Learning by Mail: The Impact of Correspondence Schools in Early 20th Century America*

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Abstract

This paper examines correspondence education as an alternative educational pathway in early 20th-century America. Using newly digitized records from the International Correspondence Schools—the largest such institution, with over 4 million students by 1940—linked to census data, I show that enrollment increased the likelihood of skilled employment by 6–10pp within 3–10 years, particularly among younger students who used it as a substitute for high school. I develop a general equilibrium Roy-style model where individuals sort into educational options by ability. Consistent with the model, correspondence education facilitated skill acquisition for lower-ability individuals and improved selection into high school, amplifying its returns.

Keywords: Correspondence education, Human capital, Occupational mobility, High school expansion

JEL codes: J24, N32, E24, I21

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In the first half of the 20th century, the United States made major strides toward universal, publicly funded secondary education. This transformation, known as the "high school movement," sparked both an educational and economic revolution by expanding access to schooling at a time when the demand for skilled labor was rising rapidly (Goldin and Katz, 1998, 1999; Doxey et al., 2025). In 1900, only 6 percent of American youths earned a high school diploma; by 1930, that figure had risen to 30 percent. However, access to high school remained highly uneven across geographic and socioeconomic lines during this time. Some areas established high schools earlier than others, and the high opportunity cost of full-time attendance placed secondary education out of reach for many.

In this paper, I document and analyze the effects of an alternative educational pathway that spread across the United States alongside the high school movement: correspondence education. Unlike high school, correspondence courses were available nationwide and offered a flexible format that allowed individuals to work while studying. Using both empirical evidence and theory, I examine the impact of correspondence schooling on occupational and social mobility in the early 20th century, and how its availability shaped the broader consequences of the high school movement.

I begin by digitizing a 1908 student register of the International Correspondence Schools (ICS), the largest and most successful correspondence education institution in the world at the time. Founded in 1891, ICS offered over 370 full-length courses across a wide range of subjects and grew rapidly, expanding from just 115 students in its first year to over 4 million by 1940, making it one of the largest educational institutions in the world at its peak. Its success reflected five key features: the prior spread of free public primary education, which had equipped most Americans with basic literacy and numeracy skills (Cremin, 1980; Kaestle, 2001); nationwide accessibility via the Postal Service; affordable financing options; self-instructive textbooks written in plain English; and a curriculum focused on practical skills and occupational advancement that stood in contrast to other educational institutions of the era, which often emphasized enlightenment and culture (Watkinson, 1996).

The 1908 ICS student register provides detailed records for the universe of individuals who enrolled in ICS and made significant progress between 1891 and 1907, including each student's name, location, enrollment year(s), and course progress. The register covers roughly 97,000 students, of whom about 92,000 were male and form the focus of this study. This group represents 0.49% of the prime-age male population (ages 25–54) in 1910, remarkably large for a single private educational program, especially given that only 13.5% of adults aged 25 and older had completed high school at the time (National Center for Education Statistics, 2021). I combine the personal information in the register with record linkage methods developed by

the Census Tree Project (Price et al., 2021; Buckles et al., 2023) to identify these individuals in the 1900 and 1910 census waves.

Using this linked dataset, I first estimate the effects of correspondence education on occupational mobility via an event-study design centered on the year of enrollment. This specification compares individuals with similar demographic characteristics, observed in the same year and county, in the years immediately before and after enrolling in correspondence school. I find that correspondence education increased the likelihood of working in a white-collar occupation by 6 to 10 percentage points within 3 to 10 years of enrollment. These gains came at the expense of blue-collar employment, and were especially pronounced among younger students who used correspondence courses as a substitute for high school.

I then develop a tractable general equilibrium education choice model a la Roy (1951) that builds on the empirical findings to analyze how correspondence education shaped human capital acquisition and occupational mobility in the early 20th century. The model features three educational regimes: (1) only correspondence school is available; (2) only high school is available; and (3) both options are available. Individuals differ in learning ability and choose between remaining unskilled or enrolling in one of the available schooling options. Education provides a chance of becoming skilled, with success probabilities that increase in learning ability and differ by schooling type, with high school offering a higher probability of success than correspondence school at all ability levels, but entailing a higher cost due to its full-time attendance requirement.

The main insight of the model is that individuals sort into educational paths based on learning ability. This sorting is shaped by both the direct tradeoffs between success probabilities and costs, and the indirect general equilibrium effects on the skill premium. In all three educational regimes, low-ability individuals choose to remain unskilled. When only one schooling option is available, those above a learning ability threshold enroll in it. When both correspondence and high school options are available, sorting becomes more granular: low-ability individuals remain unskilled, intermediate-ability individuals choose correspondence school, and high-ability individuals attend high school. This pattern arises because high school entails a higher cost, but its expected return rises more steeply with learning ability than that of correspondence school. As a result, intermediate-ability individuals opt for the lower-cost correspondence track, while high-ability individuals are willing to pay more for the greater expected payoff from high school.

These sorting patterns yield a series of testable predictions about the effectiveness of correspondence education in fostering occupational mobility and its interaction with the expansion

of high school. First, correspondence education becomes more effective at promoting occupational upskilling when the likelihood of skilled employment rises for high-ability individuals or when the cost of correspondence schooling increases, both of which strengthen positive selection into enrollment. Second, by providing an alternative educational pathway, correspondence schooling not only enabled skill acquisition among individuals of intermediate ability but also improved the composition of students selecting into high school, thereby amplifying its observed returns.

I provide empirical validation of the theory by testing these predictions in the data. I begin by using the correspondence register data and event-study framework to estimate how the impact of correspondence education on the likelihood of working in higher- versus lower-skill occupations varies across contexts. First, I show that the upskilling effects of correspondence education are stronger among urban residents and in counties with higher employment shares in manufacturing and services, where thicker labor markets and the concentration of manufacturing and service firms raised the probability that individuals with sufficient ability could find employment matching their newly acquired skills. Second, I digitize an ICS field booklet listing tuition fees for different courses and find that students enrolled in higher-priced courses within the same subject category experienced larger occupational gains, consistent with stronger positive selection into more costly tracks.

I then turn to the model's predictions about the interaction between correspondence and high school education. First, using data from Doxey et al. (2025) on the location of all US high schools in 1900, I show that correspondence school enrollment grew more slowly after 1900 in cities with a high school, suggesting that the expansion of public high schools reduced the demand for correspondence education. Second, using a neighbor exposure design, I show that men, and particularly those of intermediate-ability, were more likely to enroll in correspondence school after 1900 if they lived on the same street as another man who had enrolled before 1900, with stronger effects when the treated neighbor lived closer (e.g., two doors away rather than five). Finally, using this same neighbor exposure measure as a proxy for awareness of correspondence education, I show that high school attendees with a nearby treated neighbor were more likely to work in professional, technical, or other white-collar occupations, and less likely to work in blue-collar jobs by 1910. These findings suggest that learning about the cheaper and more flexible option offered by correspondence schools led some lower-ability students to pursue this alternative educational pathway, thereby improving selection into high school and raising its observed returns. Taken together, these results suggest that correspondence schools reshaped both the educational choices landscape and the returns to education in the early 20th century.

The rest of the paper is organized as follows. Section 1 situates the paper within the existing literature and outlines its contributions. Section 2 provides a brief history of correspondence education and documents the rise of ICS in the United States in the early 20th century. Section 3 describes the data and presents empirical evidence on the impact of correspondence education on occupational mobility. Section 4 introduces the model, characterizes its equilibrium, and derives testable predictions. Section 5 tests these predictions, providing evidence on the effectiveness of correspondence education and its interaction with the expansion of high school. Section 6 concludes.

1 Related literature

This paper contributes to several strands of literature. First, it contributes to the literature on the role of education in shaping occupational and social mobility in the early 20th-century United States. Prior work in economics has focused primarily on formal classroom-based schooling by examining the effects of primary education (such as the Rosenwald program, which expanded access for Black students in the rural South; Aaronson and Mazumder, 2011); high school education (particularly the expansion driven by the high school movement and its implications for mobility, productivity, innovation, and later-life prominence; Goldin and Katz, 1999, 2000, 2008; Doxey et al., 2025); and higher education (through the growth of junior and four-year colleges and their effects on the college premium; Bleemer and Quincy, 2025a,b). This paper contributes to this literature in two ways. First, it documents the widespread use of correspondence education, an understudied alternative to classroom-based schooling, and quantifies its impact on occupational mobility. Second, drawing on both theory and data, it shows that correspondence education not only served as a substitute for formal schooling, particularly high school, but also reshaped the ability composition of students entering classroom-based programs, thereby altering their observed returns.

Second, through its general equilibrium framework of educational and occupational choice with endogenous sorting, this paper contributes to the literature on comparative advantage and sorting in macroeconomic models. This literature employs Roy-style models with heterogeneous abilities, preferences, or skills to study selection into occupations (Lindenlaub, 2017; Mestieri et al., 2017; Adao et al., 2020; Grigsby, 2022; Dvorkin and Monge-Naranjo, 2025), sectors (Lagakos and Waugh, 2013; Adao, 2016), and college and major choice (Keane and Wolpin, 1997; Eckstein and Wolpin, 1999; Hendricks and Schoellman, 2014, 2018; Leukhina et al., 2022; Alon and Fershtman, 2024), along with their macroeconomic implications. Building on this approach, the model developed here incorporates ability-based selection into both education and occupations, but introduces correspondence schooling as a novel, non-formal

pathway for human capital acquisition. Similar to the work examining how selection influences the returns to college (Hendricks and Schoellman, 2014, 2018; Leukhina et al., 2022), the model highlights the general equilibrium effects of this additional educational option, which reshapes the composition of those selecting into formal schooling and alters its returns. In contrast to most of this literature, however, the focus here is historical and centers on how this alternative form of education affected the returns to formal schooling, rather than on sequential sorting into secondary and higher education.

Finally, this paper also relates to the literature on the effects of remote schooling on student learning and labor market outcomes, and its interaction with traditional in-person programs (Figlio et al., 2013; Deming et al., 2012, 2015; Bettinger et al., 2017; Hoxby, 2017; Goodman et al., 2019; Barrow et al., 2024; Kofoed et al., 2024; Barahona et al., 2025). Much of the work in this literature focuses on the past two decades and examines the rise of online learning. This paper contributes to this literature by analyzing the impacts of correspondence schooling, a remote learning option available over 100 years ago. Echoing findings from the modern online education literature, I highlight the tradeoffs inherent in remote correspondence instruction: while it expanded access for some students, it also diverted others from higher-quality in-person alternatives, such as high school. For example, Barahona et al. (2025) show that online higher education programs in Brazil increased enrollment among older students but drew younger students away from higher-return in-person programs, quantifying these tradeoffs using a general equilibrium model. I develop a model of educational choice featuring similar mechanisms and provide empirical evidence for comparable effects in the early 20th-century US: correspondence schooling expanded access for students unable to attend high school, but through general equilibrium forces, it reduced high school enrollment and shifted the ability composition of its student body.

2 Historical context: Correspondence education in the early 20th century

Correspondence education in the United States began in 1873 with the founding of The Society to Encourage Studies at Home in Boston by Anna Eliot Ticknor. Aimed exclusively at women, particularly those constrained by domestic responsibilities, the society offered individually planned courses and regular communication between students and instructors to promote education and personal enrichment. Over its 24 years in operation, the society enrolled more than 7,000 students (Bergmann, 2001).

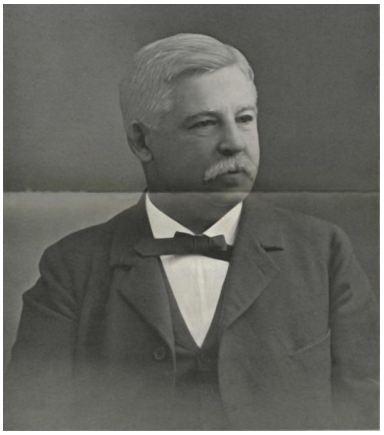
In the following decades, correspondence education expanded (Watkins, 1991). The Corre-

spondence University, which was affiliated with several colleges and universities, was established in Ithaca, New York, with the goal of offering college-level education to those unable to attend in person. This model soon spread, notably to the University of Chicago, which created an extension division offering correspondence-based instruction (Noffsinger, 1926).

The most widespread and successful form of correspondence education in the late 19th and early 20th century, however, was occupational training. This model originated with Thomas J. Foster (pictured in Panel (a) of Figure 2.1), a newspaper publisher in eastern Pennsylvania who, concerned about the high number of mining accidents in the region, began publishing safety advice for miners in the Mining Herald (later renamed the Colliery Engineer) in the late 1880s. When the Pennsylvania legislature soon after started requiring mining foremen to pass a safety examination, demand for a more structured and comprehensive form of mining education grew rapidly. In response, Foster established The Colliery Engineer School of Mines in 1891 to deliver mining instruction through correspondence (The University of Scranton Digital Collections, 2025). By mid-1892, the school had enrolled more than 1,000 miners. As inquiries from individuals looking for education in other fields followed, the curriculum expanded, and in 1894, the school was incorporated as the International Textbook Company, with its educational division renamed the International Correspondence Schools of Scranton, Pennsylvania (ICS) (Noffsinger, 1926).

Figure 2.1: Pictures of Thomas J. Foster (founder of ICS) and ICS Printery

(a) Picture of Thomas J. Foster



(b) ICS Printery in 1915

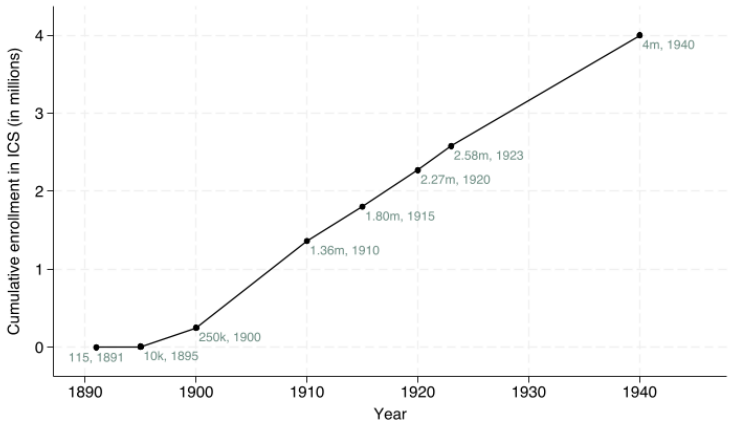


Sources: Weinberg Memorial Library, University of Scranton, International Correspondence Schools of Scranton, Pennsylvania, 1897–1996.

ICS experienced rapid growth in the years that followed, reaching a cumulative enrollment of 1,363,700 students worldwide by 1910 and offering more than 370 distinct courses. Panel (b) of Figure 2.1 and Figure 2.2 illustrate the scale and expansion of ICS's operations, showing the size of its printery in 1915 and the sharp rise in enrollment from 1891 to 1940, respectively.

By 1940, total enrollment had reached 4 million students, and ICS's reputation led the War Department to contract with the school to develop training manuals for military use (Watkinson, 1996).

Figure 2.2: Cumulative ICS enrollment over time

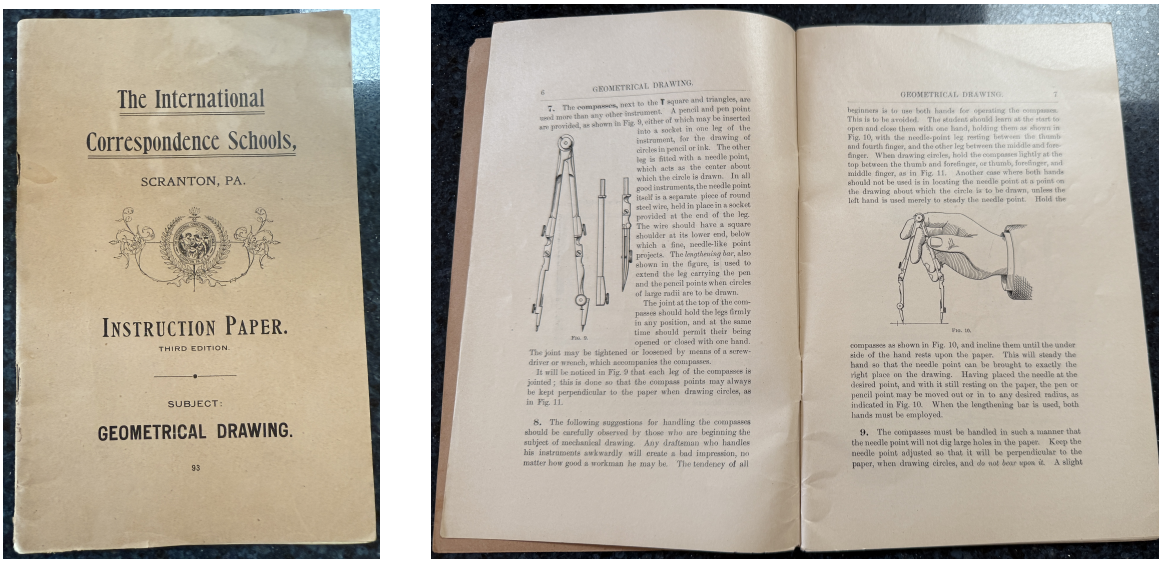


Sources: Noffsinger (1926) (1891–1923), and Watkinson (1996) (1940).

This rapid expansion was driven by five concurrent developments. First, the spread of free public primary education in the 19th century, often called the "first transformation of American education" and led by Horace Mann, equipped most Americans with basic literacy and numeracy skills, making correspondence-based learning feasible on a broad scale (Cremin, 1980; Kaestle, 2001). Second, there was strong demand for technical education to meet the needs of a rapidly industrializing society, particularly in areas where formal educational institutions were lacking. For example, the high school movement (or the "second transformation of American education") which expanded access to secondary schooling in the early 20th century, was geographically uneven, with many communities not gaining access to secondary education until decades later (Goldin and Katz, 1999). Third, the growth of the United States Postal Service, through the expansion of the Railway Mail Service after the Civil War and the introduction of Rural Free Delivery in 1896, enabled ICS to distribute its materials widely and reliably across the country (Gallagher, 2020). Fourth, while ICS courses were relatively expensive (e.g., the Architecture course cost approximately $120 in 1906, or about $3,400 in 2019 dollars), the school offered installment payment plans, with most students choosing to pay monthly (The University of Scranton Digital Collections, 2025). Finally, ICS developed its own textbooks, written in plain English and designed to be self-instructive. This contrasted with most textbooks at the time, which assumed the presence of a teacher to guide students through the material. In Figure 2.3, I present the cover and sample pages from a ICS instruction paper used in Geometrical Drawing courses. The pages offer step-by-step instructions on using a compass to draw a circle, including detailed illustrations of proper

hand positioning.

Figure 2.3: Sample pages from ICS Geometrical Drawing Instruction Paper in 1898



Source: International Correspondence Schools of Scranton, Pennsylvania, 1898.

Also notable was ICS's educational mission, which aimed to provide "practical men with a technical education, and technical men with a practical education" (Watkinson, 1996). This approach stood in contrast to prevailing educational philosophies of the era, which emphasized enlightenment, moral cultivation, and self-development over immediate application or economic advancement. ICS articulated this practical approach in its 1908 register: "Our courses are all prepared from a utilitarian standpoint; that is, it is always kept in view that the reason for the student taking one of our courses is that he desires to put the knowledge obtained into immediate practical use. We are not aiming to train the mind, but to give the student such information regarding the principles, theory, and practice as he can use in connection with the position he is aiming to fill." (International Textbook Company, 1908).

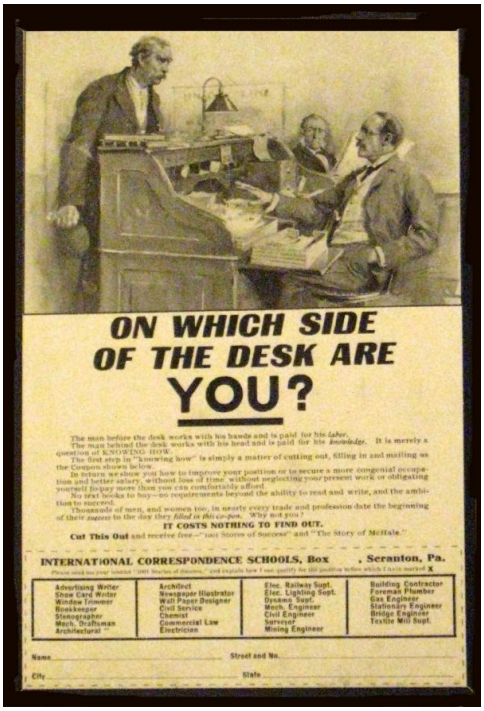
This emphasis on practical skill acquisition resonated with many students at the time, who were seeking an education that could lead to immediate socioeconomic mobility. ICS offered a pathway into skilled white-collar occupations without the need for lengthy apprenticeships or access to extended formal schooling (Watkinson, 1996).[1] In Figure 2.4, I present a 1905 advertisement for ICS that highlights this occupational upskilling mission. It reads:

"The man before the desk works with his hands and is paid for his *labor*. The man behind the desk works with his head and is paid for his *knowledge*. It is merely a question of KNOWING

[1]It is important to note, however, that the social mobility promoted by ICS was largely limited to white men. Black men and women made up only a very small share of those enrolled in ICS courses.

HOW. The first step in "knowing how" is simply a matter of cutting out, filling in and mailing us the Coupon shown below. In return we show you how to improve your position or to secure a more congenial occupation and better salary, without loss of time, without neglecting your present work, or obligating yourself to pay more than you can comfortably afford. No textbooks to buy—no requirements beyond the ability to read and write, and the ambition to succeed..."

Figure 2.4: Advertisement for ICS in 1905



Source: Weinberg Memorial Library, University of Scranton, International Correspondence Schools of Scranton, Pennsylvania, 1897–1996.

In this paper, I leverage a dataset of individuals enrolled in ICS, together with additional data and a theoretical framework, to examine the impact of correspondence education on occupational upskilling and entry into white-collar work, as well as its relationship with high school education and the high school movement. Using these analyses, I assess whether ICS fulfilled its stated mission and explore the broader implications of correspondence education for human capital formation in the early 20th century.

3 Evidence of impacts of correspondence education on occupational mobility

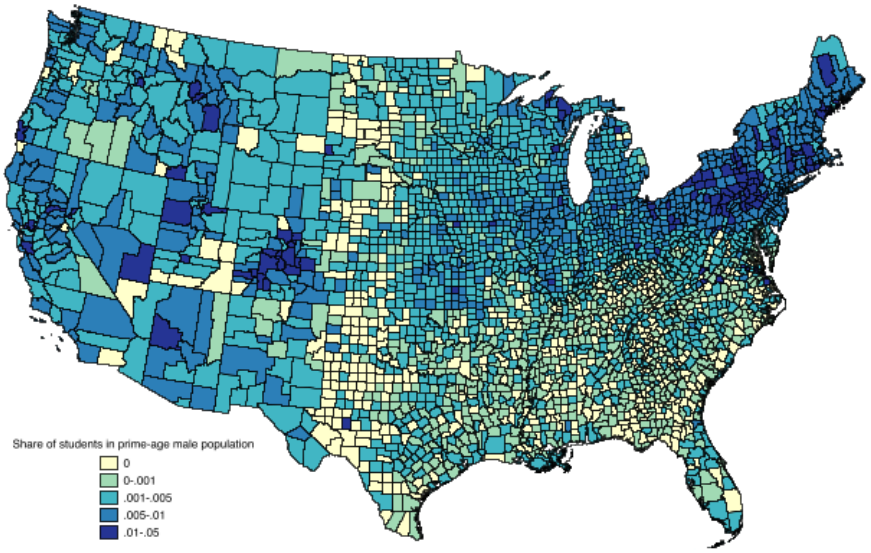
I begin by presenting evidence on the impacts of correspondence education on occupational mobility.

3.1 Register of correspondence school participants

I build a dataset of correspondence school students by digitizing the 1908 edition of the "Register of International Correspondence Schools" published by the International Textbook Company in Scranton, Pennsylvania. This register contains a list of students who had completed at least one of the technical subjects (or equivalent) in their ICS courses by August of 1907, and is organized by state and town. Each entry contains information on the name, year of enrollment, address, course(s) taken, and progress (number of subjects or drawing plates completed, and whether they earned a diploma or certificate). For details on the ICS register and construction of the student list, please see Appendix A.1.

The list of students includes 96,959 individuals residing across all states in the contiguous United States and Alaska. Of these, 95% are men, totaling 91,906 individuals. This represents 0.49% of the prime-age male population (ages 25–54) in 1910, a substantial share given the low levels of educational attainment at the time, with only 13.5% of individuals aged 25 and older having completed high school (National Center for Education Statistics, 2021). Figure 3.1 illustrates the geographic distribution of correspondence school students, reporting their share relative to the 1910 prime-age male population in each county. Enrollment rates were highest in counties across the Northeast, Midwest, and West, reaching up to 5% of prime-age men, and were lower in the South and Great Plains. This pattern is consistent with the location of ICS in northeastern Pennsylvania and with the focus of correspondence education on technical training and mining, rather than agriculture.

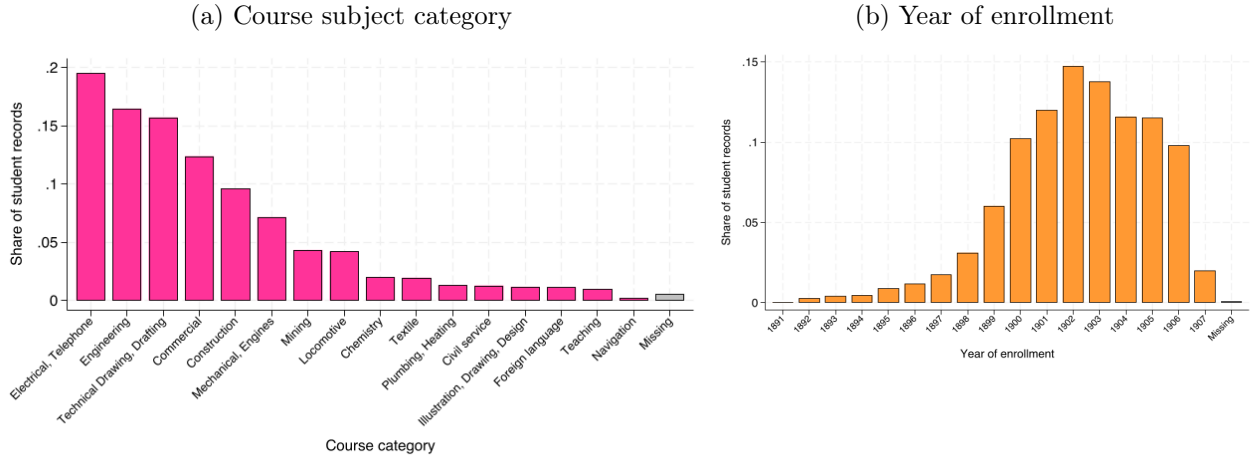
Figure 3.1: Geographic distribution of correspondence school students



Notes: This map plots the share of correspondence school students relative to the 1910 prime-aged male population in each county. The sample encompasses all male students from the "Register of International Correspondence Schools" published in 1908.

Figure 3.2 further characterizes the course content and temporal coverage of the ICS register by reporting the distribution of student records by course subject and year of enrollment. Panel (a) shows that a large share of students enrolled in technical fields related to manufacturing, industrial activity, and construction, including electrical and telephone systems, engineering, and technical drawing. A smaller but still notable share pursued other fields, such as mining, textiles, civil service, teaching, and foreign languages. Panel (b) shows that enrollment increased steadily after ICS was founded in 1891, rising through the 1890s and early 1900s before declining around 1904, likely reflecting the requirement that students demonstrate sufficient progress to be included in the register.

Figure 3.2: Share of correspondence school students by course subject category and year of enrollment



Notes: These figures plot the distribution of correspondence school student records by general course subject and year of enrollment, respectively. The sample encompasses all male student records from the "Register of International Correspondence Schools" published in 1908.

3.2 Census data and matching

I identify correspondence school students in the full-count census data from 1900 and 1910 through a two-step process.[2] First, I use name and location information from the ICS register to probabilistically match students to records in either the 1900 or 1910 census. This yields 45,030 matched individuals, representing 46.4% of those listed in the register.

Second, I trace these individuals to the other census wave using the record linkages developed by the Census Tree Project (Price et al., 2021; Buckles et al., 2023). This method leverages familial relationships recorded on the genealogy platform FamilySearch.org to link individuals across census years. By incorporating private information such as maiden names and household composition, it overcomes many of the limitations of traditional linkage approaches, in-

[2]I do not use data from 1890 since census records from this wave were largely lost to fire.

cluding name changes and missing data. The Census Tree data is further supplemented with links from other census-linking projects and machine-learning-based matches. Additional details on these two steps of the matching process are provided in Appendix A.2.2.

Given the overwhelming majority of men in both the ICS register and the early 20th-century labor force, I restrict the analysis to men. This yields a sample of 58,716 observations from 43,240 individuals observed in 1900–1910. Columns (1) and (2) of Table 3.1 report some summary statistics in 1900 and 1910 for this sample. For comparison, Columns (3) and (4) present the same statistics for the full male population in those years.

Table 3.1: Summary statistics of sample of correspondence students and full male population in 1900 and 1910

	ICS sample		**Full male pop.**	
	1900	**1910**	**1900**	**1910**
Avg. age	34.3	36.4	26.5	26.9
Share white	0.96	0.97	0.88	0.89
Lives in Northeast	0.40	0.46	0.27	0.27
Lives in Midwest	0.37	0.34	0.35	0.33
Lives in South	0.127	0.097	0.32	0.31
Lives in West	0.095	0.108	0.062	0.086
Share urban	0.49	0.65	0.38	0.45
Share in professional or technical occupations	0.059	0.077	0.034	0.031
Share in other white-collar occupations	0.15	0.23	0.12	0.15
Share in blue-collar occupations	0.80	0.70	0.85	0.82
Share in agriculture	0.35	0.18	0.50	0.42
Share in manufacturing	0.31	0.41	0.22	0.28
Share in services	0.34	0.41	0.28	0.30
Observations	20,318	38,398	38,760,184	47,611,680

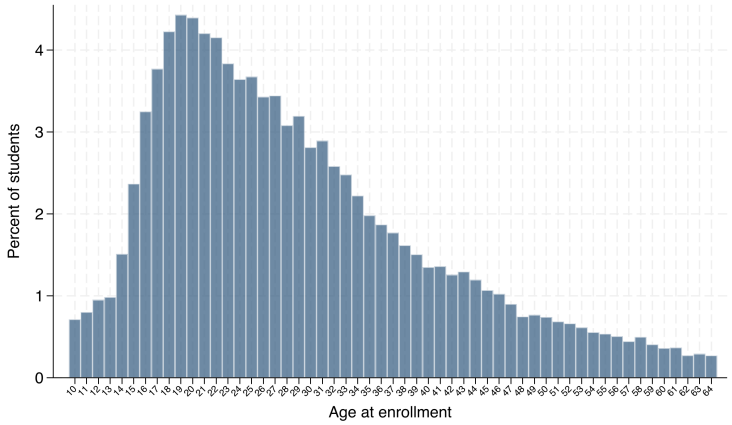
Notes: This table presents the average values for selected variables for the sample of men from the "Register of International Correspondence Schools" matched to census records in 1900 and/or 1910 using the procedure described in Section 3.2, and the full-male population, in 1900 and 1910.

Relative to the full male population, men in the ICS sample are whiter, more concentrated in the Northeast and less so in the South. Moreover, over time the ICS sample becomes increasingly urban and more concentrated in manufacturing and services relative to the full population. These patterns are consistent with correspondence education being closely linked to access to industrial jobs and skill upgrading.

Figure 3.3 shows the distribution of age at enrollment for the matched sample, indicating that most students enrolled in their late teens, twenties, and early thirties, although some

enrolled at older ages as well.

Figure 3.3: Distribution of age at enrollment



Notes: This figure shows the distribution of age at enrollment for men in the ICS sample matched to census records. Age at enrollment is computed as the difference between the year of enrollment listed in the ICS register and the individual's birth year as reported in the census.

3.3 Strategy and Identification

I study the effects of correspondence education on occupational mobility using an event-study framework centered around the year of enrollment, indexed at event time $\tau = 0$.[3] Specifically, I use data from the 1900 and 1910 census waves, and assign each individual i, observed in census year t, to an event time $\tau_{i,t} = t - \text{Year of Enrollment}_i$. Event time $\tau \in \{-T^-, -T^- + 1, \ldots, -1, 0, 1, \ldots, T^+\}$ spans a window of T^- years before and T^+ years after enrollment.

Using these event times, I estimate the following specification:

$$Y_{i,t} = \sum_{\tau=-T^-}^{T^+} \beta_\tau \mathbb{1}\{\tau_{i,t} = \tau\} + \alpha_t + \alpha_c + \alpha_{c,t} + \theta X_{i,t} + \varepsilon_{i,t}, \tag{3.1}$$

where $Y_{i,t}$ is the occupational outcome for individual i at time t. To focus on the period around enrollment, and given the limited number of observation years relative to the enrollment window, I set $T^- = 7$ and $T^+ = 10$. The coefficients β_τ capture the effect of being τ years from enrollment, relative to the base period $\tau = -1$, which is omitted. The specification includes year fixed effects (α_t), county fixed effects (α_c), and county-by-year fixed effects

[3] While the year of completion may seem a more natural reference point, it is not available in the register. Moreover, because correspondence courses were self-paced, completion times varied across students. However, most courses were completed within 6 months to 2 years (International Correspondence Schools, 1943), making the year of enrollment a good benchmark point for the event-study as many students had finished within the year.

$(\alpha_{c,t})$ to absorb time and regional trends.[4] The vector $X_{i,t}$ includes individual-level fixed effects for age, race, and broad course subject. Standard errors are clustered at the county level to account for regional heterogeneity in labor market conditions and potential spatial correlation in the effects of correspondence education.[5]

This specification compares the occupational outcomes of individuals, and in particular ICS enrollees, with similar demographic characteristics observed in the same year and county, before and after enrollment in correspondence education. Identification relies on the assumption that, conditional on these controls and fixed effects, individuals observed at different enrollment horizons are comparable and would have followed similar occupational trajectories absent enrollment. The event-study framework allows for a direct assessment of this assumption by testing for systematic pre-trends across individuals observed at different pre-enrollment event times.

I construct three broad occupational outcome categories using census occupation codes: (1) professional and technical occupations; (2) other white-collar occupations, including managers, officials, proprietors, clerical and kindred workers, and sales workers; and (3) blue-collar occupations, including farmers, craftsmen, operatives, domestic workers, service workers, farm laborers, and other laborers. This classification captures major distinctions in occupational status and enables an assessment of occupational mobility around the time of enrollment in correspondence education. I also examine the effects on the Duncan Socioeconomic Index (SEI), a census-provided measure of occupational status based on the typical income associated with each occupation.

3.4 Results

I begin by presenting the event-study results on the occupational effects of correspondence education. I then investigate the mechanisms driving these patterns, which in turn guide the structure of the theoretical model. Finally, I consider the robustness of these results to alternate specifications.

[4]Because county boundaries have changed over time in the US, I use the 1900 county definitions and link them to other years using the crosswalk developed by Eckert et al. (2020).

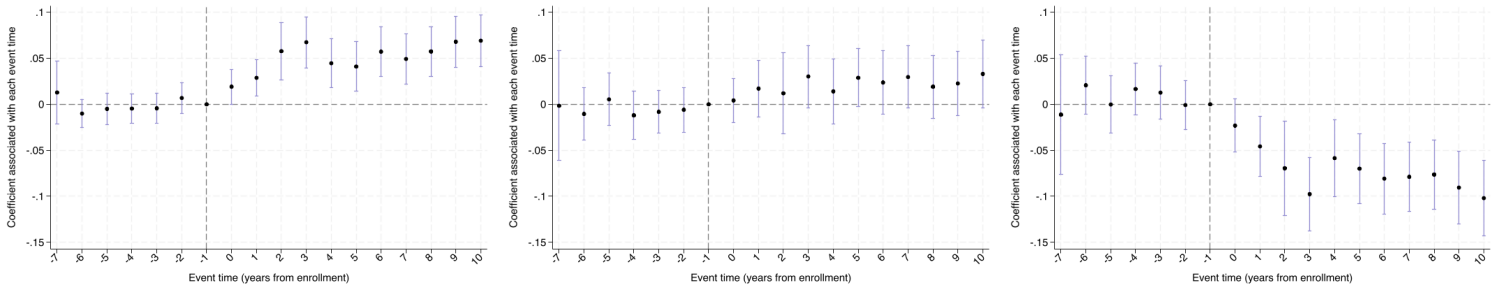
[5]I do not include individual fixed effects in this specification because enrollment year is fixed for each person, and individuals are observed at most twice. This also limits the use of the interaction-weighted event study estimator proposed by Sun and Abraham (2021), which adjusts for differential (staggered) timing of treatment and allows for treatment effect heterogeneity across year of enrollment cohorts. That approach relies on variation in cohort composition across event times, but because I observe individuals only in the 1900 and 1910 census waves, many event times correspond only to a single cohort. As a result, there is insufficient within-τ cohort variation to implement a full interaction-weighted event study. Nonetheless, I explore a simplified version in Appendix C.1, collapsing event time into pre- and post-enrollment periods to estimate average treatment effects across cohorts.

3.4.1 Effects of correspondence education on occupational outcomes

I present the event-study results on occupational outcomes in Figure 3.4. Panel (a) shows that correspondence education increased the likelihood of working in a professional or technical occupation by 4–7 percentage points in the 3 to 10 years following enrollment. Panel (b) reveals a more modest rise of 2–3 percentage points in other white-collar occupations, such as clerical and sales roles, implying an overall rise of 6 to 10 percentage points in white-collar employment. Panel (c) indicates that these gains in skilled employment were offset by an 5–10 percentage point decline in blue-collar occupations over the same period. These patterns suggest that correspondence education played an important role in promoting upward occupational mobility in the early 20th century.[6] Moreover, all three figures show no evidence of pre-trends before enrollment, consistent with the assumption that individuals observed at different enrollment horizons are comparable, and that there were no anticipatory changes in occupation.

Figure 3.4: Effect of correspondence education on occupational outcomes

(a) Professional and technical occupations (b) Other white-collar occupations (c) Blue-collar occupations



Notes: These figures plot the event-study estimates of the impact of correspondence education on occupational outcomes, corresponding to β_τ for $\tau \in \{-7, -6, \ldots, -1, 0, 1, \ldots, 10\}$ in Equation (3.1). Each coefficient captures the effect of being τ years from enrollment, relative to the base period $\tau = -1$, on indicator variables for: (1) professional and technical occupations; (2) other white-collar occupations; and (3) blue-collar occupations, respectively. The analysis includes men from the "Register of International Correspondence Schools" matched to census records in 1900 and/or 1910 using the procedure described in Section 3.2. 95% confidence intervals built from standard errors clustered at the county level are plotted.

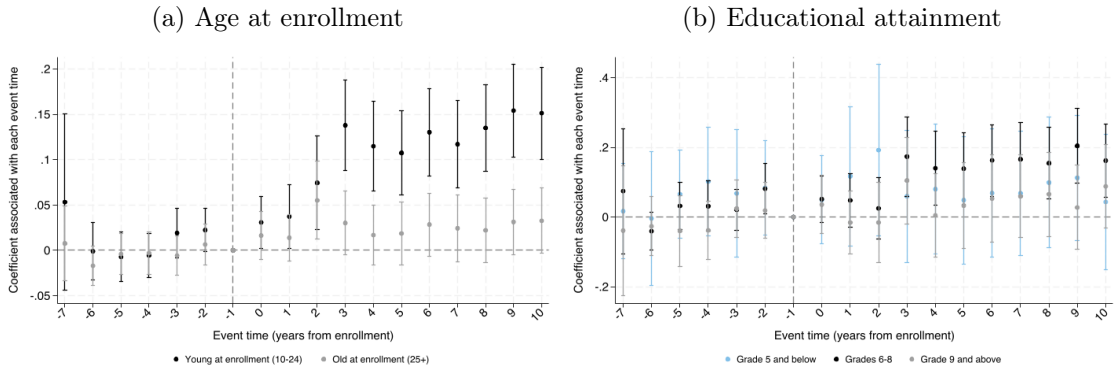
3.4.2 Mechanisms driving occupational mobility through correspondence education

To better understand the mechanisms behind the positive effects of correspondence education on occupational upskilling, I repeat the event-study analysis splitting the sample into

[6] These results are also reflected in the estimated effects on the Duncan Socioeconomic Index (SEI), presented in Figure B.1.

subgroups defined by age at enrollment and educational attainment.[7] For clarity, the results focus on the likelihood of working in a professional or technical occupation. Results for the other occupational categories and for the Duncan Socioeconomic Index (SEI) are shown in Figures B.2–B.4, and exhibit similar patterns.

Figure 3.5: Effect of correspondence education on professional and technical occupations by individual characteristics



Notes: These figures plot the event-study estimates of the impact of correspondence education on the probability of working in a professional or technical occupation, corresponding to β_τ for $\tau \in \{-7, -6, \ldots, -1, 0, 1, \ldots, 10\}$ in Equation (3.1), estimated separately for each subgroup. Each coefficient captures the effect of being τ years from enrollment, relative to the base period $\tau = -1$, on an indicator variable for this occupational category. The analysis includes men from the "Register of International Correspondence Schools" matched to census records in 1900 and/or 1910 using the procedure described in Section 3.2. 95% confidence intervals built from standard errors clustered at the county level are plotted.

Figure 3.5 presents these results showing how the occupational effects of correspondence education vary by individual characteristics. Two key patterns emerge. First, occupational gains are largest for individuals who enrolled at younger ages. Among older enrollees, the effects remain positive but are more modest, likely reflecting different motivations, such as career advancement rather than substituting for formal schooling. Second, the largest mobility gains are concentrated among individuals with 6–8 years of schooling, just below the high school threshold, suggesting that correspondence education may have served as a substitute for secondary schooling. In contrast, those with very low education levels largely remained in blue-collar work, while individuals with some high school were likely already on white-collar jobs.

Together, these patterns suggest that the upskilling and mobility benefits of correspondence education were concentrated among younger individuals who used it as a substitute for high school. This interpretation is supported by a review of exam questions from three ICS course

[7]Since educational attainment was first collected in the 1940 census, this analysis is limited to individuals observed through 1940, using the record linkages developed by the Census Tree Project (Price et al., 2021; Buckles et al., 2023). Given the potential for selection, these results should be interpreted with caution.

booklets I located online, covering arithmetic, fractions, and basic mechanics, which, according to the ICS Register, appear in a wide range of courses.[8] The level of the exam questions, examples of which are shown in Figure B.5, appears to align with upper elementary (grades 4–6), middle school (grades 6–8), and upper or technical high school, respectively, as assessed using large language models (ChatGPT and Claude). This suggests that many correspondence courses effectively served as a pathway to a technical high school-level education. This substitutability between high school and correspondence study motivates the structure of the model in the next section, where the two are treated as alternative educational pathways.

3.4.3 Robustness

In Appendix C, I assess the robustness of the results in this section to several alternative specifications. First, I collapse the event-time structure into a simple pre/post design centered on the year of enrollment and re-estimate treatment effects using both the baseline specification and the interaction-weighted (IW) estimator of Sun and Abraham (2021), which accounts for staggered enrollment and treatment effect heterogeneity across cohorts. Second, I re-estimate the event-study specification using only data from 1900. Because all individuals had enrolled by 1910, event times in that year are always positive, raising the concern that some results may be driven by comparisons across years despite the inclusion of year fixed effects. Third, I exclude men residing in the South, as this region followed markedly different patterns of schooling and migration during the period of study. Fourth, I exclude men who enrolled in two or more correspondence courses, in order to focus on individuals with a single enrollment year and no repeated exposure.

4 A model of educational choice

In this section, I develop a Roy-style education choice model that builds on the empirical findings and provides a unified general equilibrium framework to analyze how correspondence schools shaped human capital acquisition and occupational mobility in the early 20th century. The model captures the effects of correspondence education both before and after the expansion of high school education, highlighting its interaction with the high school movement. The model also generates testable implications, which I examine empirically in the next section.

[8] These courses include mechanical engineering; the shop practice series (machine-shop, toolmaking, patternmaking, foundry-work, blacksmithing, and forging); steam and locomotive engineering; gas engines; electrical and power engineering; plumbing, heating, and ventilation; architectural and structural drawing; farm machinery; and mathematics and physics.

4.1 Model setup

4.1.1 Ability and schooling choice

The economy is populated by a continuum of individuals with total mass of one. Each individual is endowed with a learning ability level a, drawn from a distribution with density $f(a)$, where $f(a) > 0$ for all a, cumulative distribution function $F(a)$, and support on $[0, \bar{a}]$.

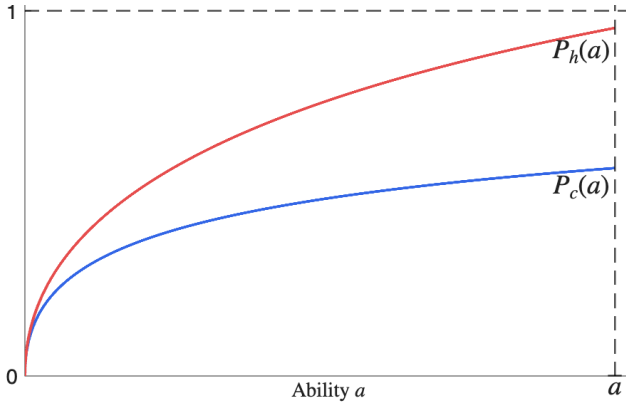
After observing their learning ability level, individuals decide whether to invest in schooling. Those who do not invest remain unskilled and earn the unskilled wage w_u. Those who choose to invest select from a set of potentially available schooling options $S \subseteq \{s_c, s_h\}$, where s_c denotes correspondence school and s_h denotes high school. Choosing option $j \in S$ requires paying a cost γ_j and results in skill acquisition with probability $P_j(a)$. If successful, the individual becomes skilled and earns the skilled wage w_s; if unsuccessful, they remain unskilled and earn w_u. For each schooling option j, the function $P_j(a)$ is bounded between 0 and 1 on the support of $a \in [0, \bar{a}]$, satisfies $P_j(0) = 0$, and is strictly increasing and concave in learning ability. This captures the idea that higher-ability individuals are more likely to become skilled, though with diminishing returns.

Although correspondence schools in the early 20th century required tuition payments, they allowed individuals to study while working full-time. As a result, their effective cost is modeled as lower than that of high school, which, despite being often free to attend, required full-time enrollment and thus carried a higher opportunity cost. Accordingly, I assume $\gamma_h > \gamma_c > 0$.[9]

Consistent with the longer duration and greater academic intensity of high school, as well as its historically large returns to occupational advancement during this period (Goldin and Katz, 1999, 2000; Doxey et al., 2025), the probability of becoming skilled is strictly higher for high school than for correspondence school at all but the lowest learning ability levels: $P_h(a) > P_c(a)$ for all $a > 0$. Moreover, the return to learning ability is greater for high school, as the gap $P_h(a) - P_c(a)$ is increasing in a. Figure 4.1 illustrates these properties by plotting an example of how $P_c(a)$ and $P_h(a)$ behave over the support $a \in [0, \bar{a}]$.

[9] These cost parameters capture both direct tuition expenses and the opportunity cost of time, and are assumed to be independent of learning ability, as compensation in the unskilled sector (where these students would otherwise work) is relatively insensitive to ability. It is also worth noting that the tuition charged by ICS was high but accessible to unskilled workers, consistent with its upskilling mission. For instance, the \$120 fee for the full ICS Architecture course in 1906 represented roughly 25% of the annual unskilled wage, estimated at about \$500. This estimate draws on data from the MeasuringWorth project, which reports an average hourly wage of \$0.16 for production workers in 1906 (Officer and Williamson, 2025), and from Whaples (2001), who document a 60-hour average workweek during this period.

Figure 4.1: Probability functions of skill acquisition under correspondence school and high school



Notes: This figure shows an example of how $P_c(a)$ and $P_h(a)$ behave over the support of $a \in [0, \bar{a}]$.

4.1.2 Production

Production is carried out by identical small firms using a constant elasticity of substitution (CES) technology that combines unskilled and skilled labor to produce a final good

$$Y = \left[\zeta L_u^{\frac{\sigma-1}{\sigma}} + (1-\zeta) L_s^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}, \tag{4.1}$$

where L_u and L_s denote the quantities of unskilled and skilled labor, respectively, $0 < \zeta < 1$ captures the relative weight of unskilled labor in production, and σ is the elasticity of substitution between the two labor types, where $\sigma > 1$, consistent with the empirical literature on the historical skill premium (Katz and Murphy, 1992; Acemoglu and Autor, 2012; Autor et al., 2020).

4.2 Characterizing the schooling choice

Each individual's utility is linear in consumption of the final good. The expected value for an individual of learning ability a is the maximum expected utility from the available schooling options:

$$V(a) = \max\left\{\mathbb{E}V_u(a),\ \mathbb{E}V_c(a),\ \mathbb{E}V_h(a)\right\}. \tag{4.2}$$

The expected lifetime values of each option are:

- Value of remaining unskilled: $\mathbb{E}V_u(a) = w_u$ (4.3)
- Value of enrolling in correspondence school: $\mathbb{E}V_c(a) = P_c(a)w_s + (1 - P_c(a))w_u - \gamma_c$ (4.4)
- Value of enrolling in high school: $\mathbb{E}V_h(a) = P_h(a)w_s + (1 - P_h(a))w_u - \gamma_h$ (4.5)

These lifetime values can be used to characterize which individuals get skilled in equilibrium, and through which of the available schooling options. Proposition 1 characterizes these

choices.

Proposition 1 (Ability cutoffs)**.**

1. ***Case 1: Only correspondence school available,*** $S = \{s_c\}$. *When only the correspondence school option is available in schooling set* S*, there exists a cutoff learning ability level* $a_{c,1} \in (0, \bar{a})$ *such that individuals with* $a < a_{c,1}$ *remain unskilled, while those with* $a \geq a_{c,1}$ *enroll in correspondence school.*

2. ***Case 2: Only high school available,*** $S = \{s_h\}$. *When only the high school option is available in schooling set* S*, there exists a cutoff learning ability level* $a_{h,2} \in (0, \bar{a})$ *such that individuals with* $a < a_{h,2}$ *remain unskilled, while those with* $a \geq a_{h,2}$ *enroll in high school.*

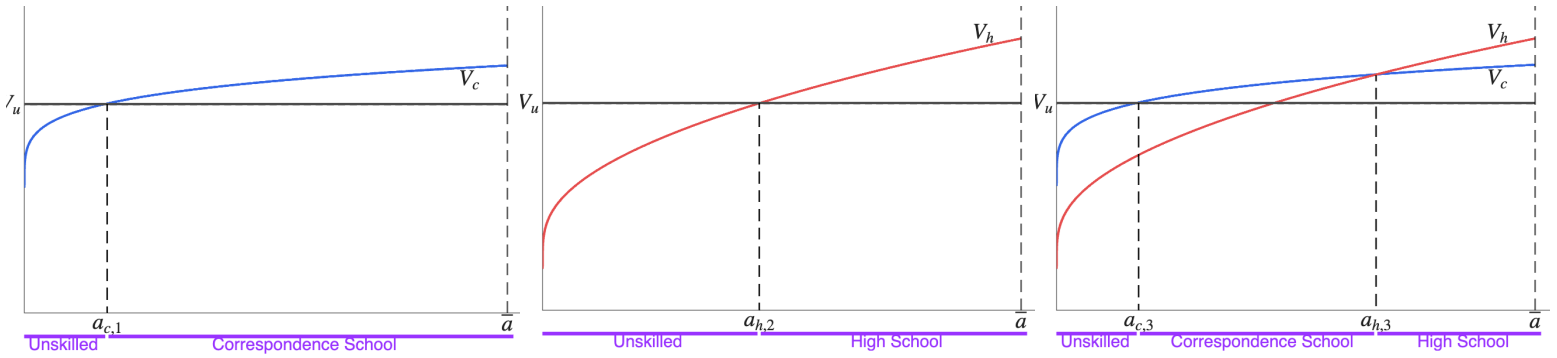
3. ***Case 3 : Both options available,*** $S = \{s_c, s_h\}$. *When both options are available in schooling set* S *and used in equilibrium, there exist cutoff learning ability levels* $a_{c,3}$, $a_{h,3} \in (0, \bar{a})$ *with* $a_{c,3} < a_{h,3}$ *such that individuals with* $a < a_{c,3}$ *remain unskilled, those with* $a_{c,3} \leq a < a_{h,3}$ *enroll in correspondence school, and those with* $a \geq a_{h,3}$ *enroll in high school.*

Proof*: See Appendix D.1.*

The intuition behind each case in this proposition is illustrated in Figure 4.2, which plots, in each panel, the lifetime value of every schooling option available under each case.

Figure 4.2: Value functions over learning ability in different cases

(a) Case 1: Only corresp. school available (b) Case 2: Only high school available (c) Case 3: Both options available



Notes: This figure plots, across three panels, the lifetime value functions corresponding to each schooling option available under the following cases: (1) only correspondence school available, (2) only high school available, and (3) both options available.

These figures show that, across all cases, low-ability individuals prefer to remain unskilled. This is because both schooling options involve costs, and the probability of becoming skilled is low at low levels of learning ability. As learning ability increases, however, individuals

eventually choose to acquire skills, since the value of both correspondence school and high school strictly increases, reflecting the increasing probabilities $P_c(a)$ and $P_h(a)$. When only correspondence school is available, individuals with learning ability above the cutoff $a_{c,1}$ enroll in correspondence school. Similarly, when only high school is available, individuals with learning ability above the cutoff $a_{h,2}$ enroll in high school. When both options are available, individuals sort more finely by learning ability: low-ability individuals remain unskilled, those with intermediate ability enroll in correspondence school, and high-ability individuals enroll in high school.

This sorting between correspondence school and high school arises from the interaction of two forces: (1) high school entails a higher cost than correspondence school; and (2) the value of high school increases more steeply with learning ability than that of correspondence school. As a result, individuals with intermediate ability, whose probability of success differs less across the two schooling options, prefer correspondence school due to its lower cost. In contrast, high-ability individuals favor high school, as their greater likelihood of success justifies the higher cost.

It is important to note that the cutoffs differ across cases, $a_{c,1} \neq a_{h,2} \neq a_{c,3} \neq a_{h,3}$, as they are general equilibrium objects jointly determined with wages. The next subsection defines the model's general equilibrium, further highlighting how the cutoffs relate to wages in each case.

4.3 Equilibrium

Definition (Competitive equilibrium)**.**

Given the schooling options available in the set $S \subseteq \{s_c, s_h\}$; the learning ability distribution with density $f(a)$, cumulative distribution function $F(a)$, and support on $[0, \bar{a}]$; and the schooling-specific probabilities of skill acquisition $P_c(a)$ and $P_h(a)$; a competitive equilibrium consists of: (1) unskilled and skilled wages w_u and w_s; (2) overall lifetime value $V(a)$ and option-specific values $V_u(a)$, $V_c(a)$, and $V_h(a)$; (3) masses of unskilled and skilled labor L_u and L_s; (4) learning ability cutoffs $\{a_{c,1}, a_{h,2}, a_{c,3}, a_{h,3}\}$; (5) labor demand for unskilled and skilled workers L_u^d and L_s^d; and (6) total output Y; such that:

- The overall lifetime value $V(a)$, and option-specific values $V_u(a)$, $V_c(a)$, and $V_h(a)$ follow Equations (4.2)–(4.5).
- Firms choose labor inputs L_u^d and L_s^d to maximize profits given the production function in Equation (4.1).

- Labor supply is consistent with individual choices based on the learning ability cutoffs $\{a_{c,1}, a_{h,2}, a_{c,3}, a_{h,3}\}$ described in Proposition 1:[10]

$$L_u = \begin{cases} F(a_{c,1}) + \int_{a_{c,1}}^{\bar{a}} f(a)(1 - P_c(a))da & \text{if } S = \{s_c\} \text{ (case 1, only corr. school)} \\ F(a_{h,2}) + \int_{a_{h,2}}^{\bar{a}} f(a)(1 - P_h(a))da & \text{if } S = \{s_h\} \text{ (case 2, only high school)} \\ F(a_{c,3}) + \int_{a_{c,3}}^{a_{h,3}} f(a)(1 - P_c(a))da + \int_{a_{h,3}}^{\bar{a}} f(a)(1 - P_h(a))da & \text{if } S = \{s_c, s_h\} \text{ (case 3, both options)} \end{cases}$$

and

$$L_s = \begin{cases} \int_{a_{c,1}}^{\bar{a}} f(a)P_c(a)da & \text{if } S = \{s_c\} \text{ (case 1, only corr. school)} \\ \int_{a_{h,2}}^{\bar{a}} f(a)P_h(a)da & \text{if } S = \{s_h\} \text{ (case 2, only high school)} \\ \int_{a_{c,3}}^{a_{h,3}} f(a)P_c(a)da + \int_{a_{h,3}}^{\bar{a}} f(a)P_h(a)da & \text{if } S = \{s_c, s_h\} \text{ (case 3, both options).} \end{cases}$$

- Labor markets clear:

$$L_u = L_u^d \quad \text{and} \quad L_s = L_s^d.$$

- The output market clears, with aggregate output matching total income net of schooling costs:

$$Y = \begin{cases} w_u F(a_{c,1}) + (w_u - \gamma_c) \int_{a_{c,1}}^{\bar{a}} f(a)(1 - P_c(a))da + (w_s - \gamma_c) \int_{a_{c,1}}^{\bar{a}} f(a)P_c(a)da & \text{if } S = \{s_c\} \text{ (case 1, only corr. school)} \\ w_u F(a_{h,2}) + (w_u - \gamma_h) \int_{a_{h,2}}^{\bar{a}} f(a)(1 - P_h(a))da + (w_s - \gamma_h) \int_{a_{h,2}}^{\bar{a}} f(a)P_h(a)da & \text{if } S = \{s_h\} \text{ (case 2, only high school)} \\ w_u F(a_{c,3}) + (w_u - \gamma_c) \int_{a_{c,3}}^{a_{h,3}} f(a)(1 - P_c(a))da + (w_u - \gamma_h) \int_{a_{h,3}}^{\bar{a}} f(a)(1 - P_h(a))da & \text{if } S = \{s_c, s_h\} \text{(case 3, both options).} \\ \quad + (w_s - \gamma_c) \int_{a_{c,3}}^{a_{h,3}} f(a)P_c(a)da + (w_s - \gamma_h) \int_{a_{h,3}}^{\bar{a}} f(a)P_h(a)da & \end{cases}$$

The equilibrium definition and Proposition 1 fully characterize the equilibrium in each regime. In the next subsection, I use these results to analyze how correspondence schools shaped human capital formation in the early 20th century and interacted with the rise of high school education.

4.4 How did correspondence schools affect human capital?

To formalize the effects of correspondence schools on human capital formation and their interaction with high school education, I begin by comparing the learning ability cutoffs across the three cases, illustrating how individual sorting into education varies across educational regimes. I then derive testable implications of the model, focusing on the factors that shape the effectiveness of correspondence schools in promoting occupational upskilling and their

[10] Note that unskilled labor includes both individuals who choose not to enroll in schooling and those who enroll but fail to become skilled. Skilled labor includes only individuals who successfully acquire skills through schooling.

broader interaction with high school education and the high school movement.

Proposition 2 (Comparing the learning ability cutoffs across cases)**.**

The learning ability cutoffs across the different schooling regime cases satisfy the following inequalities:

- $a_{c,1} < a_{c,3} < a_{h,3}$
- $a_{h,2} < a_{h,3}$

Proof*: See Appendix D.2.*

The ordering of learning ability cutoffs across cases, and thus the share of individuals who choose to invest in schooling, reflects how the costs and benefits of education shift across different educational regimes.

The first part of this proposition compares cases 1 and 3. When only correspondence school is available (case 1), the cutoff $a_{c,1}$ is lower than its counterpart in case 3, $a_{c,3}$, implying that a larger share of individuals pursue schooling in case 1. This is because, in case 1, correspondence school is the only path to becoming skilled. As its success probability $P_c(a)$ is relatively low, the supply of skilled workers remains limited, keeping the skill premium high and making enrollment attractive even for lower-ability individuals. In contrast, when both schooling options are available (case 3), high-ability individuals shift toward high school, as the higher cost is justified by a substantially greater probability of success at high ability levels. This introduces a new threshold, $a_{h,3}$, above which individuals choose high school. At the same time, the threshold for choosing correspondence school, $a_{c,3}$, rises relative to case 1. This is because high school enrollees are more likely to become skilled, increasing the overall supply of skilled workers. The resulting decline in the skill premium makes correspondence school less attractive to marginal individuals, thereby raising the learning ability level required to justify enrollment.

The second part of this proposition compares cases 2 and 3. When only high school is available (case 2), the cutoff $a_{h,2}$ is lower than its counterpart in case 3, $a_{h,3}$, implying that a larger share of individuals enroll in high school in case 2, as it is the only available path to skill acquisition. However, when both schooling options are available (case 3), some individuals who would have enrolled in high school now opt for the lower-cost correspondence school alternative. As a result, the threshold for choosing high school, $a_{h,3}$, rises relative to $a_{h,2}$.[11]

[11] This also underscores why it is difficult to further compare the threshold $a_{h,2}$ to the other cutoffs. While fewer individuals enroll in high school in case 3 compared to case 2, some now choose correspondence school

Building on these results, I now present testable implications of the theory, focusing on the factors that shape the effectiveness of correspondence schools in fostering occupational upskilling and their broader interaction with high school education and the high school movement.

Proposition 3 (Testable implications of impact of correspondence schools)**.**

1. ***Effectiveness of correspondence education:***

   The average upskilling rate of correspondence education—defined as the share of individuals who become skilled after choosing correspondence education—increases under the following conditions:

   - *In both cases 1 and 3, if the success probabilities $P_c(a)$ and $P_h(a)$ rise at high learning ability levels, that is, for $a \in [\bar{a} - \epsilon, \bar{a})$ with $\epsilon > 0$ sufficiently small.*
   - *In case 1, if the cost of correspondence education, γ_c, increases.*

2. ***Interaction with high school:***

   - *The measure of individuals who choose correspondence education is strictly lower in case 3 than in case 1.*
   - *A subset of individuals who would have chosen high school in case 2 instead enroll in correspondence school in case 3. These individuals have learning ability levels bounded away from the top of the distribution; that is, $a < \bar{a} - \epsilon$ for some $\epsilon > 0$.*
   - *The upskilling rate of high school—defined as the share of individuals who become skilled after attending high school—is higher in case 3 compared to case 2.*

***Proof**: See Appendix D.3.*

The first set of results examines the factors that shape the effectiveness of correspondence education in fostering upskilling in the two cases where it is available (cases 1 and 3). When success probabilities rise among high-ability individuals, the upskilling rate of correspondence school increases, both because high-ability enrollees are more likely to succeed, and because lower-ability individuals, deterred by low success probabilities and a declining skill premium as the supply of skilled labor expands, are less likely to enroll. Similarly, when the cost of

instead. However, the size of this group, and thus how the total share of individuals pursuing schooling compares between cases 2 and 3, depends on the shape of the success probability functions $P_c(a)$ and $P_h(a)$, the relative costs of schooling, and the density of the learning ability distribution. As such, the resulting difference in the supply of skilled labor and the skill premium between cases 2 and 3 is ambiguous, making it impossible to further rank $a_{h,2}$ without additional structure.

correspondence education rises, only higher-ability individuals find it worthwhile to enroll, strengthening positive selection and raising the average upskilling rate.[12]

The second set of results examines how correspondence school enrollment responds to the introduction of high school (comparing cases 1 and 3), and how the effectiveness of high school changes if correspondence education is also available (comparing cases 2 and 3). When high school is introduced, correspondence enrollment declines: some high-ability individuals switch to the higher-return high school option, while lower-ability individuals, facing reduced expected returns due to a declining skill premium, opt out of schooling altogether. Conversely, when correspondence education becomes available, some individuals who would have chosen high school instead opt for the lower-cost correspondence path. Because these individuals tend to be of intermediate ability—lower than those who persist in choosing high school—, the average effectiveness of high school rises through improved selection.

Taken together, these results highlight how, by altering the tradeoffs between success and cost and shifting the skill premium through general equilibrium forces, correspondence schools reshaped the educational landscape and the returns to education in the early 20th century. The first set of results indicates that the effectiveness of correspondence schooling depended on labor market conditions and its relative cost, as these shaped the ability composition of enrollees. The second set of results shows that by offering an alternative educational pathway, correspondence education not only enabled skill acquisition for intermediate-ability individuals unable to afford high school but also improved selection into high school, thereby amplifying its observed returns.

I test these theoretical predictions in the next section.

5 Testing the theory: The impact of correspondence education on human capital in the early 20th century

To test the model's predictions, I examine the effects of correspondence schooling, and its interaction with high school education, in the early 20th century. I draw on the correspondence school and census data introduced earlier, supplemented with additional sources, to construct empirical analogs for each of the theoretical predictions in Proposition 3. Following the structure of the proposition, I begin by testing the predictions related to the effectiveness of correspondence education in promoting occupational upskilling, and then turn to those concerning its interaction with high school.

[12] This latter result holds in case 1 only, as in case 3, a higher γ_c may also shift some high-ability individuals toward high school, making the selection effect ambiguous.

5.1 Effectiveness of correspondence education for occupational upskilling

To test the model's predictions about the effectiveness of correspondence education in fostering occupational upskilling, I draw on the data and event-study framework introduced in Section 3. This approach estimates the effect of correspondence education on the likelihood of working in occupations of varying skill levels, providing an empirical counterpart to the theoretical upskilling rate. This framework also allows for comparisons across settings and groups, which helps uncover the factors that shape the effectiveness of correspondence schooling.

5.1.1 Effectiveness of correspondence education in settings where skilled employment was more widespread

The first prediction posits that the effectiveness of correspondence education increases when the probability of converting newly acquired skills into skilled employment rises among high-ability individuals. A natural way to test this prediction is to compare the effects of correspondence education across areas with different concentrations of skilled jobs. For example, in urban and manufacturing and service-intensive areas, thicker labor markets and the concentration of firms requiring technical skills, such as engineers and operators in manufacturing, or bookkeepers and clerks in large-scale retailing, raised the probability that educated individuals with sufficient ability could find employment matching their newly acquired skills.[13]

Thus, to test this prediction, I repeat the event-study analysis presented in Equation (3.1), splitting the sample into (1) urban versus rural residents and (2) counties with above- versus below-average shares of manufacturing and service employment (relative to 1900). By comparing individuals just before and just after enrollment within each of these area types, I can assess whether correspondence schooling delivers larger gains in some contexts than in others.[14]

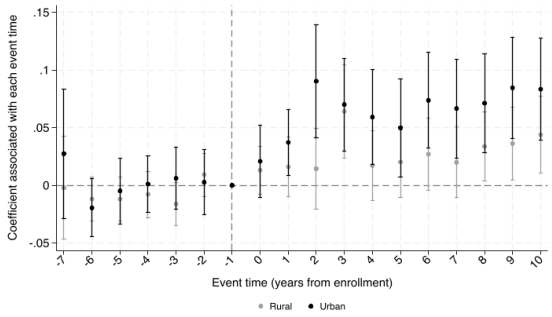
Figure 5.1 shows that the effects of correspondence education on occupational upskilling are stronger among urban residents, and in counties with above-average employment shares in manufacturing and services. These results support the prediction that correspondence education is more effective in settings where the likelihood of securing a skilled job through education is higher.

[13] More broadly, prior research shows that the returns to both education and ability are systematically higher in urban settings (Glaeser and Mare, 2001).

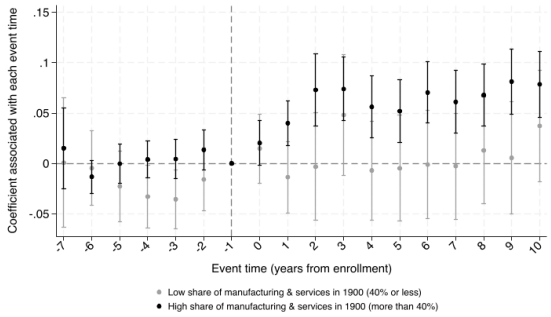
[14] As before, I focus on the likelihood of working in a professional or technical occupation for clarity. Results for other occupational categories and for the Duncan Socioeconomic Index (SEI) are presented in Figures E.1–E.3 and show similar patterns.

Figure 5.1: Effect of correspondence education on professional and technical occupations by urban status and industrial composition

(a) Urban or rural status



(b) Prevalence of manufacturing and services



Notes: These figures plot the event-study estimates of the impact of correspondence education on the probability of working in a professional or technical occupation, corresponding to β_τ for $\tau \in \{-7, -6, \ldots, -1, 0, 1, \ldots, 10\}$ in Equation (3.1), estimated separately for each subgroup. Each coefficient captures the effect of being τ years from enrollment, relative to the base period $\tau = -1$, on an indicator variable for this occupational category. The analysis includes men from the "Register of International Correspondence Schools" matched to census records in 1900 and/or 1910 using the procedure described in Section 3.2. 95% confidence intervals built from standard errors clustered at the county level are plotted.

5.1.2 Effectiveness of correspondence education by course cost

The second prediction is that correspondence education is more effective when course fees are higher, as more expensive courses are likely to attract participants with greater underlying learning ability. To test this, I digitize a 1931 ICS field booklet titled "Price List and Rules for Field Men" which lists the tuition costs for different ICS courses, and examine whether the occupational upskilling effects of correspondence education vary across courses with different price tiers.[15] Panel (a) of Figure 5.2 presents sample pages from the booklet, while Panel (b) presents average course fees by subject category, ranging from $83 for locomotive-related courses to over $200 for courses in mining.

Formally, to test this prediction, I repeat the event-study analysis presented in Equation (3.1), splitting the sample into subgroups defined by whether the course price is above or below the sample mean of $150. As before, I include fixed effects for each broad subject category to ensure that comparisons are made between similar courses with different price points. For example, I compare the more expensive Complete Cotton course to the cheaper Complete Wool course (both within the textile category) rather than comparing courses across unrelated fields such as textiles and construction.[16]

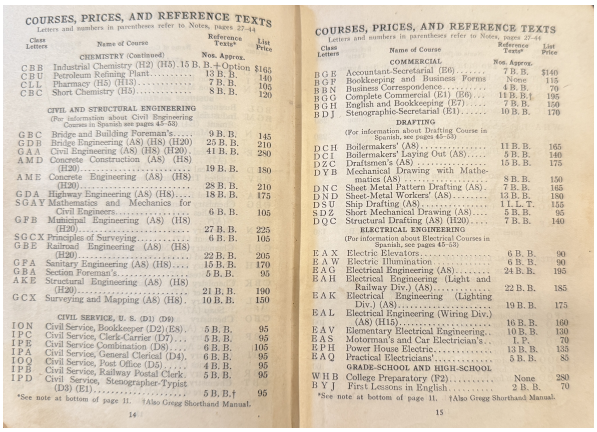
[15] Although the price list is from 1931, while the student register is from 1908, it is the earliest price list available, as many ICS materials were discarded in a landfill in the late 1990s. Due to this time gap, not all courses taken by students in the 1908 register appear in the 1931 list. The analysis is therefore limited to the subset of courses for which price data are available.

[16] As before, I focus on the likelihood of working in a professional or technical occupation for clarity. Results

Figure 5.2: Sample pages from ICS field booklet and distribution of course fees

(a) Prices in ICS field booklet

(b) Distribution of course fees



COURSES, PRICES, AND REFERENCE TEXTS

Letters and numbers in parentheses refer to Notes, pages 27-44

Class Letters	Name of Course	Reference Texts* Nos. Approx.	List Price
	CHEMISTRY (Continued)		
C B B	Industrial Chemistry (H2) (H3)	15 B. B.+Option	$165
C B U	Petroleum Refining Plant	13 B. B.	140
C L L	Pharmacy (H3) (H13)	7 B. B.	105
C B C	Short Chemistry (H5)	8 B. B.	120
	CIVIL AND STRUCTURAL ENGINEERING (For information about Civil Engineering Courses in Spanish see pages 45-53)		
G B C	Bridge and Building Foreman's	9 B. B.	145
G D B	Bridge Engineering (AS) (HS) (H20)	25 B. B.	210
G A A	Civil Engineering (AS) (HS) (H20)	41 B. B.	280
A M D	Concrete Construction (AS) (HS) (H20)	19 B. B.	180
A M E	Concrete Engineering (AS) (HS) (H20)	28 B. B.	210
G D A	Highway Engineering (AS) (HS)	18 B. B.	175
S G A Y	Mathematics and Mechanics for Civil Engineers	6 B. B.	105
G P B	Municipal Engineering (AS) (HS) (H20)	27 B. B.	225
S G C X	Principles of Surveying	6 B. B.	105
G B E	Railroad Engineering (AS) (HS) (H20)	22 B. B.	205
G P A	Sanitary Engineering (AS) (HS)	16 B. B.	170
G B A	Section Foreman's	5 B. B.	95
A K E	Structural Engineering (AS) (HS) (H20)	21 B. B.	190
G C X	Surveying and Mapping (AS) (HS)	10 B. B.	150
	CIVIL SERVICE, U. S. (D1) (D9)		
I O N	Civil Service, Bookkeeper (D2) (E8)	5 B. B.	95
I P C	Civil Service, Clerk-Carrier (D7)	5 B. B.	95
I P E	Civil Service Combination (D8)	6 B. B.	105
I P A	Civil Service, General Clerical (D4)	6 B. B.	95
I O Q	Civil Service, Post Office (D5)	4 B. B.	95
I P B	Civil Service, Railway Postal Clerk	5 B. B.	95
I P D	Civil Service, Stenographer-Typist (D3) (E1)	5 B. B.†	95

*See note at bottom of page 11. †Also Gregg Shorthand Manual.

14

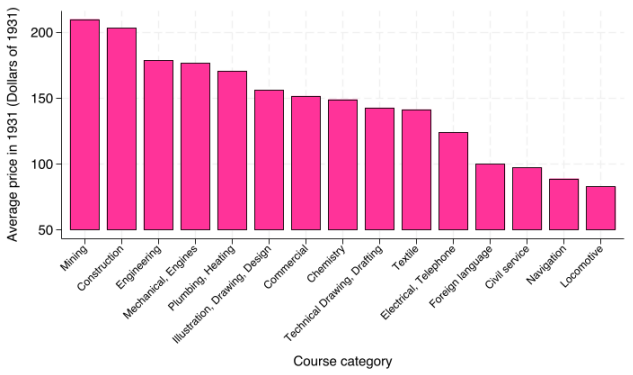
COURSES, PRICES, AND REFERENCE TEXTS

Letters and numbers in parentheses refer to Notes, pages 27-44

Class Letters	Name of Course	Reference Texts* Nos. Approx.	List Price
	COMMERCIAL		
B G E	Accountant-Secretarial (E6)	7 B. B.	$140
B G F	Bookkeeping and Business Forms	None	115
B B N	Business Correspondence	4 B. B.	70
B G G	Complete Commercial (E1) (E6)	11 B. B.†	195
B G H	English and Bookkeeping (E7)	7 B. B.	150
B D J	Stenographic-Secretarial (E1)	10 B. B.	170
	DRAFTING (For information about Drafting Course in Spanish, see pages 45-53)		
D C H	Boilermakers' (AS)	11 B. B.	165
D C I	Boilermakers' Laying Out (AS)	5 B. B.	140
D Z C	Draftsmen's (AS)	15 B. B.	175
D Y B	Mechanical Drawing with Mathematics (AS)	8 B. B.	150
D N C	Sheet-Metal Pattern Drafting (AS)	7 B. B.	165
D N D	Sheet-Metal Workers' (AS)	13 B. B.	180
D S U	Ship Drafting (AS)	1 L. L. T.	155
S D Z	Short Mechanical Drawing (AS)	5 B. B.	95
D Q C	Structural Drafting (AS) (H20)	7 B. B.	140
	ELECTRICAL ENGINEERING (For information about Electrical Courses in Spanish, see pages 45-53)		
E A X	Electric Elevators	6 B. B.	90
E A W	Electric Illumination	6 B. B.	90
E A G	Electrical Engineering (AS)	24 B. B.	195
E A H	Electrical Engineering (Light and Railway Div.) (AS)	22 B. B.	185
E A K	Electrical Engineering (Lighting Div.) (AS)	19 B. B.	175
E A L	Electrical Engineering (Wiring Div.) (AS) (H15)	16 B. B.	160
E A V	Elementary Electrical Engineering	10 B. B.	130
E A S	Motorman's and Car Electrician's	1 P.	70
E P H	Power House Electric	13 B. B.	133
E A Q	Practical Electricians'	5 B. B.	85
	GRADE-SCHOOL AND HIGH-SCHOOL		
W H B	College Preparatory (P2)	None	280
B Y J	First Lessons in English	2 B. B.	70

*See note at bottom of page 11. †Also Gregg Shorthand Manual.

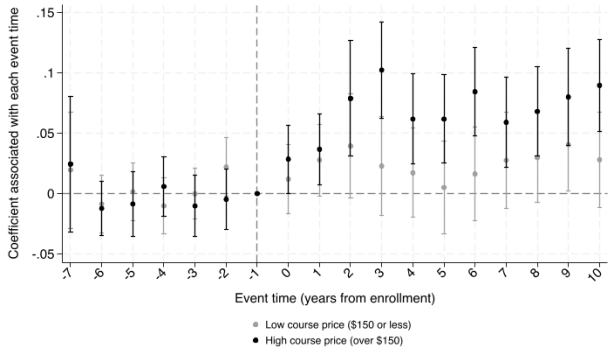
15



Notes: Panel (a) presents sample pages with price information from the "Price List and Rules for Field Men" booklet published in 1931. Panel (b) shows the distribution of average course prices by general subject category, based on courses in this booklet that can be matched to entries in the "Register of International Correspondence Schools" published in 1908.

Figure 5.3 shows that the effects of correspondence education on occupational upskilling are stronger among participants in higher-priced courses, consistent with the model's prediction that such courses attract individuals with higher ability levels, who are better positioned to benefit from the investment.

Figure 5.3: Effect of correspondence education on professional and technical occupations by course price



Notes: These figures plot the event-study estimates of the impact of correspondence education on the probability of working in a professional or technical occupation, corresponding to β_τ for $\tau \in \{-7, -6, \ldots, -1, 0, 1, \ldots, 10\}$ in Equation (3.1), estimated separately for each subgroup. Each coefficient captures the effect of being τ years from enrollment, relative to the base period $\tau = -1$, on an indicator variable for this occupational category. The analysis includes men from the "Register of International Correspondence Schools" matched to census records in 1900 and/or 1910 using the procedure described in Section 3.2 who took a course found in the "Price List and Rules for Field Men" booklet published in 1931. 95% confidence intervals built from standard errors clustered at the county level are plotted.

for other occupational categories and for the Duncan Socioeconomic Index (SEI) are presented in Figure E.4 and show similar patterns.

5.2 Interaction between correspondence and high school education

I now test the model's predictions about the interaction between correspondence and high school education.

5.2.1 Correspondence school enrollment and high school availability

The model predicts that correspondence school enrollment should be lower in settings where high school was also available. This pattern aligns with the historical record: as shown in Figure 2.2, the growth rate of ICS enrollment slowed as the 20th century progressed, coinciding with the expansion of publicly funded high school education between 1900 and 1940 (Goldin and Katz, 1999).

To further explore this relationship, I draw on data from Doxey et al. (2025), which documents the universe of US cities with a high school by 1900.[17] Because the ICS enrollment data is also recorded at the city level and can be used to construct yearly enrollment counts from 1891 to 1907, I examine whether enrollment trends differed between cities with and without a high school. Since both high school presence and correspondence school enrollment may respond to underlying labor market and industrial conditions,[18] I focus on the differential change in enrollment growth before and after 1900, which helps account for city-level factors affecting the overall level of enrollment.

I estimate the following specification across all cities and enrollment years:

$$\Delta E_{v,t} = \psi_{HS} HS_{v,1900} + \psi_{HS,post} \left(HS_{v,1900} \times Post1900_t\right) + \alpha_t + \alpha_c + \alpha_{c,t} + \varepsilon_{v,t}, \tag{5.1}$$

where $\Delta E_{v,t}$ is the growth rate in correspondence school enrollment in city v, located in county c, from year $t-1$ to t; $HS_{v,1900}$ is an indicator for whether city v had a high school by 1900; and $Post1900_t$ indicates whether the year is after 1900. The coefficients ψ_{HS} and $\psi_{HS,post}$ capture differences in average enrollment growth between cities with and without a high school, and how these differences evolve after 1900. The specification includes year fixed effects (α_t), county fixed effects (α_c), and county-by-year fixed effects ($\alpha_{c,t}$) to absorb time and regional trends. Standard errors are clustered at the county level.

I present the results of this analysis in Table 5.1. As expected, the presence of a high school in 1900 is positively associated with correspondence school enrollment growth, likely reflecting broader city-level factors that raised the returns to education. However, consistent with the model's prediction, enrollment growth slows after 1900 in cities that already had a high school

[17] Figure E.5 maps the location of these cities.

[18] For example, manufacturing towns may exhibit higher returns to education, increasing both high school availability and correspondence school enrollment.

by that year, suggesting that the expansion of public high schools reduced the demand for correspondence education.

Table 5.1: Correspondence school enrollment and high school availability

	Yearly correspondence school enrollment growth (1892–1907)
High school present in 1900	0.240***
	(0.059)
High school present in 1900 × Post 1900	-0.208***
	(0.062)
Observations	8,909
County FE	Yes
Year of enrollment FE	Yes
County × Year of Enrollment FE	Yes
Cluster	County

Notes: This table presents the results from Equation (5.1). The analysis uses city-level correspondence school enrollment counts in 1891–1907 constructed from the "Register of International Correspondence Schools" matched to city-level high school presence by 1900, as compiled by Doxey et al. (2025). Standard errors clustered at the county level in parentheses. ***p<0.01, **p<0.05, *p<0.1.

5.2.2 Correspondence school as an alternate education pathway

The model predicts that correspondence education served as an alternative pathway for intermediate-ability students, who found it more attractive than high school due to its flexibility and shorter duration. Empirically identifying this selection margin is challenging, however, since correspondence education was available nationwide and we do not observe what enrollees would have done in its absence. Nevertheless, I provide evidence that exposure to information about correspondence schooling increased individuals' likelihood of enrolling, and that those who enrolled tended to have intermediate levels of ability.

To identify these effects, I implement a neighbor exposure design that examines whether men were more likely to enroll in correspondence school after 1900 if they lived near another man who had enrolled prior to 1900. This approach builds on the strategy developed by Logan and Parman (2015), and combines enumeration district and street information with the order of census enumeration to identify neighbors at varying distances along the same street.

Exposure to information about correspondence schooling increased the likelihood of enrollment

The first part of the analysis shows that exposure to information about correspondence schooling increased individuals' likelihood of enrolling, and proceeds in two steps. First, I estimate whether having a male neighbor on the same street who enrolled in correspondence school by 1900 affects a man's likelihood of enrolling after 1900, controlling for neighborhood

(enumeration district) fixed effects.[19] The second step restricts the sample to men with at least one treated neighbor and estimates whether the likelihood of enrollment varies with proximity by comparing those who lived closer to a treated neighbor to those who lived farther away on the same street. This provides additional evidence on the role of correspondence schools in shaping educational decisions, under the assumption that individuals were more likely to learn about correspondence schools from neighbors who lived closer by.

Formally, I use data from the 1900 and 1910 census waves to construct, for each man i, measures of exposure to male neighbors who had enrolled in correspondence school by 1900. First, I define a binary indicator $I_{i,c\leq 1900}$, which equals one if at least one man living on the same street as i during the given census year had attended correspondence school by 1900. For men with $I_{i,c\leq 1900} = 1$ (that is, those with at least one treated neighbor on their street) I construct an additional variable $N_{i,c\leq 1900}$, which records their distance to the nearest such neighbor, based on the order of enumeration along the street. For example, if the nearest treated neighbor lived next door, then $N_{i,c\leq 1900} = 1$; if two doors away, then $N_{i,c\leq 1900} = 2$; and so on. I present summary statistics for these neighbor exposure measures in 1900 and 1910 in Table E.1.

I then estimate the following two specifications separately for each census year:

$$C_{i,c>1900} = \xi I_{i,c\leq 1900} + \alpha_{ed} + \theta X_{i,t} + \varepsilon_{i,t}, \tag{5.2}$$

and, for individuals with at least one treated neighbor on their street ($I_{i,c\leq 1900} = 1$):

$$C_{i,c>1900} = \sum_{k=1}^{4} \xi_k \mathbb{1}\{N_{i,c\leq 1900} \in B_k\} + \alpha_{ed} + \theta X_{i,t} + \varepsilon_{i,t}. \tag{5.3}$$

$C_{i,c>1900}$ is an indicator for whether man i enrolled in correspondence school after 1900. In Equation (5.2), the coefficient ξ captures the effect of having a treated neighbor (a man who enrolled in correspondence school prior to 1900) on the same street on the likelihood of post-1900 enrollment. In Equation (5.3), I allow for heterogeneity in exposure effects by distance by grouping the values of $N_{i,c\leq 1900}$ into four mutually exclusive distance bins B_k, where $B_1 = 1, 2, 3$, $B_2 = 4, 5, 6$, $B_3 = 7, 8, 9$, and $B_4 = 10+$. The coefficients ξ_k capture how the likelihood of post-1900 enrollment varies depending on how close the nearest treated neighbor lived, relative to the base category B_4, which corresponds to having the closest treated neighbor 10 or more houses away. Both specifications include neighborhood (enumeration

[19] Although precisely defining neighborhoods in census data is challenging, enumeration districts are commonly used for this purpose, as they were designed so that an enumerator could cover all of its households in roughly two weeks in urban areas and four weeks in rural areas, making them a reasonable proxy for sub-city neighborhood units.

district) fixed effects (α_{ed}), and a vector of individual-level fixed effects, $X_{i,t}$, for age, race, and literacy level. Standard errors are clustered at the enumeration district level.

I present the results of these regressions in Table 5.2. The estimates show that, for men observed in both 1900 and 1910, the likelihood of enrolling in correspondence school after 1900 is higher if a male neighbor on the same street had enrolled by 1900. In 1900, having at least one treated neighbor increases the probability of enrollment by 0.013 percentage points, while the estimate for 1910 is smaller and not statistically significant. Distance patterns show that effects in 1900 are concentrated among very close neighbors (1–3 doors), whereas in 1910 they extend to neighbors located up to 4–6 doors away, where the largest and statistically significant effect is observed.

Table 5.2: Correspondence school enrollment and neighbor exposure

	Correspondence school enrollment after 1900			
	1900	1910	1900	1910
Has treated neighbor	0.00013**	0.00009		
	(0.00005)	(0.00006)		
Nearest treated neighbor is 1–3 doors away			0.00010	0.00006
			(0.00012)	(0.00018)
Nearest treated neighbor is 4–6 doors away			0.00003	0.00053***
			(0.00011)	(0.00020)
Nearest treated neighbor is 7–9 doors away			-0.00019**	0.00007
			(0.00009)	(0.00019)
Sample	All	All	With treated neighbor	With treated neighbor
Observations	38,267,927	36,910,373	1,677,288	1,062,476
Neighborhood FE	Yes	Yes	Yes	Yes
Demographic controls	Yes	Yes	Yes	Yes
Cluster	Neighborhood	Neighborhood	Neighborhood	Neighborhood

Notes: This table presents the results from Equations (5.2) and (5.3). For columns 3 and 4, the omitted category is having the nearest treated neighbor be 10 or more doors away. The analysis includes men from the 1900 and 1910 census waves, and identifies correspondence school enrollment using men from the "Register of International Correspondence Schools" matched to census records in 1900 and/or 1910 using the procedure described in Section 3.2. Standard errors clustered at the enumeration district level in parentheses. ***p<0.01, **p<0.05, *p<0.1.

These results are consistent with the model's prediction that correspondence schooling provided an alternative educational pathway for some individuals. In particular, learning about this option through neighbors who had enrolled in prior years increases the likelihood that others enroll, suggesting that access to information about correspondence education encourages some individuals to pursue this path.

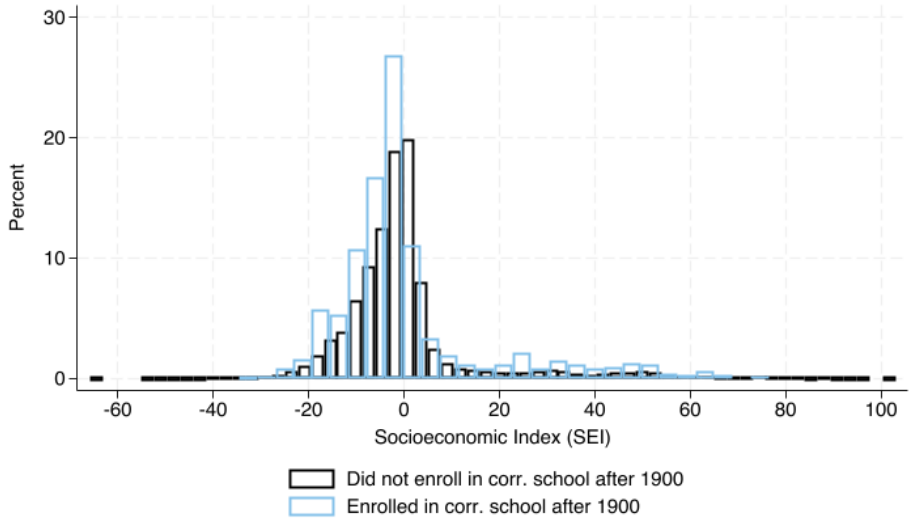
Individuals who enrolled in correspondence schools after exposure to information were of intermediate ability

The second part of the analysis shows that individuals who enrolled in correspondence school

after being exposed to it through their neighbors were of intermediate ability. To document this, I use data from 1900—prior to the enrollment of individuals exposed to early neighboring adopters—and compare the distribution of Duncan Socioeconomic Index (SEI) scores between those who eventually enrolled and those who did not. The analysis is restricted to men living on the same street as someone who had enrolled in correspondence school by 1900. To account for neighborhood and individual characteristics, I residualize SEI on enumeration district fixed effects and age, race, and literacy level fixed effects.

I plot the resulting distributions in Figure 5.4. The SEI distribution for individuals who enrolled in correspondence school after 1900, following neighbor exposure, is more concentrated around the middle of the distribution than that of their peers. This suggests that those who opted into correspondence school were of intermediate ability, while lower-ability individuals remained unskilled, and higher-ability individuals were more likely to pursue high school or other higher-return educational paths.

Figure 5.4: Distribution of 1900 SEI among individuals with a treated neighbor, by subsequent correspondence school enrollment



Notes: This figure plots the distribution of residualized Duncan Socioeconomic Index (SEI) values in 1900 for men who had a male neighbor enrolled in correspondence school by 1900, comparing those who eventually enrolled in correspondence school after 1900 to those who did not. Residualized SEI values control for enumeration district fixed effects and age, race, and literacy level fixed effects.

5.2.3 Effectiveness of high school education and correspondence school availability

The final prediction of the model is that the availability of correspondence schooling as an alternative educational pathway increased the effectiveness of high school in fostering

occupational upskilling. To test this, I again use the neighbor exposure design to proxy for individuals' awareness of correspondence education and examine whether such awareness raises the occupational returns to high school.

Specifically, I examine whether the effect of high school education on the likelihood of working in skilled occupations was greater among men who lived on the same street as someone who had enrolled in correspondence school by 1900, controlling for neighborhood (enumeration district) fixed effects. This approach tests whether knowledge of the correspondence school option selectively encouraged higher-ability individuals to enroll in high school, thereby increasing its upskilling rate.

To do this, I match men observed in the 1910 census to their records in the 1940 census, which includes information on educational attainment, using record linkages developed by the Census Tree Project (Price et al., 2021; Buckles et al., 2023).[20] Since treated neighbors had enrolled in correspondence education by 1900, I focus on men aged 16 to 35 in the 1910 census wave. This restriction ensures individuals were of plausible high school decision-making age after ICS became available, while excluding older cohorts whose educational decisions were likely finalized before correspondence schooling existed or before a neighbor could have plausibly enrolled.

Using this data, I estimate the following two specifications among high school enrollees:

$$Y_i = \delta I_{i,c\leq 1900} + \alpha_{ed} + \theta X_{i,t} + \varepsilon_{i,t}, \tag{5.4}$$

and, for the subset of individuals with at least one treated neighbor on their street ($I_{i,c\leq 1900} = 1$):

$$Y_i = \sum_{k=1}^{4} \delta_k \mathbb{1}\{N_{i,c\leq 1900} \in B_k\} + \alpha_{ed} + \theta X_{i,t} + \varepsilon_{i,t}. \tag{5.5}$$

Here, Y_i denotes the occupational outcome of interest for individual i in 1910, specifically, whether the individual worked in a professional or technical occupation, another white-collar occupation, a blue-collar occupation. As defined earlier, $I_{i,c\leq 1900}$ is an indicator equal to one if individual i had a male neighbor living on the same street in 1910 who had enrolled in correspondence school by 1900; while $N_{i,c\leq 1900}$ captures the distance to the nearest such treated neighbor and is grouped into four mutually exclusive distance bins B_k, where $B_1 = 1, 2, 3$, $B_2 = 4, 5, 6$, $B_3 = 7, 8, 9$, and $B_4 = 10+$. In Equation (5.4), the coefficient δ captures how the likelihood of working in each occupational category among high school students varies with exposure to treated neighbors—that is, how high school returns shift when correspon-

[20] Given the potential for selection into being matched in 1940, these results should be interpreted with caution.

dence education was locally available. In Equation (5.5), the coefficients δ_k capture how this effect varies with proximity to the treated neighbor, relative to the base category B_4 (nearest treated neighbor 10 or more doors away). As before, both specifications include enumeration district fixed effects (α_{ed}) and a vector of individual-level fixed effects, $X_{i,t}$, for age, race, and literacy level. Standard errors are clustered at the enumeration district level.

I present the results of these exercises in Table 5.3. The estimates show that high school attendees with a male neighbor on the same street who had enrolled in correspondence school by 1900 were more likely to work in a professional, technical, or other white-collar occupation, and less likely to work in a blue-collar occupation in 1910. These effects are stronger when the treated neighbor lived nearby, particularly for the decline in blue-collar employment. This pattern is consistent with the model's prediction that the availability of correspondence schooling as an alternative educational pathway enhanced the effectiveness of high school in fostering occupational upskilling.[21] In particular, learning about correspondence schooling through neighbors who had enrolled in prior years diverts some lower-ability individuals into the cheaper and more flexible correspondence track, thereby improving selection into high school and raising its observed returns.

Table 5.3: High school effectiveness and neighbor exposure

	Professional/technical occ.		**Other white-collar occ.**		**Blue-collar occ.**	
Has treated neighbor	0.0044**		0.0065*		-0.0110***	
	(0.0018)		(0.0036)		(0.0039)	
Nearest treated neighbor is 1–3 doors away		0.0023.		0.0141.		-0.0164*
		(0.0050)		(0.0090)		(0.0096)
Nearest treated neighbor is 4–6 doors away		-0.0001.		0.0015.		-0.0014.
		(0.0049)		(0.0092)		(0.0098)
Nearest treated neighbor is 7–9 doors away		0.0016		0.0132.		-0.0149.
		(0.0050)		(0.0095)		(0.0099)
Sample	All HS	HS w/ treated neigh.	All HS	HS w/ treated neigh.	All HS	HS w/ treated neigh.
Observations	1,371,086	38,388	1,371,086	38,388	1,371,086	38,388
Neighborhood FE	Yes	Yes	Yes	Yes	Yes	Yes
Demographic controls	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Nbhd	Nbhd	Nbhd	Nbhd	Nbhd	Nbhd

This table presents the results from Equation (5.4). The analysis includes men aged 16 to 35 in the 1910 census, who reported having attended high school in the 1940 census, and identifies correspondence school enrollment using men from the "Register of International Correspondence Schools" matched to census records in 1900 and/or 1910 using the procedure described in Section 3.2. Standard errors clustered at the enumeration district level in parentheses. ***p<0.01, **p<0.05, *p<0.1.

[21] These patterns are echoed in the estimated effects on the Duncan Socioeconomic Index (SEI), presented in Table E.2.

6 Conclusions

This paper examines the impacts of correspondence education as an alternative educational pathway in the early 20th-century United States. Using newly digitized records of the universe of students enrolled in the International Correspondence Schools (ICS) by 1907 linked to census data, I show that correspondence schooling fostered occupational mobility. I then develop a tractable Roy-style model in which individuals sort across educational options based on learning ability: low-ability individuals remain unskilled, those with intermediate ability select into correspondence education, and high-ability individuals attend high school.

These sorting patterns generate a series of testable predictions regarding the effectiveness of correspondence education and its interaction with the expansion of high school. The empirical evidence supports these predictions. For example, I show that correspondence education enabled skill acquisition among intermediate-ability individuals while also improving positive selection into high school, thereby amplifying the observed returns to high school completion.

This paper contributes to our understanding of how nontraditional educational models—often overlooked in historical work—can shape labor market outcomes and interact with the development of formal schooling systems. In particular, the analysis highlights the importance of accounting for general equilibrium effects, since the availability of an alternative educational pathway can alter the composition of students in formal institutions and, as a result, their observed returns. These insights are also relevant for contemporary policy discussions on remote learning, especially in the wake of the Covid-19 pandemic. In particular, this paper shows that while such options can expand access for students less likely to succeed in traditional settings, they may also divert some students away from higher-quality in-person education. This diversion can, in turn, increase the observed returns to traditional schooling, making the tradeoffs between access and quality appear more pronounced.

The paper leaves several important questions for future research. First, while the model emphasizes how learning ability shapes educational selection, recent work suggests that educational choices may in turn influence the development of ability across generations, particularly through parental investments (see Doepke et al. (2019) for a review). These dynamics point to potentially important intergenerational effects of alternative educational pathways like correspondence school. Second, the remarkable rise of ICS remains an open question. While this paper highlights some contributing factors, such as its focus on occupational advancement, nationwide accessibility, and the uneven spread of high schools, better understanding how such widespread demand for remote education emerged would shed light on the conditions

under which alternative schooling models can scale. Finally, while the analysis focuses on worker-level outcomes, employers likely also responded to the shifting supply of skilled labor brought about by correspondence education. This may have shaped technological adoption, firm structure, and hiring practices.

References

Aaronson, D. and B. Mazumder (2011): "The Impact of Rosenwald Schools on Black Achievement," *Journal of Political Economy*, 119, 821–888.

Acemoglu, D. and D. Autor (2012): "What Does Human Capital Do? A Review of Goldin and Katz's *The Race between Education and Technology*," *Journal of Economic Literature*, 50, 426–463.

Adao, R. (2016): "Worker Heterogeneity, Wage Inequality, and International Trade: Theory and Evidence from Brazil," .

Adao, R., M. Beraja, and N. Pandalai-Nayar (2020): "Technological Transitions with Skill Heterogeneity Across Generations," .

Alon, T. and D. Fershtman (2024): "A Dynamic Roy Model of Academic Specialization," .

Autor, D., C. Goldin, and L. F. Katz (2020): "Extending the Race between Education and Technology," *AEA Papers and Proceedings*, 110, 347–351, autor2020a.

Barahona, N., C. Dobbin, J. Fuenzalida, and S. Otero (2025): "The Effects of Widespread Online Education on Market Structure and Enrollment," .

Barrow, L., W. T. Morris, and L. Sartain (2024): "The Expanding Landscape of Online Education: Who Engages and How They Fare," *Journal of Labor Economics*, 42, S417–S443.

Bergmann, H. F. (2001): ""The Silent University": The Society to Encourage Studies at Home, 1873-1897," *The New England Quarterly*, 74, 447–477.

Bettinger, E. P., L. Fox, S. Loeb, and E. S. Taylor (2017): "Virtual Classrooms: How Online College Courses Affect Student Success," *American Economic Review*, 107, 2855–2875.

Bleemer, Z. and S. Quincy (2025a): "Changes in the College Mobility Pipeline Since 1900," .

——— (2025b): "Junior colleges and human capital," .

Buckles, K., A. Haws, J. Price, and H. Wilbert (2023): "Breakthroughs in Historical Record Linking Using Genealogy Data: The Census Tree Project," .

Cremin, L. A. (1980): *American Education: The National Experience, 1783-1876*, New York: HarperCollins.

Deming, D. J., C. Goldin, and L. F. Katz (2012): "The For-Profit Postsecondary School Sector: Nimble Critters or Agile Predators?" *Journal of Economic Perspectives*, 26, 139–164.

Deming, D. J., C. Goldin, L. F. Katz, and N. Yuchtman (2015): "Can Online Learning Bend the Higher Education Cost Curve?" *American Economic Review*, 105, 496–501.

Doepke, M., G. Sorrenti, and F. Zilibotti (2019): "The Economics of Parenting," *NBER Working Paper Series*.

Doxey, A., E. Karger, and P. Nencka (2025): "The Democratization of Opportunity: The Effects of the U.S. High School Movement," .

Dvorkin, M. and A. Monge-Naranjo (2025): "Occupation Mobility, Human Capital and the Aggregate Consequences of Task-Biased Innovations," .

Eckert, F., A. Gvirtz, J. Liang, and M. Peters (2020): "A Method to Construct Geographical Crosswalks with an Application to US Counties since 1790," *NBER Working Paper Series*.

Eckstein, Z. and K. I. Wolpin (1999): "Why Youths Drop Out of High School: The Impact of Preferences, Opportunities, and Abilities," *Econometrica*, 67, 1295–1339.

Figlio, D., M. Rush, and L. Yin (2013): "Is It Live or Is It Internet? Experimental Estimates of the Effects of Online Instruction on Student Learning," *Journal of Labor Economics*, 31, 763–784.

Gallagher, W. (2020): "A Brief History of the United States Postal Service," *Smithsonian Magazine*, section: At the Smithsonian, From the Collections, , Magazine, , History, , U.S. History, , Articles.

Glaeser, E. and D. Mare (2001): "Cities and Skills," *Journal of Labor Economics*, 19, 316–342.

Goldin, C. and L. Katz (1998): "The Origins of Technology-Skill Complementarity," *Quarterly Journal of Economics*, 113, 693–732.

——— (2008): *The Race Between Education and Technology*, Cambridge, Massachusetts: Belknap Press for Harvard University Press.

Goldin, C. and L. F. Katz (1999): "Human capital and social capital: The rise of secondary schooling in America, 1910-1940," *Journal of Interdisciplinary History*, 29, 683–723.

——— (2000): "Education and Income in the Early Twentieth Century: Evidence from the Prairies," *The Journal of Economic History*, 60, 782–818.

Goodman, J., J. Melkers, and A. Pallais (2019): "Can Online Delivery Increase Access to Education?" *Journal of Labor Economics*, 37, 1–34.

Grigsby, J. R. (2022): "Skill Heterogeneity and Aggregate Labor Market Dynamics," *NBER Working Paper Series*.

Hendricks, L. and T. Schoellman (2014): "Student abilities during the expansion of US education," *Journal of Monetary Economics*, 63, 19–36.

——— (2018): "Human Capital and Development Accounting: New Evidence from Wage Gains at Migration," *Quarterly Journal of Economics*, 133, 665–700.

Hoxby, C. M. (2017): "Online Postsecondary Education and Labor Productivity," in *Education, Skills, and Technical Change: Implications for Future US GDP Growth*, University of Chicago Press, 401–460.

International Correspondence Schools (1943): *I.C.S. Vocational Guidance Manual*, Scranton: ICS.

International Textbook Company (1908): "Register of International Correspondence Schools," Tech. rep., Scranton, Pennsylvania.

Kaestle, C. (2001): *Pillars of the Republic: Common Schools and American Society, 1780-1860*, New York: Hill and Wang.

Katz, L. F. and K. M. Murphy (1992): "Changes in Relative Wages, 1963-1987: Supply and Demand Factors," *The Quarterly Journal of Economics*, 107, 35–78.

Keane, M. P. and K. I. Wolpin (1997): "The Career Decisions of Young Men," *Journal of Political Economy*, 105, 473–522.

Kofoed, M. S., L. Gebhart, D. Gilmore, and R. Moschitto (2024): "Zooming to Class? Experimental Evidence on College Students' Online Learning during COVID-19," *American Economic Review: Insights*, 6, 324–340.

Lagakos, D. and M. E. Waugh (2013): "Selection, Agriculture, and Cross-Country Productivity Differences," *The American Economic Review*, 103, 948–980, iSBN: 0002-8282.

Leukhina, O., T. Koreshkova, and L. Hendricks (2022): "Causes and Consequences of Student-College Mismatch," Tech. rep., Federal Reserve Bank of St. Louis, St. Louis, MO, USA.

Lindenlaub, I. (2017): "Sorting Multidimensional Types: Theory and Application," *The Review of Economic Studies*, 84, 718–789.

Logan, T. and J. Parman (2015): "The National Rise in Residential Segregation," .

Mestieri, M., J. Schauer, and R. M. Townsend (2017): "Human capital acquisition and occupational choice: Implications for economic development," *Review of Economic Dynamics*, 25, 151–186.

National Center for Education Statistics (2021): "Digest of Education Statistics," Tech. rep.

Noffsinger, J. S. (1926): *Correspondence Schools, Lyceums, Chautauquas*, Macmillan, google-Books-ID: XdhEAAAAIAAJ.

Officer, L. H. and S. H. Williamson (2025): "Annual Wages in the United States, 1774-Present," .

Price, J., K. Buckles, J. Van Leeuwen, and I. Riley (2021): "Combining Family History and Machine Learning to Link Historical Records: The Census Tree Dataset," *Explorations in Economic History*, 80, 101391.

Roy, A. D. (1951): "Some Thoughts on the Distribution of Earnings," *Oxford Economic Papers*, 3, 135–146.

Sun, L. and S. Abraham (2021): "Estimating dynamic treatment effects in event studies with heterogeneous treatment effects," *Journal of Econometrics*, 225, 175–199.

The University of Scranton Digital Collections (2025): "International Correspondence Schools of Scranton Collection History," .

Watkins, B. L., ed. (1991): *The foundations of American distance education: a century of collegiate correspondence study*, Dubuque, Iowa: Kendall/Hunt Pub. Co.

Watkinson, J. D. (1996): ""Education for Success": The International Correspondence Schools of Scranton, Pennsylvania," *The Pennsylvania Magazine of History and Biography*, 120, 343–369.

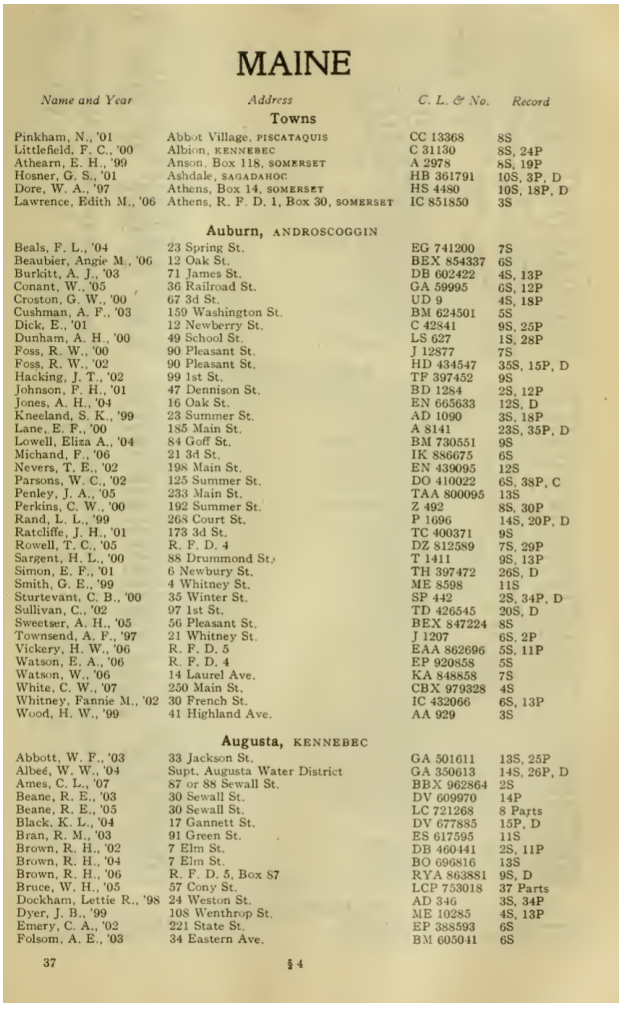
Whaples, R. (2001): "Hours of Work in U.S. History," .

A Data

A.1 Register of correspondence school participants

I build a dataset of correspondence school students by digitizing the 1908 edition of the "Register of International Correspondence Schools," published by the International Textbook Company in Scranton, Pennsylvania, using Amazon Textract OCR application, supplemented with manual verification. This register lists students who, by August 1907, had completed at least one subject (or ten drawing plates) in a technical course, or one-third of a non-technical course. It excludes individuals who made insufficient progress, enrolled only in single subjects, or explicitly requested not to be listed. In total, the ICS register includes 107,239 students from around the world. According to the preface, 601,800 students had enrolled by that date (excluding single-subject enrollees and those who opted out), implying that 17.82% had made sufficient progress to be included.

Figure A.1: Sample page from "Register of International Correspondence Schools"



MAINE

Name and Year	Address	C. L. & No.	Record
Towns			
Pinkham, N., '01	Abbot Village, PISCATAQUIS	CC 13368	8S
Littlefield, F. C., '00	Albion, KENNEBEC	C 31130	8S, 24P
Athearn, E. H., '99	Anson, Box 118, SOMERSET	A 2978	8S, 19P
Hosner, G. S., '01	Ashdale, SAGADAHOC	HB 361791	10S, 3P, D
Dore, W. A., '97	Athens, Box 14, SOMERSET	HS 4480	10S, 18P, D
Lawrence, Edith M., '06	Athens, R. F. D. 1, Box 30, SOMERSET	IC 851850	3S
Auburn, ANDROSCOGGIN			
Beals, F. L., '04	23 Spring St.	EG 741200	7S
Beaubier, Angie M., '06	12 Oak St.	BEX 854337	6S
Burkitt, A. J., '03	71 James St.	DB 602422	4S, 13P
Conant, W., '05	36 Railroad St.	GA 59995	6S, 12P
Croston, G. W., '00	67 3d St.	UD 9	4S, 18P
Cushman, A. P., '03	159 Washington St.	BM 624501	5S
Dick, E., '01	12 Newberry St.	C 42841	9S, 25P
Dunham, A. H., '00	49 School St.	LS 627	1S, 28P
Foss, R. W., '00	90 Pleasant St.	J 12877	7S
Foss, R. W., '02	90 Pleasant St.	HD 434547	35S, 15P, D
Hacking, J. T., '02	99 1st St.	TF 397452	9S
Johnson, F. H., '01	47 Dennison St.	BD 1284	2S, 12P
Jones, A. H., '04	16 Oak St.	EN 665633	12S, D
Kneeland, S. K., '99	23 Summer St.	AD 1090	3S, 18P
Lane, E. F., '00	185 Main St.	A 8141	23S, 35P, D
Lowell, Eliza A., '04	84 Goff St.	BM 730551	9S
Michand, F., '06	21 3d St.	IK 886675	6S
Nevers, T. E., '02	198 Main St.	EN 439095	12S
Parsons, W. C., '02	125 Summer St.	DO 410022	6S, 38P, C
Penley, J. A., '05	233 Main St.	TAA 800095	13S
Perkins, C. W., '00	192 Summer St.	Z 492	8S, 30P
Rand, L. L., '99	268 Court St.	P 1696	14S, 20P, D
Ratcliffe, J. H., '01	173 3d St.	TC 400371	9S
Rowell, T. C., '05	R. F. D. 4	DZ 812589	7S, 29P
Sargent, H. L., '00	88 Drummond St.	T 1411	9S, 13P
Simon, E. F., '01	6 Newbury St.	TH 397472	26S, D
Smith, G. E., '99	4 Whitney St.	ME 8598	11S
Sturtevant, C. B., '00	35 Winter St.	SP 442	2S, 34P, D
Sullivan, C., '02	97 1st St.	TD 426545	20S, D
Sweetser, A. H., '05	56 Pleasant St.	BEX 847224	8S
Townsend, A. F., '97	21 Whitney St.	J 1207	6S, 2P
Vickery, H. W., '06	R. F. D. 5	EAA 862696	5S, 11P
Watson, E. A., '06	R. F. D. 4	EP 920858	5S
Watson, W., '06	14 Laurel Ave.	KA 848858	7S
White, C. W., '07	250 Main St.	CBX 979328	4S
Whitney, Fannie M., '02	30 French St.	IC 432066	6S, 13P
Wood, H. W., '99	41 Highland Ave.	AA 929	3S
Augusta, KENNEBEC			
Abbott, W. F., '03	33 Jackson St.	GA 501611	13S, 25P
Albee, W. W., '04	Supt. Augusta Water District	GA 350613	14S, 26P, D
Ames, C. L., '07	87 or 88 Sewall St.	BBX 962864	2S
Beane, R. E., '03	30 Sewall St.	DV 609970	14P
Beane, R. E., '05	30 Sewall St.	LC 721268	8 Parts
Black, K. L., '04	17 Gannett St.	DV 677885	15P, D
Bran, R. M., '03	91 Green St.	ES 617595	11S
Brown, R. H., '02	7 Elm St.	DB 460441	2S, 11P
Brown, R. H., '04	7 Elm St.	BO 696816	13S
Brown, R. H., '06	R. F. D. 5, Box 87	RYA 863881	9S, D
Bruce, W. H., '05	57 Cony St.	LCP 753018	37 Parts
Dockham, Lettie R., '98	24 Weston St.	AD 346	3S, 34P
Dyer, J. B., '99	108 Wenthrop St.	ME 10285	4S, 13P
Emery, C. A., '02	221 State St.	EP 388593	6S
Folsom, A. E., '03	34 Eastern Ave.	BM 605041	6S

37 § 4

In Figure A.1, I present a sample page from the ICS register to show how student information is organized. This page includes students' names, enrollment years, and additional details for several towns in Maine. For instance, the first entry for Auburn records student F. L. Beals, enrolled in 1904, residing at 23 Spring Street, registered in the EG course (telephone engineering), and having completed seven subjects.

As this page shows, for towns with more than ten students, such as Auburn and Augusta, the register specifies the town name and county above the student listings. In contrast, for smaller towns with fewer than ten students, the register uses the label "Towns," and provides the town and county information alongside each student's address. Examples of this latter format appear at the top of the sample page for towns like Abbot Village, Albion, Anson, Ashdale, and Athens.

It is also worth noting that the register distinguishes between men and women by including either the full names of female students or the titles "Miss" or "Mrs." For example, on this page, all listed students are men except for five women: Edith M. Lawrence, Angie M. Beaubier, Eliza A. Lowell, Fannie M. Whitney, and Lettie R. Dockham. Additionally, students may appear multiple times in the register if enrolled in different courses. An example of this from this page is R. E. Beane from Augusta, who enrolled in the DV course (show-card writing) in 1903 and in the LC course (French language) in 1905.

A.2 Census data and matching

I identify correspondence school students in the full-count census data from 1900 and 1910 through a two-step process.

A.2.1 First step: Locating correspondence school students in the census

First, I use the personal information recorded in the ICS register to locate students in the 1910 or 1900 census using probabilistic matching methods. I begin by attempting to match students to the 1910 census based on their name and location, using the dtalink probabilistic data linking protocol in Stata. This algorithm assigns a matching score based on the similarity of selected variables and retains the highest-scoring match for each record. To reduce the dimensionality of the problem and ensure computational feasibility, the method allows for blocking variables, which restrict comparisons to records sharing key attributes.

In the first pass, I block on the NYSIIS phonetic code of the last name (to account for nicknames and spelling variations), first initial, last two letters of the last name, sex, state,

and county. Matching variables include last name, middle initial, and town.[22] To account for possible migration across counties or errors in county reporting, I perform a second pass in which I drop county from the set of blocking variables and instead include it as a matching variable.[23] For students still unmatched after these two passes, I apply the same procedure using the 1900 census.

This procedure yields 45,030 matched individuals, representing 46.4% of those listed in the register.

A.2.2 Second step: Following correspondence school students over time

In the second step, I trace these individuals across census waves using the record linkages developed by the Census Tree Project (Price et al., 2021; Buckles et al., 2023). This method leverages familial relationships recorded on the genealogy platform FamilySearch.org to link individuals across census years. As users build their family trees, they attach source documents, such as census records, to individual profiles, thereby creating longitudinal links. These user-contributed connections rely on private information, including maiden names and household composition, allowing for more accurate matches across census years. FamilySearch hosts information and family trees for over 1.2 billion deceased individuals and is supported by a community of more than 12.6 million registered users.

While a large share of Census Tree links originate from FamilySearch user submissions, additional matches are generated using supervised machine learning algorithms trained on those links, as well as through the incorporation of matches from the Census Linking Project and the IPUMS Multigenerational Longitudinal Panel. The final data set contains 67.8% of the potential matches between the 1900 and 1910 full-count US censuses (42.7 million matches). Please see Price et al. (2021), Buckles et al. (2023), and Censustree.org for further details about this data.

I use the record-linking information to build an unbalanced panel of correspondence school students observed between 1900 and 1910.[24] I restrict the the analysis to men, which yields a sample of 58,716 observations from 43,240 individuals.

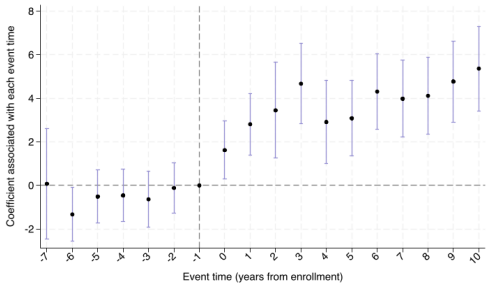
[22] Although the census includes address information, this is missing for many students in the ICS register and therefore cannot be used at scale.

[23] I continue to block on state to limit the size of the matching problem and to improve match quality. Thus, interstate movers are excluded from this data.

[24] For some additional analyses, I extend the panel to follow individuals through 1940.

B Additional results of the effects of correspondence education on occupational mobility

Figure B.1: Effect of correspondence education on the Duncan Socioeconomic Index (SEI)

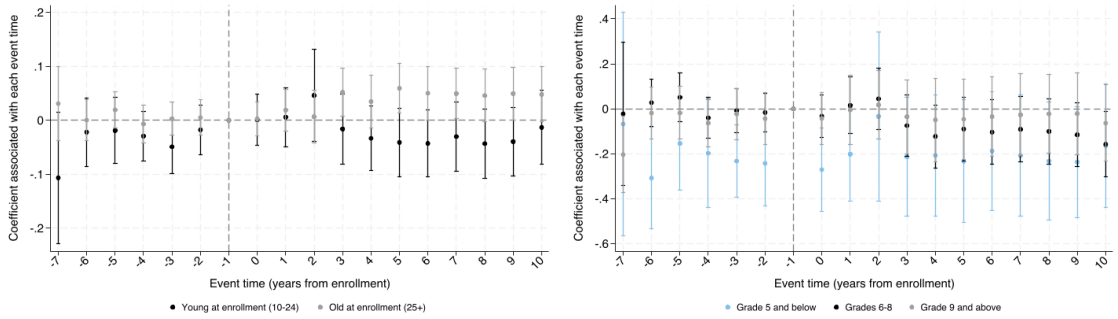


Notes: These figures plot the event-study estimates of the impact of correspondence education on the SEI, corresponding to β_τ for $\tau \in \{-7, -6, \ldots, -1, 0, 1, \ldots, 10\}$ in Equation (3.1). Each coefficient captures the effect of being τ years from enrollment, relative to the base period $\tau = -1$ on this index. The analysis includes men from the "Register of International Correspondence Schools" matched to census records in 1900 and/or 1910 using the procedure described in Section 3.2. 95% confidence intervals built from standard errors clustered at the county level are plotted.

Figure B.2: Effect of correspondence education on other white-collar occupations by individual characteristics

(a) Age at enrollment

(b) Educational attainment

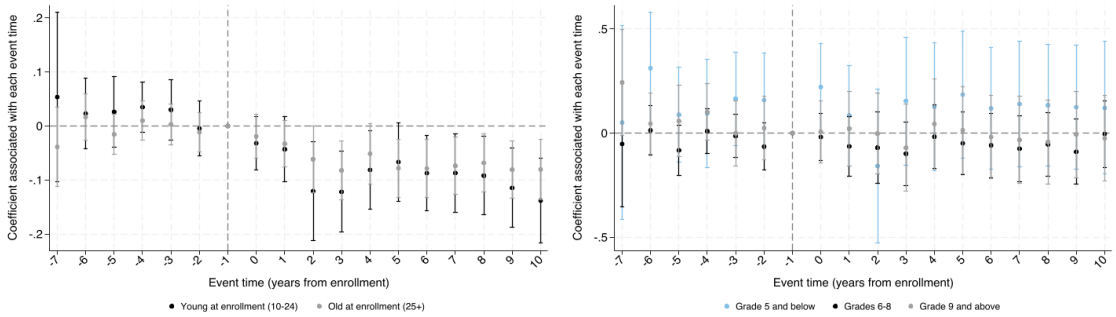


Notes: These figures plot the event-study estimates of the impact of correspondence education on the probability of working in other white-collar occupations, corresponding to β_τ for $\tau \in \{-7, -6, \ldots, -1, 0, 1, \ldots, 10\}$ in Equation (3.1), estimated separately for each subgroup. Each coefficient captures the effect of being τ years from enrollment, relative to the base period $\tau = -1$, on an indicator variable for this occupational category. The analysis includes men from the "Register of International Correspondence Schools" matched to census records in 1900 and/or 1910 using the procedure described in Section 3.2. 95% confidence intervals built from standard errors clustered at the county level are plotted.

Figure B.3: Effect of correspondence education on blue-collar occupations by individual characteristics

(a) Age at enrollment

(b) Educational attainment

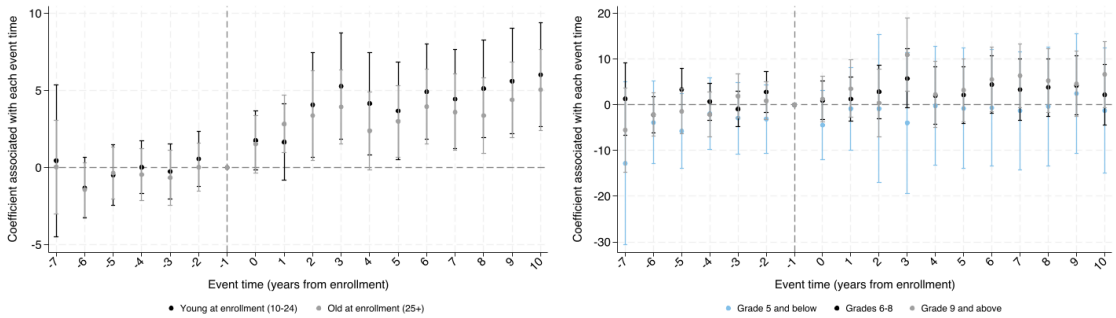


Notes: These figures plot the event-study estimates of the impact of correspondence education on the probability of working in a blue-collar occupation, corresponding to β_τ for $\tau \in \{-7, -6, \ldots, -1, 0, 1, \ldots, 10\}$ in Equation (3.1), estimated separately for each subgroup. Each coefficient captures the effect of being τ years from enrollment, relative to the base period $\tau = -1$, on an indicator variable for this occupational category. The analysis includes men from the "Register of International Correspondence Schools" matched to census records in 1900 and/or 1910 using the procedure described in Section 3.2. 95% confidence intervals built from standard errors clustered at the county level are plotted.

Figure B.4: Effect of correspondence education on the Duncan Socioeconomic Index (SEI) by individual characteristics

(a) Age at enrollment

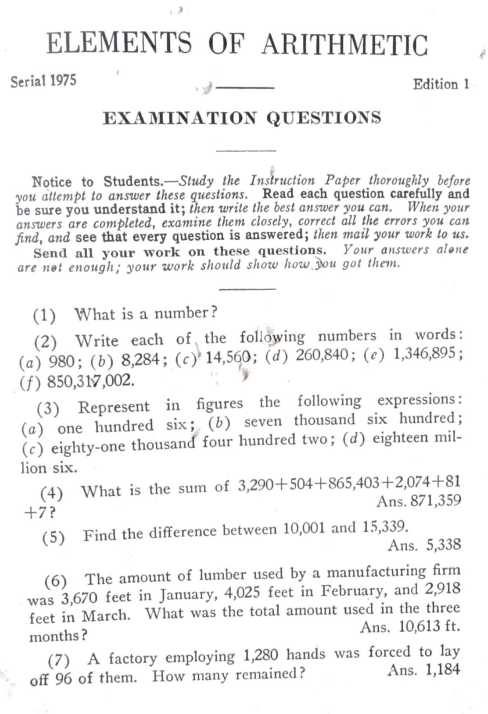
(b) Educational attainment



Notes: These figures plot the event-study estimates of the impact of correspondence education on the SEI, corresponding to β_τ for $\tau \in \{-7, -6, \ldots, -1, 0, 1, \ldots, 10\}$ in Equation (3.1), estimated separately for each subgroup. Each coefficient captures the effect of being τ years from enrollment, relative to the base period $\tau = -1$, on this index. The analysis includes men from the "Register of International Correspondence Schools" matched to census records in 1900 and/or 1910 using the procedure described in Section 3.2. 95% confidence intervals built from standard errors clustered at the county level are plotted.

Figure B.5: Sample exam questions from ICS courses on arithmetic, fractions, and elementary mechanics

(a) Arithmetic



ELEMENTS OF ARITHMETIC

Serial 1975 Edition 1

EXAMINATION QUESTIONS

Notice to Students.—*Study the Instruction Paper thoroughly before you attempt to answer these questions.* **Read each question carefully and be sure you understand it;** *then write the best answer you can. When your answers are completed, examine them closely, correct all the errors you can find, and* **see that every question is answered;** *then mail your work to us.*

Send all your work on these questions. *Your answers alone are not enough; your work should show how you got them.*

(1) What is a number?

(2) Write each of the following numbers in words: (*a*) 980; (*b*) 8,284; (*c*) 14,560; (*d*) 260,840; (*e*) 1,346,895; (*f*) 850,317,002.

(3) Represent in figures the following expressions: (*a*) one hundred six; (*b*) seven thousand six hundred; (*c*) eighty-one thousand four hundred two; (*d*) eighteen million six.

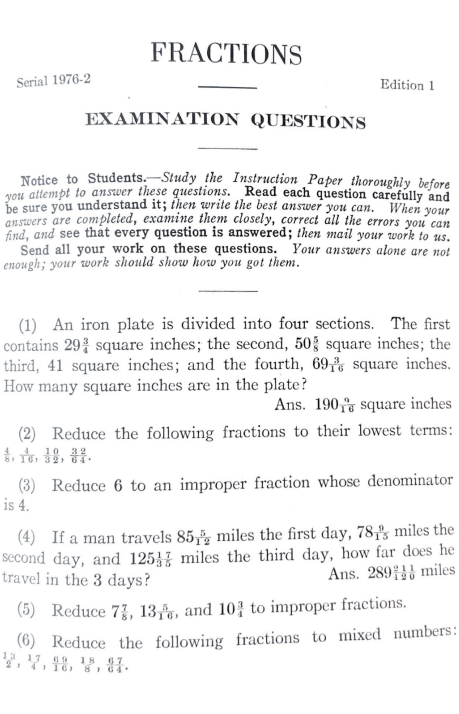
(4) What is the sum of 3,290+504+865,403+2,074+81+7? Ans. 871,359

(5) Find the difference between 10,001 and 15,339. Ans. 5,338

(6) The amount of lumber used by a manufacturing firm was 3,670 feet in January, 4,025 feet in February, and 2,918 feet in March. What was the total amount used in the three months? Ans. 10,613 ft.

(7) A factory employing 1,280 hands was forced to lay off 96 of them. How many remained? Ans. 1,184

(b) Fractions



FRACTIONS

Serial 1976-2 Edition 1

EXAMINATION QUESTIONS

Notice to Students.—*Study the Instruction Paper thoroughly before you attempt to answer these questions.* **Read each question carefully and be sure you understand it;** *then write the best answer you can. When your answers are completed, examine them closely, correct all the errors you can find, and* see that **every question is answered;** *then mail your work to us.*

Send all your **work on these questions.** *Your answers alone are not enough; your work should show how you got them.*

(1) An iron plate is divided into four sections. The first contains $29\frac{3}{4}$ square inches; the second, $50\frac{5}{8}$ square inches; the third, 41 square inches; and the fourth, $69\frac{3}{16}$ square inches. How many square inches are in the plate? Ans. $190\frac{9}{16}$ square inches

(2) Reduce the following fractions to their lowest terms: $\frac{4}{8}$, $\frac{4}{16}$, $\frac{10}{32}$, $\frac{32}{64}$.

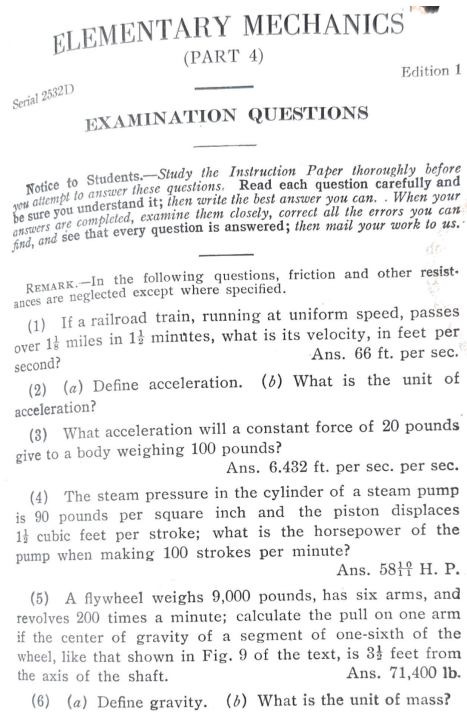
(3) Reduce 6 to an improper fraction whose denominator is 4.

(4) If a man travels $85\frac{5}{12}$ miles the first day, $78\frac{9}{15}$ miles the second day, and $125\frac{17}{35}$ miles the third day, how far does he travel in the 3 days? Ans. $289\frac{311}{420}$ miles

(5) Reduce $7\frac{7}{8}$, $13\frac{5}{16}$, and $10\frac{3}{4}$ to improper fractions.

(6) Reduce the following fractions to mixed numbers: $\frac{13}{2}$, $\frac{17}{4}$, $\frac{69}{16}$, $\frac{18}{8}$, $\frac{67}{64}$.

(c) Elementary mechanics



ELEMENTARY MECHANICS

(PART 4)

Serial 2532D Edition 1

EXAMINATION QUESTIONS

Notice to Students.—*Study the Instruction Paper thoroughly before you attempt to answer these questions.* **Read each question carefully and be sure you understand it;** *then write the best answer you can. When your answers are completed, examine them closely, correct all the errors you can find, and* see that **every question is answered;** *then mail your work to us.*

REMARK.—In the following questions, friction and other resistances are neglected except where specified.

(1) If a railroad train, running at uniform speed, passes over $1\frac{1}{8}$ miles in $1\frac{1}{2}$ minutes, what is its velocity, in feet per second? Ans. 66 ft. per sec.

(2) (*a*) Define acceleration. (*b*) What is the unit of acceleration?

(3) What acceleration will a constant force of 20 pounds give to a body weighing 100 pounds? Ans. 6.432 ft. per sec. per sec.

(4) The steam pressure in the cylinder of a steam pump is 90 pounds per square inch and the piston displaces $1\frac{1}{2}$ cubic feet per stroke; what is the horsepower of the pump when making 100 strokes per minute? Ans. $58\frac{10}{11}$ H. P.

(5) A flywheel weighs 9,000 pounds, has six arms, and revolves 200 times a minute; calculate the pull on one arm if the center of gravity of a segment of one-sixth of the wheel, like that shown in Fig. 9 of the text, is $3\frac{1}{2}$ feet from the axis of the shaft. Ans. 71,400 lb.

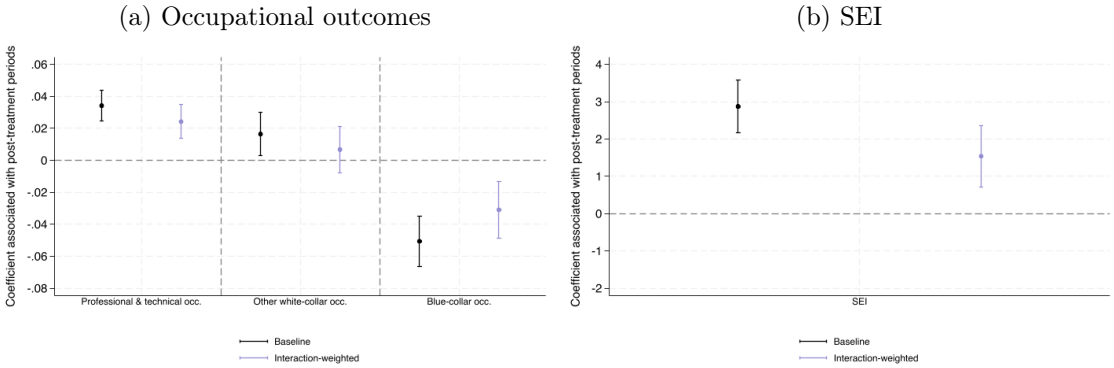
(6) (*a*) Define gravity. (*b*) What is the unit of mass?

Source: ICS course booklets on arithmetic, fractions, and elementary mechanics from 1975, 1976, and 1937, respectively.

C Robustness of the effects of correspondence education on occupational mobility

C.1 Robustness to pre/post design and interaction-weighted estimation

Figure C.1: Effect of correspondence education on occupational outcomes and Duncan Socioeconomic Index (SEI), using pre/post design and interaction-weighted estimation

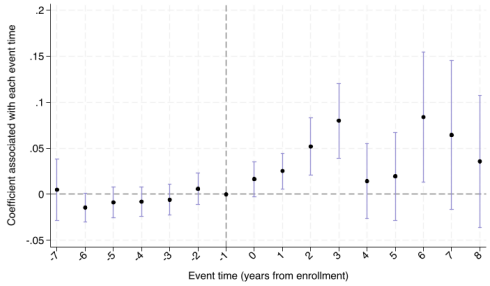


Notes: These figures plot the estimates of the impact of correspondence education on occupational outcomes and the SEI, using a pre/post event structure. The baseline specification follows Equation (3.1), but collapses event time τ into two groups: pre-enrollment ($\tau < 0$) and post-enrollment ($\tau \geq 0$). The interaction-weighted (IW) estimates implement the method of Sun and Abraham (2021) within this framework to account for treatment effect heterogeneity across cohorts, defined by year of enrollment. The 1907 enrollees (the last treated cohort) serve as the control group in this case, and are included only in their pre-treatment 1900 observations to ensure they are not yet treated when used as controls. The plotted coefficients capture the effect of post-enrollment, relative to the pre-enrollment period, on indicator variables for: (1) professional and technical occupations; (2) other white-collar occupations; (3) blue-collar occupations; and (4) the SEI, respectively. The analysis includes men from the "Register of International Correspondence Schools" matched to census records in 1900 and/or 1910 using the procedure described in Section 3.2. 95% confidence intervals built from standard errors clustered at the county level are plotted. Results by individual characteristics available upon request.

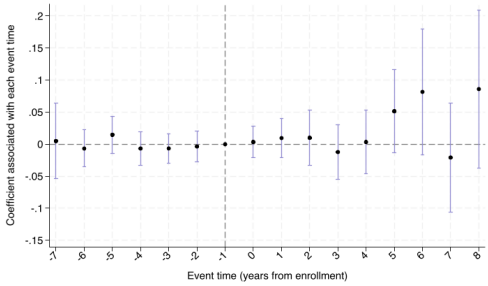
C.2 Robustness to using data from 1900 only

Figure C.2: Effect of correspondence education on occupational outcomes and Duncan Socioeconomic Index (SEI), using data from 1900 only

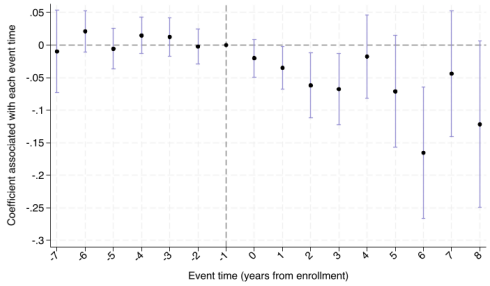
(a) Professional and technical occupations



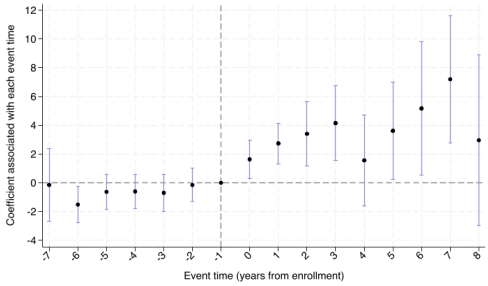
(b) Other white-collar occupations



(c) Blue-collar occupations



(d) SEI

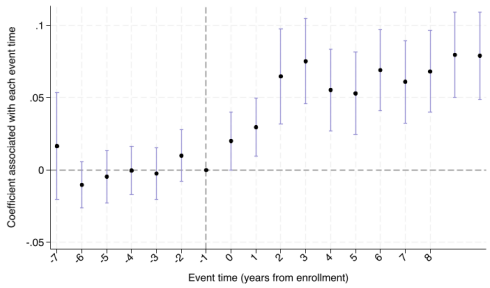


Notes: These figures plot the event-study estimates of the impact of correspondence education on occupational outcomes and the SEI, corresponding to β_τ for $\tau \in \{-7, -6, \ldots, -1, 0, 1, \ldots, 8\}$ in Equation (3.1).[25]Each coefficient captures the effect of being τ years from enrollment, relative to the base period $\tau = -1$, on indicator variables for: (1) professional and technical occupations; (2) other white-collar occupations; (3) blue-collar occupations; and (4) the SEI, respectively. The analysis includes men from the "Register of International Correspondence Schools" matched to census records in 1900 using the procedure described in Section 3.2. 95% confidence intervals built from standard errors clustered at the county level are plotted. Results by individual characteristics available upon request.

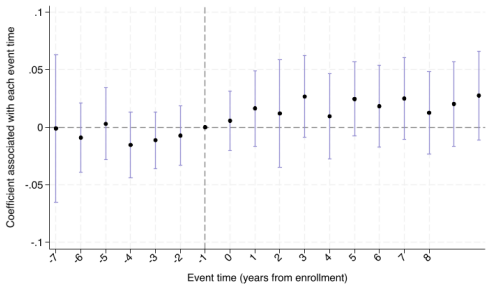
C.3 Robustness to excluding individuals in the South

Figure C.3: Effect of correspondence education on occupational outcomes and Duncan Socioeconomic Index (SEI), excluding individuals living in the South

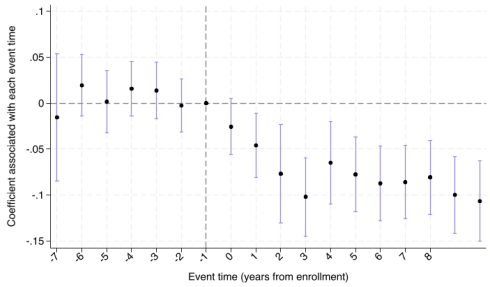
(a) Professional and technical occupations



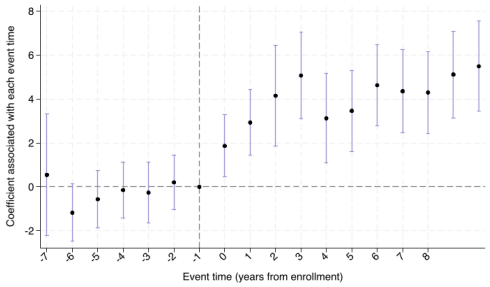
(b) Other white-collar occupations



(c) Blue-collar occupations



(d) SEI



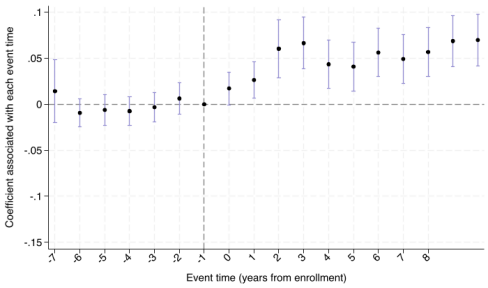
Notes: These figures plot the event-study estimates of the impact of correspondence education on occupational outcomes and the SEI, corresponding to β_τ for $\tau \in \{-7, -6, \ldots, -1, 0, 1, \ldots, 10\}$ in Equation (3.1). Each coefficient captures the effect of being τ years from enrollment, relative to the base period $\tau = -1$, on indicator variables for: (1) professional and technical occupations; (2) other white-collar occupations; (3) blue-collar occupations; and (4) the SEI, respectively. The analysis includes men from the "Register of International Correspondence Schools" matched to census records in 1900 and/or 1910 using the procedure described in Section 3.2, and who did not live in Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, or West Virginia. 95% confidence intervals built from standard errors clustered at the county level are plotted. Results by individual characteristics available upon request.

[25] Given that the analysis is restricted to 1900, I restrict the highest possible event time, τ, to be 8 corresponding to enrollment in 1892.

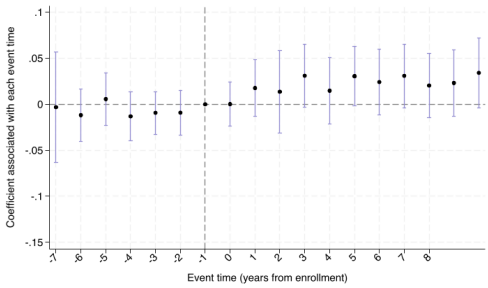
C.4 Robustness to excluding individuals who enrolled in two or more correspondence courses

Figure C.4: Effect of correspondence education on occupational outcomes and Duncan Socioeconomic Index (SEI), excluding individuals who enrolled in two or more correspondence courses

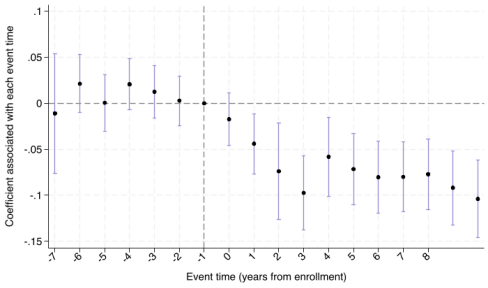
(a) Professional and technical occupations



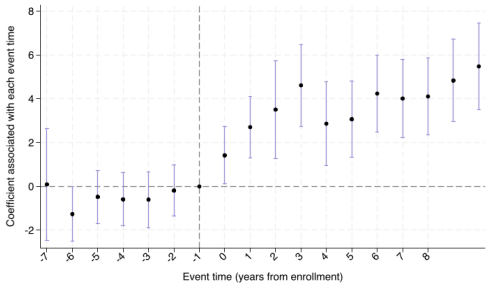
(b) Other white-collar occupations



(c) Blue-collar occupations



(d) SEI



Notes: These figures plot the event-study estimates of the impact of correspondence education on occupational outcomes and the SEI, corresponding to β_τ for $\tau \in \{-7, -6, \ldots, -1, 0, 1, \ldots, 10\}$ in Equation (3.1). Each coefficient captures the effect of being τ years from enrollment, relative to the base period $\tau = -1$, on indicator variables for: (1) professional and technical occupations; (2) other white-collar occupations; (3) blue-collar occupations; and (4) the SEI, respectively. The analysis includes men from the "Register of International Correspondence Schools" matched to census records in 1900 and/or 1910 using the procedure described in Section 3.2, and who had only enrolled in one correspondence course by 1907. 95% confidence intervals built from standard errors clustered at the county level are plotted. Results by individual characteristics available upon request.

D Model proofs

D.1 Proof of Proposition 1

Case 1: Only correspondence school available, $S = \{s_c\}$

First, note that both unskilled and skilled individuals must be present in equilibrium, implying that some individuals choose to remain unskilled while others enroll in correspondence school. If either group were absent (that is, if all individuals chose to remain unskilled or all chose to become skilled), then the wage for this missing type would tend to infinity under the CES production function in Equation (4.1). This would create arbitrage opportunities, inducing individuals to switch occupations, thereby violating equilibrium.[26]

We now determine which individuals choose to remain unskilled and which enroll in correspondence school by comparing their respective value functions. At the lowest learning ability level $a = 0$, individuals strictly prefer to remain unskilled because $P_c(0) = 0$. Specifically, the value of remaining unskilled is $V_u(0) = w_u$, while the value of enrolling in correspondence school is $V_c(0) = P_c(0)w_s + (1 - P_c(0))w_u - \gamma_c = w_u - \gamma_c$. Since $\gamma_c > 0$, we have $V_u(0) > V_c(0)$.

As learning ability a increases, the value of correspondence school $V_c(a)$ strictly increases because $P_c(a)$ is strictly increasing, while both $V_u(a)$ and the cost of correspondence school remain constant.

Therefore, there exists a unique cutoff $a_{c,1} \in (0, \bar{a})$ such that:

- for individuals with $a < a_{c,1}$, $V_u(a) > V_c(a)$, so they remain unskilled,
- for individuals with $a \geq a_{c,1}$, $V_c(a) \geq V_u(a)$, so they choose to enroll in correspondence school.

Case 2: Only high school available, $S = \{s_h\}$

As before, both unskilled and skilled individuals must be present in equilibrium, implying that some individuals choose to remain unskilled while others enroll in high school.

[26] Specifically, the first-order conditions of the CES production function imply:

$$w_u = \left[\zeta L_u^{\frac{\sigma-1}{\sigma}} + (1-\zeta) L_s^{\frac{\sigma-1}{\sigma}}\right]^{\frac{1}{\sigma-1}} \cdot \zeta L_u^{-\frac{1}{\sigma}},$$

$$w_s = \left[\zeta L_u^{\frac{\sigma-1}{\sigma}} + (1-\zeta) L_s^{\frac{\sigma-1}{\sigma}}\right]^{\frac{1}{\sigma-1}} \cdot (1-\zeta) L_s^{-\frac{1}{\sigma}}.$$

Since $\sigma > 1$, each of these wages tends to infinity as $L_u \to 0$ or $L_s \to 0$, respectively.

We determine which individuals choose to remain unskilled and which enroll in high school by comparing their respective value functions. At the lowest learning ability level $a = 0$, individuals strictly prefer to remain unskilled because $P_h(0) = 0$. Specifically, the value of remaining unskilled is $V_u(0) = w_u$, while the value of enrolling in high school is $V_h(0) = P_h(0)w_s + (1 - P_h(0))w_u - \gamma_h = w_u - \gamma_h$. Since $\gamma_h > 0$, we have $V_u(0) > V_h(0)$.

As learning ability a increases, the value of high school $V_h(a)$ strictly increases because $P_h(a)$ is strictly increasing, while both $V_u(a)$ and the cost of high school remain constant.

Therefore, there exists a unique cutoff $a_{h,2} \in (0, \bar{a})$ such that:

- for individuals with $a < a_{h,2}$, $V_u(a) > V_h(a)$, so they remain unskilled,
- for individuals with $a \geq a_{h,2}$, $V_h(a) \geq V_u(a)$, so they choose to enroll in high school.

Case 3: Both options available, $S = \{s_c, s_h\}$

As before, both unskilled and skilled individuals must be present in equilibrium. Since we assume that both the correspondence school and high school options are used in equilibrium,[27] it follows that all three types, unskilled, correspondence-schooled, and high school-schooled individuals, must be present in equilibrium.

We determine which individuals choose to remain unskilled and which enroll in correspondence school or high school by comparing their respective value functions. At the lowest learning ability level $a = 0$, individuals strictly prefer to remain unskilled because $P_c(0) = P_h(0) = 0$ so $V_u(0) = w_u > w_u - \gamma_c = V_c(0) > w_u - \gamma_h = V_h(0)$.

As learning ability a increases, the values of correspondence school $V_c(a)$ and high school $V_h(a)$ strictly increase, since the probabilities $P_c(a)$ and $P_h(a)$ are strictly increasing. In contrast, the value of remaining unskilled $V_u(a)$ and the costs of both schooling options remain constant.

However, $V_c(a)$ crosses $V_u(a)$ at a lower learning ability level than $V_h(a)$ does. If instead $V_h(a)$ were to cross $V_u(a)$ first, individuals would bypass correspondence school entirely, since $P_h(a)$ increases more steeply with learning ability than $P_c(a)$, making high school strictly more attractive across the relevant range.[28] Eventually, for some $a < \bar{a}$, $V_h(a)$ overtakes $V_c(a)$ (and thus $V_u(a)$) as otherwise, no individual would choose high school in equilibrium.[29]

[27] This assumption is consistent with the historical record showing that even well into the 20th century, after high school became widely accessible, many individuals continued to enroll in correspondence schools.

[28] For this to occur, $P_c(a)$ would have to increase too slowly with learning ability, or the cost of correspondence schools γ_c would need to be exceedingly high.

[29] For this to occur, $P_h(a)$ would need to increase too slowly relative to $P_c(a)$.

Therefore, there exist two unique cutoffs $a_{c,3}, a_{h,3} \in (0, \bar{a})$ with $a_{c,3} < a_{h,3}$ such that:

- for individuals with $a < a_{c,3}$, $V_u(a) > V_c(a), V_h(a)$, so they remain unskilled;
- for individuals with $a_{c,3} \leq a < a_{h,3}$, $V_c(a) > V_u(a), V_h(a)$, so they enroll in correspondence school;
- for individuals with $a \geq a_{h,3}$, $V_h(a) > V_u(a), V_c(a)$, so they enroll in high school.

D.2 Proof of Proposition 2

We begin by stating the equations that characterize the cutoff learning ability levels in each case. These follow from equating the values of the different options available in each case at the cutoff, where the individuals are indifferent between the two.

- **Case 1: Only correspondence school available, $S = \{s_c\}$.** The cutoff $a_{c,1}$ satisfies $P_c(a_{c,1})(w_{s,1} - w_{u,1}) = \gamma_c$.
- **Case 2: Only high school available, $S = \{s_h\}$.** The cutoff $a_{h,2}$ satisfies $P_h(a_{h,2})(w_{s,2} - w_{u,2}) = \gamma_h$.
- **Case 3: Both options available, $S = \{s_c, s_h\}$.** The cutoffs $a_{c,3}$ and $a_{h,3}$ satisfy $P_c(a_{c,3})(w_{s,3} - w_{u,3}) = \gamma_c$, and $(P_h(a_{h,3}) - P_c(a_{h,3}))(w_{s,3} - w_{u,3}) = \gamma_h - \gamma_c$.

We now proceed to compare these cutoff values across the different cases.

1. Comparing cutoffs in cases 1 and 3: showing that $a_{c,1} < a_{c,3} < a_{h,3}$

We begin by comparing the cutoffs in cases 1 (only correspondence school) and 3 (both options available). From the cutoff conditions in each case, we have:

$$P_c(a_{c,1})(w_{s,1} - w_{u,1}) = \gamma_c = P_c(a_{c,3})(w_{s,3} - w_{u,3}).$$

To show that $a_{c,1} < a_{c,3} < a_{h,3}$, we proceed by contradiction.

Option 1: Suppose $a_{h,3} > a_{c,1} > a_{c,3}$.

Since $P_c(a)$ is strictly increasing, it follows that $P_c(a_{c,1}) > P_c(a_{c,3})$. Given the equality above, this implies $w_{s,1} - w_{u,1} < w_{s,3} - w_{u,3}$. In our CES framework where wages are determined by the relative supplies of skilled and unskilled labor, a smaller skill premium in case 1 implies that $L_{s,1} > L_{s,3}$. We now compare these two quantities using the equilibrium definitions:

$$L_{s,1} = \int_{a_{c,1}}^{\bar{a}} f(a) P_c(a) da$$

$$L_{s,3} = \int_{a_{c,3}}^{a_{h,3}} f(a)P_c(a)da + \int_{a_{h,3}}^{\bar{a}} f(a)P_h(a)da$$

Splitting these integrals, we can write:

$$L_{s,1} = \int_{a_{c,1}}^{a_{h,3}} f(a)P_c(a)da + \int_{a_{h,3}}^{\bar{a}} f(a)P_c(a)da$$

$$L_{s,3} = \int_{a_{c,3}}^{a_{c,1}} f(a)P_c(a)da + \int_{a_{c,1}}^{a_{h,3}} f(a)P_c(a)da + \int_{a_{h,3}}^{\bar{a}} f(a)P_h(a)da$$

Subtracting, we obtain:

$$L_{s,1} - L_{s,3} = \int_{a_{h,3}}^{\bar{a}} f(a)[P_c(a) - P_h(a)]\, da - \int_{a_{c,3}}^{a_{c,1}} f(a)P_c(a)\, da.$$

Since $P_h(a) > P_c(a)$ for all $a > 0$, the first term is negative, and the second term is strictly positive. Thus, the entire expression is negative, $L_{s,1} - L_{s,3} < 0$, which contradicts the earlier implication that $L_{s,1} > L_{s,3}$. Therefore, the assumed ordering $a_{h,3} > a_{c,1} > a_{c,3}$ cannot hold.

Option 2: Suppose $a_{c,1} > a_{h,3} > a_{c,3}$.
Again, $P_c(a_{c,1}) > P_c(a_{c,3}) \Rightarrow w_{s,1} - w_{u,1} < w_{s,3} - w_{u,3} \Rightarrow L_{s,1} > L_{s,3}$. As before:

$$L_{s,1} = \int_{a_{c,1}}^{\bar{a}} f(a)P_c(a)\, da,$$

$$L_{s,3} = \int_{a_{c,3}}^{a_{h,3}} f(a)P_c(a)\, da + \int_{a_{h,3}}^{\bar{a}} f(a)P_h(a)\, da.$$

Since $a_{h,3} < a_{c,1}$, the integration domain for $L_{s,1}$ is a strict subset of that for $L_{s,3}$, and $P_h(a) > P_c(a)$, so $L_{s,3} > L_{s,1}$, which contradicts the earlier implication that $L_{s,1} > L_{s,3}$. Thus, this assumed ordering also cannot hold.

Combining the contradiction arguments above with the result from Proposition 1 that $a_{c,3} < a_{h,3}$, we conclude that the only possible ordering is $a_{c,1} < a_{c,3} < a_{h,3}$.

2. Comparing cutoffs in cases 2 and 3: showing that $a_{h,2} < a_{h,3}$

We now compare the cutoffs in cases 2 (only high school) and 3 (both options available). Putting together the cutoff conditions in cases 2 and 3, we get:

$$P_h(a_{h,3})(w_{s,3}-w_{u,3})-P_c(a_{h,3})(w_{s,3}-w_{u,3}) = \gamma_h-\gamma_c = P_h(a_{h,2})(w_{s,2}-w_{u,2})-P_c(a_{c,3})(w_{s,3}-w_{u,3}.)$$

To show that $a_{h,2} < a_{h,3}$, we proceed by contradiction.

Suppose $a_{h,2} > a_{h,3}$.

Since $P_c(a)$ is strictly increasing and $a_{h,3} > a_{c,3}$, this means that $P_c(a_{h,3})(w_{s,3} - w_{u,3}) > P_c(a_{c,3})(w_{s,3} - w_{u,3})$, and thus that:

$$P_h(a_{h,3})(w_{s,3} - w_{u,3}) > P_h(a_{h,2})(w_{s,2} - w_{u,2}).$$

Since $P_h(a)$ is also strictly increasing, it follows that $P_h(a_{h,3}) < P_h(a_{h,2})$, so for this to hold, $w_{s,2} - w_{u,2} < w_{s,3} - w_{u,3}$, so $L_{s,2} > L_{s,3}$. We now compare these two quantities using the equilibrium definitions:

$$L_{s,2} = \int_{a_{h,2}}^{\bar{a}} f(a)P_h(a)da$$

$$L_{s,3} = \int_{a_{c,3}}^{a_{h,3}} f(a)P_c(a)da + \int_{a_{h,3}}^{\bar{a}} f(a)P_h(a)da.$$

Since $a_{h,2} > a_{h,3}$, the integration domain for $L_{s,2}$ is a strict subset of that for $L_{s,3}$, and $P_h(a) > P_c(a)$, so $L_{s,3} > L_{s,2}$, which contradicts the earlier implication that $L_{s,2} > L_{s,3}$. Thus, this assumed ordering cannot hold, and we have $a_{h,2} < a_{h,3}$.

D.3 Proof of Proposition 3

1. Effectiveness of correspondence education

The upskilling rate of correspondence education, denoted by R_c, is defined as the share of individuals who become skilled after choosing correspondence education. In cases 1 and 3, this is given by:

$$R_c = \begin{cases} \frac{\int_{a_{c,1}}^{\bar{a}} f(a)P_c(a)\,da}{\int_{a_{c,1}}^{\bar{a}} f(a)\,da} & \text{if } S = \{s_c\} \text{ (case 1, only corr. school)} \\ \frac{\int_{a_{c,3}}^{a_{h,3}} f(a)P_c(a)\,da}{\int_{a_{c,3}}^{a_{h,3}} f(a)\,da} & \text{if } S = \{s_c, s_h\} \text{ (case 3, both options)} \end{cases}$$

The relevant cutoff conditions are:

- For case 1: $P_c(a_{c,1})(w_{s,1} - w_{u,1}) = \gamma_c$,
- For case 3: $P_c(a_{c,3})(w_{s,3} - w_{u,3}) = \gamma_c$, and $(P_h(a_{h,3}) - P_c(a_{h,3}))(w_{s,3} - w_{u,3}) = \gamma_h - \gamma_c$.

Effect of increasing $P_c(a)$ at high learning ability levels

We consider the effect of increasing $P_c(a)$ for individuals with learning ability levels close to

the upper bound $\bar{a}$, i.e., for $a \in [\bar{a} - \epsilon, \bar{a})$ with small $\epsilon > 0$, on the upskilling rate R_c in cases 1 and 3.

In case 1, individuals with learning ability levels close to $\bar{a}$ are enrolled in correspondence education, as their learning ability exceeds the cutoff $a_{c,1}$. Increasing $P_c(a)$ in this upper tail raises the probability that these individuals become skilled. This, in turn, increases the overall share of skilled workers in the economy, which reduces the skilled wage premium $w_{s,1} - w_{u,1}$ in equilibrium.

To maintain the cutoff condition $P_c(a_{c,1})(w_{s,1} - w_{u,1}) = \gamma_c$, and since $P_c(a)$ remains unchanged at lower learning ability levels, the decline in the skilled premium must be offset by an increase in $a_{c,1}$. That is, the marginal individual must now have a higher learning ability level to justify the same investment in correspondence education. As a result, the pool of individuals enrolling in correspondence school becomes more positively selected on ability. This selection effect, together with the increase in $P_c(a)$ at the top, raises the average success rate among enrollees—i.e., the upskilling rate R_c increases.

In case 3, a similar logic applies. High-ability individuals close to $\bar{a}$ enroll in high school, as their learning ability exceeds the high school cutoff $a_{h,3}$. An increase in $P_h(a)$ in this region raises the overall share of skilled workers, which reduces the skilled wage premium $w_{s,3} - w_{u,3}$. This, in turn, lowers the returns to skill acquisition for marginal individuals, whether choosing between correspondence school and remaining unskilled, or between correspondence school and high school.

To maintain the cutoff condition $P_c(a_{c,3})(w_{s,3} - w_{u,3}) = \gamma_c$, and given that $P_c(a)$ remains unchanged at lower learning ability levels, the correspondence school cutoff $a_{c,3}$ must rise. Likewise, to satisfy the cutoff condition $(P_h(a_{h,3}) - P_c(a_{h,3}))(w_{s,3} - w_{u,3}) = \gamma_h - \gamma_c$, and given that $P_c(a)$ and $P_h(a)$ are unchanged at lower learning ability levels, the high school cutoff $a_{h,3}$ must also rise. These joint adjustments imply stronger positive selection into correspondence education, thereby increasing the average upskilling rate R_c.

Effect of increasing γ_c

We now consider the effect of increasing the cost of correspondence education, γ_c, in case 1.

To maintain the cutoff condition $P_c(a_{c,1})(w_{s,1} - w_{u,1}) = \gamma_c$, the increase in γ_c must be offset by an increase in $a_{c,1}$. That is, the marginal individual must now have a higher learning ability level to justify a higher cost for correspondence education. As a result, the pool of individuals enrolling in correspondence school becomes more positively selected on ability,

thereby increasing the average upskilling rate R_c.[30]

2. Interaction with high school

Measure of individuals enrolling in correspondence school in cases 1 and 3

The measure of individuals who enroll in correspondence education in cases 1 and 3 is given by:

- Case 1: $\int_{a_{c,1}}^{\bar{a}} f(a)\,da = 1 - F(a_{c,1})$
- Case 3: $\int_{a_{c,3}}^{a_{h,3}} f(a)\,da = F(a_{h,3}) - F(a_{c,3})$

Since $a_{c,1} < a_{c,3}$, as shown in Proposition 2, it follows that the measure of individuals enrolling in correspondence education is strictly larger in case 1 than in case 3.

Reallocation of lower-ability individuals from high school to correspondence school in cases 2 and 3

The share of individuals enrolling in either high school or correspondence school in cases 2 and 3 is given by:

- High school share in case 2: $\int_{a_{h,2}}^{\bar{a}} f(a)\,da = 1 - F(a_{h,2})$
- High school share in case 3: $\int_{a_{h,3}}^{\bar{a}} f(a)\,da = 1 - F(a_{h,3})$
- Correspondence school share in case 3: $\int_{a_{c,3}}^{a_{h,3}} f(a)\,da = F(a_{h,3}) - F(a_{c,3})$

Since $a_{h,2} < a_{h,3}$ and $a_{c,3} < a_{h,3}$, as shown in Proposition 2, some individuals who would have enrolled in high school in case 2 instead choose correspondence education in case 3. Moreover, because $a_{h,3} < \bar{a}$, we can write $a_{h,3} = \bar{a} - \epsilon$ for some $\epsilon > 0$. Hence, those who switch from high school to correspondence school have learning ability levels strictly below $\bar{a}$; that is, $a < \bar{a} - \epsilon$.

Upskilling rate of high school in cases 2 and 3

The upskilling rate of high school, denoted by R_h, is defined as the share of individuals who

[30] Notice that for case 3, the increase in γ_c also induces more individuals to enroll in high school as it has become relatively cheaper than correspondence school. This reduces the high school cutoff $a_{h,3}$, and makes the effect on R_c, ambiguous as the ability distribution of correspondence students is higher at the lower end but lower at the upper end.

become skilled after choosing to enroll in high school. In cases 2 and 3, this is given by:

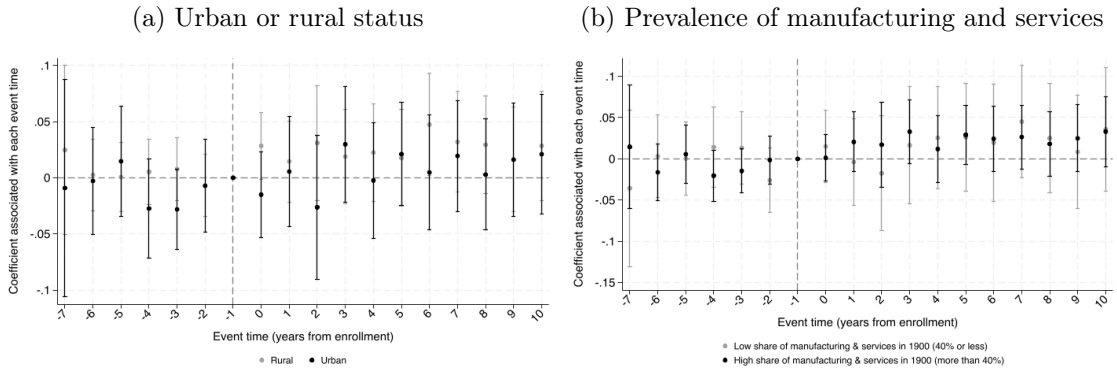
$$R_h = \begin{cases} \dfrac{\int_{a_{h,2}}^{\bar{a}} f(a) P_h(a)\, da}{\int_{a_{h,2}}^{\bar{a}} f(a)\, da} & \text{if } S = \{s_h\} \text{ (case 2: only high school)} \\ \dfrac{\int_{a_{h,3}}^{\bar{a}} f(a) P_h(a)\, da}{\int_{a_{h,3}}^{\bar{a}} f(a)\, da} & \text{if } S = \{s_c, s_h\} \text{ (case 3: both options)} \end{cases}$$

Since $a_{h,2} < a_{h,3}$, as shown in Proposition 2, the pool of individuals selecting into high school in case 3 is more positively selected on learning ability. Given that $P_h(a)$ is strictly increasing in a, the upskilling rate R_h is therefore higher in case 3 than in case 2.

E Additional empirical results supporting the testable implications of the theory

E.1 Effectiveness of correspondence education for occupational upskilling

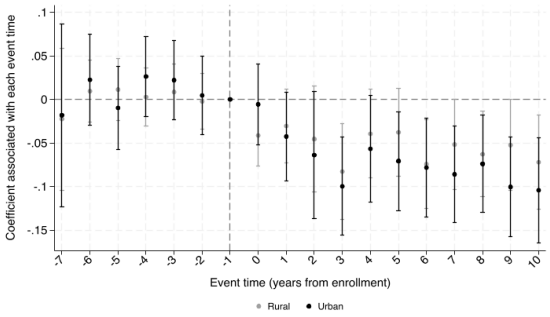
Figure E.1: Effect of correspondence education on other white-collar occupations by urban status and industrial composition



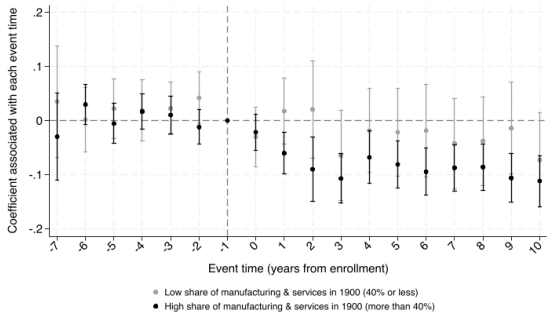
Notes: These figures plot the event-study estimates of the impact of correspondence education on the probability of working in other white-collar occupations, corresponding to β_τ for $\tau \in \{-7, -6, \ldots, -1, 0, 1, \ldots, 10\}$ in Equation (3.1), estimated separately for each subgroup. Each coefficient captures the effect of being τ years from enrollment, relative to the base period $\tau = -1$, on an indicator variable for this occupational category. The analysis includes men from the "Register of International Correspondence Schools" matched to census records in 1900 and/or 1910 using the procedure described in Section 3.2. 95% confidence intervals built from standard errors clustered at the county level are plotted.

Figure E.2: Effect of correspondence education on blue-collar occupations by urban status and industrial composition

(a) Urban or rural status



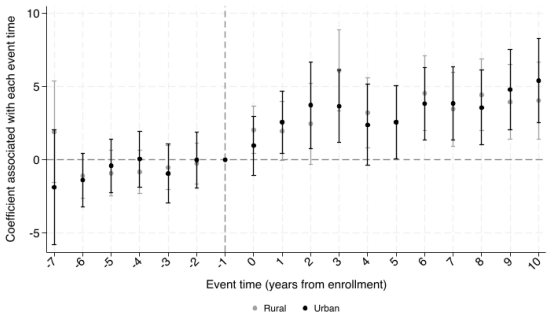
(b) Prevalence of manufacturing and services



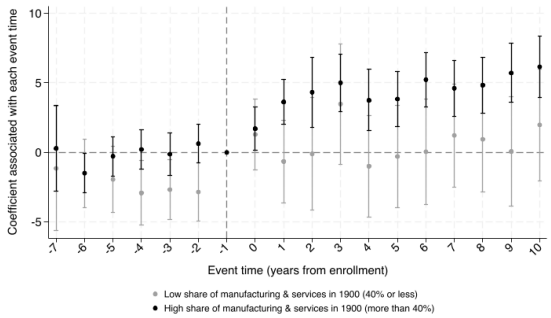
Notes: These figures plot the event-study estimates of the impact of correspondence education on the probability of working in blue-collar occupations, corresponding to β_τ for $\tau \in \{-7, -6, \ldots, -1, 0, 1, \ldots, 10\}$ in Equation (3.1), estimated separately for each subgroup. Each coefficient captures the effect of being τ years from enrollment, relative to the base period $\tau = -1$, on an indicator variable for this occupational category. The analysis includes men from the "Register of International Correspondence Schools" matched to census records in 1900 and/or 1910 using the procedure described in Section 3.2. 95% confidence intervals built from standard errors clustered at the county level are plotted.

Figure E.3: Effect of correspondence education on the Duncan Socioeconomic Index (SEI) by urban status and industrial composition

(a) Urban or rural status



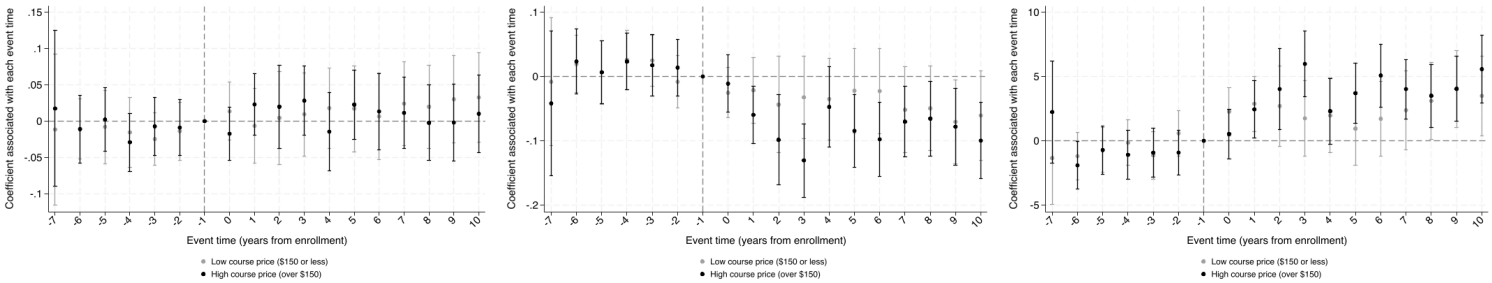
(b) Prevalence of manufacturing and services



Notes: These figures plot the event-study estimates of the impact of correspondence education on the SEI, corresponding to β_τ for $\tau \in \{-7, -6, \ldots, -1, 0, 1, \ldots, 10\}$ in Equation (3.1), estimated separately for each subgroup. Each coefficient captures the effect of being τ years from enrollment, relative to the base period $\tau = -1$, on this index. The analysis includes men from the "Register of International Correspondence Schools" matched to census records in 1900 and/or 1910 using the procedure described in Section 3.2. 95% confidence intervals built from standard errors clustered at the county level are plotted.

Figure E.4: Effect of correspondence education on occupational outcomes and Duncan Socioeconomic Index (SEI) by course price

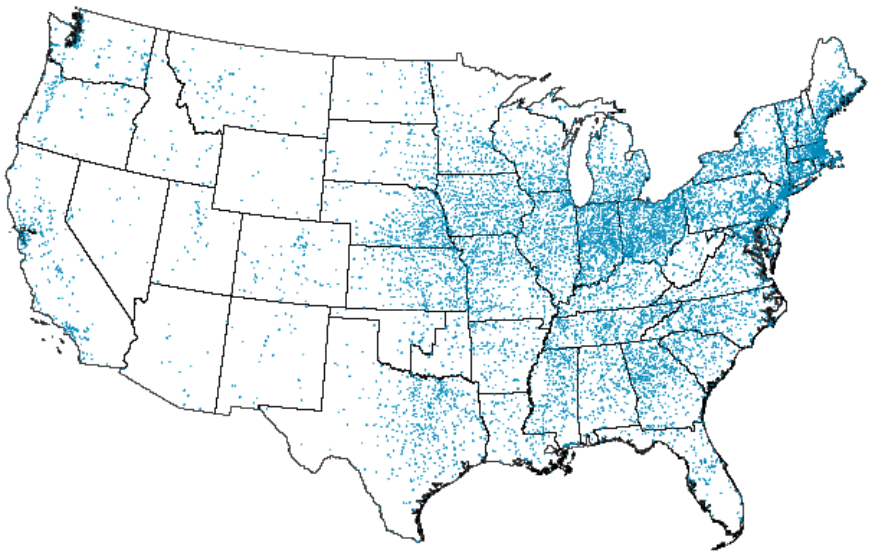
(a) Other white-collar occupations (b) Blue-collar occupations (c) SEI



Notes: These figures plot the event-study estimates of the impact of correspondence education on occupational outcomes and the SEI, corresponding to β_τ for $\tau \in \{-7, -6, \ldots, -1, 0, 1, \ldots, 10\}$ in Equation (3.1), estimated separately for each subgroup. Each coefficient captures the effect of being τ years from enrollment, relative to the base period $\tau = -1$, on indicator variables for: (1) other white-collar occupations; (2) blue-collar occupations; and (3) the SEI, respectively. The analysis includes men from the "Register of International Correspondence Schools" matched to census records in 1900 and/or 1910 using the procedure described in Section 3.2 who took a course found in the "Price List and Rules for Field Men" booklet published in 1931. 95% confidence intervals built from standard errors clustered at the county level are plotted.

E.2 Interaction between correspondence and high school education

Figure E.5: Cities with a high school by 1900



Notes: This map indicates all US cities that had a public or private high school in operation by 1900, based on the dataset compiled by Doxey et al. (2025).

Table E.1: Summary statistics for neighbor exposure measures of full male population 1900 and 1910

	1900	**1910**
Has treated neighbor	0.047	0.032
Nearest treated neighbor is 1 doors away	0.001	0.001
Nearest treated neighbor is 2 doors away	0.001	0.001
Nearest treated neighbor is 3 doors away	0.001	0.001
Nearest treated neighbor is 4 doors away	0.001	0.001
Nearest treated neighbor is 5 doors away	0.001	0.001
Nearest treated neighbor is 6 doors away	0.001	0.001
Nearest treated neighbor is 7 doors away	0.001	0.001
Nearest treated neighbor is 8 doors away	0.001	0.001
Nearest treated neighbor is 9 doors away	0.001	0.001
Nearest treated neighbor is 10 or more doors away	0.04	0.03
Observations in full sample with all men	38,757,848	47,609,664
Observations in sample with treated neighbor	1,817,197	1,531,536

Notes: This table presents the average values for the measures of exposure to male neighbors living on the same street who enrolled in correspondence school by 1900, for men in the 1900 and 1910 census waves. Correspondence school enrollment is identified using men from the "Register of International Correspondence Schools" matched to census records in 1900 and/or 1910 using the procedure described in Section 3.2.

Table E.2: High school effectiveness and neighbor exposure (for the Duncan Socioeconomic Index, SEI)

	SEI	
Has treated neighbor	0.51***	
	(0.18)	
Nearest treated neighbor is 1–3 doors away		0.42.
		(0.44)
Nearest treated neighbor is 4–6 doors away		0.33.
		(0.45)
Nearest treated neighbor is 7–9 doors away		0.78*
		(0.47)
Sample	All HS	HS w/ treated neigh.
Observations	1,508,129	42,658
Neighborhood FE	Yes	Yes
Demographic controls	Yes	Yes
Cluster	Nbhd	Nbhd

This table presents the results from Equation (5.4). The analysis includes men aged 16 to 35 in the 1910 census, and identifies correspondence school enrollment using men from the "Register of International Correspondence Schools" matched to census records in 1900 and/or 1910 using the procedure described in Section 3.2. Standard errors clustered at the enumeration district level in parentheses. ***p<0.01, **p<0.05, *p<0.1.