Predicting School Attendance with Weather Based Income Shocks

Paul Lombardi

University of California, Irvine

plombard@uci.edu

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Abstract

Black men born in the Cotton South during the turn of the twentieth century attended school for three and half fewer years relative to their white counterparts. To explain why blacks received fifty percent less schooling than whites, recent research examines the role of the southern cotton industry in explaining schooling differences. Based on a model of opportunity costs and the value of child labor, researchers have previously found a negative relationship between black school attendance and cotton production. However, I observe a positive correlation while using individual level data from US Censuses from the early twentieth century. A positive relationship between black school attendance and cotton production is consistent with a model of consumption smoothing.

Introduction

In 1940, black men made fifty percent less in earnings than their white counterparts. Researchers commonly explain the wage gap by pointing to the difference in the two groups' investments in human capital (Carruthers and Wanamaker 2015 and O'Neil 1990). For men born in the Cotton South[1], the mean years of schooling for whites was three and half years higher than that of blacks for children born in 1910[2]. This leads to the question of why did blacks attend school at such lower rates relative to whites?

One explanation for the low attendance rates of black students focuses on the role of the southern cotton industry. Researchers find a negative correlation between cotton production and school attendance. During the early twentieth century, cotton crops tended to be child labor intensive and the primary agricultural product of the southern United States. As cotton production and demand for pickers declined, the opportunity cost of attending school declined resulting in higher attendance rates (Greenbaum (2009) and Baker (2013)). The child laborers came disproportionately from black households as ninety percent of blacks lived in southern states at the turn of the twentieth century.

Contemporaries observed a different pattern between black children's attendance rates and cotton production. Following a decline in cotton production due to heavy summer rains a Georgian superintendent observed that "… the enrollment of the white children was reduced by 3 percent, and that of the colored 26 percent, as compared with last year's enrollment …" (Brittain 1911). The observation does not fit a model where a decline in the opportunity costs leads to an increase in school attendance.

Development economics provides an alternative explanation for the declining attendance rates based on household consumption smoothing. Developing nations tend to lack complete credit markets. Therefore, if a household experiences a negative income shock, they will use household assets, including child labor, in place of borrowing against future earnings to smooth consumption (Jacoby and Skoufias 1997). Empirical studies using weather shocks to farming households' crops find the resulting income losses lead to increases in child labor. This result is particularly strong for poorer households who likely have few assets and limited credit market access. Researchers also find the increase in child labor is correlated with a decrease in educational outcomes, including school attendance.[3]

Early twentieth century African-American farming households in the United States' Cotton South fit the conditions necessary for the consumption smoothing explanation for child labor due to the legacy of slavery. Following the Civil War, freed slaves faced similar economic conditions as many farming households do in modern developing countries. The credit markets were underdeveloped. The former slaves had few tangible assets that could be used as collateral

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[1] Throughout the paper the Cotton South (unless specified otherwise) refers to the ten U.S. states that produced around 95% of cotton during the late 19th and early 20th century: Arkansas, Alabama, Georgia, Florida, Louisiana, Mississippi, North and South Carolina, Tennessee, and Texas.

[2] The averages are based on the school obtainment values of individuals born in the Cotton South in 1910. The school obtainment values come from the 1940 Census. The 1910 is used because blacks born in this year should be in educated in graded schools. Earlier cohorts were potentially taught in ungraded school house(Margo 1990).

[3] Many papers find that working reduces time spent on schooling. However, this pattern is not universal. Ravallion and Wodon (2000) find that increases in hours worked come at the expense of idleness and not schooling.

to access traditional credit markets. Households' crops were susceptible to weather shocks. There were no government programs to insure against income loses. Children from farming households were active participants in the labor market, as more than fifty percent of black children aged 10-14 worked.

My paper extends the existing literature by being the first to measure the effect of income shocks on the schooling choices of rural farming households in the Cotton South. Previous research focuses on the gradual decline in the marginal product of child labor as farmers switched away from cotton to peanuts and sweet potatoes. Differences in my paper's data structure and mechanism lead to different finds than the previous research (Greenbaum (2009) and Baker (2013)). I find a positive correlation between cotton yields and school attendance for rural black farming households in the United States' Cotton South during the early twentieth century. I expand the literature further by showing this pattern was not confined to black farmers. I find the school attendance rates for children from tenant farming and farm laborer households decline following negative income shocks. I measure the effect of income shocks by regressing school attendance on cotton yields (a proxy for household incomes). To address the possible endogeneity of cotton yields, I also estimate the relationship using an instrumental variable strategy with similar results. Cotton yields are instrumented for with precipitation data.

Historical Background on Southern Labor and Capital Markets

The conclusion of the Civil War marked the end of slavery in the United States. However, the legacy of slavery was clearly visible in Southern states for decades to come. Rural black[4] farmers had limited access to credit markets in part due to a lack of assets. The combination of the lack of credit market access and federal insurance programs left the farmers susceptible to income fluctuations due to weather shocks to their primary crop—cotton.

Small rural black farmers had few assets following the end of slavery. At the conclusion of the Civil War, there was no general pattern of land redistribution. Most land remained in the hands of the white elite. In Georgia, only one percent of the land was owned by blacks in 1874 and one point six percent by 1880. Across the Cotton Belt, less than ten percent of the farm land was owned by blacks (Ransom and Sutch 2001). Farm land was not the only assets blacks lacked. Within rural counties of Georgia, blacks owned less than three percent of the total taxable assets[5] (Ransom and Sutch 2001). Beyond a lack of assets, black household also accumulated assets at a slower pace than whites (Higgs 1982). However, one physical asset the rural farmer owned that could be used as collateral was his future crop production. From the perspective of a lender, a farmer "'… could give virtually no security for his loans except the forthcoming crop (Anderson 2013).'" While crop liens gave farmers access to the credit market, they severely limited the sources of credit available to them.

The lack of assets besides crop liens limited the credit market for rural black farmers to the local merchant. Following the defeat of the Confederate Army, much of the South's formal

[4] Poor farmers faced similar credit constraints regardless of their race (Wright 1986 and Ransom and Sutch 2001). Tenant farmers and farm laborers did not own land and had few assets to secure a loan besides crop liens. Credit could be secured only through the local merchant. Government laws on child labor and social programs were the same for all farmers.

[5] Taxable assets includes land, city and town property, money and liquid assets, kitchen and household furniture, mules, horses, hogs, and etc., planation and mechanical tools, and all other property.

banking system collapsed. In 1860, there were forty-nine state charter banks in Georgia and South Carolina. Only three of these banks survived the Civil War (Ransom and Sutch 2001). Even following the Reconstruction Era, the South's banking system lagged relative to other parts of the country. Of the nearly three thousand national banks in the United States in 1890, less than four hundred of them were located in the twelve southern states[6] (Ransom and Sutch 2001). Beyond this general tightness of credit markets in the South, the lack of land ownership ensured most rural black farmers were cut off from traditional sources of credit. To fill this void, local merchants offered credit to rural farmers by taking crop liens as collateral. Merchants' reliance on personal knowledge of individuals to judge their credit worthiness limited the threat of competition from outsiders. While landowners' wealth and familiarity with locals represented a potential threat, merchants and landowners often worked together or simply were the same individual. Therefore, merchants were able to exercise a "territorial monopoly" (Ransom and Sutch 2001). The strength of the merchant's monopoly can be seen in the level of interest charged for credit. Based on data from 1880s Georgian merchants, Ransom and Sutch (2001) estimate that the average markup for corn purchased on credit was thirty-five percentage points higher than cash purchases. From the differences in price markups, they estimate an implicit annual interest rate of 59.4%. Merchants' monopoly power can also be observed in how the crop liens were written.

Merchants' control of the credit market led to crop liens requiring farmers to grow just cotton. From the perspective of the merchant, cotton had several benefits over other crops. The market for cotton was large and well established. Cotton can be easily stored without fear of spoilage. By forcing the farmers to grow just cotton, the merchant reinforced the farmer's dependence as the farmer had to buy food and animal feed on credit. Indebted farmers knew the importance of growing cotton: "…cotton is the only crop that will bring money… cotton brings the money, and money pays debts…" (Wright 1986). Besides cementing the farmer's reliance on the merchant, cotton yields declined due to this practice. Southern farmers were not able to apply scientific farming techniques used by northern farmers to increases yields--crop rotation and fallow fields. While the local merchant's monopoly over credit developed organically, other features of the southern farming economy grew from the white elites' desire to limit the economic advancement of former slaves.

During the first half of the twentieth century, Southern congressmen voted to eliminate or limit federal programs meant to insure individuals against idiosyncratic shocks. Research by Alston and Ferrie (1999) details the strategies used by southern congressmen to exclude farmers from federal welfare programs. When the U.S. Congress passed the Social Security Act, farmers were excluded from both the unemployment and old age provisions. Southern congressman also succeeded in having farmers excluded from the Fair Labor Standards Act. By eliminating farmers, children were still able to work on farms. In the case of the Farm Security Administration, the southern congressmen were initially able to defund the program and later have the act that established it abolished. The act would have provided grants to farmers following natural disasters. (The administration also threatened merchant control by establishing co-operatives of farmers) (Alston and Ferrie 1999). While the motivation of Southern congressmen is not critical for the current paper, their success in affecting policy is. Farmers

[6] The South in this case refers to Arkansas, Alabama, Georgia, Florida, Louisiana, Mississippi, North and South Carolina, Tennessee, Texas, Virginia, and West Viriginia.

were not insured against weather shocks. And farming was one area of the labor market in which children could still participate.

Table 1 provides the reader with descriptive statistics on workforce participation[7], school enrollment[8], and idleness by race, age, and gender for children from farming households in the rural Cotton South. (Idle identifies children who are neither enrolled in school nor participating in the workforce). Even in the youngest age group, over eight percent of boys work. By the middle group, more than half of them are in the workforce. Black children work more and attend school less frequently than their white counterparts. Nearly fifty percent of black children and forty percent of white children aged five to nine are idle. By the ages ten to fourteen, idleness declines to twelve percent or less.

Development Economics Literature Review

The literature examining how external shocks effect child labor force participation in developing countries follows two broad branches. One considers how a positive external shock to the economy increases the opportunity cost of attending school. The other focuses on the use of child labor to smooth consumption in response to negative external shocks. Whatever the cause for the increase in child labor, both branches generally find that the increase comes at the expense of school attendance and obtainment.

Several empirical papers find child labor increases in response to improvements or positive external shocks to the macro economy. When Brazil's economy was booming in the late 1990s, Duryea and Arends-Kuenning (2003) found child labor force participation increased significantly in urban areas. Kruger (2007) found a similar response in rural areas of Brazil when the price of coffee beans spiked. The response is not specific to Brazil either. Researchers found a positive correlation between rice prices and child labor hours in rural Vietnam (Beegle et al. 2009 and Edmonds and Pavcnik 2004).

When a positive relationship between child labor force participation and the macro economy is observed, researchers explain the relationship by arguing the opportunity cost of attending school is increasing (Duryea and Arends-Kuenning 2003). As GDP increases, wages tend to increase including those of child workers. Under the assumption that working and earning a wage is the opportunity cost of attending school, as the economy's output increases so does the cost of attending school.

Researchers have also generally found negative external shocks increase child labor force participation. Following a twelve percent decline in Indonesia's GDP, Thomas et al. (2004) observed increases in child labor force participation. In rural Vietnam, child labor hours increased following natural disasters (i.e. flooding, landslides, and etc.)(Beegle et al. 2009). Farming households in India (Jacoby and Skoufias 1997) and Tanzania (Beegle et al. 2006)

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[7] Per the 1910 Census' Instructions to Enumerators, children on farms who helped their parent's farm or worked off the farm were identified as "Farm Laborer." Children who performed chores or general household work were not given an occupation. Without an occupation, children were not considered a labor force participant (Haines).
[8]Per the 1910 Census' Instructions to Enumerators, individuals who attended school anytime between September 1, 1909 and their enumeration date were counted as having attended school. Individuals aged between 5 and 21 who did not attend school were counted as "No." The question is left blank for individuals over 21 and those who did not attend school (Haines).

increased child labor usage in response to crop shocks. Duryea and Arends-Kuenning (2003) did not observe an increase in child labor force participation in Brazil during recessions. However, the authors suggest social insurance programs caused the breakdown in the relationship between child labor and the contracting economy.

Researchers explain the relationship between negative external shocks and increases in child labor by arguing that credit constrained households use child labor to consumption smooth. Rajan (1999) uses a two period Overlapping Generations model to illustrate this connection. The model sensibly assumes the returns to schooling are higher than the market rate of return. When households are not credit constrained, they always invest in schooling. However, if households are constrained and experience a negative shock, they use child labor to increase household income and consumption.

Empirical evidence supports the theoretical prediction that credit constrained households increase child labor usage following a negative external shock. In Indonesia, poorer households increased child labor usage by more than wealthier ones following the decline of GDP (Thomas et al. 2004). Credit constrained farming households in India (Jacoby and Skoufias 1997) and Tanzania (Beegle et al. 2006) increased child labor usage following crop shocks.

Whatever the cause, researchers consistently find a negative relationship between increases in child labor force participation and schooling outcomes. Using Brazilian data, Cavalieri (2002) finds child labor force participation reduces the probability of completing a grade. For farming households in India, increases in child labor force participation were associated with declines in school attendance (Jacoby and Skoufias 1997). Using household surveys from Vietnam, Beegle et al. (2009) found a negative correlation between school enrollment and child labor hours. The authors also found a similar relationship between education levels and child labor hours.

Black Cotton South Literature Review

One explanation for the wage gap between whites and blacks during the late 19th and early 20th century is blacks attended school at lower rates. Looking at table 1, the reader sees blacks are less likely to be enrolled in school relative to their white counterparts. The paper's empirical results will confirm this fact as well. This paper contributes to the literature that tries to understand why black school attendance lagged whites in the Cotton South by looking at determinants of school attendance. The literature focuses on three factors: school quality, household characteristics, and labor market conditions.

Lower quality schools reduce black school attendance. In several papers, Margo finds a positive relationship between school quality and black schooling outcomes (Margo 1985 & 87). Southern black schools received less funding and lower skilled teachers relative to whites (Margo1990).[9] The quality discrepancies led to lower attendance and literacy rates among southern blacks (Margo 1985 & 87).

[9] A separate literature examines the reasons for the underfunding of black schools in the Cotton South. Researchers tend to focus on the role of disenfranchisement and school boards decisions (Collins and Margo 2006 and Naidu 2012).

Researchers find household characteristics are important determinants of the probability of children attending school in the Cotton South. Two factors that increase school attendance independent of race are higher levels of parental education and wealth. Using a sample of children from North and South Carolina, Barnhouse Walters and Briggs (1993) find a positive relationship between parent education and school attendance. The researchers use literacy as a proxy for parental education. This result matches previous research by Margo (1985 & 87). Using dwelling ownership as an indicator of household wealth, the researchers observe a positive correlation between school attendance and household wealth.

The local agricultural labor market conditions have also been found to affect black school attendance in the South at the beginning of the twentieth century. Papers by Greenbaum (2009) and Baker (2013) observe child labor force participation declines as Georgia's cotton production declined over the 1920s. The decline in labor force participation was accompanied by a rise in school attendance. The researchers estimate the relationships with county level datasets on cotton production and school attendance from Georgia. Both authors instrument for cotton production: Greenbaum uses rain fall as an instrumental variable. Baker uses rain fall and the arrival of the boll weevil.

The current paper is partially a mix of the previous two branches of the Cotton South literature. Using U.S. Census data, I control for household characteristics including parental literacy and dwelling ownership[10]. I use weather variables as a source of exogenous variation. I consider the relationship between school attendance and the local labor market.

The current paper extends the literature by being the first to analyze the effect of income shocks on the probability of attending school in the Cotton South. Following a negative income shock, children from black households attend school less frequently. I observe the reverse is true as well (i.e. a positive income shock increases school attendance). Using cotton yields as a proxy for household incomes, I find a positive correlation between school attendance and cotton yields. I continue by showing that the attendance rates of children from tenant farming and farm laborer households have the same positive correlation with cotton yields. My empirical results are consistent with the predictions of a model where child labor is used by credit constrained households to consumption smooth (Ranjan 2001).

The empirical finding of a positive correlation between income and school attendance contradicts the pattern observed by Greenbaum (2009) and Baker (2013). There are several explanations for the discrepancies between the results: By using county level datasets, Greenbaum (2009) and Baker (2013) cannot control for variation at the household level (i.e. parental education levels and dwelling ownership). Without house characteristics, the researchers can not restrict the sample to rural farming households. The researchers rely on a panel from a single state as compared to my repeated cross section of the Cotton South. Beyond differences in the datasets, the results could be capturing different effects of cotton production. Theory can predict both a positive and negative correlation between cotton production and school attendance depending on the interpretation of cotton production. Greenbaum (2009) and Baker (2013) use

[10] My estimates will match the correlations Barnhouse Walters and Briggs (1993) observe between house income and parent education with school attendance. However, these variables are not the focus of this paper.

cotton output as a proxy for the marginal product of child labor. The current paper uses cotton yields as a proxy for income in farming households.

Theoretical Model

To generate predictions about the relationship between cotton yields and schooling choices, I rely on a general equilibrium model with overlapping generations. The model comes directly from Ranjan's (2001) household production model with credit constraints. The steady state equilibrium[11] features child labor despite parents having altruistic utility functions and the returns to schooling being higher than those for capital. The lack of access to credit is critical to achieving a steady state with child labor. If parents could borrow against futures, the model would not have child labor as every parent would send the child to school.

Households feature one parent and one child. Each individual lives for two periods: one as a child and then one as a parent. The parent's value function is altruistic in nature. The function is composed of the utility of consumption in the current period and the value function in the next. The latter half of the function means the parent considers not just the child's utility, but the child's child's utility and so forth.

$$V_t = U(C_t) + \beta V_{t+1} \tag{1}$$

Parents discount the value of future generations by β where $0 < \beta < 1$. To maximize the value function, the parent selects to have the child attend school in the current period or not. If the child does not attend school, he earns a faction of the adult unskilled wage ($w_c = \theta w_u$, where $0 < \theta < 1$) in period t and the unskilled wage in $t + 1$. Children who attend school receive no wage in period t and the individual's talent level multiplied by the skilled wage ($\sigma_i w_s$ where $\sigma_i \in [\underline{\sigma}, \bar{\sigma}]$) in $t + 1$. Talent represents the amount of human capital individuals gain from attending school. The budget constraint is the sum of the parent's income plus the child's (i.e. $b_t + W_c$ or b_t). Therefore, the parent's maximization problem takes the form:

$$V_t(b_{t,}\sigma_i) = \max(U(b_t + w_c) + \beta V_{\boldsymbol{t+1}}(w_u, \sigma_i), U(b_t) + \beta V_{\boldsymbol{t+1}}(\sigma_i w_s, \sigma_i)), \tag{2}$$

For a given σ_i there exists a threshold level of parental income $b^*(\sigma_i)$ such that parents with a $b_t > b^*(\sigma_i)$ send the child to school. In terms of the maximization problem, $b^*(\sigma_i)$ is the level of income conditional the on σ_i such that the parent is indifferent between sending the child to school or not (i.e. $(\sigma_i w_s) = (1-\beta)[U(b_t + w_c) - U(b_t)] + \beta U(w_u + w_c)$). In the case of a logarithmic utility function, $b^*(\sigma_i)$ is given by:

$$b^*(\sigma_i) = \frac{(w_u + w_c)^{\frac{\beta}{1-\beta}}}{(\sigma_i w_s)^{\frac{\beta}{1-\beta}} - (w_u + w_c)^{\frac{\beta}{1-\beta}}} \tag{3}$$

Based on the equilibrium, we can consider how the model fits the observed patterns of school attendance for children from rural farms. For a given talent level, school attendance is an increasing function of parental income. On average, white households were wealthier and attend

[11] I only present the steady state equilibrium of interest. Ranjan (2001) discusses the two trivial equilibria where all households send the child to school and not.

school more frequently than black households. I observe a similar pattern in my dataset when looking at home owners versus renters. The odds of attending school are also an increasing function of σ_i (i.e. the human capital gained from attending school). The historical literature shows that black schools were of a lower quality than white ones (Margo1990). Assuming lower quality schools lead to less human capital gains, the observed lower attendance rate by blacks fits the model's prediction.

Using comparative statics, the reader can observe how the model can predict both a positive and negative relationship between cotton production and school attendance. If cotton yield is used as a proxy for parental income, an increase in cotton yields increases school attendance. This mechanism is the basis of the current paper. Greenbaum (2009) and Baker (2013) papers' find a negative relationship between the marginal product of child labor and school attendance. My theoretical model has a similar prediction: a decline in θ (the fraction of the adult unskilled wage the child receives based on their margin product) leads to an increase in school attendance. Using cotton production as a proxy for the marginal product of child labor, Greenbaum (2009) and Baker (2013) find a negative correlation between cotton production and school attendance. Therefore depending on what cotton production is a proxy for, the model is capable of predicting either a positive or negative relationship with school attendance.[12]

Data

The weather data used to measure crop shocks comes from the nClimDiv dataset from the National Oceanic and Atmospheric Administration. The dataset is based at the Climate Division level. Each state is composed of half dozen or more divisions. The divisions themselves are composed of several counties. Figure one shows a map of the United States broken down into Climate Divisions. From the map, we can see the nClimDiv database provides weather data across the entire contiguous United States at a level in-between the state and county levels.

From the nClimDiv dataset, I use the twelve month Standardized Precipitation Index[13]. The measure is normalized using the division's historical rainfall patterns over the period 1901 to 2001. A measure of zero represents the median value. Negative values are associated with dry periods and positives with wet periods. The greater the magnitude of the measure the more severe the weather conditions are. The variation within a climate division's measures is critical to my instrumental variable strategy. Figures two and three provide the reader with a visual representation of this variation.

As part of my robustness checks, I convert the continuous measure from the twelve month Standardized Precipitation Index into two dummy variables: Wet and Dry. Wet refers to cases when a division is experiencing a severe rainy period. Based on the National Oceanic and Atmospheric Administration's (NOAA) definition, wet equals one when the index equals one or higher. Dry refers to cases when a division is experiencing a severe dry period. Dry equals one

[12] Baker (2013) uses a modified version of Baland and Robinson's (2000) one-sided altruism model. The model can generate the same predictions as the current paper's. The model predicts an increase in schooling following an increase in parental incomes.
[13] Using a linear model with year and division fixed effects, the 12 Month Standardized Precipitation Index performed the best when compared to several Palmer drought severity measures and the 1 Month Standardized Precipitation Index.

when the Standard Precipitation Index equals negative one or lower. Again the value cutoff is based on NOAA's definition.

Cotton output and acreage comes from the U.S. Agricultural Census. I collect the 1920 Agricultural Censuses data from the Inter-university Consortium for Political and Social Research's Historical, Demographic, Economic, and Social Data: The United States, 1790-2002 series. For 1930, I transcribed the values from digital copies of the U.S. Agricultural Census (Ruggles). The output and acreage variables are measured at the county level. Using these values, I calculate the cotton yield per acre by dividing the county's total cotton output by the total acres of cotton.

Individual level data come from the Integrated Public Use Microdata Series' one percent sample from the 1920 and the five percent sample from the 1930 U.S. Census. The key variable of interest is school attendance by individuals. The Census asked individuals if they attended school during the school year leading up to the census (i.e. the 1919-1920 and 1929-1930 school years). From this variable, I generate a dummy variable equal to one if an individual attended school during the academic year beginning in 1919 (or 1929) and zero otherwise.

By combining Census information on whether individuals live in urban or rural areas with farm status, I restrict my sample to rural farming households. I further restrict my sample to individuals from the Cotton South[14]. These restrictions reduce my sample to two hundred-forty thousand individuals (I also restrict the sample to individuals between the ages five and eighteen.). (In terms of the Climate Divisions, the sample has seventy-three divisions.)

The Censuses also provides demographic controls: age, race, gender, and number of siblings. Previous research into child labor shows that children's age, gender, and number of siblings are all important factors in the household's decision to use child labor. I control for gender by including a dummy variable equal to one for females and zero for males. Individuals' values for age and number of siblings are included directly in the estimation equations. Unlike previous studies, controlling for individuals' race is critical for my results. I find that blacks and whites responded differently to the same shocks. These finding are not surprising given the legacy of slavery.

The final set of individual level variables I gather from the Censuses are those for parental controls and household assets. The education level of parents is strongly correlated with their children's levels. The 1920 and 30 Censuses do not have a direct measure of individual's educational obtainment. Instead, I use literacy as a measure of individual's educational level. The Census defines literacy as the ability to read and write. Based on this definition, seventy percent of my sample is literate. From the literacy variable, I generate a variable equal to one when at least one of a child's parents is literate. (In households where only grandparents are present, I use their literacy in place of the parents'.) I control for household assets by including information on if the household owns or rents their dwelling. I create a dummy variable equal to one whether the household owns their dwelling and zero otherwise.[15] I combine information on ownership status

[14] I use the same group of states as Davis et al. (2009): Arkansas, Alabama, Georgia, Florida, Louisiana, Mississippi, North and South Carolina, Tennessee, and Texas. These states produced around 95% of cotton during the late 19th and early 20th century

[15] In addition to the dummy for owning the household dwelling, I tried to include a dummy variable for owning the dwelling out right, but the variable is dropped due to multicollinearity.

and parent occupation to create a dummy variable for tenant farmers. If the household head is a farmer and the farm is rented, the tenant farmer dummy variable equals one. The variable equals zero if households own their dwelling or are headed by farm laborers.

Table two provides the reader with the differences in means of child school attendance rates based on several household characteristics. My sample of rural farming households from the Cotton South matches patterns previously observed by researchers. Children from black households attend school at lower rates than their white counterparts. The attendance rates of children with a literate parent are almost twenty percentage points higher than households with illiterate parents. This difference is even larger than the gap between landowners and renters—12.8. Female children attend school at slightly higher rates than males. Children from tenant farming households attend school in lower rates than other groups.[16]

The key assumption of the current paper is fluctuations in cotton yields (a proxy for household income) affect household schooling choices. Tables three and four provide support for this belief. Table three looks at how weather shocks influence attendance rates. Table four directly examines the effect of cotton yields on the attend rates of children from rural farming households from the Cotton South.

Table three gives the differences in means of school attendance rates of household types conditioned on severe dry and wet Mays. Dry Mays tend to raise cotton yields while wet ones reduce yields. Therefore, cotton farmers' incomes likely fall following wet periods and rise after dry periods. From the table, the reader can observe school attendance rates are higher following a dry May for children from black, white, and tenant farming household. Only land owning households were unaffected. Following a wet May, the school attendance rates are lower across all households. However, the magnitudes of the differences are smaller than following a dry period except for landowners.

Table four compares the attendance rates of households in counties with high and low cotton yields. Counties in the high sample have yields in the top ten percent and counties in the low sample have yields in the bottom ten percent. Similar to the dry period portion of table three, the reader observes that children from black, white, and tenant farming households attend school with higher probabilities in high yield counties versus low yield counties. However, the differences are smaller than those based on dry periods. The difference is likely due to weather shocks capturing the fluctuations in incomes while the yields corresponds more to income levels. I fail to find a statistical difference between the attendance rates of children from land owning households from counties with high and low cotton yields.

In addition to individual controls, the U.S. Decennial Census provides county level controls. The county level controls come from the Inter-university Consortium for Political and

[16] The difference between tenant farming and non-tenant farming households is misleading. The non-tenant farming category is composed of landowners and farm laborers.

Social Research's Historical, Demographic, Economic, and Social Data: The United States, 1790-2002 series. The controls include information on the county's area, population, and farms. The county's area is given in terms of square miles. Population variables include the county's totals for the following groups: total, rural, white males, black males, individuals over the age of nine, illiterate individuals over the age of nine, and individuals between six and twenty enrolled in school. For farms, I include the total number of farms, farms owned by native whites, and tenant farms. Within the category of tenant farms, I include the total acreage and value of farmland and implements.

The final set of controls measures school accessibility. I use the school quality dataset from Carruthers and Wanamaker 2015. The authors use annual education reports from southern states between 1910 and 1940 to generate a county level dataset. I include the total number of teachers at black and white schools, total number of black and white schools, and total expenditure per student.

Empirical Methods

Examining the features of the ideal model to test the relationship between income shocks and school attendance in credit constrained households guides the paper's model decisions. The sample population would experience the same exogenous shock to their incomes. The shock would only affect the schooling choice through the income channel. We would have data on household, school, and community characteristics. We would use a Probit regression to model the binary choice of attending school or not.

The general form of the latent variable version of the Probit model is based on the following data generating model:

$$Y^* = X'\beta + \varepsilon$$

where Y^* is a nx1 matrix of continuous dependent variable. X' is a nxk matrix of covariates and ε is a nx1 matrix of error terms. The researcher only obverses the outcome Y where:

$$Y = \begin{cases} 1\ if\ Y^* > 0 \\ 0\ if\ Y^* \leqslant 0 \end{cases}$$

If $Y^* > 0$, that implies $-\varepsilon < X'\beta$. Following is a proof of the equivalence between the data generating model and indicator function:

$$\Pr(Y = 1|X) = \Pr(Y^* > 0) = \Pr(X'\beta + \varepsilon > 0) = \Pr(\varepsilon > -X'\beta) = \Pr(-\varepsilon > X'\beta) = \Phi(X'\beta)$$

where Φ is cumulative distribution function of the standard normal distribution. I estimate the model's betas with the Maximum Likelihood approach.

For the current paper, the ideal Probit model could have the following form:

$$\Pr\left(School\ Att\widehat{endance} = 1 \middle| \Delta Y_i, CC_i, X_i, X_c\right) = F(\alpha + \beta_{1i}\Delta Y_i + \beta_{2i}(CC_i * \Delta Y_i) + \beta_{ni}X_i + \beta_{mc}X_c)$$

where ΔY_i is the change in household i's income from the previous period. CC_i is a measure of household i's level of credit constraint. X_i and X_c are household and community controls respectively. We expect β_{2i} to be positive and significant if households are credit constrained and using child labor to consumption smooth. If households can borrow against future earnings, they will not change schooling choices following a change in household income and β_{2i} will be insignificant.

One adjustment to the ideal model I make is to the income variable—ΔY_i. There are no datasets with individual level income data from the early twentieth century with individual characteristics. Therefore, I replace individual income with a proxy variable. As previous researchers have done (Greenbaum 2009 and Baker 2013), I use a measure of cotton production as proxy for the incomes of farmers in the Cotton South. Yields times price provides a good approximation of farming incomes. Due to the accessibility of data and variation at the county level, I use cottons yields over cotton prices as a proxy for incomes in rural farming households in the Cotton South.

I also use a proxy variable in place of a direct measure of household's level of credit constraint. My proxy variable for being credit constrained is black.[17] Based on the historical evidence, freed slaves tended to not have land or other tangible assets that banks would accept as collateral. Liens on future crop production were the only assets many freedmen owned and the local merchant was the only individual willing to accept these as collateral. Therefore, we expect the average black farmer to be more credit constrained than his white counterpart.

After incorporating the two proxy variables, I estimate the following Probit model:

$$\begin{aligned}\Pr\left(School\ \widehat{Attendace} = 1 \middle| Cotton\ Yield_{ct}, Black_i, X_i, X_{ct}\right) \\ = F(\ \alpha + \beta_c Cotton\ Yield_{ct} + \beta_{1i}(Black_i * Cotton\ Yield_{ct}) + \beta_{ni} X_i + \beta_{mc} X_{ct} \\ + \delta_t + \gamma_c)\end{aligned}$$

where i refers to individuals and c to counties. X_i and X_c are matrices of individual and county controls. $Black$ is a dummy variable equal to one if an individual is identified as black in the Census and zero otherwise. $Cotton\ Yield$ is a continuous variable equal to a county's cotton yield in a given year. The unit is five hundred pound cotton bales per acre. The model includes both year, δ_t, and county, γ_c, fixed effects. The model's errors are clustered at the county level. The sample includes six hundred-ninety-one counties.

The model's key variable of interest is the interaction term between cotton yield and Black. If the consumption smoothing explanation for child labor is correct, we expect the coefficient on the interaction term, β_{1i}, to be significant. A significant β_{1i} means the credit constrained group reacts differently to income fluctuations relative to the reference group—whites.

To control for household characteristics, I add individual level controls to the model. The controls include parental literacy, age, number of sibling, and dummy variables for dwelling ownership and female. Previous child labor research shows that all of these individual

[17]As a robustness check, I replace black with tenant farmer and farm laborer as proxies for being credit constrained in some regressions.

characteristics are significant factors in household's education decisions. The household's assets affect their access to credit markets. To control for this access, I include a dummy variable equal to one if the household's dwelling is owned.

County controls include two other categories of variables researchers commonly have in child labor models: measures of school accessibility and local characteristics. For school accessibility, I include county level measures of the supply of schooling. The variables include the total number of black and white schools, total number of teachers at black and white schools, and total expenditures per student. For local characteristics, I add information on the county's population and farming community.

To address the possibility of cotton yields being endogenous, I implement an instrumental variable strategy. I use May values of the 12 Month Standardized Precipitation Index as an instrument. The instrument allows me to extract the exogenous portion of cotton yields. May rain is correlated with cotton yields and unlikely to affect school attendance. The first stage has the form[18]:

$$Cotton\ Yield_{ct} = \beta_d 12Month\ SP_{dt} + \beta_{ni}X_i + \beta_{mc}X_{ct} + \delta_t + \gamma_d$$

where $12Month\ SP_{dt}$ is the May value of twelve month Standardized Precipitation Index at the climate division level—d. The model includes year and division fixed effects. The other portion of the equation is variables from the second stage (i.e. individual and county control). To accommodate the instrumental variable strategy, I make several adjustments to my Probit model:

$$\begin{aligned}\Pr\left(School\ \widehat{Attendace} = 1 \middle| \widehat{Cotton\ Yield}_{ct}, X_i, X_{ct}\right) \\ = F(\alpha + \beta_c \widehat{Cotton\ Yield}_{ct} + \beta_{ni}X_i + \beta_{mc}X_{ct} + \delta_t + \gamma_d)\end{aligned}$$

The estimated cotton yields replace the true values. I drop the interaction term between Black and cotton yield. Therefore, I restrict the sample to black households.[19] Due to the instrument, I cluster the errors and include fixed effects at the climate division level.

Two potential threats to the excludability of the instrumental variable involve the weather directly affecting school attendance. Rainy weather could physically prevent children from attending school due to unpassable roads and water damage. This could explain a correlation between wet periods and declines in school attendance. However, the timing does not fit my model. Farmers begin to plant their cotton crop in April. The crops experience the weather shocks in May. Attendance data come from the school year that begins around September, which is just before the time cotton crops are picked—October. The four month gap between the occurrence of the weather shock and the start of school makes it unlikely that the weather directly causes changes in attendance rates. May storms could be severe enough that schools are damaged and unable to reopen in time for the new school year several months later. To address this threat, I add school access variables from the previous school year to my model (i.e. for 1930

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[18] Incorporating the instrumental variable into the general Probit model:

$$Y = \begin{cases} 1\ if\ Y^* > 0 \\ 0\ if\ Y^* \leqslant 0 \end{cases} \qquad Y^* = X'\beta + \hat{Z}'\gamma + \varepsilon \qquad Z = X'\phi + \nu$$

I include the school access variables from the school years 1928-1929 and 1929-30). If the weather is closing schools, the closures will show up as decreases in the number of schools between the two school years.

Weather shocks could reduce household incomes and consumption. Under this explanation school is simply a normal good which the households consumes less of following a decline in incomes. However, this mechanism does not fit as public primary and secondary schools were free during the early twentieth century.[20]

Results

The theoretical model provides several testable predictions. If black rural farming households are credit constrained, we expect to observe school attendance rates of black children to vary with fluctuations in household incomes. Using cotton yields as a proxy for household incomes, the model predicts attendance rates will be positively correlated with cotton yields. Due to being less credit constrained, the model predicts white attendance rates will not vary with cotton yields.

Figure four shows the predicted marginal effect of cotton yields on the probability of black and white children attending school based on my Probit model. The marginal effects are conditioned on all of the controls (i.e. year and county fixed effects and county, school access, and household controls). As predicted by the theoretical model, the marginal effect of cotton yields differs between blacks and whites. The slope of the marginal effect is steeper for blacks relative to whites. The ninety-five percentage confidence intervals show the black slope is statistically significant while cotton yields appear to have zero effect on whites. The positive correlation between black school attendance rates and cotton yields also fit with the model predictions.

I provide the point estimates for the Probit model in table five. The statistically significant result that black children attended school less frequently than white children matches previous research into the schooling choices of rural farming households in the Cotton South. With no controls, the coefficient on the key interaction, Cotton Yield X Black, is not significant and the coefficient on cotton yield is. However, the addition of school access and individual controls shifts the significance from the Cotton Yield to Cotton Yield X Black. The positive and significant coefficient on Cotton Yield X Black matches the predictions generated from my theoretical model. The schooling choices of the credit constrained group (black households) are positively correlated with income fluctuations (cotton yield). The model also predicts the less credit constrained group (white households) will not change their schooling choices with income fluctuations. The reader can observe the empirical results confirm this theoretical prediction as the coefficient on Cotton Yield is insignificant after including all of the controls. (The coefficient on Cotton Yield represents the response of white households to income fluctuations as they are the reference group.)

[20] The estimates do not match the normal good explanation. The households uniformly experience income losses. However, the school attendance rates of children from credit constrained households respond differently to the income losses.

A few technical notes regarding table five: The marginal effects in figure four are based on the regression in column four. The four regressions include year and county fixed effects. I cluster the errors at the county level. The addition of School Access controls from Carruthers and Wanamaker (2015) reduce the number of counties from nine hundred-thirty to six hundred-ninety-one.

A potential issue with the results in table five is the endogeneity of cotton yields. I address the issue by using the May value of the twelve Month Standardized Precipitation Index to extract the exogenous portion of the cotton yield's variation. Figure five shows the reader the marginal effect of my instrument on cotton yields. For the Standardized Precipitation Index, negative values correspond to drier than normal periods and positives to wetter periods. Larger magnitudes represent more severe conditions. Cotton yields are higher in drier periods relative to wet ones. Based on the ninety-five percent confidence intervals, we observe the May values from the twelve Month Standardized Precipitation Index are a statistically significant predictor of cotton yields.[21]

Table six shows the second stage results from regressing school attendance on the predicted cotton yields. Adding the first stage strengthens the results presented in table five. For black households, cotton yield is statistically significant at the one percent level in all four regressions. The probability of attending school for black children from rural farming households rises as cotton yields rise. In columns five through eight, we see that cotton yields do not impact the schooling choices of white farming households. The addition of variables to control school accessibility and county and household characteristic do not affect the results.

The estimates in tables five and six show that income fluctuations due to changes in cotton yields was a significant factor in the schooling choices made by credit constrained farming households in the Cotton South. Using black as a proxy for credit constrained, I find children from credit constrained households attend school more frequently after a rise in cotton yields and less when cotton yields fall. While black school attendance rates show a positive correlation with cotton yields, white attendance rates are unaffected. The result matches the prediction of the theoretical model as white households were less credit constrained.

Robustness Checks

To further test my results, I estimate several models: I run the same model IV Probit model with different populations: urban, urban blacks, and rural non-farming blacks. I estimate a reduced form model with Ordinary Least Squares and Logistic. I replace black with tenant farmer and farm laborer as my proxy for being credit constrained[22].

As a falsification test, I replace my sample of rural black farming households from the Cotton South with several groups whose attendance rates should be unaffected by cotton yields. A significant result would suggest my main empirical results are capturing a different

[21] The first stage point estimates capture the same relationship. The beta on the May measure from the twelve Month Standardized Precipitation Index is negative and statistically significant in all eight regressions in table six.

[22] I generated similar results using the year 1910 Census. However, I use a different school access dataset in place of Carruthers and Wanamaker (2015). The results include estimates based on a sample of divisions with high cotton intensity. I don't run a similar regression with the panel from 1920 and 1930 as the Agriculture Census changed the meaning of variables used to generate the cotton intensity measure.

mechanism than my theoretical model predicts. To show the my results are specific to black farming households, I show the estimates of regressing the attendance rates of children from urban, urban black, and rural non-farming black households on cotton yields in table seven. The results are insignificant in all three cases. For the rural non-farming black households, the children likely attend the same schools as the children in my main sample. Therefore, my main results cannot be caused by May storms closing schools.

In table eight, I provided reduced form estimates based on weather shocks in place of cotton yields. I run the model with Ordinary Least Squares (OLS) and Logistic. For weather shocks, I generate dummy variables for severe dry and wet periods based on the twelve month Standardized Precipitation Index. Wet periods reduce cotton yields and dry periods increase yields. Therefore, we expect to see a positive correlation between black school attendance and dry periods and a negative correlation with wet periods. Both regressions have the full set of controls with white as the omitted category. Under both OLS and Logistic, the coefficient on the interaction between Dry and Black is significant at the one percent level. Therefore, the attendance rates of black children increases with increases in household incomes. The coefficient on Dry shows the reader that white households did not increase schooling following a rise in income. For wet periods, the pattern is less clear. Attendance rates decline for blacks and whites following a rainy period. The interaction term between wet and Black is only significant at the ten percent level under OLS.

I replace Black as my proxy for credit constrained households with two other measures—tenant farmer and farm laborer. Black households had similar credit characteristics as tenant farming households: The households lacked tangible assets to be used as collateral for traditional loans. They relied on crop liens with the merchant to buy supplies. Government unemployment insurance did not cover farmers. Insurance against crop failures did not exist. Farm laborer access to credit was further limited by the lack of a crop or good reputation to borrow against. Therefore, the predicted coefficient pattern for tenant farmers and farm laborers is the same as black households: positive coefficient on the dry interaction term and negative on the wet interaction term. Due to farm laborers being relatively more credit constrained than tenant farmers, the pattern maybe more pronounced.

I present my reduced form estimates for tenant farming and farm laborer households in table nine. The omit category is land owning farmers. The model includes year and division fixed effects and controls for household, county, and school access characteristics. The results match the patterns predicted by the theoretical model and empirical results for black households. Following a positive income shock, the school attendance rates rise for children from tenant farming and farm laborer households (i.e. the coefficient on Dry X Tenant Farmer and Dry X Farm Laborer are positive and statistically significant at the one percent level). The results are weaker for the wet interaction terms. Wet X Tenant Farmer is not statistically significant. The coefficient on Wet X Farm Laborer is significant at the ten percent in my logistic model and five percent level in the linear model. As predicted, the estimates are stronger for the more credit constrained households—farm laborer.

Conclusion

Previous research into the effect of exogenous shocks to household incomes shows schooling outcomes of children from credit constrained households improve after a positive income shock and decline after a negative shock. Researchers base their studies on data sets from modern developing countries. I extend the literature by being the first to observe the same pattern in the U.S. Cotton South[23] during the early twentieth century.

Using cotton yields as a proxy for incomes, I find a positive correlation between the probability of black children attending school and positive exogenous shocks to household incomes. I restrict my sample to rural farming households in the U.S. Cotton South. Using historical evidence, I show black rural farming households tended to be credit constrained due to their lack of assets or access to credit markets. In my main specification, I regress school attendance rates on cotton yields and controls for county, household, and school access characteristics. The model includes year and county fixed effects. To control for the endogeneity of cotton yields, I estimate a first stage regression with the May value of twelve month Standardized Precipitation Index as an instrumental variable. I show following severe dry periods cotton yields increase and decrease after wet periods. Based on the first stage estimates, I regress the probability of attending school on the predicted cotton yields. I consistently find a positive correlation between cotton yields and the school attendance rates of black child.

Finding a correlation between income shocks and school attendance in the U.S. Cotton South during the early twentieth century leads to two research questions. First, what is the long term effect of income fluctuation on educational obtainment? The current paper only considers the year following an income shock. Do children who did not attend school following a year with a negative income simply return the next year and eventually obtain the same level of educational obtainment as they would have done without the shock? Or do negative shocks lead to permanent reductions in schooling levels? Second, what U.S. policies were effective in mitigating the side effects of negative income shocks on farming households? Finding answers to this question could help modern developing countries reduce child labor and increase schooling.

[23] I use the same group of states as Davis et al. (2009): Arkansas, Alabama, Georgia, Florida, Louisiana, Mississippi, North and South Carolina, Tennessee, and Texas. These states produced around 95% of cotton during the late 19th and early 20th century

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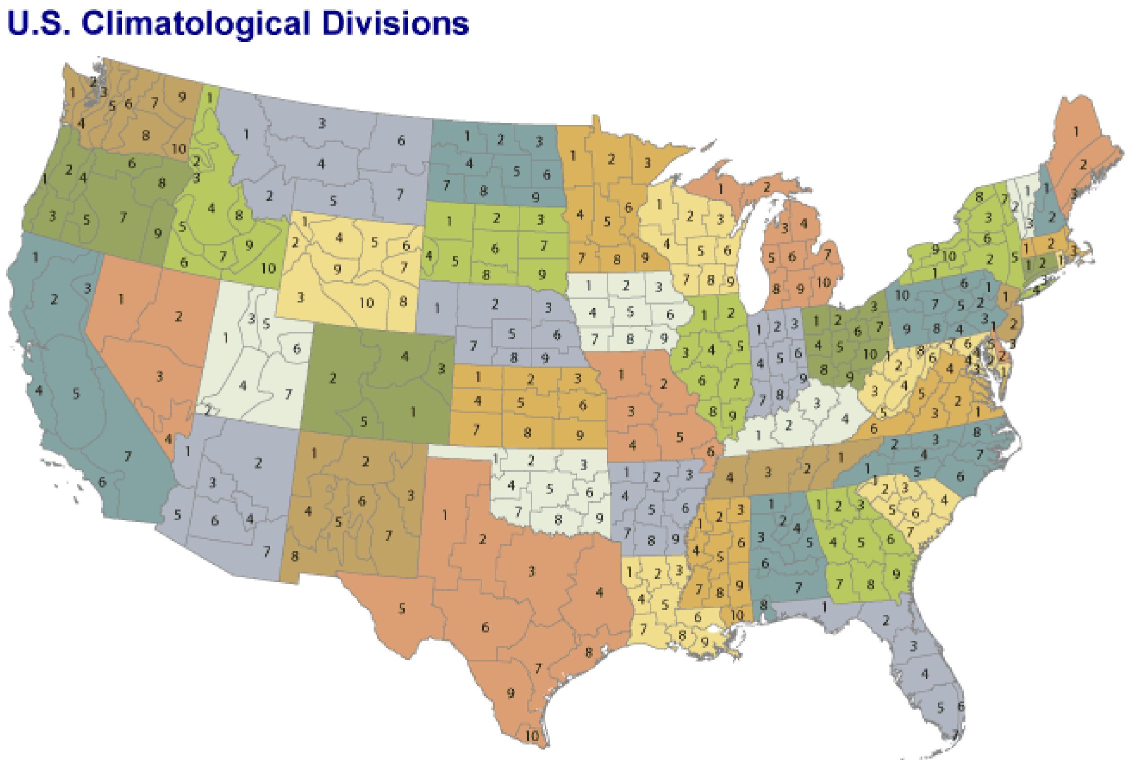
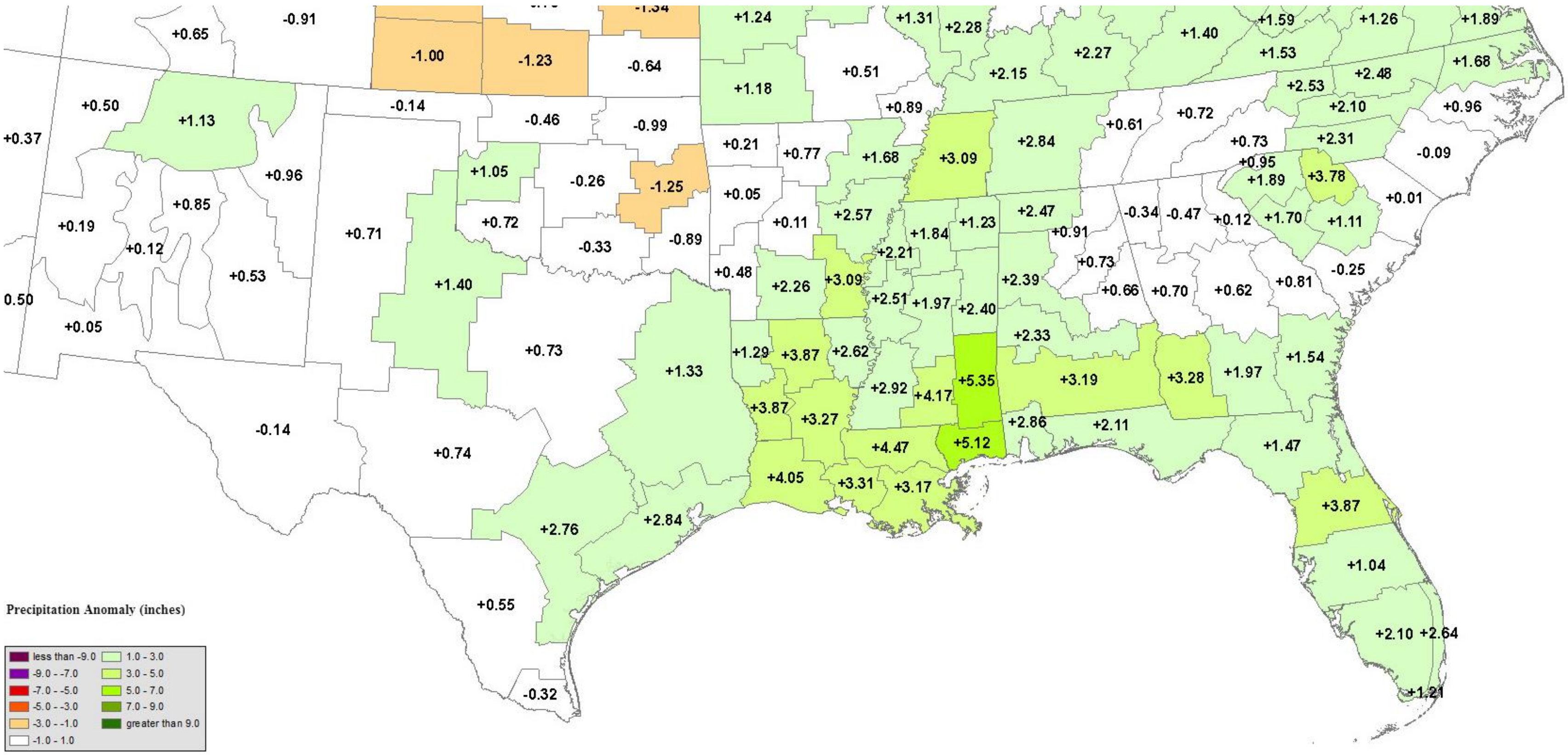
Figure 1: Map of the United States broken down into Climate Divisions



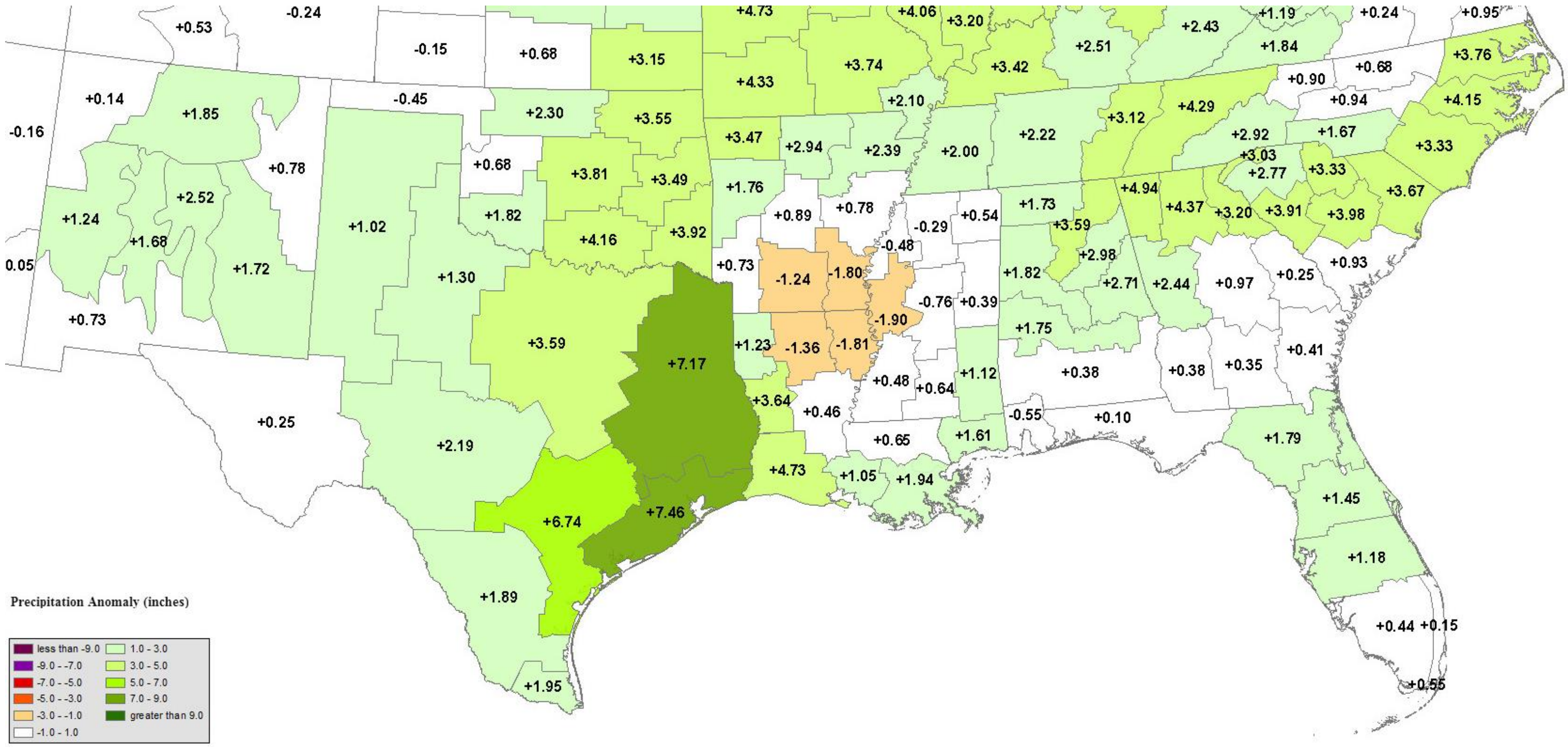
Source: National Oceanic and Atmospheric Administration/ National Weather Service Prediction Center

Figure 2: Map of the southern United States with Climate Divisional Precipitation Anomalies in May 1919



Source: National Oceanic and Atmospheric Administration/ National Weather Service Prediction Center

Figure 3: Map of the southern United States with Climate Divisional Precipitation Anomalies in May 1929



Source: National Oceanic and Atmospheric Administration/ National Weather Service Prediction Center

Figure 4: Marginal Effects of Cotton Yields on Predicted Probability of Attending School for Black and White Children

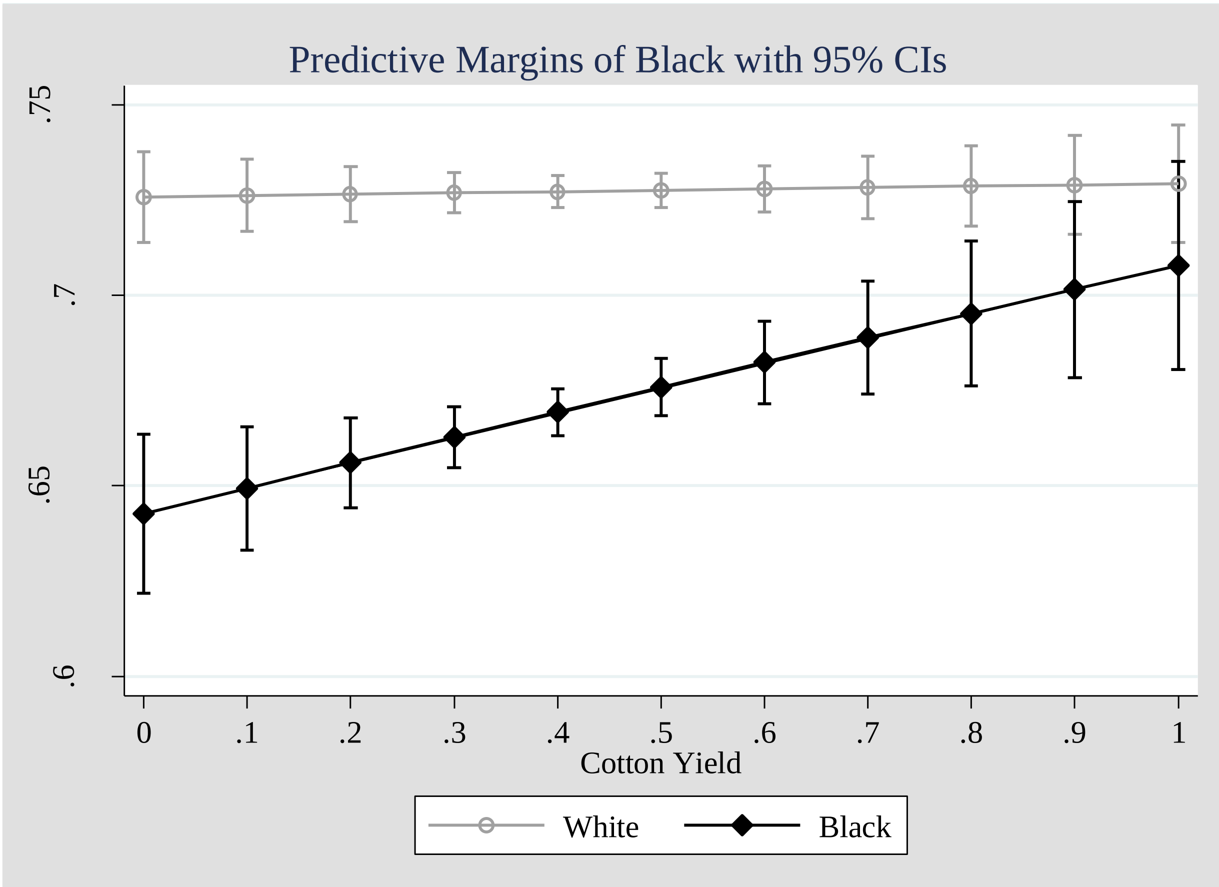


Figure 5: Marginal Effect of the May 12 Month Standardized Precipitation Measure on Cotton Yields

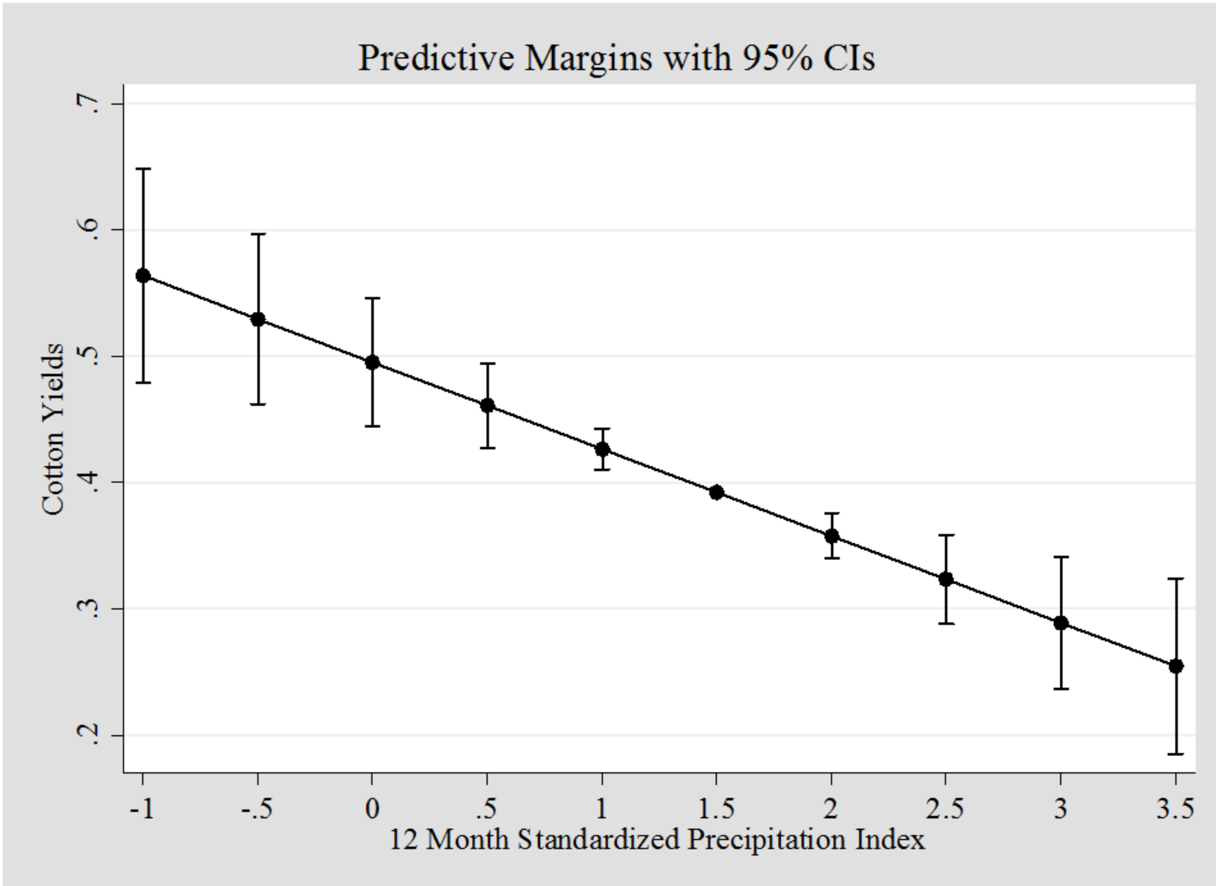


Table 1: Percentage of Farm Household Children Enrolled in School, Participating in the Workforce, and Idle by Race, Sex, and Age

	Male			***Female***		
	Ages 5-9	Ages 10-14	Ages 15-19	Ages 5-9	Ages 10-14	Ages 15-19
Black Children:						
In School	45.6	67.1	45.3	48.2	75.4	59.0
In Workforce	8.3	61.1	80.9	7.1	50.2	65.7
Idle	51.0	11.6	9.1	49.5	11.3	13.5
Observations	3,425	3,263	1,542	3,573	3,173	1,549
White Children:						
In School	59.1	87.3	72.4	60.7	88.3	73.6
In Workforce	8.3	52.8	73.4	4.2	24.8	28.6
Idle	39.5	5.4	5.6	38.5	8.0	17.3
Observations	5,121	4,790	2,605	5,132	4,349	2,294

Notes: Idle identifies children that are neither in school or the workforce. Observations come from the IPUMS 1% sample of the 1910 US Decennial Census.

Table 2: Probability of Attending School Based on Household Characteristics Pooled Sample from the 1920 and 1930 Censuses

	Status			
	Yes	No	Difference	P-Value
Household Characteristic:				
Literate Household Head	72.4	54.0	18.4	0.00
Male	69.1	71.8	-2.7	0.00
Black	65.9	73.0	-7.1	0.00
Tenant Farmer	67.4	74.2	-6.8	0.00
Landowner	78.6	65.8	12.8	0.00

Note: The observations come from the IPUMS 1% sample of the 1920 and 5% sample of the 1930 US Decennial Census.

Table 3: Probability of Attending Schooling Following a Weather Shock in 1919 or 1929

	Dry Period			
	Yes	No	Difference	P-Value
Household Type:				
Black	73.7	65.9	7.8	0.01
White	81.0	73.0	8.0	0.00
Tenant Farmer	77.7	67.3	10.4	0.00
Landowner	79.2	78.6	0.6	0.76
	Wet Period			
	Yes	No	Difference	P-Value
Household Type:				
Black	63.8	68.7	-4.9	0.00
White	72.2	74.0	-1.8	0.00
Tenant Farmer	65.8	69.3	-3.5	0.00
Landowner	77.5	80.1	-2.6	0.00

Note: The observations come from the IPUMS 1% sample of the 1920 and 5% sample of the 1930 US Decennial Census.

Table 4: Probability of Attending School in 1920 or 1930 Conditioned on Cotton Yield

	Cotton Yield			
	High	Low	Difference	P-Value
Household Type:				
Black	70.1	64.4	5.7	0.00
White	73.0	67.4	5.6	0.00
Tenant Farmer	69.8	62.5	7.3	0.00
Landowner	77.2	77.4	-0.2	0.73

Notes: The observations come from the IPUMS 1% sample of the 1920 and 5% sample of the 1930 US Decennial Census. High corresponds to counties with yields in the highest decile and low to the lowest decile.

Table 5: Probability of Individuals Attending School Regressed on Cotton Yield, Black, and Cotton Yield X Black

	(1)	(2)	(3)	(4)
Black	-0.279***	-0.270***	-0.325***	-0.224***
	(0.024)	(0.023)	(0.033)	(0.032)
Cotton Yield X Black	0.073	0.051	0.148**	0.157**
	(0.045)	(0.042)	(0.067)	(0.064)
Cotton Yield	0.149**	0.076*	-0.033	-0.036
	(0.064)	(0.046)	(0.059)	(0.051)
Controls:				
County	No	Yes	Yes	Yes
School Access	No	No	Yes	Yes
Individual	No	No	No	Yes
No. of Counties	930	930	691	691

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Errors are clustered at the county level. All regressions include year and county fixed effects.

Table 6: Probability of Individuals Attending School Regressed on Cotton Yield Using an Instrumental Variable Probit Model for Black and White Households

		Black		
	(1)	(2)	(3)	(4)
Cotton Yield	1.273***	1.171***	1.211***	1.257***
	(0.262)	(0.305)	(0.334)	(0.332)
Controls:				
County	No	Yes	Yes	Yes
School Access	No	No	Yes	Yes
Individual	No	No	No	Yes
		White		
	(5)	(6)	(7)	(8)
Cotton Yield	0.580	0.529	0.200	0.271
	(0.433)	(0.379)	(0.216)	(0.209)
Controls:				
County	No	Yes	Yes	Yes
School Access	No	No	Yes	Yes
Individual	No	No	No	Yes

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Errors are clustered at

the climate division level. All regressions include year and division fixed effects.

Table 7: Probability of Individuals Attending School Regressed on Cotton Yields Using an Instrumental Variable Probit Model for Urban and Black Non-Farming Rural Households

	Urban Households	***Black Urban Households***	***Black Non-Farming Rural Households***
	(1)	(2)	(3)
Cotton Yield	0.503	0.468	0.154
	(0.372)	(0.469)	(1.454)
No. of Divisions	67	59	62

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Errors are clustered at
the division level. All regressions include year and dividion fixed effects.

Table 8: Probability of Individuals Attending School Using Reduced Form Estimation with Black and White Households and Weather Shock Dummy Variables

	Ordinary Least Squares	***Logistic***
	(1)	(2)
Black	-0.040***	-0.227***
	(0.009)	(0.046)
Wet	-0.039***	-0.216***
	(0.012)	(0.060)
Wet X Black	-0.020*	-0.066
	(0.011)	(0.053)
Dry	0.007	0.047
	(0.009)	(0.049)
Dry X Black	0.070***	0.227***
	(0.009)	(0.046)

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Errors are clustered at the division level. All regressions include year and division fixed effects.

Table 9: Probability of Individuals Attending School Using Reduced Form Estimation with Tenant Farmer, Farm Laborer, and Landowner Households and Weather Shock Dummy Variables

	Ordinary Least Squares	***Logistic***
	(1)	(2)
Tenant Farmer	0.047***	0.165**
	(0.014)	(0.069)
Farm Laborer	0.012	0.019
	(0.017)	(0.085)
Wet	-0.025*	-0.159***
	(0.013)	(0.069)
Wet X Tenant Farmer	-0.007	0.006
	(0.010)	(0.052)
Wet X Farm Laborer	-0.045**	-0.157*
	(0.018)	(0.086)
Dry	-0.030***	-0.174***
	(0.008)	(0.045)
Dry X Tenant Farmer	0.070***	0.564***
	(0.009)	(0.044)
Dry X Farm Laborer	0.192***	1.137***
	(0.016)	(0.080)

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Errors are clustered at the division level. All regressions include year and division fixed effects.