U.S. Office of Education in response to federal legislation, documents the condition and progress of education across states. Published every two years from 1918 to 1958, the survey includes detailed statistics on state school systems, including attendance rates by gender (from primary through high school), teacher gender ratios, school infrastructure (e.g., number of books), and available school funds. These data allow for a comprehensive characterization of the school environment experienced by boys and girls at different education levels across states.

To quantify exposure to parental absence for a graduation cohort at time t who were children of a given age c during the war years ($\tau \in [1941, 1945]$), I construct the following measure:

$$\text{parental absence}_{s,\tau,t} = \frac{\sum_{\tau \in T(c)} \text{inductions}_{s,\tau,t} + \text{enlistments}_{s,\tau,t}}{\text{registrations}_{s}},$$

where $T(c)$ denotes the set of war years between 1941 and 1945 during which chil-

dren were of age c. This measure captures the cumulative number of inductions and enlistments during the war years when children were of a specific age, normalized by the number of Selective Service registrations in a state. It serves as a proxy for the intensity of potential paternal absence experienced by a given cohort.

The empirical strategy exploits this variation in exposure to paternal absence as an exogenous source of family disruption. Identification relies on the assumption that differences in the timing and intensity of inductions and enlistments across states are plausibly exogenous to unobserved determinants of educational outcomes. In particular, variation in military mobilization, driven by administrative quotas and enlistment patterns, proxies for the likelihood that children were exposed to paternal absence at critical stages of development. This approach addresses concerns that unobserved parental characteristics may simultaneously affect both family structure and children's human capital formation.

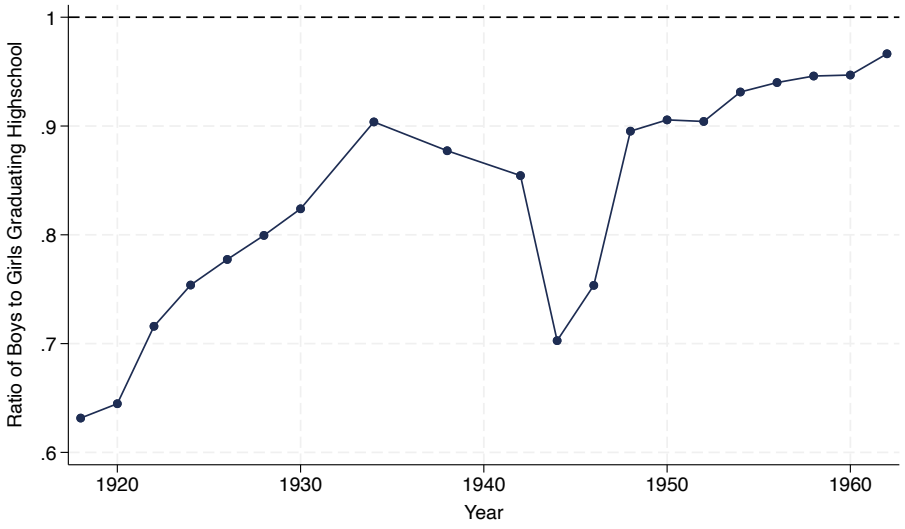


Figure 1: Ratio of Boys-to-Girls High School Graduates

Notes: Data comes from the Biennial Survey of Education from 1917 to 1958 and the Digest of Educational Statistics in 1962 and 1963.

Figure 1 displays the ratio of boys to girls among high school graduates for graduation cohorts from 1917/18 to 1961/1962. Girls have historically graduated from high

school in greater numbers than boys. The expansion of secondary education in the United States particularly benefited women. The most significant growth in high school graduates occurred before the 1940s (Goldin, 1998). This period is often referred to as the "high school movement," as the U.S. led the world in establishing universal, publicly funded secondary education (Goldin and Katz, 1998). During World War II, high school graduation rates declined across all regions, affecting both boys and girls. For boys, this decline was not primarily due to military enlistment, but rather to increased employment in low-skill jobs, as wartime demand drove up wages in those sectors. A similar, though less pronounced, decline in graduation rates occurred among girls, likely for the same reasons. After the war, graduation rates rebounded, particularly for boys, although girls continued to graduate in higher numbers throughout the early 1960s.

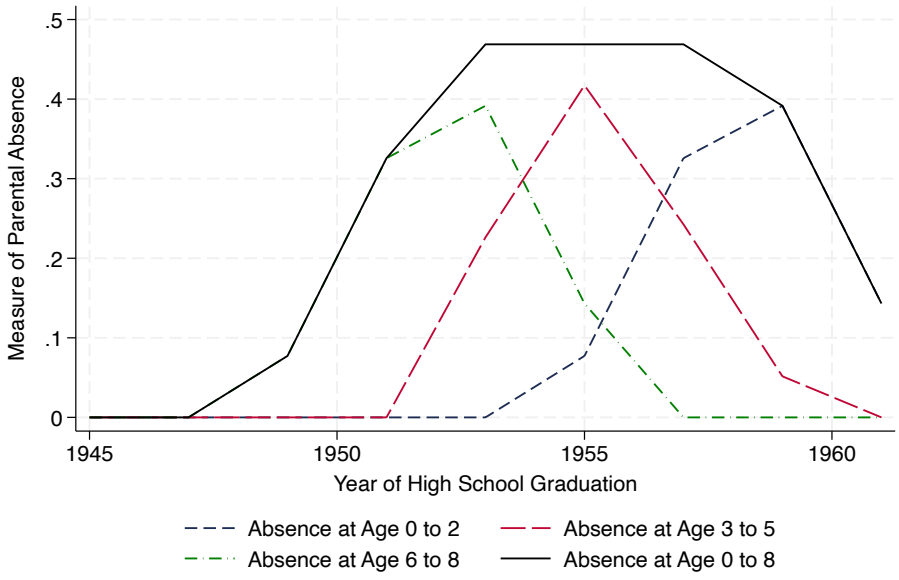


Figure 2: Measure of Parental Absence for Affected High School Graduates

Notes: Data comes from the Biennial Survey of Education from 1917 to 1958 and the Digest of Educational Statistics in 1962 and 1963. I plot the average measure of parental absence across US states in a given graduation year.

Figure 2 summarizes the average measure of parental absence across states by graduation year. It shows that cohorts exposed to parental absence between ages 0 and 8 graduated from high school starting around 1948/49. Cohorts affected at ages 0 to 2

graduated starting around 1953/54. There is substantial within-age-group variation in the intensity of parental absence exposure. As seen in Figure 1, large swings in the gender graduation ratio occurred prior to 1948. The average male-to-female graduation ratio in 1950 was around 0.9 and increased to approximately 0.95 by 1960.

High school graduation rates may also be influenced by state-level labor market conditions, particularly the occupational structure (high- vs. low-skill jobs) and the educational composition of the workforce (Hendricks and Schoellman, 2014; Chetty and Hendren, 2018a,b). I argue that individuals slightly older than a given graduating cohort provide the most relevant reference group for capturing the educational and labor market opportunities available at the time. Accordingly, I use U.S. Census data to construct state-level variables measuring the share of men and women aged 22 to 27 with a college degree and the share employed in high-skill occupations, as defined by Autor and Dorn (2013).

The Selective Training and Service Act of 1940 triggered the largest mobilization of manpower in U.S. history, with over half of men aged 18 to 45 eventually serving in World War II (Jaworski, 2014). This mass enlistment substantially increased the prevalence of paternal absence across the country, reducing the share of boys and girls who grew up with both parents present during key developmental years. To estimate the impact of this disruption on educational attainment, I first examine the impact of parental absence on boys' versus girls' high school graduation separately using the following regression model:

$$y^g_{s,\tau,t} = \beta_0 + \beta_1(\text{parental absence})_{s,\tau,t} + \delta_s + \lambda_t + X'_{s,t}\theta + \varepsilon_{s,\tau,t},$$

where $y^g_{s,\tau,t}$ denotes the natural logarithm of the number of high school graduates of gender $g \in \{f, m\}$ in state s, graduation year t, and age τ during the war years. The coefficient of interest, β_1, captures the effect of parental absence on gender-specific gradua-

tion outcomes. State fixed effects δ_s control for time-invariant differences across states, while year fixed effects λ_t account for nationwide trends in graduation rates. The vector $X'_{s,t}$ includes state-level controls measured at the time of graduation. These controls include: (i) teacher gender ratios in primary and middle school, to capture long-term exposure to same-gender educators (Dee, 2005); and (ii) teacher-to-student ratios, to account for variation in the school environment. To capture education and labor market opportunities at the time of graduation, the model also controls for (iii) the share of men and women aged 22–27 with a college degree, and (iv) the corresponding shares employed in high-skill occupations.

Table 1 presents the main results. Exposure to parental absence between ages 0 and 8 has a strong negative effect on the number of both male and female high school graduates. However, the estimated effect is more than twice as large for male graduates. This finding is consistent with existing research suggesting that boys' development is more sensitive to early-life shocks, such as parental divorce. The gender composition of teachers in primary and middle school also matters for educational outcomes. A higher ratio of male to female teachers is associated with a decrease in the number of both male and female graduates, though the magnitude of the effect differs only slightly by gender. In contrast, the relative share of male to female college graduates does not significantly influence high school graduation rates. This may reflect the fact that returns to college education were not monotonically increasing over the period studied (Goldin and Katz, 2009). Finally, a higher share of women employed in high-skill occupations is positively associated with graduation rates, whereas no similar effect is found for men.

Next, I examine whether exposure to paternal absence differentially affects boys' versus girls' high school graduation rates by using the graduation ratio as the dependent variable. I define $\tilde{y}_{s,\tau,t}$ as the ratio of boys to girls graduating from high school in state s

Table 1: Effect of Parental Absence on the Ln Number of High School Graduates

	Male Graduates		Female Graduates	
	(1)	(2)	(3)	(4)
Absence at Age 0 to 8	-2.797^{***}	-2.166^{***}	-1.923^{***}	-1.039^{**}
	(0.447)	(0.483)	(0.459)	(0.505)
School Environment				
Teacher Ratio Primary		-0.514^{***}		-0.654^{***}
		(0.137)		(0.138)
Teacher Ratio Secondary		-0.136^{***}		-0.121^{**}
		(0.045)		(0.047)
Labor Market Opportunities				
Female Col Grads		-0.760		-0.392
		(0.639)		(0.602)
Share HS Women		0.560^{***}		0.808^{***}
		(0.209)		(0.202)
Male Col Grads		-0.003		-0.233
		(0.384)		(0.392)
Share HS Men		0.225		0.074
		(0.288)		(0.295)
Time FE	X	X	X	X
State FE	X	X	X	X
N	1,127	980	1,127	980
adj. R^2	0.967	0.973	0.964	0.971

Notes: Standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. High School Graduation Cohorts: 1917-1958. Data on graduation rates, secondary enrollment, teacher gender ratios in primary and secondary schools, as well as average daily attendance are digitized using the Biennial Survey of Education 1917-1958. Parental Absence is defined as the sum of enlistments and inductions relative to the number of registrants in each state. The share college graduates and high-skilled workers ages 22-27 at the time of graduates comes from the US Census 1940 (full-count) for all graduation cohorts up until 1939-40 and from the 1960 Census (1% sample) for all later cohorts.

in graduation year t, whose cohort was age τ during the World War II years 1941–1945:

$$\tilde{y}_{s,\tau,t} = \beta_0 + \beta_1(\text{parental absence})_{s,\tau,t} + \delta_s + \lambda_t + X'_{s,t}\theta + \varepsilon_{s,\tau,t}.$$

Table 2 reports the results and further decomposes the effect of parental absences into three age groups: 0-2, 3-5, and 6-8. The results show that parental absence significantly affect the ratio of male to female high school graduates. Importantly, the detrimental effect on educational attainment is also more pronounced among cohorts who experienced parental absence at younger ages. In addition, a higher share of male primary school teachers benefit male high school students as a higher share of male teachers leads to more high school graduation of boys relative to girls. Similarly, a higher share of male college graduates among the age group 22-27 when boys graduate high school positively affects their graduation rate. In contrast, a higher share of high-skilled women among the 22-27 year-olds are associated with an increase in female high school graduates and a decline in the ratio of male to female graduates.

Evidence from Project Talent Data The state-level evidence can be supplemented with evidence from individual-level data from the Project Talent survey. Project talent surveyed 377,016 high school students enrolled in grades 9 to 12 in 1960. Students who were between 15 and 19 in 1960 belonged to 1941-1945 birth cohort and were among the youngest children affected by the war draft. The 1960 survey also includes information on cognitive ability, personality, academic aptitude, home environment, and socioeconomic status. The students were interviewed again one, five and eleven years after their anticipated high school graduation, making it possible to track their educational attainment beyond high school. Further, the data can be supplemented with detailed information on school size, class size, courses taught, teacher characteristics, student retention and graduation rates, as well as community characteristics. This allows to further disentangle the effect coming from parental absence from the human capital

Table 2: Effect of WWII Mobilization on High School Graduation Ratio (Boys/Girls)

	Dependent Variable: Ratio of Boys to Girls High School Graduates					
	(1)	(2)	(3)	(4)	(5)	(6)
Absence at Age 0 to 2	-0.638^{***}	-0.906^{***}				
	(0.145)	(0.192)				
Absence at Age 3 to 5			-0.372^{***}	-0.629^{***}		
			(0.143)	(0.159)		
Absence at Age 6 to 8					-0.363^{**}	-0.586^{***}
					(0.149)	(0.162)
School Environment						
Teacher Ratio Primary		0.093^{**}		0.090^{**}		0.078^{**}
		(0.039)		(0.040)		(0.040)
Teacher Ratio Secondary		-0.009		-0.008		-0.007
		(0.011)		(0.011)		(0.011)
Teacher Student Ratio		0.001		0.001		0.001
		(0.000)		(0.000)		(0.000)
Labor Market Opportunities						
Female Col Grads		-0.186		-0.192		-0.245
		(0.181)		(0.175)		(0.180)
Share HS Women		-0.248^{***}		-0.252^{***}		-0.246^{***}
		(0.064)		(0.064)		(0.064)
Male Col Grads		0.162		0.180^{*}		0.214^{**}
		(0.106)		(0.104)		(0.106)
Share HS Men		0.147^{*}		0.163^{*}		0.128
		(0.086)		(0.086)		(0.086)
Time FE	X	X	X	X	X	X
State FE	X	X	X	X	X	X
N	1127	980	1127	980	1127	980
adj. R^2	0.842	0.841	0.841	0.842	0.841	0.841

Notes: Standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. High School Graduation Cohorts: 1917-1962. Data on graduation rates, secondary enrollment, teacher gender ratios in primary and secondary schools, as well as average daily attendance are digitized using the Biennial Survey of Education 1917-1958. Mobilization rates are defined as the sum of enlistments and inductions relative to the number of registrants in each state. The share college graduates and high-skilled workers ages 22-30 at the time of graduates comes from the US Census 1940 (full-count) and 1960 (1% sample).

investments received in school.

The Project Talent data is federally funded and in the process of being transferred to a new institution. As a result, only the publicly available data for the base interview in 1960 can be currently used for the analysis. Since students had not yet completed high school at the time of the baseline survey, I use their average grades across all courses, as well as in mathematics and English, to assess gender gaps in academic achievement. Additionally, because the public version of the data only identifies four broad census regions, the state-level parental absence measure is aggregated to the regional level. The sample is restricted to high school students aged 15 to 19 who were between ages 0 and 4 during the war years (1941–1945).

Table 3 reports the impact of parental absence on students' average grades. The first two columns present the effect of regional mobilization rates, as a proxy for parental absence, on student grades, including the main effect of being male and the interaction between gender and parental absence. Consistent with the underlying hypothesis, the negative effect of parental absence is significantly more pronounced for male students. Column (2) includes school fixed effects to account for unobserved school-level heterogeneity. Columns (3) and (4) add further controls, such as parental education (whether the mother or father completed high school), the number of children in the household, and student health status. Tables 4 and 5 disaggregate student grades into mathematics and English, respectively. The pattern of a larger negative effect of parental absence on male students' performance persists across both subject areas.

Taken together, the empirical results suggest that parental absence during early childhood has a more detrimental effect on boys' educational attainment than on girls'. The next section develops a model that captures this effect.

Table 3: Effect of WWII Mobilization on Average School Grades

	Dependent Variable: Average School Grades			
	(1)	(2)	(3)	(4)
Absence at Age 0 to 5	0.024	−0.017	−0.130***	−0.132***
	(0.036)	(0.035)	(0.039)	(0.038)
Male	−0.104***	−0.117***	−0.080***	−0.086***
	(0.010)	(0.010)	(0.011)	(0.011)
Absence at Age 0 to 5 × Male	−0.470***	−0.465***	−0.416***	−0.414***
	(0.049)	(0.048)	(0.054)	(0.052)
Mother High School			0.083***	0.127***
			(0.007)	(0.006)
Father High School			0.080***	0.123***
			(0.006)	(0.006)
Nb. of Children			−0.004***	−0.015***
			(0.001)	(0.001)
Health			0.087***	0.107***
			(0.002)	(0.002)
School FE		X		X
N	286873	286873	221075	221075
adj. R^2	0.005	0.055	0.030	0.094

Notes: Standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. Data comes from the Project Talent base year in 1960. The sample is restricted to students ages 15 to 19 who attend grade 9 to 12. Absence at age 0 to 5 is defined as mobilization rate, i.e. the sum of enlistments and inductions relative to the number of registrants in each Census region. All regressions include person weights.

Table 4: Effect of WWII Mobilization on Math Grades

	Dependent Variable: Math Grades			
	(1)	(2)	(3)	(4)
Absence at Age 0 to 5	-0.367^{***}	-0.412^{***}	-0.495^{***}	-0.516^{***}
	(0.037)	(0.036)	(0.042)	(0.040)
Male	-0.023^{**}	-0.027^{***}	0.010	0.016
	(0.010)	(0.010)	(0.012)	(0.011)
Absence at Age 0 to 5 $\times$ Male	-0.258^{***}	-0.259^{***}	-0.238^{***}	-0.244^{***}
	(0.051)	(0.049)	(0.057)	(0.054)
Mother High School			0.069^{***}	0.113^{***}
			(0.007)	(0.007)
Father High School			0.088^{***}	0.130^{***}
			(0.007)	(0.007)
Nb. of Children			0.005^{***}	-0.006^{***}
			(0.001)	(0.001)
Health			0.088^{***}	0.111^{***}
			(0.002)	(0.002)
School FE		X		X
N	286873	286873	221075	221075
adj. R^2	0.002	0.063	0.024	0.096

Notes: Standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. Data comes from the Project Talent base year in 1960. The sample is restricted to students ages 15 to 19 who attend grade 9 to 12. Absence at age 0 to 5 is defined as mobilization rate, i.e. the sum of enlistments and inductions relative to the number of registrants in each Census region. All regressions include person weights.

Table 5: Effect of WWII Mobilization on English Grades

	Dependent Variable: English Grades			
	(1)	(2)	(3)	(4)
Absence at Age 0 to 5	-0.320^{***}	-0.377^{***}	-0.483^{***}	-0.504^{***}
	(0.037)	(0.036)	(0.041)	(0.039)
Male	-0.411^{***}	-0.442^{***}	-0.389^{***}	-0.414^{***}
	(0.010)	(0.010)	(0.011)	(0.011)
Absence at Age 0 to 5 $\times$ Male	-0.381^{***}	-0.370^{***}	-0.322^{***}	-0.311^{***}
	(0.050)	(0.049)	(0.056)	(0.053)
Mother High School			0.132^{***}	0.185^{***}
			(0.007)	(0.007)
Father High School			0.134^{***}	0.184^{***}
			(0.007)	(0.006)
Nb. of Children			-0.006^{***}	-0.018^{***}
			(0.001)	(0.001)
Health			0.122^{***}	0.145^{***}
			(0.002)	(0.002)
School FE		X		X
N	286873	286873	221075	221075
adj. R^2	0.031	0.104	0.080	0.167

Notes: Standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. Data comes from the Project Talent base year in 1960. The sample is restricted to students ages 15 to 19 who attend grade 9 to 12. Absence at age 0 to 5 is defined as mobilization rate, i.e. the sum of enlistments and inductions relative to the number of registrants in each Census region. All regressions include person weights.

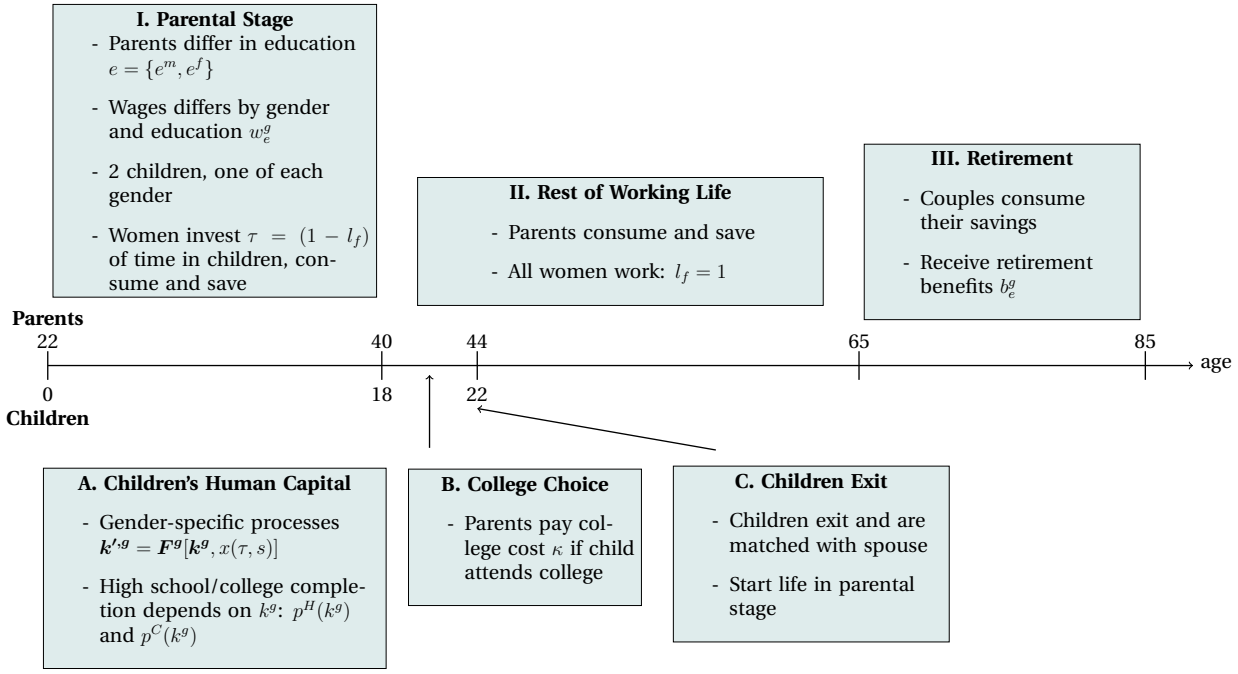
3 Model

This section develops an overlapping generations model with parents who influence their children's human capital development. A parent's lifecycle consists of three stages: (1) the parental stage, (2) the middle stage, and (3) retirement. Each adult is characterized by a gender (male or female) and an education level ($< hs$, hs, col). New young adults sort into couples and have two children: one boy and one girl. At the end of the parental stage, children leave the household, and parents decide whether to send them to college. Parents are altruistic toward their children and can increase the probability that they graduate from high school and obtain a college degree by investing in their children's human capital.

Figure 3 summarizes the three stages of the parental lifecycle and the decisions made in each stage. In the first (parental) stage, children live in the household. Men always work and earn a gender- and education-specific wage w_e^g, while women choose whether to work, l_f, or instead allocate time to child investment τ_f. The mother's time investment determines the human capital accumulation of both the son and the daughter. Accumulated human capital translates into the probability of high school graduation and college completion, denoted by ($p^H(k^g)$ and $p^C(k^g)$), respectively. At the end of stage one, parents and children jointly decide whether the child attends college. If the child attends, parents pay a college fee κ. After this decision, children leave the household and form their own families. Parents then enter the middle stage, during which they work and save, before eventually retiring. In retirement, they receive an education- and gender-specific benefit b_e^g.

Children's Human Capital Development The key innovation in the model is the gender-specific human capital accumulation process. Tomorrow's human capital of a child of gender $g = \{\text{male}, \text{female}\}$, $k'^{,g}$, depends on the amount of time parents invest, τ_f, government investments in the form of schooling, s, as well as today's level of human capi-

Figure 3: Model Overview



tal, k^g. Child human capital evolves according to a nested CES production function. The skill aggregator, $x(\tau_f, s)$, represents the CES inner nest and describes how parental and government investments contribute to the production of skills:

$$x(\tau_f, s) = \pi_0 \left[\pi_1(\tau_f/\bar{\tau_f})^{\pi_2} + (1 - \pi_1)(s/\bar{s})^{\pi_2})\right]^{\frac{1}{\pi_2}},$$

where $\bar{\tau_f}$ and $\bar{s}$ serve as normalization parameters that take care of the different units that parental time investments and schooling expenditures are measured in. The outer nest of the CES production function is a function of the skill aggregator $x(\tau_f, s)$ and the current, gender-specific stock of human capital k^g. Starting from the innate level human capital level at birth, k_0, children's human capital evolves according to a gender-specific process given by:

$$k'^{,g} = F^g\left[x(\tau_f, s), k^g\right] = \psi_0^g \left[\psi_1(k^g/\bar{k})^{\psi_2} + (1 - \psi_1)x(\tau_f, s)^{\psi_2}\right]^{\frac{1}{\psi_2}}.$$

One key advantage of defining skill accumulation in this nested CES form is that the

elasticity of substitution can differ between all inputs. It is important to note that the initial human capital at birth, k_0, is not gender-specific. Hence, I do not assume any innate differences between boys and girls at birth. $\psi_0^{\mathbf{g}}$ is a gender-specific productivity parameter that governs how productive investments in children are for girls relative to boys and $\bar{k}$ is a normalization parameter. Conditional on the biological age of the child, ψ_0^g changes the human capital profile for boys relative to girls and thus changes the returns to skill accumulation. The gender gap in human capital accumulation is defined as $\psi_0^m - \psi_0^f$. It is pinned down by the estimates obtained in the previous section.

Parental Stage I: Child Development A man and a woman of the same age, with education levels e^m and e^f, respectively, form a couple. They spend j_P periods in stage I as parents. During this stage, they decide on consumption (c), savings (a'), and how the woman splits her time between market work (l_f) and child-rearing (τ_f). The couple draws a common innate level of human capital for their two children, a boy and a girl, denoted k_0. The couple pays a utility cost q if both spouses are active in the labor market. This cost captures, for example, forgone home production or reduced family time when both parents work outside the home. The couple jointly maximizes

$$
\begin{aligned}
V_1(a, j, k^f, k^m; e^f, e^m, k_0) = \max_{c, l_f, \tau_f, a'} \; & \log c - q\mathbb{I}(l_f > 0) \\
\text{subject to} \quad c + a' &= w_e^f(1 - \tau_f) + w_e^m + (1 + r)a' \\
k'^{,g} &= F^g\left[x(\tau_f, s), k^g\right] \quad \text{for } g \in f, m \\
a_0 &\geq 0
\end{aligned}
$$

College Choice If children have accumulated a sufficient level of human capital, they graduate from high school. Conditional on successful high school completion, the family decides whether to send one or both children to college. College attendance is costly, and parents must pay κ in tuition per child. They form expectations about the lifetime

utility their children will attain, depending on their gender g and accumulated human capital k^g. The expected lifetime utility of a young adult with gender g and human capital k^g is given by

$$\hat{V}_1^g(k^g) = p^H(k^g)\Big\{p^C(k^g)\hat{V}_1^{C,g} + [1 - p^C(k^g)]\hat{V}_1^{H,g}\Big\} + [1 - p^H(k^g)]\hat{V}_1^{D,g}.$$

If a child graduates from high school with probability $p^H(k^g)$, they may attend college. With probability $p^C(k^g)$, they successfully complete college and earn a college premium throughout their working life, reflected in $\hat{V}_1^{C,g}$. If they attend college but fail to complete it, which happens with probability $[1 - p^C(k^g)]$, they receive the lifetime utility of a high school graduate, $\hat{V}_1^{H,g}$. Finally, with probability $[1 - p^H(k^g)]$, the child does not complete high school and becomes a dropout, resulting in the lowest lifetime utility $\hat{V}_1^{D,g}$.

Parental Stage II: Rest of Working Life After the college decision is made, children leave the household and their expected lifetime utility is realized. Parents are altruistic toward their children, and their children's expected utility enters the parental utility function directly. In Stage II, parents continue to consume, work, and save throughout the remainder of their working life. The household maximizes:

$$V_2(a, j; e^f, e^m) = \max_{c,a'} \log c - q\mathbb{I}(l_f > 0) + \beta^k \mathbb{E}[\hat{V}_1^f(k^f)] + \beta^k \mathbb{E}[\hat{V}_1^m(k^m)]$$
$$\text{subject to} \quad c + a' = w_e^f + w_e^m + (1 + r)a'.$$

Here, β^k captures the strength of parental altruism towards their children, and $\hat{V}_1^g(k^g)$ represents each child's expected lifetime utility as described in the previous section. Parents continue to work and earn wages based on their education levels, and accumulate savings for retirement.

Parental Stage III: Retirement In the final stage of life, parents retire and stop working. They receive gender- and education-specific retirement benefits, b_e^f and b_e^m, and consume from these benefits as well as any accumulated savings. Their problem is:

$$V_3(a, j; e^f, e^m) = \max_{c,a'} \log c$$
$$\text{subject to} \quad c + a' = b_e^f + b_e^m + (1 + r)a'.$$

Equilibrium An equilibrium in this model is characterized by the following three conditions. First, the choices of couples and singles are consistent with their respective maximization problems. Second, parents' expectations about their children's lifetime utility—with and without a high school degree and, conditional on high school graduation, with and without a college degree—must align with the actual expected lifetime utilities of the next generation of young parents. Third, the fraction of college-educated individuals in the parent generation must equal the fraction of college-educated individuals in the child generation, implying a stationary distribution of college- and non-college-educated individuals in the economy.

The key equilibrium objects of the model are the lifetime utility values of young adults (future parents) with either a high school or college degree, for each child gender g ($\hat{V}_1^g$). When deciding on investments in their children, parents must account for how an increase in the probability of college completion translates into higher expected lifetime utility for their children. At the same time, these investment decisions influence children's human capital and, consequently, their own lifetime utility as future parents. This interdependence necessitates a fixed-point iteration procedure to determine the equilibrium values of $\hat{V}_1^g$.

4 Calibration and Next Steps

The key innovation in the model is the gender-specific human capital accumulation process. Tomorrow's human capital of a child of gender $g = \{\text{male}, \text{female}\}$, $k'^{,g}$, depends on the amount of time parents invest, τ, government investments in the form of schooling, s, as well as today's level of human capital, k^g.

A key advantage of specifying human capital accumulation in a nested CES form is the flexibility to allow different elasticities of substitution between inputs. Importantly, initial human capital at birth, k_0, is assumed to be the same for boys and girls; that is, the model does not impose any innate gender differences at birth. The parameter $\psi_0^{\mathbf{g}}$ is a gender-specific productivity parameter that governs how productive investments in children are for girls relative to boys and $\bar{k}$ is a normalization parameter. Conditional on the biological age of the child, ψ_0^g changes the human capital profile for boys relative to girls and thus the returns to skill accumulation. The gender gap in human capital accumulation is defined as $\psi_0^m - \psi_0^f$. It is pinned down by the estimates obtained in Section 2.

The remaining parameters of the human capital production function will be calibrated using either external estimates or by targeting data moments. For example, the empirical coefficient capturing the effect of school spending or educational resources on graduation rates can inform π_1, the weight on schooling in the human capital function. Following standard assumptions in the literature, π_2 and ϕ_2 are typically set to zero, implying Cobb-Douglas forms for both sub-nests. The parameter ϕ_1 governs the weight on current human capital k^g and shapes the slope of the human capital accumulation profiles. It can be calibrated to match average observed human capital profiles across children, without conditioning on gender.

Time investment by parents is not directly observable in historical data. However, the U.S. Census provides information on the number of women who were neither formally employed nor engaged in farm or family business work (Ngai et al., 2024b). This

statistic can be used to infer the average discretionary time that mothers had available for child-rearing, and thereby anchor the distribution of τ_f across families.

Analysis and Policy Experiments The model will be calibrated to cohorts that graduated high school between 1916 and 1938. These cohorts completed college prior to the beginning in the dramatic rise in army enlistments starting in 1942. As a first step, it will be analyzed whether the calibrated model with gender-specific human capital accumulation can replicate the gender gap in high school graduation rates of these cohorts. In a second step, the high school graduation rates of cohorts that were affected by the shock will be explored. Cohorts who graduated between 1948 and 1956 were between 0 and 8 years of age at the time of the war drafts. Resulting parental absences will be introduced as a shock to children's human capital. With a certain probability, children face an absent father, which will be pinned down by the aggregated probability of army enlistment. If a father is absent, the productivity of the investment composite $x(\tau_f, s)$, π_0, will be reduced to capture the negative impact on the child's human capital accumulation. π_0 will be calibrated so that the shock matches the average impact of the share of enlisted men on high school completion rates in the data. Through the model, it can be assessed how much of the aggregate decline in graduation rates and the increase in the high school gender gap that we see in national statistics over the years following the war can be explained by parental absences.

The model will then be used to analyze the impact of the G.I. bill on the evolution of the gender gap in college attendance throughout the 20th century. Two experiments are proposed. In the first experiment, the G.I. Bill will be introduced into the model. The policy provided veterans of World War II with generous college subsidies, often enabling those from less-educated families to attend college. This fact gave the policy the reputation of leading to the "democratization" of the American higher education system (Bound and Turner, 2002). Yet, the policy mainly benefited men, an aspect that has re-

ceived less attention (Hendricks et al., 2021). This is striking given the fact a gender gap in college enrollment rates in favor of men only emerged for cohorts who benefited from the G.I. bill (Goldin and Katz, 2009). The policy will be implemented as a reduction in κ for men only and the model will be used to assess the increase in male college enrollment that can be attributed to the G.I. bill. Two counterfactual experiments will explore how much the gender gap in college enrollment and completion would have narrowed if the G.I. Bill (*i*) had not been in place, or (*ii*) both genders had received equal access to the college subsidy, meaning κ will be reduced for both men and women equally.

5 Outlook (Preliminary)

This paper offers an important historical perspective on the gender education gap. Its potential impact is substantial, as much of the current public debate attributes the gender gap in school performance to recent curriculum changes or shifts in teacher gender ratios (Tyre, 2008; Farrell and Gray, 2018). The findings presented here challenge such views by demonstrating that the high school graduation gap in favor of girls has existed in the United States since the introduction of mandatory schooling in the early 20th century.

Moreover, this project has the potential to show that post–World War II policies contributed to widening the college enrollment gap in favor of men. Consequently, the eventual reversal of the college attendance gap in favor of women during the 1970s may not be as surprising as it is often portrayed. Rather, the continued rise in women's college attendance appears to reflect a persistent long-term trend—one that would likely have surfaced earlier had policies not disproportionately expanded college access for men.

References

Abbott, B., G. Gallipoli, C. Meghir, and G. L. Violante (2019). Education Policy and Intergenerational Transfers in Equilibrium. *Journal of Political Economy 127*(6), 2569–2624.

Adamopoulou, E., A. Hannusch, K. Kopecky, and T. Obermeier (2024). Cohabitation, Child Development, and College Costs. Working Paper.

Attanasio, O., H. Low, and V. Sánchez-Marcos (2008). Explaining Changes in Female Labor Supply in a Life-cycle Model. *American Economic Review 98*(4), 1517–1552.

Autor, D. H. and D. Dorn (2013). The Growth of Low-Skill Service Jobs and the Polarization of the US Labor Market. *American Economic Review 103*(5), 1553–97.

Autor, D. H., L. F. Katz, and M. S. Kearney (2008). Trends in US Wage Inequality: Revising the Revisionists. *The Review of Economics and Statistics 90*(2), 300–323.

Bacher, A. (2024). The Gender Investment Gap over the Life-Cycle. Working Paper.

Bellue, S. and L. Mahler (2024). Efficiency and Equity of Education Tracking: A Quantitative Analysis. Working Paper.

Bick, A., A. Blandin, and R. Rogerson (2022). Hours and Wages. *The Quarterly Journal of Economics 137*(3), 1901–1962.

Bick, A. and N. Fuchs-Schündeln (2018). Taxation and Labour Supply of Married Couples Across Countries: A Macroeconomic Analysis. *The Review of Economic Studies 85*(3), 1543–1576.

Binder, A. J. and J. Bound (2019). The Declining Labor Market Prospects of Less-educated Men. *Journal of Economic Perspectives 33*(2), 163–190.

Blandin, A. and C. Herrington (2022). Family Structure, Human Capital Investment, and Aggregate College Attainment. *American Economic Journal: Macroeconomics 14*(4), 438–478.

Bolt, U., E. French, J. H. MacCuish, and C. O'Dea (2023). Intergenerational Altruism and Transfers of Time and Money: A Life Cycle Perspective. Technical report, Federal Reserve Bank of Minneapolis.

Bound, J. and S. Turner (2002). Going to War and Going to College: Did World War II and the GI Bill Increase Educational Attainment for Returning Veterans? *Journal of Labor Economics 20*(4), 784–815.

Brandlistuen, R. E., M. Flatø, C. Stoltenberg, S. S. Helland, and M. V. Wang (2021). Gender Gaps in Preschool Age: A Study of Behavior, Neurodevelopment and Pre-academic skills. *Scandinavian Journal of Public Health 49*(5), 503–510.

Case, A. and A. Deaton (2021). *Deaths of Despair and the Future of Capitalism*. Princeton University Press.

Caucutt, E. M. and L. Lochner (2020). Early and Late Human Capital Investments, Borrowing Constraints, and the Family. *Journal of Political Economy 128*(3), 1065–1147.

Caucutt, E. M., L. Lochner, J. Mullins, and Y. Park (2023). Child Skill Production: Accounting for Parental and Market-based Time and Goods Investments. Working Paper.

Chetty, R. and N. Hendren (2018a). The Impacts of Neighborhoods on Intergenerational Mobility I: Childhood Exposure Effects. *The Quarterly Journal of Economics 133*(3), 1107–1162.

Chetty, R. and N. Hendren (2018b). The Impacts of Neighborhoods on Intergenerational

Mobility II: County-level Estimates. *The Quarterly Journal of Economics 133*(3), 1163–1228.

Daruich, D. (2021). The Macroeconomic Consequences of Early Childhood Development Policies. *R & R at Journal of Political Economy*.

Dee, T. S. (2005). A Teacher Like Me: Does Race, Ethnicity, or Gender Matter? *American Economic Review 95*(2), 158–165.

DiPrete, T. A. and C. Buchmann (2013). *The Rise of Women: The Growing Gender Gap in Education and What it Means for American Schools*. Russell Sage Foundation.

Doepke, M., H. Foerster, A. Hannusch, and M. Tertilt (2024). The Political Economy of Laws to "Protect" Women. Working Paper.

Erosa, A., L. Fuster, G. Kambourov, and R. Rogerson (2022). Hours, Occupations, and Gender Differences in Labor Market Outcomes. *American Economic Journal: Macroeconomics 14*(3), 543–590.

Farrell, W. and J. Gray (2018). *The Boy Crisis: Why Our Boys Are Struggling and What We Can Do About It*. BenBella Books.

Fuchs-Schündeln, N., D. Krueger, A. Ludwig, and I. Popova (2022). The Long-Term Distributional and Welfare Effects of Covid-19 School Closures. *The Economic Journal 132*(645), 1647–1683.

Goldin, C. (1998). America's Graduation from High School: The Evolution and Spread of Secondary Schooling in the Twentieth Century. *The Journal of Economic History 58*(2), 345–374.

Goldin, C. (2014). A Grand Gender Convergence: Its Last Chapter. *American Economic Review 104*(4), 1091–1119.

Goldin, C. and L. F. Katz (1998). Human capital and social capital: The rise of secondary schooling in America, 1910 to 1940. *NBER Working Paper No. 6439*.

Goldin, C. and L. F. Katz (2009). *The Race between Education and Technology*. Harvard University Press.

Goldin, C., L. F. Katz, and I. Kuziemko (2006). The Homecoming of American College Women: The Reversal of the College Gender Gap. *Journal of Economic Perspectives 20*(4), 133–156.

Greenwood, J., N. Guner, and K. Kopecky (2022). The Downward Spiral. NBER Working Paper No. 29764.

Greenwood, J., A. Seshadri, and M. Yorukoglu (2005). Engines of Liberation. *The Review of Economic Studies 72*(1), 109–133.

Guner, N., R. Kaygusuz, and G. Ventura (2012). Taxation and Household Labour Supply. *The Review of Economic Studies 79*(3), 1113–1149.

Guner, N., R. Kaygusuz, and G. Ventura (2020). Child-related Transfers, Household Labour Supply, and Welfare. *The Review of Economic Studies 87*(5), 2290–2321.

Hannusch, A. (2024). Taxing Families: The Impact of Child-related Transfers on Maternal Labor Supply. Conditionally accepted at *American Economic Journal: Macroeconomics*.

Hendricks, L., C. Herrington, and T. Schoellman (2021). College Quality and Attendance Patterns: A Long-Run View. *American Economic Journal: Macroeconomics 13*(1), 184–215.

Hendricks, L. and T. Schoellman (2014). Student Abilities During the Expansion of US Education. *Journal of Monetary Economics 63*, 19–36.

Hines, M. (2011). Gender Development and the Human Brain. *Annual Review of Neuroscience 34*(1), 69–88.

Jang, Y. and M. Yum (2024). Aggregate and Intergenerational Iimplications of School Closures: A Quantitative Assessment. *American Economic Journal: Macroeconomics 16*(3), 90–130.

Jaworski, T. (2014). "You're in the Army Now:" The Impact of World War II on Women's Education, Work, and Family. *The Journal of Economic History 74*(1), 169–195.

Jones, M. C. (1957). The Later Careers of Boys Who Were Early-or Late-maturing. *Child Development*, 113–128.

Kolb, D. A. (1965). Achievement Motivation Training for Underachieving High-school Boys. *Journal of Personality and Social Psychology 2*(6), 783.

Krueger, A. B. (2017). Where have all the Workers Gone? An Inquiry into the Decline of the US Labor Force Participation Rate. *Brookings Papers on Economic Activity 2017*(2), 1.

Krueger, D., A. Ludwig, and I. Popova (2024). Shaping Inequality and Intergenerational Persistence of Poverty: Free College or Better Schools. Working Paper.

Lee, S. Y. and A. Seshadri (2019). On the Intergenerational Transmission of Economic Status. *Journal of Political Economy 127*(2), 855–921.

Lincoln, E. A. (1927). *Sex Differences in the Growth of American School Children.* Baltimore: Warwick & York.

Lochner, L. J. and A. Monge-Naranjo (2011). The Nature of Credit Constraints and Human Capital. *American Economic Review 101*(6), 2487–2529.

Mulligan, C. B. (2021). Deaths of Despair and the Incidence of Excess Mortality in 2020. Working Paper 28303, National Bureau of Economic Research.

Ngai, L. R., C. Olivetti, and B. Petrongolo (2024a). Gendered Change: 150 Years of Transformation in US Hours. Working Paper 32475, National Bureau of Economic Research.

Ngai, R., C. Olivetti, and B. Petrongolo (2024b). Structural Transformation over 150 years of Women's and Men's Work. Working Paper.

Reeves, R. V. (2022). *Of Boys and Men: Why the Modern Male is Struggling, Why It Matters, and What to Do About It.* Brookings Institution Press.

Ruggles, S., M. A. Nelson, M. Sobek, C. A. Fitch, R. Goeken, J. D. Hacker, E. Roberts, and J. R. Warren (2024). IPUMS Ancestry Full Count Data: Version 4.0 [dataset]. Minneapolis, MN: IPUMS.

Satterthwaite, T. D., S. Vandekar, D. H. Wolf, K. Ruparel, D. R. Roalf, C. Jackson, M. A. Elliott, W. B. Bilker, M. E. Calkins, K. Prabhakaran, et al. (2014). Sex Differences in the Effect of Puberty on Hippocampal Morphology. *Journal of the American Academy of Child & Adolescent Psychiatry 53*(3), 341–350.

Schoellman, T. (2016). Early Childhood Human Capital and Development. *American Economic Journal: Macroeconomics 8*(3), 145–74.

Schore, A. N. (2017). All Our Sons: The Developmental Neurobiology and Neuroendocrinology of Boys at Risk. *Infant Mental Health Journal 38*(1), 15–52.

Shayer, M., D. Ginsburg, and R. Coe (2007). Thirty Years on–A Large Anti-Flynn Effect? The Piagetian Test Volume & Heaviness Norms 1975–2003. *British Journal of Educational Psychology 77*(1), 25–41.

Stroud, J. B. and E. Lindquist (1942). Sex Differences in Achievement in the Elementary and Secondary Schools. *Journal of Educational Psychology 33*(9), 657.

Tyre, P. (2008). *The Trouble with Boys: A Surprising Report Card on Our Sons, Their*

Problems at School, and What Parents and Educators Must Do. New York: Three River Press.

Yum, M. (2023). Parental Time Investment and Intergenerational Mobility. *International Economic Review 64*(1), 187–223.