Compulsory Education and Occupational Persistence: Evidence from US Agriculture *

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Abstract

This paper examines the impact of US compulsory education laws on occupational persistence in agriculture. Using the US Decennial Census and the Census of Agriculture from 1860 to 1910, difference-in-difference estimates indicate an 8% decrease in the probability of children from farm households becoming farmers. Heterogeneity analysis by gender, birth order, and race indicates that disadvantaged groups were more likely to shift from agricultural to non-agricultural sectors. The number of farms declined as average farm size concurrently increased, suggesting a consolidation of the farm sector. This study shows evidence that US compulsory education laws play a role in accelerating structural transformation.

Keywords: Farming Succession, Compulsory Education Laws, Structural Transformation
JEL Codes: I28, Q15, O13, N51, J24

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1 Introduction

Why and when do people choose the same occupation as their parents in farming? Education plays an important role in increasing inter-generational mobility and accelerating the labor force shift from the agricultural to non-agricultural sectors. With the introduction of compulsory education laws, farming remained the most inherited profession in the United States (US) by the early 20th century concurrently (Blau and Duncan, 1967). During the mid-19th century, the number of farms in the US experienced substantial growth, reaching a peak of 6.8 million farms in 1935 (USDA, 2022*b*). Although the number of US farms has declined to approximately 2.2 million in 2021, family farms continue to play a dominant role in US agricultural production, constituting 98% of all farms and contributing to 88% of agricultural output (USDA, 2022*a*).

This paper examines the impacts of compulsory education laws on inter-generational occupational choices within the US agricultural sector. While past research suggests that children of farmers often pursue their parents' professions due to factors such as farmland inheritance and knowledge transmission (Laband and Lentz, 1983; Mishra, El-Osta and Shaik, 2010), compulsory education laws can disrupt this occupational persistence and prompt a shift of the farming labor force to non-agricultural sectors.

Using the US full count decennial census data from 1860 to 1910 at the individual level, this study analyzes approximately 19.8 million individuals from states that enacted compulsory education laws between the 1870s and 1910s. Parents' occupations are identified by using IPUMS-constructed family interrelationship variables. Specifically, children from farm households are defined as those with at least one parent who worked as a farmer before the laws' implementation, and occupational persistence is defined by these children's continuation in farming.

I treat compulsory education laws as plausibly exogenous shocks, using the difference-in-difference (DiD) model to estimate the effect on occupational choices. The treatment group is defined based on the timing of states enacting these laws, with states not yet implemented as the comparison group.[1] I also apply generalized DiD estimators as proposed by Callaway and

[1]Figure I presents the timeline of implementing compulsory education laws in each state of the contiguous US.

Sant'Anna (2021), Borusyak, Jaravel and Spiess (2021), and Sun and Abraham (2021). Additionally, I include the state-fixed effect specifications with (1) year and birth cohort fixed effect, (2) linear time trend, (3) quadratic time trend, and (4) state-year linear trend as robustness checks.

The identification of the estimation strategy depends on the parallel trends assumption, which assumes that the average outcomes for treatment and comparison groups would follow similar paths over time in the absence of treatment. The dynamic DiD results support the validity of the parallel trends assumption in this study. The differences in occupational persistence rates in agriculture between the treatment and comparison groups were similar before implementing compulsory education laws.

Baseline results show that compulsory education laws significantly decrease the probability of children from farm households working as farmers by 7% to 10%. These results remain robust when applying recently proposed generalized DiD estimators. I find that White male children were more likely to persist in agriculture. That is, the impact of compulsory education laws on occupational choices across generations is primarily driven by disadvantaged groups, including females and non-White individuals.

Much of the previous research has documented inter-generational occupational persistence, mainly focusing on White male-patterned inheritance in farming occupations (Blau and Duncan, 1967; Laband and Lentz, 1983; Rauscher, 2016; Featherman and Hauser, 2018). There is limited research examining daughters' inheritance patterns and occupational choices and the influence of mothers, specifically in farming occupations. This study addresses this by thoroughly examining the effect of compulsory education laws on employment by race and gender in the agricultural sector.

Additionally, this study contributes to the literature by using an empirical causal inference approach to examine inter-generational occupational choice in agriculture at the individual level. It is documented that parents are highly correlated with their children's labor market outcomes through financial and human capital transformation (Solon, 2018; Ulvestad and Markussen, 2022). While previous studies have shown a positive inter-generational correlation in self-employment,

the results are not distinguished by occupation (Colombier and Masclet, 2008). Building on previous work of Rauscher (2016), this paper investigates the causal relationship between compulsory education laws and inter-generational occupational choices, specifically for children from farm households.

Moreover, this study shows that compulsory education laws significantly reshaped the US agricultural landscape. With the spread of compulsory education laws in the US, there was a decline in the number of farms, accompanied by a growth in the average size of farms—suggesting a potential consolidation of small farms into larger units. Concurrently, the asset values of agricultural land and its structures declined. Notably, there was no significant change in grain corn production after the introduction of compulsory education laws. This suggests that the decline in farm numbers did not adversely affect overall agricultural production.

In sum, this study contributes to the existing literature by examining the comprehensive interplay between compulsory education laws and occupational choices through parents' occupation in the agricultural sector. Additionally, it provides insights into the role of education expansion policies in shaping farming succession and the agricultural landscape in the US.

The remaining paper proceeds as follows. Section 2 provides the historical background of the US compulsory education laws. Section 3 describes the data. Section 4 illustrates the DiD model and identification strategy. Section 5 presents the results. Section 6 concludes.

2 Historical Background

Between 1852 to 1918, all states in the US started to enact compulsory education laws, which required children to attend elementary school during their school-age (Goldin and Katz, 2008).[2] Figure I illustrates the timeline of when states passed compulsory education laws. Massachusettes was the first state to implement the laws in 1852, followed by the District of Columbia and Vermont

[2]Figure A1 shows the required school age by state. Each state's minimum required school age during the research period is eight years old, while the maximum required school age varies by state. Most states require attending school until children are 14 years old.

during the 1860s.

The implementation of compulsory education laws in the southern states of the US was relatively late compared to other states. The delay was attributed to various factors in terms of history, economy, culture, and society (Anderson, 2010). Agricultural production heavily relied on child labor for farm work, leading to resistance against mandatory elementary education (Rauscher, 2014). Additionally, cultural and social factors, including traditional attitudes toward education, racial tensions, and socioeconomic disparities, delayed enacting compulsory education laws (Anderson, 2010). Due to these regional differences, the sample used in this study does not include children from the southern states where compulsory education laws were implemented in the 1910s.

The goal of compulsory education laws is to promote school attendance rates among children of school age, particularly targeting minority groups and immigrants who do not have access to primary education. Nevertheless, it is important to note that even with the implementation of compulsory education laws across the US by the 1910s, class, racial, and ethnic segregation persisted in many schools, leading to inequality and disparities in access to quality education resources (Card and Krueger, 1992; Zunz, 1982).

Mandatory education plays a role in meeting the labor and socialization demands of capitalism, industrialization, and urbanization (Field, 1976; Baker, 1999; Katz, 2001; Bowles and Gintis, 2002). Elementary schools are the key institutions that teach children basic knowledge, including reading, writing, comprehension, and computation. Moreover, these schools are instrumental in fostering a sense of national identity and conveying "American values" to the next generation (McAfee and McAfee, 1998; Lleras-Muney and Shertzer, 2015).

Compulsory education laws aim to promote social mobility, improve literacy rates, and help meet the increasing demands of skilled workers in a growing economy. Nevertheless, there is a debate about how compulsory education laws impact school attendance and later labor market outcomes. Some studies find no significant effect on school attendance (Landes and Solmon, 1972; Stephens Jr and Yang, 2014), while some studies show important effects on school attendance (Edwards, 1978), educational attainment (Oreopoulos, 2006), wage, and mortality (Lleras-Muney,

2005).

Some studies have explored research questions closely related to mine, focusing on the inter-generational effect of compulsory education laws on employment outcomes and social mobility of the next generation (Oreopoulos, Page and Stevens, 2006; Rauscher, 2016). In the most relevant study, Rauscher (2015*a*) shows that early US compulsory education laws changed the state-level occupation structure, reallocating from farming to skilled non-agricultural occupations.

Building on previous research, this study investigates the effect of compulsory education laws on individual-level employment outcomes for children from farm households and the mechanism driving the heterogeneity (Lleras-Muney, 2002; Goldin and Katz, 2009; Rauscher, 2014; Lleras-Muney and Shertzer, 2015). The findings shed light on the plausible impact of mandatory elementary education and the mechanism that may drive different occupational persistence patterns in the agricultural sector.

3 Data and Descriptive Statistics

I use 1860 to 1910 individual US decennial census data obtained from IPUMS (Ruggles et al., 2022). The US Census Bureau conducts the decennial census to determine the number of representatives assigned to each state. The census survey collects demographic information, including the state of current residency, sex, race, age, and occupation of each household member. It also collects information on living situations, including farm status, rural location, number of siblings, and relation to the household head. Overall, the decennial census data includes much social and economic information and is highly representative during the mid-19th to early 20th century.

To retrieve the inter-generational information within a household, I use the family inter-relationship variables constructed by IPUMS to link children to their parents' data who lived in the same household Ruggles et al. (2022). To investigate the effect of compulsory education laws on occupational persistence, I drop the sample not linked to any of their parents' information. To show the heterogeneity by parents' occupation, the full sample includes children with and without parents as

farmers.

The primary interest of outcome is occupational choices. Based on the 1950 Census Bureau occupational, I define working as a farmer for those whose occupation is one of the following categories: (1) Farmers (owners and tenants); (2) Farm managers; (3) Farm foremen; (4) Farm laborers, wage workers; (5) Farm laborers, unpaid family workers; (6) Farm service laborers, self-employed.

Additionally, I follow the 1950 Census Bureau industrial classification system to classify three main sectors: (1) the Primary Sector, including Agriculture, Forestry, Fishing, and Mining; (2) the Secondary Sector, including Construction and Manufacturing; and (3) Tertiary Sector, including Transportation, Communication, Business Services, and Public Administration. Classifying a job based on occupation and industry classification helps provide the robustness checks for structural transformation from agriculture to non-agriculture.

The data of compulsory education laws for each state is obtained from Rauscher (2016). Figure I illustrates the map of contiguous US states along with the decade in which each state implemented compulsory education laws. Massachusetts was the earliest state to require children to attend school, requiring children to attend school in the 1850s.[3] The southern states are the latest to implement compulsory education laws. I use the state of current residency to define the treatment timing. During the research time period, the migration rates are relatively low (Rauscher and Oh, 2021). The migration rate in my linked census sample is approximately 10%. I then exclude children who moved to different states from the final sample.

Table A1 shows the descriptive statistics at the individual level for children from farm households living in states grouped based on the timing of implementing compulsory education laws. The full sample comprises approximately 19.8 million individual-year observations, with 3.9 million children from farm households. Table A1 shows that children from farm households in states with earlier implementation of compulsory education laws have a lower proportion (65%) of children working as farmers. In contrast, states with later implementation exhibit a higher percentage

[3]Since the sample only includes 1860 to 1910, the analysis does not include individuals living in states that passed compulsory education laws in the 1850s, 1860s, and 1910s.

(76%) of children working in farming occupations. The mean differences across groups may lead to concerns about the endogeneity of the policy change and, thus, the validity of the parallel trends assumption. I address these concerns in the Empirical Framework Section.

The family characteristics, in terms of family size and the number of siblings, show similar patterns across the treatment and comparison groups. To further assess the balance between these groups, Table A2 presents the results of the balance test before the implementation of compulsory education laws. To account for family characteristics, I include them as individual-year varying controls in the main analysis. Additionally, I provide baseline results without the inclusion of these controls as a robustness check. By doing so, I check that including the controls does not substantially affect the estimated coefficient, but rather, it leads to smaller standard errors.

4 Empirical Framework

4.1 Estimation Strategy

To evaluate the impact of compulsory education laws on occupation persistence in agriculture, I apply the TWFE model to examine the average treatment effect on the treated (ATT) of compulsory education laws on employment for children from farm households. Depending on the quasi-experimental variation of timing in which states passed compulsory education laws, I define the treatment group as children residing in states that had previously implemented these laws. The comparison group is those living in not-yet-treated states. The baseline specification is as follows

$$Y_{ist} = \gamma D_{st} + \mathbf{X}_{it}\beta + \alpha_s + \tau_t + \varepsilon_{1ist} \tag{1}$$

where Y_{ist} denotes the binary outcome of occupational choice for child i in state s in year t, including (i) work as a farmer, (ii) work in the primary sector, (iii) work in the secondary sector, (iv) work in the tertiary sector. D_{st} denotes the treatment dummy variable equaling one if living in state s where implementing the compulsory education laws in year t. $\mathbf{X}_{it}$ is a vector of individual-level

controls that varies over time, including the number of siblings and family size. α_s and τ_t are state and year fixed effects, respectively. ε_{1ist} is an error term with zero mean representing other factors affecting occupational choices.

I use ordinary least squares with binary outcome variables to estimate Equation 1. I cluster the standard error at the state level, which is the same level as the treatment variable Abadie et al. (2023). To alleviate the concerns of too few clusters, I apply the bootstrap cluster standard errors with 50 replications. Clustering the standard errors at the state level address the potential unobserved shocks that are related to all residents' occupational choices within the state.

By estimating the coefficient γ from Equation 1, I capture the effect of compulsory education laws on children's occupational choices. The null hypothesis is H_0: $\gamma = 0$ versus the alternative hypothesis H_A: $\gamma \neq 0$. Rejecting the null hypothesis in favor of $\hat{\gamma}$ is significantly negative implies that compulsory education laws decrease the probability of occupational persistence in agriculture for children from farm households. In other words, compulsory education laws may contribute to reallocating the labor force from the agricultural sector to secondary or tertiary sectors.

4.2 Identification Strategy

The estimation strategy relies on the parallel trend assumption. It implies that in the absence of compulsory education laws, the probability of working as a farmer for children living in earlier and later implementing states would have followed a similar trend over time. Nevertheless, there is a main concern regarding potential unobservable factors that may have influenced the timing of implementing compulsory education laws. For example, states located on the east coast might have had more non-farm job opportunities, leading to a greater demand for public education. These unobservable confounders can introduce bias if not properly accounted for in the analysis.

To address the concern mentioned above, I apply a dynamic version of equation 1 to show the evidence of pretrends. Specifically, I estimate the specification as follow

$$Y_{ist} = \sum_{k=-40}^{-10} \delta_k D_{sk} + \sum_{k=0}^{30} \gamma_k D_{sk} + \mathbf{X}_{it}\beta + \alpha_s + \tau_t + \varepsilon_{2ist} \tag{2}$$

where Y_{ist} denotes employment outcomes for a child i living in state s in year t. D_{sk} is a set of treatment indicator variables that are equal to one if state s is k years from implementing the compulsory education laws. α_s and τ_t are state and year fixed effects, respectively. ε_{2ist} is an error term with zero mean. The coefficient of interest, γ_k, captures the time dynamic effects of the compulsory education laws on employment.

The statistical test examines whether the coefficients of the interaction variables in equation (2) are statistically different from zero, indicating heterogeneous effects of compulsory education laws over the year. The null hypothesis H_0: $\gamma_k \neq 0$, while the alternative hypothesis H_A: $\gamma_k \neq 0$. Rejecting the null hypothesis and showing that $\hat{\gamma}_k$ is negative implies that compulsory education laws decreased the probability of occupational persistence in agriculture over time.

Consider another null hypothesis H_0: $\delta_k \neq 0$ with the alternative hypothesis H_A: $\delta_k \neq 0$. Failing to reject the null hypothesis supports the presence of parallel pre-trends and provides evidence for the validity of the parallel trend assumption. This implies that, in the absence of compulsory education laws, there would have been no significant difference in children's occupational choices between the treatment and comparison groups

Additionally, I show the robustness of the pretrends by applying the frontier alternative TWFE estimators proposed by Callaway and Sant'Anna (2021), Borusyak, Jaravel and Spiess (2021), and Sun and Abraham (2021). For the baseline specification, I present the results using the specifications with (1) year and birth cohort fixed effect, (2) linear time trend, (3) quadratic time trend, and (4) state-year linear trend as robustness checks.

A threat to the identification strategy comes from data limitations, which potentially cause measurement error. To define the treatment variable, I use the current state residency and survey year to determine if a child lives in a state that requires to attend school. Even though I exclude those identified to migrate, decennial census data does not fully capture the short-term migration record. For example, if a person moved to different places within the past ten years and returned to their hometown state for the next survey year. In other words, compulsory education laws may induce internal migration for those required to attend school (Rauscher and Oh, 2021). This

measurement error in defining the treatment group may bias the estimated results.

Since women's labor participation rates had been low before the mid-20th century in the US, most of them worked as helping with housework or their partner in the sample. To understand the potential impacts of compulsory education laws for both men and women, I include those women whose occupations were housewives or helping at home and track their occupational choice over time. To link the information for two-generation, measurement errors can come in. I use family variables constructed by IPUMS to link all plausible parent/child samples in the core analysis.

Lastly, it is important to note that the Black population is underrepresented in the US historical census data (Steckel, 1991). Despite this data limitation, I include the non-White population in my analysis in order to examine the impact of public education on disadvantaged groups. By considering a broader range of racial and ethnic groups, this research contributes to a more comprehensive understanding of the heterogeneity treatment effect by race and ethnicity.

5 Results

5.1 Baseline Results

Table I presents estimated γ in equation 1, indicating the effects of compulsory education laws on occupational persistence in agriculture. The first column presents results from the simple specification with state and year-fixed effects and without additional controls. In the second column, I include the number of family sizes and siblings as controls in the two-way fixed effect specification. In the third column, I add the cohort fixed effect to account for different birth cohort characteristics in occupational choices. In the fourth to sixth columns, I show the results with linear time trend, quadratic time trend, and state linear time trend, respectively. Across all six specifications, the results remain robust.

Overall, the results in Table I indicate that compulsory education laws significantly decrease the probability of working as a farmer by 7.4% to 9.5% for children from farm households. These findings suggest that compulsory education laws shape occupational choices for the next genera-

tion, significantly steering them away from agricultural sectors.

Additionally, I estimate equation 1 for employment outcomes across three sectors. Tables II presents the results for employment in the primary sector, which exhibit similarities to the findings regarding farming occupation. This alignment can be attributed to the fact that farmers constitute the majority, accounting for over 90%, of the primary sector workforce. Table III presents that compulsory education laws significantly increase the probability of working in the secondary sector for children from farm households. The estimated coefficients range from 1 to 2 percentage points (pp), indicating a substantial increase of approximately 15% to 30%. Similarly, Table IV shows that compulsory education laws also contribute to a higher probability of children from farm households working in the tertiary sector. The estimated coefficients range from 2 to 3 pp, indicating an approximate increase of 20% to 25%.

Notably, these results are consistent across various specifications and employment outcomes, further supporting the robustness of the findings. These findings prove that compulsory education laws plausibly drive structural transformation and the transition of the labor force from the agricultural sector to the non-agricultural sectors.

5.2 Event Study Results

To provide evidence for the parallel trends assumption and examine the dynamic treatment effects over year, I estimate equation 2, which is a dynamic version of the TWFE model. As discussed in the Methodology Section, the conventional TWFE model with multiple periods may yield biased estimates due to potential negative weighting if the assumption of homogeneous treatment effects is not valid (Goodman-Bacon, 2021). To address this concern and allow for heterogeneity in treatment effects across years, I implement the dynamic TWFE model and include the event study estimators recently proposed by Callaway and Sant'Anna (2021), Borusyak, Jaravel and Spiess (2021), and Sun and Abraham (2021) as robustness checks. These approaches help ensure the reliability and validity of the results obtained.

Figure II illustrates the dynamic treatment effects based on the relative year of implementing

compulsory education laws. This event study figure provides evidence supporting the validity of the parallel trend assumption, as the estimates prior to the implementation of education laws consistently exhibit parallel pre-trends. Moreover, Figure II demonstrates that compulsory education laws significantly reduce the probability of working as a farmer over time. The estimates show a significant decrease of 5 to 7 pp during the post-implementation periods of compulsory education laws. The results remain robust when applying recently proposed event study estimators.

In sum, the findings show a significant decrease in the probability of occupational persistence among children from farm households plausibly due to compulsory education laws. It indicates that children are less likely to pursue farming as their occupation, deviating from their parents' footsteps. The findings suggest that the laws for mandatory primary education plausibly reallocate the labor force from the primary sector to the secondary and tertiary sectors. This implies a plausible role of compulsory education laws in driving the structural transformation of the labor market.

5.3 Heterogeneity Analysis

5.3.1 By Parents' Occupation

I present event study results using the estimator proposed by Callaway and Sant'Anna (2021). While my primary analysis focuses on children from farm households, I also examine the results for children from non-farm households to explore potential heterogeneity in the treatment effect by parents' occupation.

Figure III illustrates the effects of compulsory education laws on children's employment by parents' occupation. Among children from farm households, they are significantly less likely to work as a farmer by 7pp after a decade of implementing compulsory education laws. The effects remain consistent over time. In contrast, for children from non-farm households, the treatment effects show a significant decrease of 5 pp during the first decades. The effects are negative but insignificant for the second and third decades.

Figure IIIb presents the estimated results for the probability of working in the primary sector.

Children from farm households are significantly less likely to work in the primary sector by 7pp for the first three decades following the implementation of compulsory education laws. The similarity between Figures IIIa and IIIb can be attributed to the fact that farmers constitute over 90% of the population working in the primary sector.

I present the estimated results for the probability of working the secondary and tertiary sectors separately in Figures IIIc and IIId. The parallel pre-trends observed in these figures provide evidence supporting the validity of the parallel trend assumptions. In Figure IIIc, I find that children from farm households are more likely to work in the secondary sector by 3pp. In contrast, children from non-farm are significantly less likely to work in the secondary sector by 2pp. In Figure IIId, I find that compulsory education laws lead to an increase in the probability of working in the tertiary sector for children from both farm and non-farm households. The estimated effects indicate approximately a 2 pp increase during the first decades.

5.3.2 By Gender

Previous studies document that men predominantly held the majority of land ownership in the US during the 19^{th} and 20^{th} centuries. This ownership was often passed down through generations, as sons inherited the land from their fathers and continued the tradition by passing it on to their sons (Laband and Lentz, 1983; Ruggles, 2003). Given this context, I explore potential heterogeneity in the treatment effect by gender over time. By examining how compulsory education laws impact occupational choices for children of farmers, disaggregated by gender, I can better understand how educational reforms interact with existing gender dynamics in the agricultural sector.

Figure IV illustrates the effects of compulsory education laws on employment for children of farmers by gender. Echoing previous research that documents the higher likelihood of sons inheriting farmland, my findings indicate that compulsory education laws have a relatively smaller effect on farmers' sons. Specifically, men experience a decrease of approximately 5 pp in the probability of working as a farmer during the first three decades following the implementation of education laws. In contrast, women exhibit a substantial decrease of 37 pp in the likelihood of

working as a farmer after three decades.

Figures IVc and IVd illustrate the event study results of compulsory education laws on the probability of working in the secondary and tertiary sectors, respectively. The findings suggest that men are 2pp more likely to work in the secondary sector, while there is no significant increase in women's employment in the secondary sector. In contrast, women are significantly more likely to work in the tertiary sector, whereas there is no significant effect on men's employment in the tertiary sector.

5.3.3 By Birth Order and Gender

In addition to gender, previous research has documented that first-born children are more likely to inherit the family farm and take responsibility for caring for their parents, particularly first-born son (Alston and Schapiro, 1984; Menchik, 1980; Fernando, 2014). The notion of primogeniture suggests an unequal distribution of occupational inheritance based on gender and birth order (Tyree and Treas, 1974; Kennedy, 1991). To capture the potential heterogeneity in the effects of compulsory education laws, I explore the treatment effect by the interplay of birth order and gender.

Figure V illustrates that the effect of compulsory education laws is more substantial for non-firstborn children, while still exhibiting a similar pattern as that observed for firstborns. Figure A3 presents a comprehensive analysis of the heterogeneity by birth order and gender. I find that gender is the primary mechanism driving the heterogeneous effects of compulsory education laws on employment outcomes. Robust results consistently demonstrate that women are more likely to transition out of the primary sector and into the tertiary sector following the implementation of compulsory education laws.

5.3.4 By Race

During the late 19^{th} to early 20^{th} centuries in the United States, mandatory public education was actually segregated based on race and ethnicity. The minority ethnic group and immigrants, especially the Black population, faced segregated schools and pervasive discrimination (Anderson,

2010; Rauscher, 2015*b*). The practice of racial segregation in education, leading to limited access to equal social advancement, may have resulted in heterogeneity in the impact of compulsory education laws on children's employment by race and ethnicity.

Figure VI demonstrates the effect of compulsory education laws on employment by race. The findings suggest that the effects of compulsory education laws are less pronounced for White, non-Hispanic children from farm households. While there is a significant decrease of 5pp in the probability of working as a farmer for White, non-Hispanic individuals, this effect remains relatively stable across decades. Moreover, compulsory education laws have no significant impact on employment in the secondary and tertiary sectors for White, non-Hispanic children from farm households. In contrast, the findings show that non-White children from farm households are significantly less likely to work as a farmer by 20 to 25pp after two decades of compulsory education laws. Additionally, after three decades, there is an increase of approximately 10pp in the probability of transitioning to the secondary and tertiary sectors.

In sum, the findings suggest that the effects of compulsory education laws may vary by race, with White, non-Hispanic children experiencing less substantial changes in their employment choices compared to non-White children. It is important to note that these results should not be interpreted as justifying the historical injustices and the limited access to quality education. Instead, the findings only suggest that even with limited access to quality public education, primary education still plays a role in reallocating the disadvantaged groups from more risky farming occupations to more stable employment opportunities in non-agricultural sectors.

5.4 Extension to the Core Finding

5.4.1 Number of Farms and Farm Size

To investigate the transformation in the agricultural landscape during this period, I use Census of Agriculture data to examine the plausible impact of compulsory education laws on farmland areas and the number of farms. Figure VIIa shows that with the widespread implementation of compulsory education laws in the US, the number of farms decreased by 50 thousand after the

first decades of law implementation. Furthermore, with the passage of more decades following the implementation of compulsory education laws, there was a significant and continuous decline in the number of farms.

While the implementation of compulsory education laws in the US led to a decrease in the number of farms, Figure VIIb illustrates a concurrent increase in average farm size. Following the first decade of compulsory education law implementation, the log of farmland area per farm experienced a 0.5 log point increase. Over time, as compulsory education laws continued to be enforced, there was a continuous expansion in farm size. This trend indicates a shift from numerous small farms to a smaller number of larger farms, shedding light on another aspect of the structural transformation spurred by compulsory education laws during the course of US history.

5.4.2 Asset Values and Productivity

Figure VIIIa illustrates that the log of asset values per acre, including agricultural land and buildings, experienced a decline of 0.4 log points after two decades of implementing compulsory education laws in the US. Over the course of five decades, this decline deepened to 1 log point. Despite this decrease in asset values, Figure VIIIb shows that there were no significant changes in the productivity of grain corn. This implies that corn productivity remained unchanged after the implementation of compulsory education laws.

6 Conclusion and Discussion

I estimate the effect of compulsory education laws on occupational persistence in agriculture by using the generalized TWFE model. I link the 1860 to 1910 US decennial census data for children from farm households and track their employment outcomes over time. This research contributes to a better understanding of the role of compulsory education in shaping intergenerational occupational choices, particularly in the agricultural sector.

The findings show that compulsory education laws significantly decrease the probability of

occupational persistence in agriculture by 8%. The results are robust with recently proposed generalized TWFE estimators. Furthermore, the treatment effects are more pronounced for female and non-White children. Females are more likely to transfer to the tertiary sector, while males are more likely to persist in agriculture after implementing compulsory education laws. Similarly, non-White children are more likely to transfer from the primary sector to the secondary or tertiary sectors, while White, non-Hispanic children are more likely to persist in agriculture.

Nevertheless, it is important to note that the low female labor force participation rate in the early 20th century (Goldin, 2006) and the segregated education faced by the Black population, leading to disparities in funding, infrastructure, and school quality (Anderson, 2010). The effect of compulsory education laws on employment for the disadvantaged group should not overshadow the injustice and inequality in gender, race, and ethnicity. Instead, the findings only suggest that public education may provide an opportunity for disadvantaged groups to transition from the relatively risky farming sector to more stable employment in the secondary or tertiary sectors.

Given the higher risks and uncertainties associated with agricultural production, employment in the secondary and tertiary sectors may provide higher return opportunities and improve household income stability (Mishra and Goodwin, 1997). Nevertheless, children who are more likely to run family farms and inherit the farmland may tend to persist in agriculture due to its role as a main resource for intergenerational wealth transmission (Fernando, 2014).

In light of this, this study highlights that children from farm households are significantly more likely to transfer from agricultural to non-agricultural sectors following the implementation of compulsory education laws. The effects of these education laws are particularly substantial for disadvantaged groups who have limited access to farmland ownership or inheritance. Moreover, this research provides empirical evidence that mandatory elementary education policies contribute to structural transformation within the US economy during the early 20th century.

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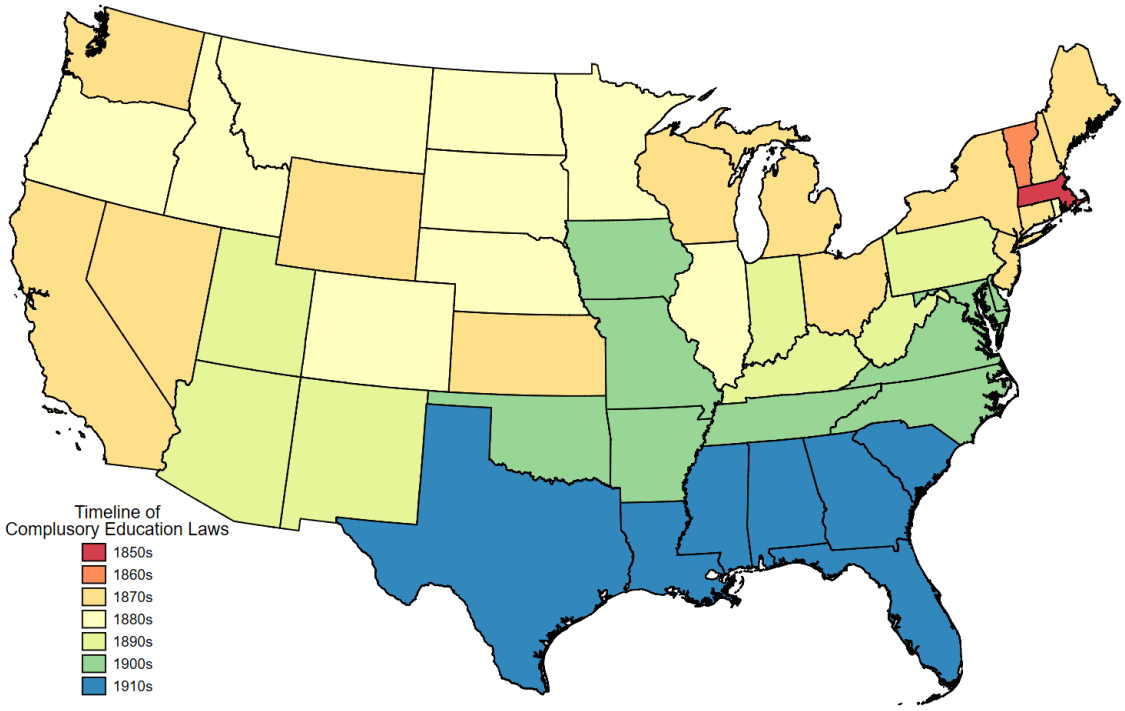


FIGURE I: Timeline for Compulsory Education Laws.

Notes: The timeline of compulsory education laws for each state is obtained from Rauscher (2016). Due to the research period (1860-1910) and census data limitations, children living in states that passed compulsory education laws in the 1850s, 1860s, and 1910s are not included in my analysis.

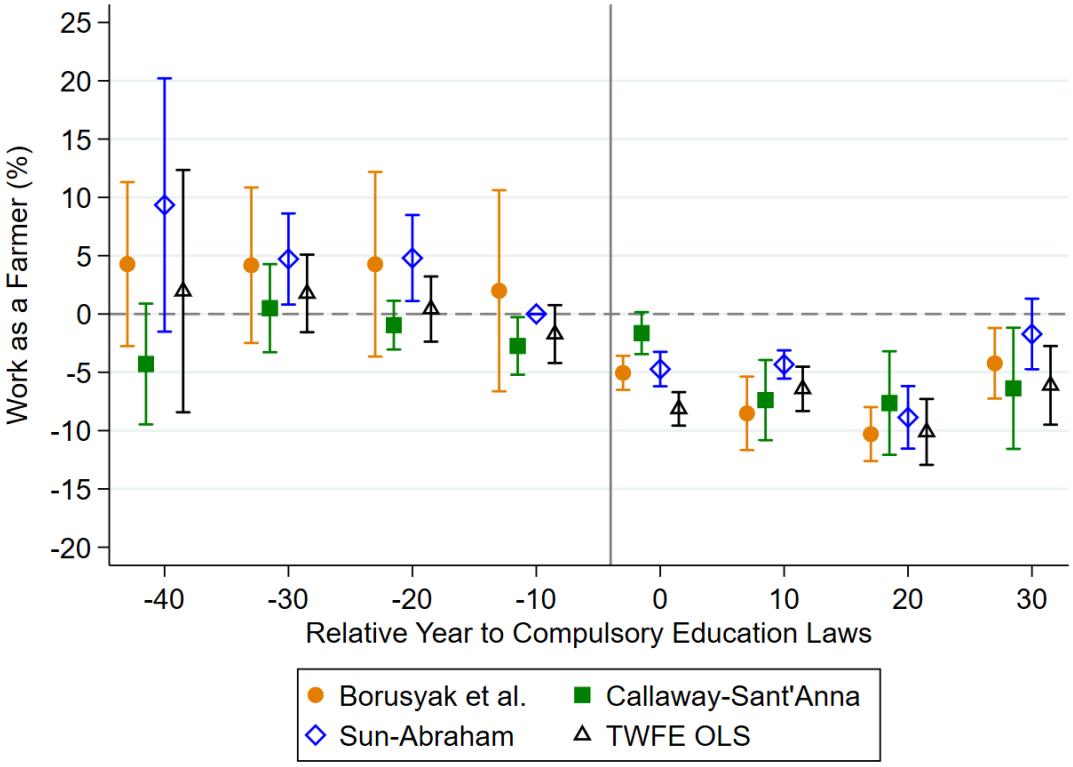
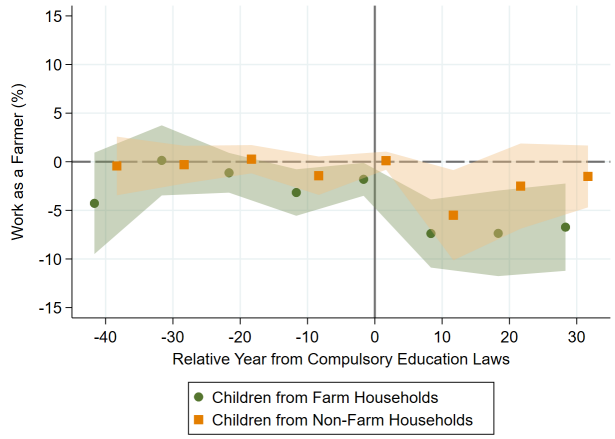
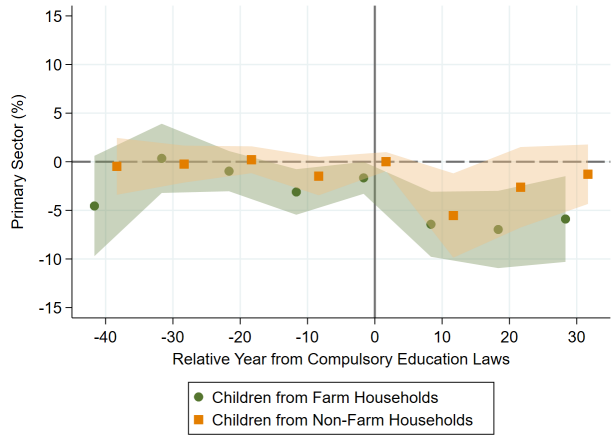


FIGURE II: Event Study for the Effects of Compulsory Education Laws on the Probability of Working as a Farmer for Children from Farm Households.

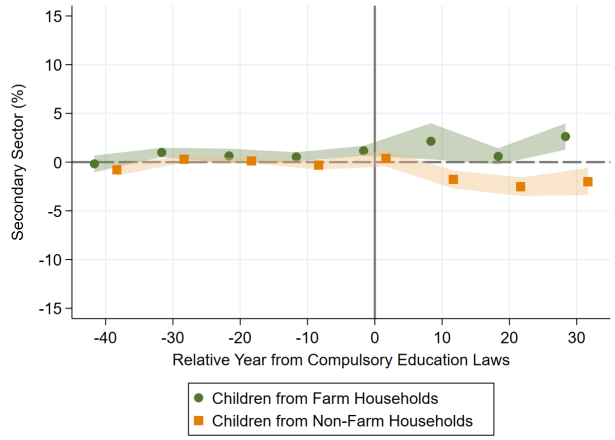
Notes: This figure presents the time dynamic version of the TWFE model estimated from Equation 2. The event study plots are estimated using four different estimators: (1) Borusyak, Jaravel and Spiess (2021), marked as orange with circles; (2) Callaway and Sant'Anna (2021), marked as green with squares; (3) Sun and Abraham (2021), marked as blue with diamonds; (4) OLS with TWFE, marked as black with triangles. The outcome variable is the probability of working as a farmer, and the time variable represents the relative year of compulsory education law implementation by states. The bars represent 95 percent confidence intervals, and standard errors are clustered at the state level.



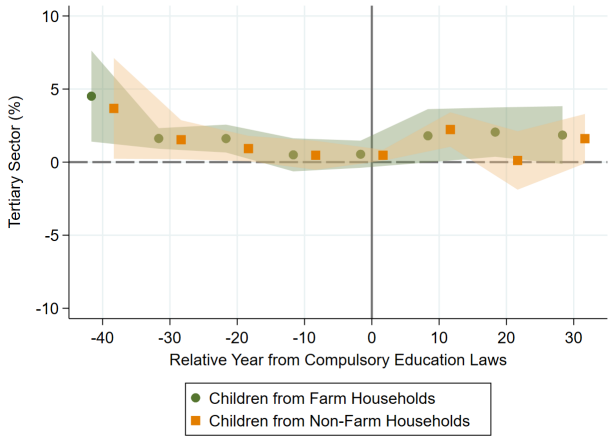
(A) Work as a Farmer



(B) Work in the Primary Sector



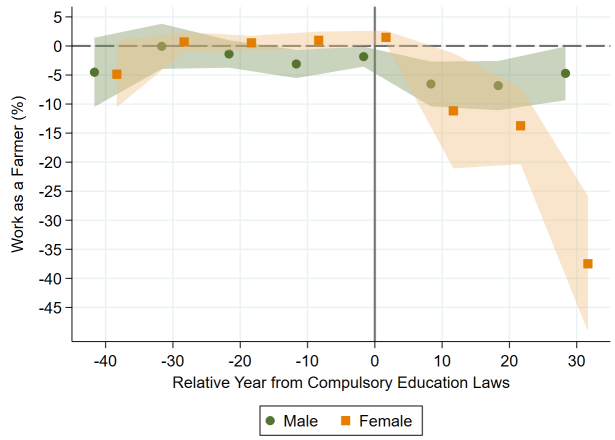
(C) Work in the Secondary Sector



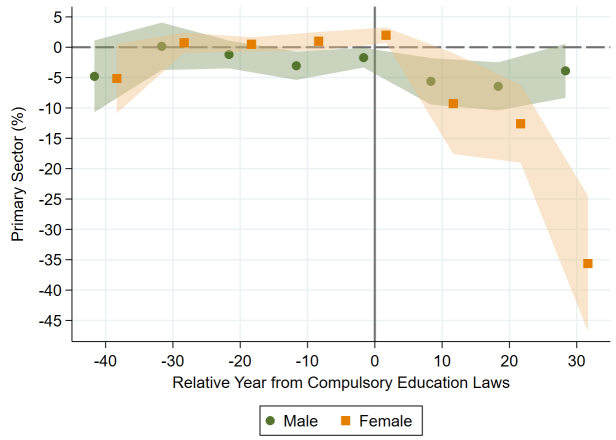
(D) Work in the Tertiary Sector

FIGURE III: Effects of Compulsory Education Laws on Employment by Parents' Occupation.

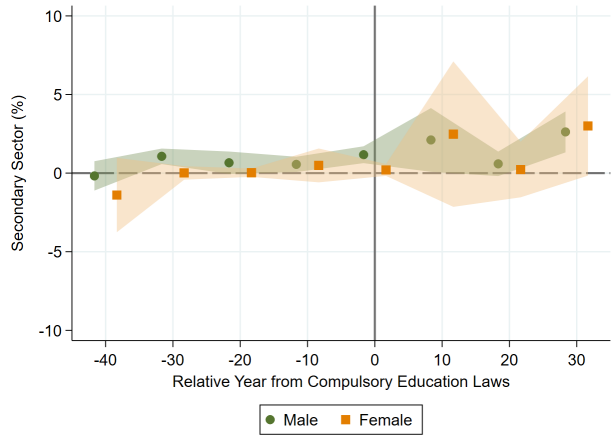
Notes: The figures illustrate the time dynamic version of the TWFE model estimated from Equation 2, using estimators proposed by Callaway and Sant'Anna (2021). The event study plots the results for the full sample by parents' occupation. Controls include family size and the number of siblings. The areas represent 95 percent confidence intervals, and standard errors are clustered at the state level using bootstrapping with 50 repetitions.



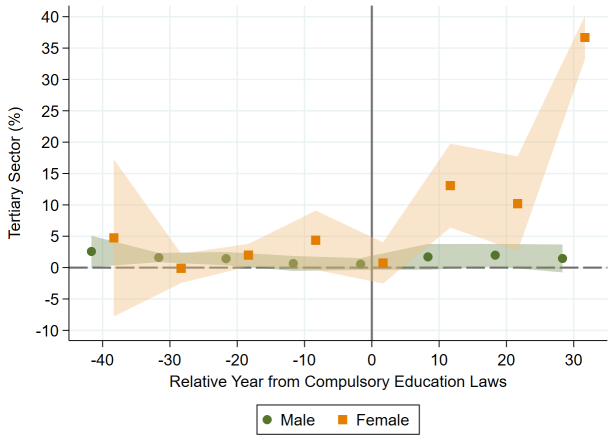
(A) Work as a Farmer



(B) Work in the Primary Sector



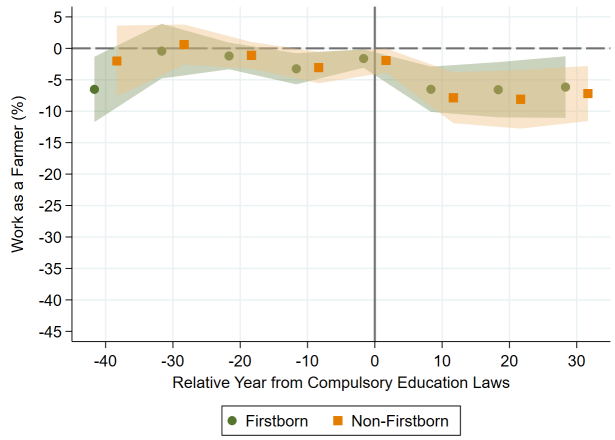
(C) Work in the Secondary Sector



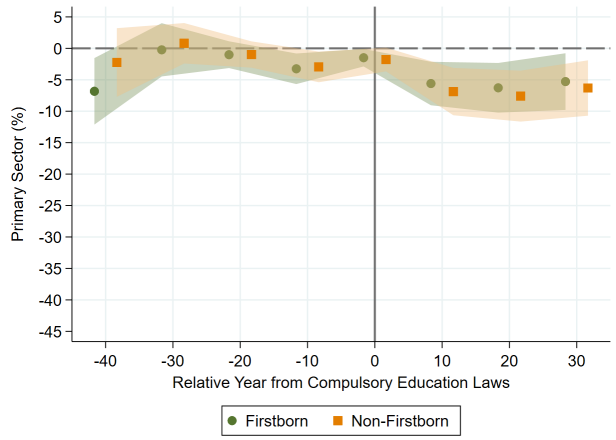
(D) Work in the Tertiary Sector

FIGURE IV: Effects of Compulsory Education Laws on Employment for Children of Farmers by Gender.

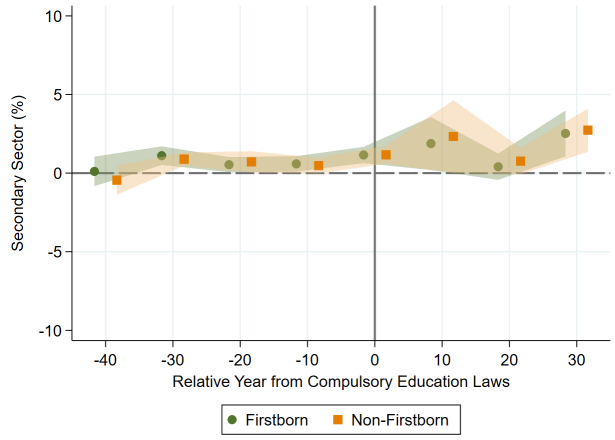
Notes: The figures illustrate the time dynamic version of the TWFE model estimated from Equation 2, using estimators proposed by Callaway and Sant'Anna (2021). The event study plots the results for children from farm households by gender. Controls include family size and the number of siblings. The areas represent 95 percent confidence intervals, and standard errors are clustered at the state level using bootstrapping with 50 repetitions.



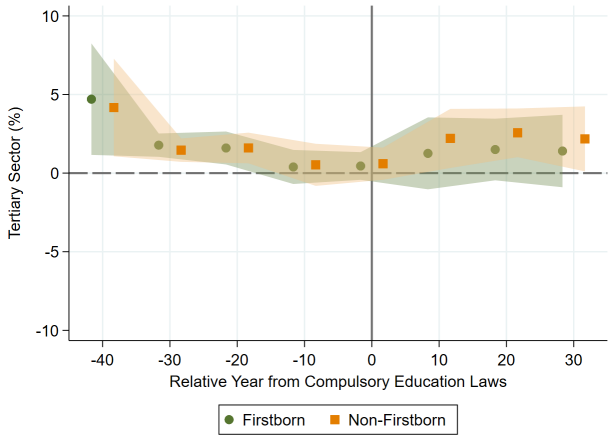
(A) Work as a Farmer



(B) Work in the Primary Sector



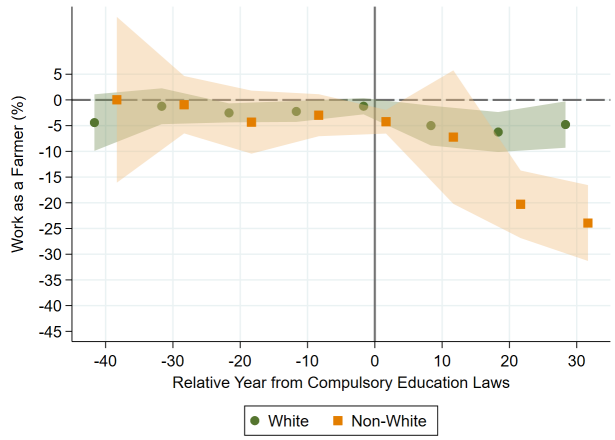
(C) Work in the Secondary Sector



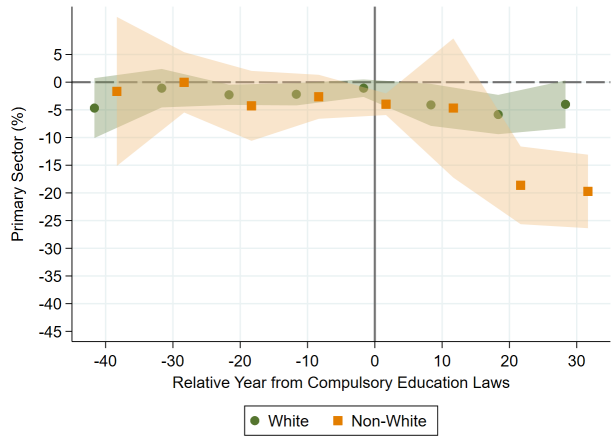
(D) Work in the Tertiary Sector

FIGURE V: Effects of Compulsory Education Laws on Employment for Children of Farmers by Birth Order.

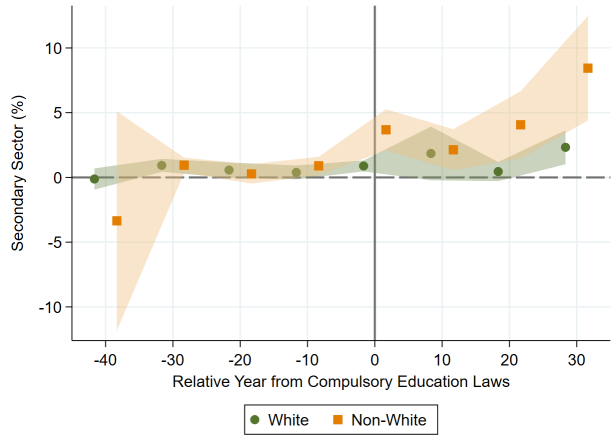
Notes: The figures illustrate the time dynamic version of the TWFE model estimated from Equation 2, using estimators proposed by Callaway and Sant'Anna (2021). The event study plots the results for children from farm households by birth order. Controls include family size and the number of siblings. The areas represent 95 percent confidence intervals, and standard errors are clustered at the state level using bootstrapping with 50 repetitions.



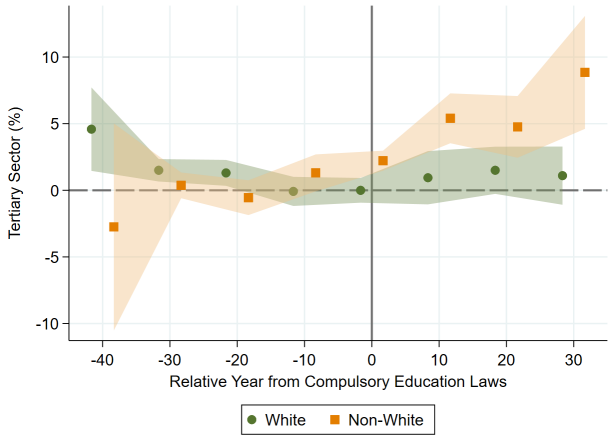
(A) Work as a Farmer



(B) Work in the Primary Sector



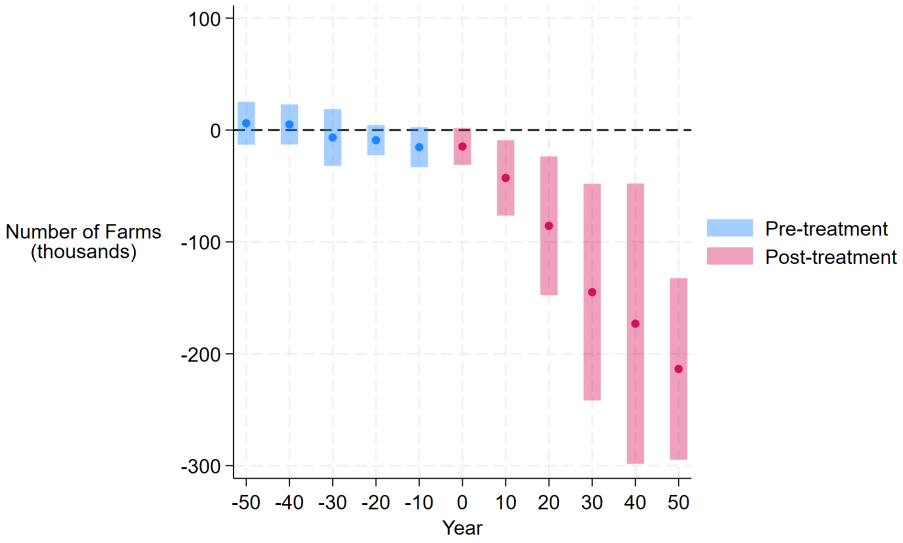
(C) Work in the Secondary Sector



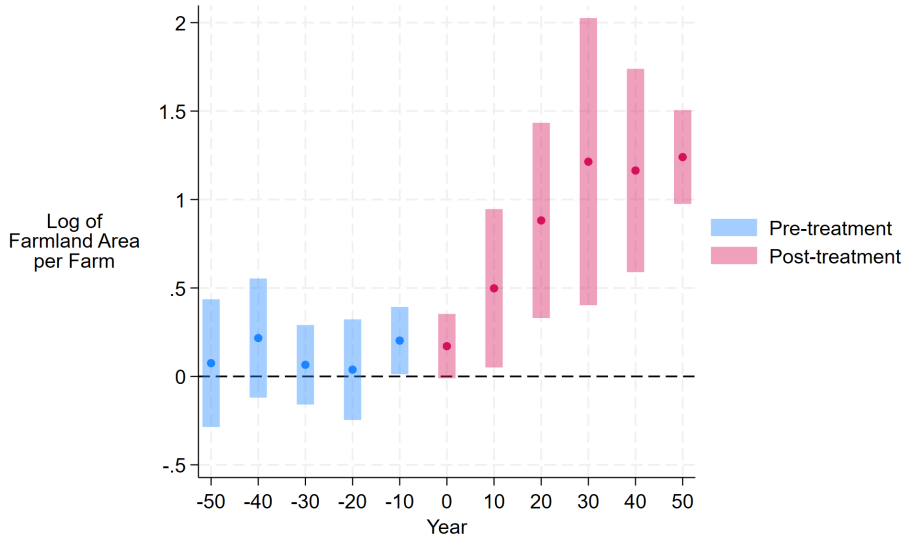
(D) Work in the Tertiary Sector

FIGURE VI: Effects of Compulsory Education Laws on Employment for Children of Farmers by Race.

Notes: The figures illustrate the time dynamic version of the TWFE model estimated from Equation 2, using estimators proposed by Callaway and Sant'Anna (2021). The event study plots the results for children from farm households by race. Controls include family size and the number of siblings. The areas represent 95 percent confidence intervals, and standard errors are clustered at the state level using bootstrapping with 50 repetitions.



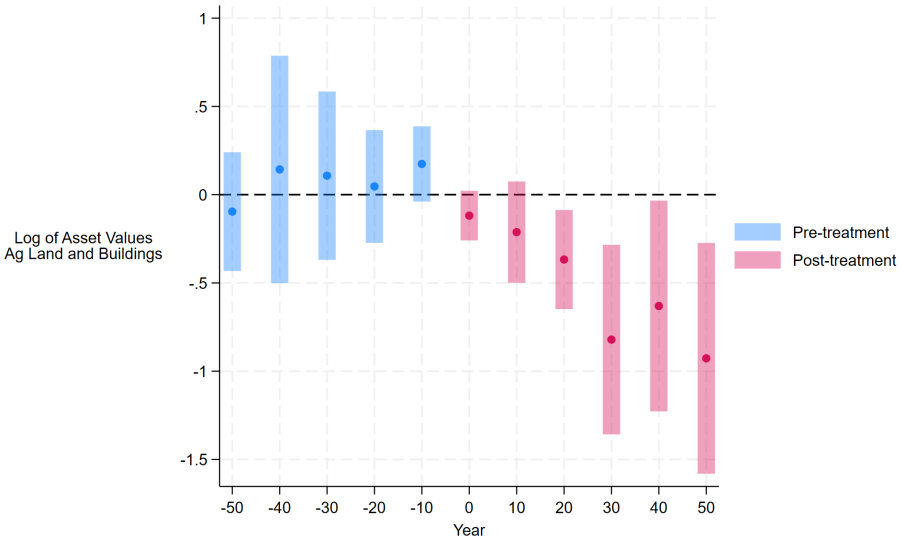
(A) Number of Farms



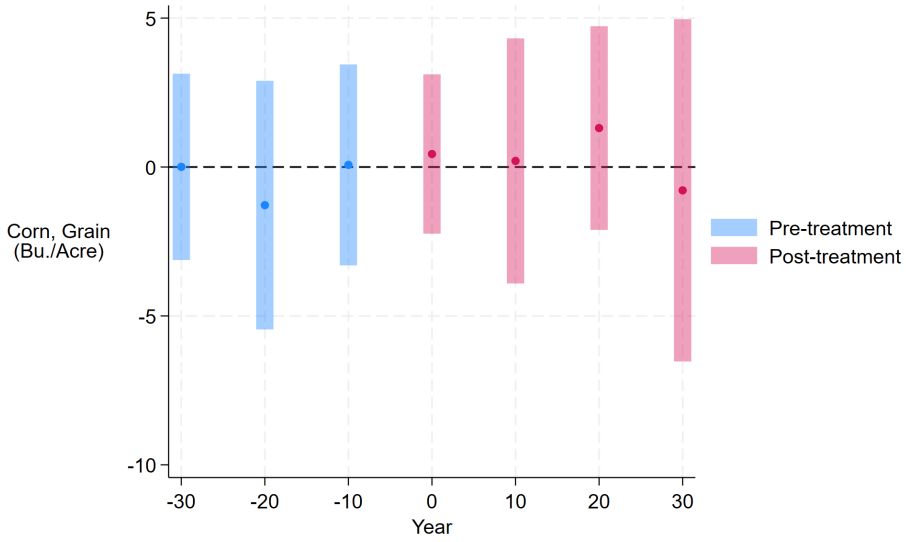
(B) Farmland Area Per Farm

FIGURE VII: Effects of Compulsory Education Laws on US Farm and Farmland.

Notes: The figures illustrate the time dynamic version of the TWFE model estimated from Equation 2, using estimators proposed by Callaway and Sant'Anna (2021). The event study plots the effect of compulsory education laws on the number of farms and farmland area per farm at the state level. The bars represent 95 percent confidence intervals, and standard errors are clustered at the state level using bootstrapping with 1000 repetitions.



(A) Asset Values



(B) Corn Yields

FIGURE VIII: Effects of Compulsory Education Laws on Asset Values and Corn Yields.

Notes: The figures illustrate the time dynamic version of the TWFE model estimated from Equation 2, using estimators proposed by Callaway and Sant'Anna (2021). The event study plots the effect of compulsory education laws on asset values, including farmland and buildings, and corn yields at the state level. The bars represent 95 percent confidence intervals, and standard errors are clustered at the state level using bootstrapping with 1000 repetitions.

TABLE I: Baseline Effect of Compulsory Education Laws on the Probability of Working as a Farmer for Children from Farm Households

	Work as a Farmer (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Post Compulsory Education Laws	-6.77***	-5.82***	-5.64***	-6.19***	-5.21***	-6.18***
	(0.79)	(0.74)	(0.69)	(1.36)	(0.74)	(1.36)
Controls		✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	
Year FE	✓	✓	✓			
Cohort FE			✓	✓	✓	✓
Linear Time Trend				✓		
Quadratic Time Trend					✓	
State Linear Time Trend						✓
Mean of Dependent Variable	70.68	70.68	70.68	70.68	70.68	70.68
Percent Change (%)	-9.57	-8.23	-7.98	-8.76	-7.37	-8.75
Observations	3,964,581	3,964,581	3,964,581	3,964,581	3,964,581	3,964,581
R-squared	0.04	0.05	0.05	0.05	0.05	0.05

This table presents the baseline effect of the implementation of compulsory education laws on the probability of working as a farmer for children from farm households, as estimated from Equation 1. Standard errors in parentheses are clustered at the state level. Controls include family size and the number of siblings. * p<0.10, ** p<0.05, *** p<0.01

TABLE II: Baseline Effect of Compulsory Education Laws on the Probability of Working in the Primary Sector for Children from Farm Households

	Primary Sector (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Post Compulsory Education Laws	-6.71***	-5.76***	-5.61***	-5.72***	-4.95***	-5.72***
	(0.79)	(0.74)	(0.69)	(1.23)	(0.80)	(1.22)
Controls		✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	
Year FE	✓	✓	✓			
Cohort FE			✓	✓	✓	✓
Linear Time Trend				✓		
Quadratic Time Trend					✓	
State Linear Time Trend						✓
Mean of Dependent Variable	72.08	72.08	72.08	72.08	72.08	72.08
Percent Change (%)	-9.30	-7.99	-7.78	-7.94	-6.86	-7.93
Observations	3,964,581	3,964,581	3,964,581	3,964,581	3,964,581	3,964,581
R-squared	0.04	0.04	0.05	0.05	0.05	0.05

This table presents the baseline effect of the implementation of compulsory education laws on the probability of working in the primary sector for children from farm households, as estimated from Equation 1. Standard errors in parentheses are clustered at the state level. Controls include family size and the number of siblings. * p<0.10, ** p<0.05, *** p<0.01

TABLE III: Baseline Effect of Compulsory Education Laws on the Probability of Working in the Secondary Sector for Children from Farm Households

	Secondary Sector (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Post Compulsory Education Laws	1.19***	1.03***	1.01***	1.96***	1.44***	1.97***
	(0.23)	(0.22)	(0.21)	(0.64)	(0.32)	(0.64)
Controls		✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	
Year FE	✓	✓	✓			
Cohort FE			✓	✓	✓	✓
Linear Time Trend				✓		
Quadratic Time Trend					✓	
State Linear Time Trend						✓
Mean of Dependent Variable	6.77	6.77	6.77	6.77	6.77	6.77
Percent Change (%)	17.53	15.27	14.95	29.01	21.23	29.02
Observations	3,964,581	3,964,581	3,964,581	3,964,581	3,964,581	3,964,581
R-squared	0.03	0.03	0.03	0.03	0.03	0.03

This table presents the baseline effect of the implementation of compulsory education laws on the probability of working in the secondary sector for children from farm households, as estimated from Equation 1. Standard errors in parentheses are clustered at the state level. Controls include family size and the number of siblings. * p<0.10, ** p<0.05, *** p<0.01

TABLE IV: Baseline Effect of Compulsory Education Laws on the Probability of Working in the Tertiary Sector for Children from Farm Households

	Tertiary Sector (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Post Compulsory Education Laws	2.93***	2.63***	2.53***	3.03***	2.44***	3.04***
	(0.33)	(0.29)	(0.28)	(0.45)	(0.34)	(0.44)
Controls		✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	
Year FE	✓	✓	✓			
Cohort FE			✓	✓	✓	✓
Linear Time Trend				✓		
Quadratic Time Trend					✓	
State Linear Time Trend						✓
Mean of Dependent Variable	11.84	11.84	11.84	11.84	11.84	11.84
Percent Change (%)	24.77	22.25	21.35	25.57	20.61	25.63
Observations	3,964,581	3,964,581	3,964,581	3,964,581	3,964,581	3,964,581
R-squared	0.02	0.03	0.03	0.03	0.03	0.03

This table presents the baseline effect of the implementation of compulsory education laws on the probability of working in the tertiary sector for children from farm households, as estimated from Equation 1. Standard errors in parentheses are clustered at the state level. Controls include family size and the number of siblings. * p<0.10, ** p<0.05, *** p<0.01

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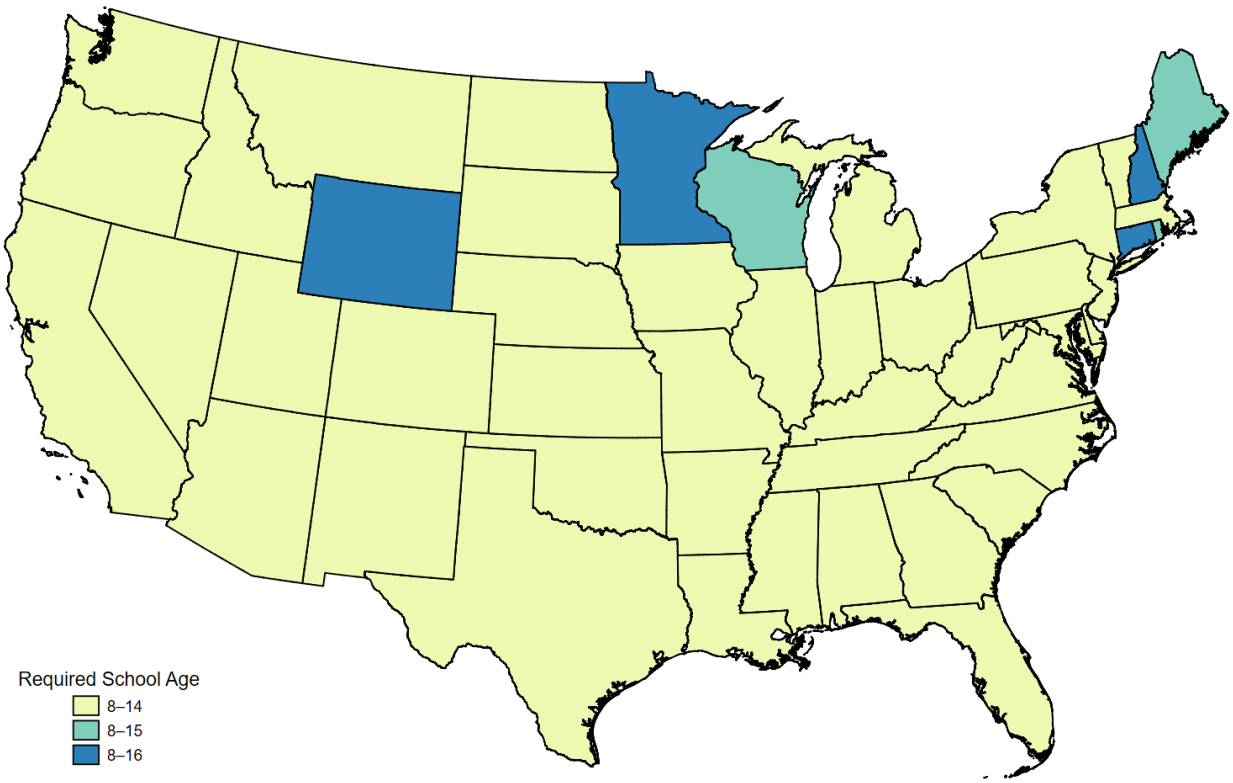
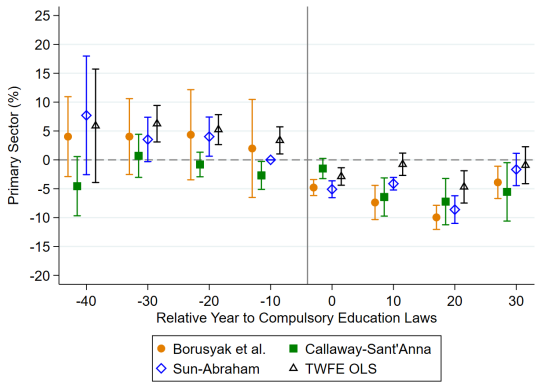
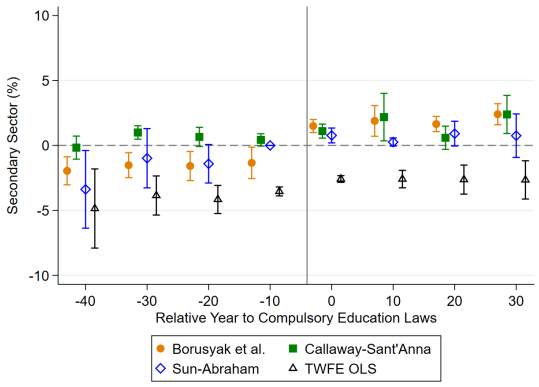


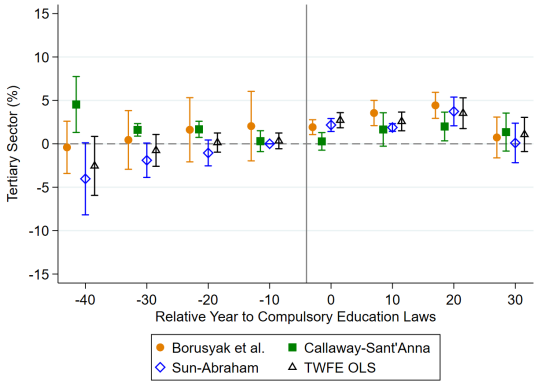
FIGURE A1: Maximum Age Required to Attend School



(A) Work in the Primary Sector



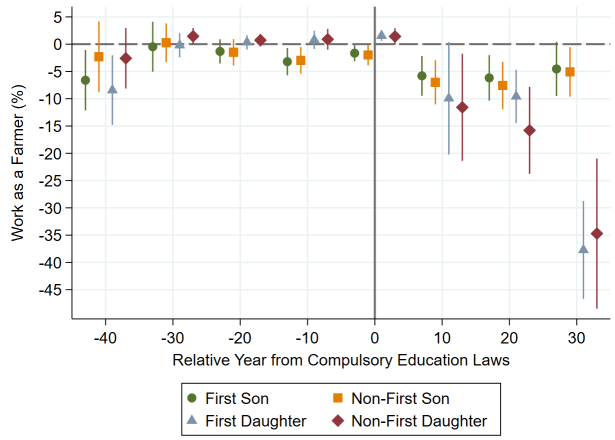
(B) Work in the Secondary Sector



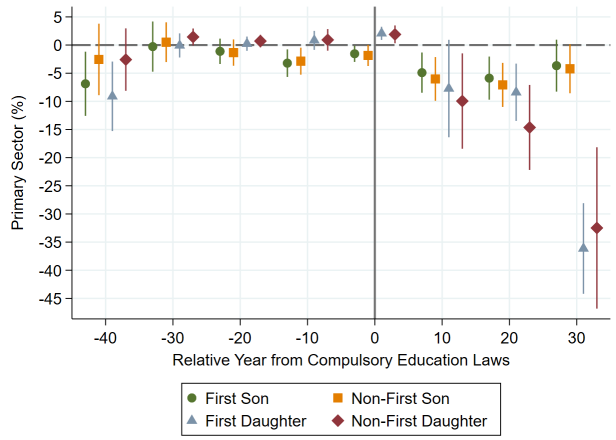
(C) Work in the Tertiary Sector

FIGURE A2: Event Study for the Effects of Compulsory Education Laws on the Employment for Children from Farm Households.

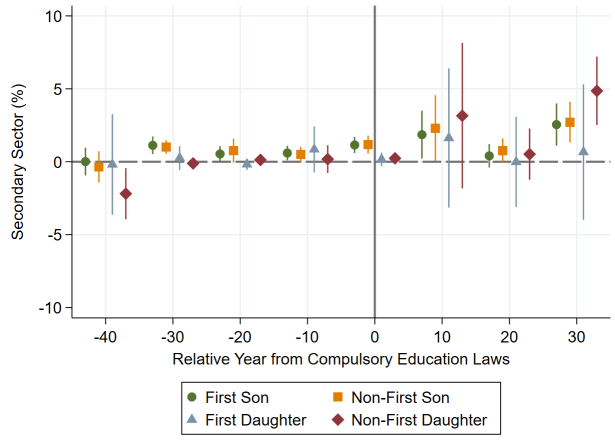
Notes: This figure presents the time dynamic version of the TWFE model estimated from Equation 2. The event study plots are estimated using four different estimators: (1) Borusyak, Jaravel and Spiess (2021), marked as orange with circles; (2) Callaway and Sant'Anna (2021), marked as green with squares; (3) Sun and Abraham (2021), marked as blue with diamonds; (4) OLS with TWFE, marked as black with triangles. The outcome variable is employment in primary, secondary, and tertiary sectors. The time variable represents the relative year of compulsory education law implementation by states. The bars represent 95 percent confidence intervals, and standard errors are clustered at the state level.



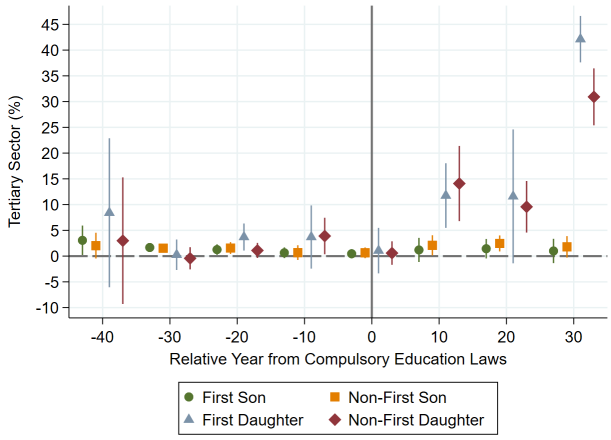
(A) Work as a Farmer



(B) Work in the Primary Sector



(C) Work in the Secondary Sector



(D) Work in the Tertiary Sector

FIGURE A3: Effects of Compulsory Education Laws on Employment for Children of Farmers by Gender and Birth Order.

Notes: The figures illustrate the time dynamic version of the TWFE model estimated from Equation 2, using estimators proposed by Callaway and Sant'Anna (2021). The event study plots the results for children from farm households by gender and birth order. The areas represent 95 percent confidence intervals, and standard errors are clustered at the state level using bootstrapping with 50 repetitions.

TABLE A1: Summary Statistics for Children from Farm Household by Groups of Compulsory Education Laws

	Group 1870s	Group 1880s	Group 1890s	Group 1900s
Farmer (%)	65.60	70.05	67.56	76.51
	(47.50)	(45.81)	(46.81)	(42.40)
Primary Sector (%)	66.79	71.62	69.40	77.73
	(47.10)	(45.08)	(46.08)	(41.61)
Secondary Sector (%)	8.65	5.81	8.06	4.87
	(28.10)	(23.39)	(27.22)	(21.52)
Tertiary Sector (%)	13.37	13.95	12.43	9.77
	(34.04)	(34.65)	(32.99)	(29.70)
Family Size	5.09	5.35	5.49	5.93
	(2.36)	(2.57)	(2.51)	(2.69)
Number of Siblings	1.16	1.26	1.31	1.84
	(1.91)	(2.06)	(2.13)	(2.44)
Observations	1,070,145	423,640	974,048	1,496,748

The sample is children from farm households. Group 1870s represents states that implemented their compulsory education laws during that decade, similar to Group 1880s, 1890s, and 1900s. For the analysis, the treatment timing is defined as the latest decennial census survey year. Specifically, "Group 1870s" is considered to have started receiving treatment in the 1880 survey year. The comparison group for the two-way fixed effects (TWFE) analysis includes "Group 1900s" and states that have not yet implemented compulsory education laws.

TABLE A2: Balance Table

	Treatment Group	Comparison Group	Difference	S.E.
Farmer (%)	71.19	76.79	-5.60***	0.12
Primary Sector (%)	71.69	77.14	-5.45***	0.12
Secondary Sector (%)	5.26	2.07	3.19***	0.05
Tertiary Sector (%)	8.38	5.76	2.62***	0.07
Family Size	6.01	6.63	-0.62***	0.01
Number of Siblings	2.41	2.94	-0.52***	0.01
Male (0/1)	0.90	0.90	-0.00*	0.00
Age	24.76	22.70	2.06***	0.02
White non-Hispanic (0/1)	0.99	0.89	0.10***	0.00
Observations	516,900	197,959		

Sample includes children from farm households before the implementation of compulsory education laws. The comparison group here only includes the children living in states that implemented compulsory education laws in the 1900s. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

TABLE A3: Baseline Effect of Compulsory Education Laws on the Probability of Working as a Farmer for Children from Non-Farm Households

	Work as a Farmer (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Post Compulsory Education Laws	-2.92***	-3.05***	-4.92***	-4.30**	-6.04***	-4.21**
	(1.00)	(0.96)	(0.95)	(1.91)	(2.04)	(1.91)
Controls		✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	
Year FE	✓	✓	✓			
Cohort FE			✓	✓	✓	✓
Linear Time Trend				✓		
Quadratic Time Trend					✓	
State Linear Time Trend						✓
Mean of Dependent Variable	34.18	34.18	34.18	34.18	34.18	34.18
Percent Change (%)	-8.54	-8.91	-14.40	-12.58	-17.68	-12.31
Observations	15,904,229	15,904,229	15,904,229	15,904,229	15,904,229	15,904,229
R-squared	0.08	0.09	0.13	0.11	0.12	0.11

This table presents the baseline effect of the implementation of compulsory education laws on the probability of working as a farmer for children from non-farm households, as estimated from Equation 1. Standard errors in parentheses are clustered at the state level. Controls include family size and the number of siblings. * p<0.10, ** p<0.05, *** p<0.01

TABLE A4: Baseline Effect of Compulsory Education Laws on the Probability of Working in the Primary Sector for Children from Non-Farm Households

	Primary Sector (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Post Compulsory Education Laws	-3.24***	-3.36***	-5.08***	-4.06**	-5.95***	-3.97**
	(0.99)	(0.95)	(0.91)	(1.93)	(1.95)	(1.93)
Controls		✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	
Year FE	✓	✓	✓			
Cohort FE			✓	✓	✓	✓
Linear Time Trend				✓		
Quadratic Time Trend					✓	
State Linear Time Trend						✓
Mean of Dependent Variable	35.97	35.97	35.97	35.97	35.97	35.97
Percent Change (%)	-9.01	-9.33	-14.11	-11.30	-16.55	-11.05
Observations	15,904,229	15,904,229	15,904,229	15,904,229	15,904,229	15,904,229
R-squared	0.08	0.08	0.11	0.10	0.11	0.10

This table presents the baseline effect of the implementation of compulsory education laws on the probability of working in the primary sector for children from non-farm households, as estimated from Equation 1. Standard errors in parentheses are clustered at the state level. Controls include family size and the number of siblings. * p<0.10, ** p<0.05, *** p<0.01

TABLE A5: Baseline Effect of Compulsory Education Laws on the Probability of Working in the Secondary Sector for Children from Non-Farm Households

	Secondary Sector (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Post Compulsory Education Laws	-0.25	-0.16	0.56*	2.17**	1.35***	2.15**
	(0.29)	(0.29)	(0.30)	(0.96)	(0.22)	(0.96)
Controls		✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	
Year FE	✓	✓	✓			
Cohort FE			✓	✓	✓	✓
Linear Time Trend				✓		
Quadratic Time Trend					✓	
State Linear Time Trend						✓
Mean of Dependent Variable	13.63	13.63	13.63	13.63	13.63	13.63
Percent Change (%)	-1.82	-1.14	4.14	15.92	9.90	15.77
Observations	15,904,229	15,904,229	15,904,229	15,904,229	15,904,229	15,904,229
R-squared	0.03	0.04	0.05	0.04	0.05	0.04

This table presents the baseline effect of the implementation of compulsory education laws on the probability of working in the secondary sector for children from non-farm households, as estimated from Equation 1. Standard errors in parentheses are clustered at the state level. Controls include family size and the number of siblings. * p<0.10, ** p<0.05, *** p<0.01

TABLE A6: Baseline Effect of Compulsory Education Laws on the Probability of Working in the Tertiary Sector for Children from Non-Farm Households

	Tertiary Sector (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Post Compulsory Education Laws	0.48	0.60	1.19**	2.70**	1.53**	2.69**
	(0.66)	(0.60)	(0.58)	(1.24)	(0.67)	(1.24)
Controls		✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	
Year FE	✓	✓	✓			
Cohort FE			✓	✓	✓	✓
Linear Time Trend				✓		
Quadratic Time Trend					✓	
State Linear Time Trend						✓
Mean of Dependent Variable	18.37	18.37	18.37	18.37	18.37	18.37
Percent Change (%)	2.61	3.24	6.50	14.72	8.34	14.67
Observations	15,904,229	15,904,229	15,904,229	15,904,229	15,904,229	15,904,229
R-squared	0.04	0.06	0.06	0.05	0.06	0.05

This table presents the baseline effect of the implementation of compulsory education laws on the probability of working in the tertiary sector for children from non-farm households, as estimated from Equation 1. Standard errors in parentheses are clustered at the state level. Controls include family size and the number of siblings. * p<0.10, ** p<0.05, *** p<0.01