NBER WORKING PAPER SERIES

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Working Paper 18296
http://www.nber.org/papers/w18296

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
August 2012

For comments and suggestions, we thank Ran Abramitzky, Daron Acemoglu, Lee Alston, Hoyt Bleakley, Leah Boustan, Bill Collins, Paul David, Dave Donaldson, Price Fishback, Claudia Goldin, Larry Katz, Paul Rhode, Andrei Shleifer, Jeff Vincent, Gavin Wright, and seminar participants at AEA, Arizona, BREAD, Columbia, CIFAR, Pittsburgh, Harvard, NBER, Stanford, UC Berkeley, and UC San Diego. For financial support, we thank CIFAR and the WCFIA's Project on Justice, Welfare, and Economics. Tom Beckford, James Feigenbaum, Lillian Fine, Andrew Das Sarma, and Leo Schwartz provided excellent research assistance. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research. For financial support, we thank CIFAR and the WCFIA's Project on Justice, Welfare, and Economics.

When the Levee Breaks: Black Migration and Economic Development in the American South
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NBER Working Paper No. 18296
August 2012
JEL No. N32,N52,O10

ABSTRACT

In the American South, post-bellum economic stagnation has been partially attributed to white landowners' access to low-wage black labor; indeed, Southern economic convergence from 1940 to 1970 was associated with substantial black out-migration. This paper examines the impact of the Great Mississippi Flood of 1927 on agricultural development. Flooded counties experienced an immediate and persistent out-migration of black population. Over time, landowners in flooded counties dramatically mechanized and modernized agricultural production relative to landowners in nearby similar non-flooded counties. Landowners resisted black out-migration, however, benefiting from the status quo system of labor-intensive agricultural production.

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Under-developed societies often have a large population of low-wage agricultural workers. Economic growth requires a reallocation of labor, yet various factors may keep workers in rural agriculture (Lewis, 1954; Kuznets, 1955; Brenner, 1986; Banerjee and Newman, 1998). Low-wage agricultural labor may discourage labor-saving technological innovation (Habakkuk, 1962; Allen, 2009; Acemoglu, 2010) or the adoption of new capital-intensive technologies (Atkinson and Stiglitz, 1969; Basu and Weil, 1998).

The Southern United States experienced a remarkable economic transition from 1940 to 1970 (Wright, 1986). The US South shifted from a largely agrarian low-wage economy to a more industrial economy paying comparable wages to the North; within the agricultural sector, production became more capital-intensive and farm sizes increased. The mechanization and modernization of Southern agriculture coincided with large-scale black out-migration, though a direct causal relationship is difficult to observe.

At the beginning of the 20th century, Southern white planters dominated areas with concentrated black populations. The Mississippi Delta exemplified this system of racial inequality and discrimination that fostered paternalistic black labor relations and narrowed black economic opportunities. The Great Mississippi Flood of 1927 displaced workers and disrupted the traditional racial labor market equilibrium, leading to an exodus of black laborers and sharecroppers from flooded areas.

This paper examines the impact of the 1927 Mississippi flood on agricultural development, emphasizing the relationship between black out-migration and Southern economic development. Empirical estimates support historical accounts of a black exodus from flooded areas. Agriculture then became substantially mechanized and modernized in flooded counties relative to nearby similar non-flooded counties. Estimated changes in agricultural land values are consistent with white landowners' coercive efforts to resist black out-migration after the flood and maintain the status quo system of labor-intensive agricultural production.

Using county-level data from the Censuses of Agriculture and Population, from 1900 to 1970, the main empirical specifications compare changes between flooded counties and non-flooded counties within the same state and with similar pre-1927 outcome values. The analysis of black population declines is supplemented with individual-level Census data, matched between 1920 and 1930.

The empirical estimates are robust to controlling for other differences between flooded and non-flooded counties, including differential changes associated with: distance to the Mississippi river; geographic suitability for cotton and corn; terrain ruggedness; or longitude and latitude. The estimates are also robust to controlling for differential intensity of plantations or differential impacts of New Deal program spending.

In a similar analysis of counties near other major Southern rivers, compared to counties further from rivers, there is little estimated relative change in black population or agricultural development in the absence of a flood. Counties near other major Southern rivers exhibit many of the same outcome patterns prior to 1927, yet do not experience the subsequent large relative changes estimated in flooded counties.

Our main interpretation of the empirical results is that flood-induced black out-migration encouraged the adoption of capital-intensive technologies and larger-scale farm operation, consistent with contemporary and historical qualitative accounts. The empirical estimates appear less consistent with alternative interpretations, such as direct impacts of the flood on capital investment or land productivity. Further, general equilibrium impacts on non-flooded counties appear to be small.

In the wake of the 1927 flood, black out-migration and agricultural development in flooded areas provides a microcosm of subsequent out-migration and development across the American South. In under-developed societies with a substantial population of low-wage agricultural workers, rural out-migration may encourage agricultural mechanization and modernization. Whether caused by push factors (e.g., rural natural disasters) or pull factors (e.g., urban labor demand), decreased agricultural labor surpluses may promote structural economic development.

I Historical Background

I.A Southern Under-development and the Mississippi Delta

Even prior to the revolutionary war, the Southern economy was distinctive. Slavery and a geographic suitability for plantation agriculture contributed to a system of labor-intensive agricultural production. As slavery expanded into new states during the 19th century, political conflict between Northern free states and Southern slave states culminated in the Civil War. Four million slaves were emancipated and enfranchised; by 1900, however, most Southern states had effectively disenfranchised black populations via poll taxes and literacy tests (Naidu, 2012).

Southern white planters attempted to use their political influence to restrict black labor mobility and exert control over black agricultural workers.[1] Anti-enticement laws made it illegal for one planter to hire another planter's workers, while anti-vagrancy laws made it illegal to be unemployed and without housing (Naidu, 2010). There has been substantial debate over the effectiveness of these measures and the overall degree of black labor mobility (see, e.g., Myrdal, 1944; Higgs, 1973; Mandle, 1978; Wright, 1986; Fishback, 1989; Margo, 1990, 1991; Ransom and Sutch, 2001; Alston and Kauffman, 2001); less controversial, how-

[1] We use agricultural "workers" to refer to both wage laborers and tenant farmers, who received "wages" in the form of production shares, housing, and advances of inputs and/or money.

ever, is that Southern white planters valued black labor immensely and used both carrots and sticks in an attempt to retain labor.

Southern black labor relations were also distinguished by the threat of racial violence (Rosengarten, 1975; Tolnay and Beck, 1995). Southern white planters often pursued a strategy of paternalism to retain black workers, offering protection from white violence and implicit insurance. "Protection was important .... particularly for black workers, because they lacked civil rights and society condoned violence"(Alston and Ferrie, 1999, p. 20). During a period of labor scarcity, a team of anthropologists observed: "One of the bases of competition between landlords for tenants was the landlord's reputation among tenants with regard to his use of physical violence. At the same time the field evidence reveals that the use of threats of violence by white planters is one of the basic controls upon labor" (Davis, Gardner and Gardner, 2009, p. 392).

The Southern economy remained persistently under-developed between the Civil War and World War II, and the relative abundance of low-wage black agricultural labor is one potential explanation. While the North developed large manufacturing sectors, the South remained primarily agricultural. Northern wheat threshing became increasingly mechanized in the 19th century (David, 1975), while the mechanization of Southern cotton-picking was delayed until the mid-20th century.[2]

Early cotton mechanization was mainly in planting and cultivation, where replacing mules and horses with tractors was associated with a 30% reduction in labor inputs (Hurst, 1933). Tractors and other labor-saving innovations have been influential in American agricultural development (Olmstead and Rhode, 2001; Gardner, 2002; Steckel and White, 2012), yet adoption lagged in the South. "Technology for mechanizing the preharvest operations was available well before the 1930s, yet it was hardly used at all in the South, and least of all in the plantation belt" (Wright, 1986, p. 133). Early tractors could replace mule-drawn carts in transporting cotton to gins (Ellenberg, 2007), yet continued high demand for harvest labor encouraged annual labor contracts and may have discouraged the partial mechanization of pre-harvest operations (Whatley, 1987). "Not only cheap labor, but also the form of that cheap labor, reduced the profitability of mechanization" (Whatley, 1985, p. 1208).

Southern economic convergence and agricultural mechanization coincided with large-scale black out-migration. Wright (1986) describes a 1940 to 1970 economic transition from the "Old South" to the "New South," attributing much of this change to a breakdown of regional labor markets and increased mobility of Southern blacks out of the region. Contemporaries recognized a feedback relationship between labor scarcity encouraging agricultural mecha-

[2]These differences may not just reflect crop choice, as California mechanized cotton before the US South (Whatley, 1985).

nization and technological improvements displacing workers (Raper, 1946).[3] Farm sizes increased as agriculture became more capital-intensive and as mules and horses were replaced with tractors and harvesters (Kirby, 1987).[4]

The United States' Southern economy experienced remarkable economic growth in the mid-20th century. Much regional convergence in the United States was driven by labor movement out of Southern agriculture and relative increases in Southern agricultural wages (Caselli and Coleman, 2001). Aside from the role of black out-migration, however, important events were the New Deal, World War II, and Civil Rights regulation (Wright, 1986; Heckman and Payner, 1989; Donohue and Heckman, 1991; Besley, Persson and Sturm, 2010).[5]

This paper focuses on the lower Mississippi region, which embodied historical Southern under-development. The Mississippi-Yazoo Delta has been dubbed the "most southern place on earth" (Cobb, 1994), and became infamous for racial inequality and abuse.[6] However, powerful white planters recognized their economic dependence on local black labor. Some planters experimented with recruiting Chinese and Italian workers, but were unable to find adequate and willing substitutes. Planters, such as Leroy Percy, resisted the Klu Klux Klan to protect their black workers. Retaining a local labor force became increasingly difficult, however, during World War I and the first Great Migration. The lower Mississippi region would soon experience an exodus of black labor that foreshadowed the second Great Migration across the US South.

I.B The Great Mississippi Flood of 1927

> *"A great deal of labor from the flooded section after being returned to the plantations is going North. It is thus a serious menace and it is going to offer a tremendous problem to all of us"* – Alex Scott, Delta planter.

The Mississippi river basin stretches into the central United States to channel water down through the winding Mississippi river. The river itself is somewhat undefined, historically changing course and spilling into natural floodplains. Over the late 19th and early 20th centuries, levees were constructed to contain the river and its natural spillways were closed. In 1926, the new chief of the Army Corps of Engineers "for the first time officially stated in his annual report that the levees were finally in condition 'to prevent the destructive effect

[3] Some economic historians have emphasized the role of the mechanical cotton picker in displacing workers (Day, 1967; Grove and Heinicke, 2003), while others have emphasized the impact of labor scarcity on mechanization of the cotton harvest (Peterson and Kislev, 1986; Holley, 2000).

[4] While land ownership was often concentrated, "farm size" refers to the parcel size of farm operators.

[5] Additional important factors include malaria eradication (Bleakley, 2007) and the introduction of air conditioning (Arsenault, 1984).

[6] In 1921, William Pickens, Arkansan NAACP secretary, dubbed the Mississippi River Valley the "American Congo." In 1919 alone, at least 18 black citizens were lynched in the Delta (Woodruff, 2003).

of floods"' (Barry, 1998, p. 175).

In 1927, the levee system failed catastrophically along the lower Mississippi river. Heavy rains throughout the Mississippi river basin accumulated in rising river levels and enormous pressure created 145 levee breaks that flooded 26,000 square miles. In the three most-affected states (Mississippi, Louisiana, Arkansas), flooding hit 36% of agricultural land and 29% of the population (Red Cross, 1928). The flood is estimated to have caused $400 million in property damage and drowned 246 people.[7]

The Red Cross coordinated flood relief efforts, which focused on emergency short-term needs (Red Cross, 1928). Of the $17 million spent, 30% was for food and 14% was for livestock feed. The Red Cross spent 16% on seed for farmers to replant flooded cropland: two-thirds of this land could be replanted in 1927, though the late planting season required some land to be shifted from cotton to corn, and the remaining lands were replanted in 1928. Building construction, repairs, and household furnishings totaled 15% of expenditures, and the remaining 25% was mainly for rescue and setup of refugee camps.[8]

The Red Cross established refugee camps that held 45% of the black population from flooded areas in Mississippi, Louisiana, and Arkansas (Red Cross, 1928).[9] Refugee camp administration was placed under the control of local counties and, in effect, powerful local white planters.

Many refugee camps became centers of repression and racial abuse. Black work gangs were conscripted and forced to work on levees or planters' farms; those caught attempting to leave were beaten and returned.[10]

Flood relief mainly refused direct payments to individuals, instead providing in-kind transfers through Red Cross camps.[11] Much of this aid was captured by white planters or withheld unless blacks worked on prescribed tasks. Planters justified withholding rations on the grounds that rations would "spoil" black workers and weaken the control planters had in "the old system" (Spencer, 1994, p. 176).

Amidst stories of racial abuse, white planters in flooded areas retained little credibility in

[7] There was little flood insurance at this time (White, 1945), and "[f]looding in the MS basin in 1927 and 1928 led the few companies that were selling cover to abandon the business. It was not until the 1950s that flood insurance again began to be discussed seriously" (Parker, 2000, p. 413).

[8] An additional $6 million in services and supplies were donated by the railroads, US military, and other Federal agencies, mainly for rescue and setup of refugee camps.

[9] Refugee camps held 26% of the white population from flooded areas in these three states. The Red Cross also gave relief outside of camps to 33% of the white population and 36% of the black population from flooded areas.

[10] In May 1927, 21 black workers were caught and whipped by the National Guard for trying to escape a relief camp (Spencer, 1994, p. 177). In another case, a black insurance officer who refused to work was openly shot and killed by the mayor of Lake Providence, LA (Barry, 1998, p. 330).

[11] The Bill prefigured New Deal legislation by providing a federal transfer to landowners without requiring local contributions.

offering paternalistic protection to their black workers. One infamous Red Cross camp in the Delta was controlled by Will Percy, son of LeRoy Percy, who forced blacks to work in the camp for free and wear laborer tags to receive food.[12] "Following a killing of a black man by a white policeman on the levees, Will Percy gave a condescending lecture to the black community at Mount Horeb church 'Because of your sinful, shameful laziness, because you refused to work on your own behalf unless you were paid, one of your race has been killed.' After this, the bond between the Percys and the blacks was broken" (Barry, 1998, p. 333).

A circulated black newspaper, *The Chicago Defender*, provided detailed accounts of racial abuse in Red Cross camps and listed job openings for blacks in Northern cities.[13] Migration costs also declined as a result of the flood, due to temporary displacement and lower labor demand for cotton harvesting in 1927.

Faced with the potential exodus of black workers, white planters made every effort to retain their black labor force. Following directives from the Mississippi governor and the National Guard commander, the Red Cross issued a memo on the "return of refugees," stating: "Plantation owners desiring their labor to be returned from Refugee Camps will make application to the nearest Red Cross representative," whereupon they "will issue passes to refugees" (Barry, 1998, pp. 313-314). The Delta & Pine Land Company, one of the nation's largest cotton plantations, established its own refugee camp and had its workers transferred by special train.

Despite such efforts, or perhaps encouraged by such efforts, many black families left flooded areas in search of better political and economic opportunities. Contemporary accounts describe black families, once displaced from their homes, continuing on to Chicago and other Northern cities.[14] "The *Afro-American* reported that the relief camp experience had "inspired many backwoods farm[h]ands to to make their first break for better things"' (Spencer, 1994, p. 177). Social networks shifted toward favoring migration; in Greenville MS, black leaders left for Chicago and crowds of blacks gathered at the local railway station every Saturday night to see who was leaving and say goodbye (Barry, 1998).[15]

[12] Barry (1998, p. 315) recorded a black man saying: "The colored people caught tough times around Greenville.... Whites were kicking coloreds and beating them and knocking them around like dogs. Hungry people, they wouldn't feed them sometimes." A white woman remembered: "The [National] Guard would come along and say 'There's a boat coming up. Go unload.' If they didn't hurry up, they'd kick them. They didn't mind taking their guns, pistols out, and knocking them over the head."

[13] Commerce Secretary Herbert Hoover gained national prominence through his management of flood relief operations and secured the presidential nomination. However, racial abuses during the flood eventually cost him the support of national black leader Robert Moton, who had been in charge of investigating racial abuses in relief camps, and contributed to the departure of blacks from the Republican party.

[14] This episode was influential in the development of Delta blues and Chicago blues (see, e.g., "When the Levee Breaks" and "High Water Everywhere").

[15] Reverend E.M. Weddington, who pastored Mount Horeb church, left shortly after the flood receded, but not before allegedly writing an anonymous letter saying "All of this mean and brutish treatment of the

Landowners' accounts emphasize the damages from losing their labor force, rather than direct losses from the flood. LeRoy Percy reported: "The most serious thing that confronts the planter in the overflowed territory is the loss of labor, which is great and is continuing" (Barry, 1998, p. 416). The director of the Delta Land and Pine Company reported to shareholders: "Labor was completely demoralized and the plantation was left almost completely without labor."

White planters in flooded counties were forced to adapt to the decreased availability of black workers. In November 1927, the Engineering News Record noted: "In certain sections of the lower Delta above the Arkansas and Yazoo where a crop could not be made this year two-thirds to four-fifths of the families have moved away. In these districts farm-machinery salesmen have been busy, and farm experts are watching the result with some apprehension." In 1931, a Mississippi Agricultural Extension Service bulletin discusses the "serious problem" of black out-migration and explores "the possible solution in mechanical farming," comparing five tenant-operated plantations and five tractor-operated plantations in the Delta (Vaiden, Smith and Ayres, 1931). Contemporaneous accounts describe a reorganization of agricultural production and increased mechanization in the Delta, even prior to the introduction of the cotton harvester: "Many planters have turned to the use of wage labor and large-scale machinery in an effort to improve production efficiency and decrease costs" (Langston and Thibodeaux, 1939, p. 3).

The Mississippi Delta has often been examined as a microcosm of historical Southern underdevelopment; after the 1927 flood, the Delta also provides a microcosm of Southern economic development following black out-migration. In contrast to the subsequent black out-migration across the South, the particular flooded areas experienced a sharp exogenous decrease in black population due to temporary displacement and a decline in the opportunity cost of migration, a breakdown of trust between planters and black workers, and a shift in black social networks toward favoring migration.

II A Model of Flooding, Migration, and Agricultural Development

II.A Model Setup

Assume that a representative Southern planter in county c and year t produces agricultural goods for a world market with fixed prices: $A_c F(K_{ct}, L^B_{ct}, L^W_{ct})$. Each county has a fixed supply of land with productivity A_c. Capital K_{ct} is defined broadly to include equipment and machinery, mules and horses, fertilizer, and land improvements. Capital is sufficiently mobile or depreciable that the marginal return to capital r is equalized across counties. Labor

colored people is nothing but downright slavery" (Barry, 1998, p. 416).

is supplied inelastically by resident black workers L_{ct}^B and resident white workers L_{ct}^W.[16]

Capital and labor are assumed to be substitutes, reflecting a choice between "Old South" labor-intensive production and "New South" capital-intensive production.[17] Capital is an important input in older production methods, but newer production methods are embodied in capital goods. Black workers and white workers are also substitutes, and we consider allowing for higher capital-labor substitutability for black workers (e.g., due to differences in average education).

White workers are perfectly mobile and earn a fixed outside "Northern" wage normalized to w^W. Black workers can earn an outside wage w^B or a home county wage w_H^B. Planters have established a reputation for protecting their own workers from racial violence, which is worth a to black workers in each period. Black workers also pay a one-time moving cost M, equivalent to paying m in each future period, reflecting racially-biased labor market institutions. Home county wages are set in equilibrium such that $w_H^B = w^B - a - m$. Each county is in an initial steady-state with L_{c0} black workers.

In the first period, the Southern planter chooses inputs to maximize: $A_c F(K_{c1}, L_{c1}^B, L_{c1}^W) - rK_{c1} - (w^B - a - m)L_{c1}^B - w^W L_{c1}^W$, subject to $L_{c1}^B \leq L_{c0}^B$.[18] We focus on the case in which this constraint binds and $L_{c1}^B = L_{c0}^B$, consistent with efforts by Southern planters to limit black out-migration. Capital investment and the number of white workers are determined by:

$$A_c F_K(K_{c1}, L_{c0}^B, L_{c1}^W) = r \quad (1)$$

$$A_c F_L^W(K_{c1}, L_{c0}^B, L_{c1}^W) = w^W \quad (2)$$

In particular, equilibrium choices of capital and white workers depend on the initial number of black workers: more black workers leads to a lower capital stock and fewer white workers. Paternalism and moving costs both have the effect of lowering planters' labor costs in counties with more black workers.

II.B Comparative Statics after the Flood

Consider the impact of a flood in some counties between periods 1 and 2. Workers are housed in refugee camps controlled by the planter, and racial abuses in these camps lower

[16] "Workers" include wage laborers, share croppers, and share tenants who receive "wages" in the form of cash, production shares, housing, and/or inputs.

[17] In particular, we assume that the above production function represents an upper envelope over "Old South" and "New South" technological choices. Increased use of "New South" methods is assumed to be "strongly labor-saving" (Acemoglu, 2010); that is, in the case where machines replace labor, the adoption of capital-intensive methods reduces the marginal product of labor. Note, however, that output per worker will still increase following a decline in labor availability and the adoption of labor-saving technology.

[18] The planter could hire more black workers at wage w^B, but this would contradict the assumption of an initial steady-state with L_{c0} black workers.

the planter's ability to provide credible protection from white violence. The flood also temporarily reduces the moving cost for black workers, either by imposing some share of that cost or by reducing the opportunity cost of migration. Black workers in refugee camps may also receive additional information about Northern job opportunities or, as leaders of the black community migrate, social networks may shift toward encouraging migration. The value of protection falls to some fraction α and the cost of moving falls to some fraction β, though the planter may use a combination of incentives and threats to induce workers to return at cost $(1-\alpha)a + (1-\beta)m$.

After the flood, the Southern planter chooses inputs to maximize: $A_c F(K_{c2}, L^B_{c2}, L^W_{c2}) - rK_{c2} - (w^B - \alpha a - \beta m)L^B_{c2} - w^W L^W_{c2}$, subject to $L^B_{c2} \leq L^B_{c0}$. The flood effectively increases the cost of employing black workers. Assume that the flood's impacts are sufficiently large, i.e., α and β are sufficiently small, that the constraint no longer binds and the population of black workers declines in equilibrium ($L^B_{c2} < L^B_{c0}$).

In flooded counties, there will also be increases in the capital stock, the population of white workers, and output per worker. The loss of low-wage black workers increases planters' labor costs, which encourages the adoption of labor-saving capital-intensive production methods. This technological transition will be especially pronounced if there is a higher substitutability between capital and black workers; for example, if there is capital-skill complementarity and white workers are higher-skilled on average.

This model does not include dynamic adjustment costs. In practice, it may take a number of periods to make technological adjustments and to accumulate the desired capital stock. However, the out-migration of black workers is predicted to be immediate and persistent.

Agricultural land values reflect the present discounted value of rents and, in this baseline model, decline immediately due to the loss of exploitable low-cost black labor. For this reason, land-owning Southern planters are predicted to resist black out-migration. Land values may increase over time if capital investments become fixed to the land, but this is a matter of accounting and does not reflect gains for landowners.

If there were sufficiently large externalities in capital investment, however, the flood may cause a "big push" toward mechanization that increases land values. Allowing for multiple planters in each county, as a single planter internalizes all within-county spillovers, the private return to capital investment may be increasing in county-level total capital investment due to knowledge spillovers or coordinated investments in new capital equipment and infrastructure (see, e.g., Romer, 1986; Murphy, Shleifer and Vishny, 1989; Foster and Rosenzweig, 1995). Agricultural mechanization may also increase over time due to learning-by-doing, but land values would only increase immediately after the flood if there were substantial externalities associated with anticipated agricultural mechanization.

III Data Construction and Baseline Differences in Flooded Counties

III.A Data Construction and Aggregate Trends

Historical county-level data are drawn from the Census of Agriculture and the Census of Population (Haines, 2005).[19] The main variables of interest include: black population, value of agricultural equipment and machinery, number of mules and horses, number of tractors, average farm size, and value of agricultural land and buildings.[20] The value of agricultural equipment and machinery includes all tools, wagons, cotton gins, threshing machines, and all other machinery used in carrying out farm business (engines, motors, tractors, automobiles, and motor trucks); note that this measure excludes the value of mules and horses, levees, or any land improvements (Census Bureau, 1927).

For the 1920's, a direct measure of migration is drawn from matched individual-level census data in 1920 and 1930 (Boustan, Kahn and Rhode, 2012).[21] The match rate of 24% is comparable with the existing literature, though false matches will tend to overstate migration rates. Later analysis examines the fraction of matched individuals in 1930 that have left their 1920 county, state, or the South (and differences by race).

The empirical analysis focuses on a balanced panel of 163 counties, from 1900 to 1970, for which data are available in every period of analysis. To account for county border changes, data are adjusted in later periods to maintain 1900 county definitions (Hornbeck, 2010).

Figure 1 maps the extent of flooding in 1927, overlaid with county borders in 1900. The shaded area represents the flooded region, as compiled by the US Coast and Geodetic Survey. To focus the analysis on initially more-comparable flooded and non-flooded counties, the main sample is restricted to counties with a black population share greater than 0.10 in 1920 and a fraction of cropland in cotton greater than 0.15 in 1920.[22] Additional specifications examine counties elsewhere in the South, particularly those near other major rivers.

Figure 2 reports aggregate changes in the sample region from 1900 to 1970. Black population decreased substantially from 1940 to 1970, during the second Great Migration; and decreased somewhat in the 1910's, during the first Great Migration (panel A). Total population increased through 1940, before declining into the 1960's (panel B). The value of agricultural capital increased through 1920, remained mainly constant from 1920 to 1940 during a period of relatively few technological improvements, and then increased substantially by 1970 after the second Great Migration, the Civil Rights movement, and introduction of the cotton harvester (panel C). By contrast, the number of mules and horses were mainly constant

[19] We thank Michael Haines and collaborators for providing additional data from ongoing collection.

[20] Note that "farm size" refers to the size of farm operator parcels, rather than units of land ownership.

[21] We are grateful to Leah Boustan, Matt Kahn, and Paul Rhode for sharing their matched census data.

[22] The sample is further restricted to contiguous counties in Arkansas, Louisiana, Mississippi, and Tennessee.

through 1940, and then declined substantially through 1960 (panel D). Average farm sizes declined through 1930, before increasing substantially through 1970 (panel E).[23] The value of agricultural land per farm acre increased during World War I, declined somewhat through the Depression, and then increased substantially through 1970 as agricultural productivity increased (panel F). This figure provides some background on regional trends, whereas the main empirical analysis estimates within-state relative changes for flooded counties.

III.B Baseline Differences in Flooded Counties

In an initial step, the empirical analysis explores pre-differences between flooded and non-flooded counties. In 1925 or 1920, depending on data availability, county outcome Y is regressed on the fraction of county land flooded in 1927 and state fixed effects:

$$Y_c = \beta FractionFlood_c + \alpha_s + \epsilon_c \tag{3}$$

For each outcome variable, the estimated β reflects within-state differences in pre-flood characteristics for flooded counties and non-flooded counties.

To explore differences in pre-trends between flooded and non-flooded counties, equation (3) is modified to regress the change in outcome Y from 1910 to 1920 (or from 1920 to 1925) on the fraction of county land flooded in 1927 and state fixed effects:

$$Y_{ct} - Y_{c(t-1)} = \beta FractionFlood_c + \alpha_s + \epsilon_c \tag{4}$$

For each outcome variable, the estimated β reflects within-state differences in pre-flood trends in characteristics for flooded counties and non-flooded counties.

Table 1, column 1, reports average county characteristics prior to the 1927 flood. Column 2 reports within-state differences in pre-flood characteristics for flooded counties, and column 3 reports these differences conditional on six county-level controls (distance from the Mississippi river, geographic suitability for cotton and corn, terrain ruggedness, and longitude and latitude). Column 4 reports within-state differences in pre-flood trends for flooded counties, and column 5 reports these differences in trends conditional on the above six county-level controls.

Prior to the 1927 flood, flooded counties and non-flooded counties are estimated to have had similar changes in most outcomes.[24] Flooded counties had an initially higher black population and a greater intensity of small-scale agricultural production, though these differences

[23] Note that increases in "farm size" refer to increases in the size of farm operator parcels, rather than the concentration of land ownership.

[24] The main results tables report pre-flood changes for each outcome variable in all available pre-periods, relative to 1920.

are partly mitigated by the six county-level controls. To the extent that flooded counties were different in pre-trends or levels, the main empirical specifications report robustness to controlling for pre-flood differences.

IV Empirical Framework

The main empirical specifications estimate year-specific differences between flooded counties and non-flooded counties, relative to a base year of 1925 or 1920. Outcome Y in county c and year t is regressed on the fraction of county land flooded in 1927, state-by-year fixed effects, and county fixed effects:

$$Y_{ct} = \beta_t FractionFlood_c + \alpha_{st} + \alpha_c + \epsilon_{ct} \quad (5)$$

Note that β is allowed to vary by year, so each estimated β is interpreted as the average difference between flooded counties and non-flooded counties in that year relative to the omitted base year of 1925 or 1920. The main identification assumption is that flooded counties would have changed similarly to non-flooded counties in the same state, if not for the flood.

In practice, further specifications control for county characteristics (X_c) that may predict differential changes between flooded and non-flooded counties:

$$Y_{ct} = \beta_t FractionFlood_c + \alpha_{st} + \alpha_c + \theta_t X_c + \epsilon_{ct} \quad (6)$$

Most specifications control for pre-flood values of the outcome variable, flexibly allowing for convergence over time in the outcome variable or otherwise differential changes associated with initially different values (i.e., columns 2 and 3 of Table 1).[25] Further specifications control for distance to the Mississippi river; geographic suitability for cotton and corn; terrain ruggedness; and longitude and latitude.

For the statistical inference in all specifications, standard errors are clustered at the county level to adjust for heteroskedasticity and within-county correlation over time. When allowing for spatial correlation among sample counties, the estimated standard errors generally increase by less than 15%.[26] The regressions are weighted by county size, so the estimates reflect changes for an average acre of flooded land.

[25] Note that this specification is not a lagged dependent variable model; instead, the specification controls only for pre-treatment values of the dependent variable.

[26] Spatial correlation among counties is assumed to be declining linearly up to a distance cutoff and zero after that cutoff (Conley, 1999). For distance cutoffs of 50 miles, 100 miles, or 200 miles, the estimated Conley standard errors are generally less than 15% higher than the standard errors when clustering at the county level, depending on the outcome variable and year.

V Main Results

V.A Population

Table 2 reports estimated changes in black population for flooded counties, relative to changes for non-flooded counties. From estimating equation (5), column 1 reports that flooded counties experienced a 14% (0.151 log point) decline from 1920 to 1930 in their black population share. Following the 1927 flood, this short-run decline in black population share persisted through 1970.

Consistent with the main identification assumption, the black population share changed similarly in flooded counties and non-flooded counties prior to the 1920's. Further, from estimating equation (6), column 2 reports that the estimated decline in black population share is robust to controlling for changes correlated with counties' black population share in 1920, 1910, and 1900. The demographic shift was mainly caused by a decline in the black population (columns 3 and 4), with little change in total population (columns 5 and 6).[27]

Changes in county-level population reflect net migration, but a more direct measure of out-migration uses matched individual-level census data from 1920 and 1930. Average migration rates may be overstated due to false matches, though any bias should not be differential across flooded counties and non-flooded counties.[28] The county-level out-migration rate is calculated as the number of matched people leaving the county, divided by the total number of matched people originally in the county. The estimated regression is the same as equation (5), except the regression is weighted by the number of matched people in each county.[29]

Table 3, panel A and column 1, reports that the fraction of matched people leaving their county between 1920 and 1930 is 11.8 percentage points higher in flooded counties than in non-flooded counties. Flooded counties also have a higher fraction of matched people leaving their state (column 2), though a similar fraction leaving the South entirely (column 3).[30]

Migration estimates are more striking for the subsample of individuals whose race is observed. Panel B reports estimated differences in black out-migration from flooded counties, and panel C reports estimated differences in white out-migration from flooded counties. Blacks in flooded counties are 13.9pp more likely to leave their county (column 1), 17.8pp more likely to leave their state (column 2), and 6.8pp more likely to leave the South en-

[27] Predicted changes in total population depend on the functional form of the production function, but the offsetting increase in white population may reflect an inelastic demand for labor. Estimated increases in farmland (below) imply a decline in population per farm acre.

[28] All successful matches are required to be unique by name and place of birth (state or country) within a 5-year age band.

[29] In weighting by the number of matched people, the regressions estimate the change in probability of migration for the average person.

[30] Southern states are defined as Arkansas, Louisiana, Tennessee, Mississippi, Alabama, North Carolina, South Carolina, Georgia, and Florida.

tirely (column 3); by contrast, there are no statistically significant differences in whites' out-migration rates.

Overall, the estimates are consistent with historical accounts of an immediate and persistent decline in black population in flooded counties. The empirical results do not identify whether this decline in population reflects the flood's temporary displacement effect and a decline in the opportunity cost of migration, a breakdown of trust between planters and black workers, or a shift in black social networks toward favoring migration. Regardless of the mechanism, however, the subsequent empirical analysis explores the impact of decreased black labor availability on agricultural development.

V.B Agricultural Mechanization and Modernization

Table 4, columns 1 and 2, report that the value of agricultural capital equipment and machinery fully recovered in flooded counties by 1930 from losses sustained during the 1927 flood. By 1940, the value of agricultural capital had increased substantially in flooded counties, relative to non-flooded counties. Relative increases in agricultural capital continued through 1970; that is, the shift toward mechanization does not simply reflect earlier mechanization in flooded counties and convergence over time. Figure 3 graphs the estimated coefficients from column 1 of Tables 2 and 4, highlighting the relationship between a declining black population share and increased agricultural mechanization.

Mules and horses were an important early source of agricultural power; used by agricultural workers, but overall a substitute for manpower.[31] Columns 3 and 4 report that flooded counties experienced an initial increase in mules and horses, despite animal deaths as a direct consequence of the flood. By the 1950's and 1960's, however, use of this "Old South" power source declined.

Tractors were still rare in the sample region during the 1920's and 1930's, and estimated changes are more sensitive to controlling for counties' number of tractors in 1925. Column 5 reports that flooded counties adopted tractors faster in the late 1930's and 1940's, while column 6 indicates a more permanent increase in tractor usage.[32]

Increased farm sizes were strongly associated with a transition from an "Old South" system to a "New South" system of agricultural production. Columns 7 and 8 report that flooded counties experienced a gradual and substantial increase in average farm size, relative to non-flooded counties. Farm sizes increased particularly during the 1950's and 1960's as mechanized cotton harvesters became increasingly available.

[31] Mules and horses are a form of "capital," but their value is not included in the value of agricultural capital equipment and machinery.

[32] While tractor quality is unobserved, higher agricultural capital in later periods and a similar number of tractors may indicate higher tractor quality in flooded counties.

It is difficult to measure the increase in labor productivity associated with reported changes in production inputs and methods. As a proxy, however, data are available for the value of crops per capita. From estimating equations (5) and (6), the log value of crops per capita changed similarly in flooded and non-flooded counties from 1910 through 1930. This proxy for average labor productivity increased substantially in flooded counties through the 1930's, 1940's, and 1950's.[33]

Overall, the estimated increases in farm capital appear to embody labor-saving technological change in the agricultural sector. Much of the early labor-saving adjustment relied on mules and horses, i.e., older vintage technologies, though subsequent mechanization appears to reflect increased use of new labor-saving technologies like the cotton harvester. Gradually increased farm operation sizes are associated with a bundle of production methods associated with the "New South" rather than the "Old South."

The flood itself was likely too small to encourage labor-saving technological innovation (e.g., Habakkuk, 1962; Allen, 2009; Acemoglu, 2010), but decreased labor availability appears to have made flooded counties more suitable for the adoption of new capital-intensive technologies (e.g., Atkinson and Stiglitz, 1969; Basu and Weil, 1998). Increases over time in agricultural mechanization and modernization may reflect learning-by-doing, increased availability of wage workers during the Depression and New Deal, and/or subsequent increases in the availability of cotton harvesters and other mechanical innovations.

V.C Farmland Acreage and Value

Table 5, columns 1 and 2, report that flooded counties experienced a substantial relative increase in farmland from 1930 through 1970. As farms became larger and more capital-intensive, agricultural production in flooded counties also became more land-intensive. Clearing and plowing additional farmland appears to be complementary with increased mechanization.[34]

Substantial increases in total farmland, along with increased investment, complicate an analysis of the value of agricultural land and buildings. In principle, changes in agricultural land values reflect the loss (or gain) to landowners from decreased labor availability and subsequent agricultural adaptation. New farmland may be of generally lower quality than initial farmland, however, causing a downward bias in the value of farmland per farm acre.

[33] From equation (5), the estimated coefficients (and standard errors) are 0.395 (0.078) in 1940, 1.235 (0.167) in 1950, and 2.158 (0.246) in 1960. From equation (6), the estimated coefficients are 0.373 (0.067) in 1940, 0.933 (0.138) in 1940, and 1.741 (0.223) in 1960. Estimated relative changes are similar for the log value of crops per person living in rural areas of the county.

[34] The increase in agricultural land may represent a decrease in land under the public domain, or an increase in the fraction of privately-owned land that is in operation (or fallow) and captured by Census enumerators. Note that the empirical specifications estimate relative changes, so the reported increases may also reflect less of a decline in farmland in some flooded counties relative to non-flooded counties.

By contrast, clearing and plowing new farmland requires substantial sunk investments; as these investments are capitalized into land values, there will be an upward bias in the value of farmland per county acre.

Flooded counties experienced a substantial and persistent decline in the value of agricultural land and buildings per farm acre (Table 5, column 3). Land values declined further over time, which may reflect a compositional decline in average land quality. Controlling for initial differences, flooded counties experienced only marginally statistically significant declines in land value (column 4).

Flooded counties experienced little immediate change in the value of agricultural land and buildings per county acre (column 5). Increased land values in later periods may indicate that landowners unexpectedly benefited from technological innovation that favored capital-intensive agricultural production; however, rising land values also reflect substantial sunk investments in clearing and plowing new farmland (column 6). Across all four specifications, the estimates reject a substantial immediate increase in agricultural land values that might suggest landowners anticipated benefiting from the forced economic transition.[35]

Landowners' coordinated resistance to black out-migration is consistent with landowners not anticipating economic gains from a "big push" toward increased agricultural mechanization. Indeed, Appendix Figure 1 shows that the Delta Land and Pine Company did not experience an increase in reported profits (Dong, 1993).[36] Overall, the estimates appear consistent with a single equilibrium in which landowners adapt to labor availability.

Overall, this empirical exercise is not focused on whether the flood itself was beneficial or detrimental to landowners and workers. Black migrants presumably benefited from the option to migrate after the flood, though this does not imply that migrants benefited overall from the flood.[37] Instead, the empirical exercise is focused on potential lessons from this historical episode for understanding the relationship between decreased labor availability and increased agricultural mechanization and modernization.

[35] Data on land values and building values are available separately, by decade, from 1900 to 1940. In 1920, the value of land averages 77% of the combined value of land and buildings. Focusing on changes in the value of land only, in 1930 and 1940, the estimates from columns 3 and 5 are more negative and statistically significant and the estimates from columns 4 and 6 are more negative and statistically insignificant.

[36] The Company's return on investment likely declined, as profits remained similar and capital investment increased. The Delta Land and Pine company, however, was special in that given its size, it was reluctant to adopt labor-saving machinery due to public disapproval of the resulting unemployment. While it experimented with tractors in the early 1930s, it did not adopt them until World War 2.

[37] There would need to be some externality or coordination failure among migrants to generate welfare gains from flood-induced out-migration when the black population had previously chosen to stay in the region. Chay and Munshi (2012) examine Southern black migration networks in the early 20th century, which are consistent with potential externalities.

VI Threats to Validity

VI.A General Robustness

An empirical concern is that inherent differences between flooded and non-flooded areas may have caused some county characteristics to change differently after 1927, even in the absence of the flood.[38] A series of robustness checks explore the importance of inherent differences between flooded and non-flooded counties. In Tables 6 – 9, the baseline results are robust to a variety of control variables and alternative specifications.

As a basis for comparison, column 1 presents the baseline results when controlling for initial outcome differences. Table 6, panel A, reports estimated changes in black population share, relative to 1920; panel B reports estimated changes in the value of agricultural machinery and equipment, relative to 1925. Table 7 reports estimated changes for black population (panel A) and total population (panel B). Table 8 reports estimated changes for mules and horses (panel A), tractors (panel B), and average farm size (panel C). Table 9 reports estimated changes for farmland (panel A), the value of farmland per farm acre (panel B), and the value of farmland per county acre (panel C). Some years' coefficients are omitted for conciseness.

Column 2 controls for counties' distance to the Mississippi river, interacted with each year. Counties closer to the Mississippi are more likely to be flooded in 1927, and nearby counties have greater historical flooding and better river access to markets. This specification allows for the impact of river proximity to change over time. Alternatively, the estimates are robust to restricting the sample to counties within 50km or 100km of the Mississippi river.

Column 3 controls for counties' geographic suitability for cotton and corn, separately interacted with each year. Cotton and corn are the two major crops in 1925 in the sample region. Crop suitability reflects the maximum potential yield of that crop, as calculated by the FAO using data on climate, soil type, and ideal growing conditions for that crop.[39] This specification allows for crop-specific changes in technology and prices, or changes that otherwise differentially affect areas suitable for different crops.

Column 4 controls for counties' terrain ruggedness, interacted with each year. Counties' ruggedness is measured as the standard deviation in altitude across points in the county, calculated from the USGS National Elevation Dataset.[40] Areas with more uniform terrain may be more suitable for mechanization, or may otherwise change differently over time.[41]

[38] In particular, the assumption that flooded and non-flooded areas would have changed similarly becomes stronger in later periods.

[39] The FAO's Global Agro-Ecological Zone maps (version 3.0) are used to create county-level average crop suitability for cotton and corn. Potential yields are calculated using climate averages from 1961 to 1990 and rain-fed conditions with intermediate inputs.

[40] The estimates are similar when ruggedness is measured by the maximum range in altitude across points in the county.

[41] The estimates are also similar when controlling for interactions between terrain ruggedness and geo-

Column 5 controls for counties' longitude and latitude, separately interacted with each year. This specification controls for spatial patterns in economic changes that may be correlated with flooding.

Column 6 includes all of the controls from columns 2 – 5.

Column 7 instead measures flood intensity using the fraction of population affected by flooding in each county. Rather than focus on the fraction of each county's land that is flooded, these estimates use Red Cross reports on the population affected by flooding in each county.[42]

Column 8 controls for counties' estimated flood propensity score, interacted with each year. The probability that a county experienced any flooding is modeled as a probit function of the county's black population share in 1920 and fraction of cropland allocated to cotton in 1920. The sample is limited to flooded and non-flooded counties with overlapping values of this propensity score, which removes 6 of the original 163 counties. This specification is an alternative method to control for initial differences in county outcomes, and to ensure that flooded and non-flooded counties are drawn from an initially similar sample.

VI.B Falsification Exercise

Despite the above robustness checks, non-flooded areas may be an inherently poor control for flooded areas near the Mississippi river. As an alternative check on the results, a falsification exercise explores whether there are also differential changes between counties close to other major Southern rivers and counties further from other major Southern rivers. Restricting the analysis to non-flooded states, this sample includes 171 counties within 50km of a major river and 72 counties between 50km and 150km of a major river.[43]

As in the main sample, counties near other major Southern rivers have a higher black population in 1920 and a greater intensity of small-scale agricultural production in 1925 than counties further from other major Southern rivers. Further, as in the main sample, these counties had been experiencing similar trends in the county outcomes of interest.[44]

Table 10 reports that counties near other major Southern rivers changed similarly after

graphic suitability for cotton and corn (and their main effects).

[42] Alternatively, the estimates are robust to using Red Cross data on the fraction of agricultural land flooded or the fraction of total land flooded (Red Cross, 1928). We are grateful to Paul Rhode for sharing these Red Cross data, which we supplemented.

[43] These cutoffs reflect typical distances to the Mississippi for flooded counties and non-flooded counties, respectively. As in the main sample, the sample is restricted to counties with a black population share greater than 0.10 in 1920 and a fraction of cropland in cotton greater than 0.15 in 1920. Data are unavailable for tractors in the entire South, as we only supplemented available data for the main sample region in 1925. The major rivers shapefile was obtained from ESRI Inc. ("Major Rivers of the United States").

[44] Analogous to the estimates from Table 1, these estimates refer to modified versions of equations (3) and (4), where the fraction of county flooded is replaced with a dummy variable for whether the county is within 50km of a major river.

1927 to counties further from other major Southern rivers.[45] Of the few statistically significant estimates, counties close to other major Southern rivers experienced somewhat less mechanization over time.

Overall, in the absence of a catastrophic flood, counties near other major Southern rivers do not experience the black out-migration and increased mechanization that appeared in counties flooded by the Mississippi in 1927. While the Mississippi river is a special river within the Southern United States, other counties near major rivers showed many of the same differences in characteristics prior to 1927. These estimates lend support to the identification assumption that flooded counties would have changed similarly to non-flooded counties in the absence of the flood.

VI.C Plantation Counties and New Deal Programs

One particular empirical concern is that flooded counties are more likely to be "plantation counties," as recorded by Brannen (1924) for 1910.[46] New Deal programs may have displaced tenants from plantations, increasing the availability of harvest laborers and encouraging pre-harvest mechanization in the 1930's (Whatley, 1983; Depew, Fishback and Rhode, 2012). In non-flooded Southern states, however, plantation counties are estimated to have little differential change from 1930 to 1940 in the main outcome variables of interest.[47] Between 1940 and 1970, plantation counties do experience some relative declines in black population and increases in agricultural capital, average farm size, and farmland.[48]

In the main sample of flooded and non-flooded counties, the empirical results are robust to controlling for differential changes in plantation counties.[49] Further, the impacts of the flood on agricultural development are not driven by plantation counties. Allowing for heterogeneous effects of the flood on plantation counties and non-plantation counties, the non-plantation counties experience clear declines in black population and increases in

[45] In a modified version of equation (6), the fraction of county flooded is replaced with a dummy variable for whether the county is within 50km of a major river. The specification controls for changes over each time period that are correlated with state and initial outcome differences.

[46] A plantation is defined as a "unified agricultural organization of considerable size under one management, of practically a continuous tract of land, operated as a single unit with respect to the methods of control of labor and products, all of which may be worked by wage hands, or all or a part of which may be subdivided and let to tenants" (Brannen, 1924, p. 9). Brannen used since-lost census data and judgment to select counties where "plantation farming in these counties is known to be important" (Brannen, 1924, p. 69).

[47] In a modified version of equation (6), the fraction of county flooded is replaced with a dummy variable for whether the county is a "plantation county."

[48] In a modified version of equation (6), as described above, plantation counties have some statistically insignificant relative declines in black population. Relative to 1925, agricultural mechanization is similar in plantation counties through 1940 and higher by 0.23 log points by 1970.

[49] As in equation (6), the specification controls for a dummy variable for whether the county is a plantation county (interacted with year).

agricultural development.[50] The results are also robust to controlling for differential changes associated with five measures of New Deal spending.[51]

VI.D Alternative Interpretations

Consistent with contemporary and historical qualitative accounts, our main interpretation of the empirical results is that flood-induced black out-migration encouraged agricultural development. Black labor availability had discouraged the accumulation of agricultural capital and encouraged smaller-scale farm operation. This Southern system of labor-intensive agricultural production began to break down in flooded areas, previewing the subsequent breakdown of this system throughout the South over the 20th century.

There are two other main channels through which the 1927 flood may have had lasting economic impacts. First, the flood may have caused general economic disruption and the replacement of vintage capital stocks with more technologically-advanced capital.[52] Second, the flood may have changed land productivity.

In the first case, by causing general economic disruption, the flood may encourage landowners to reevaluate and update agricultural production.[53] In particular, reconstruction may replace damaged "vintage" capital goods with newer capital goods, leading to a short-run increase in capital investment and modernized capital equipment in flooded areas. As capital stocks depreciate in non-damaged areas, however, natural replacement leads to convergence in the quantity and age of capital goods.

The empirical results are generally inconsistent with this first alternative interpretation. The value of agricultural capital equipment and machinery is found to diverge over time in flooded counties, rather than increase immediately and converge over time. Initial increases in capital investment were also mainly in older capital goods, such as mules and horses. Technologically-advanced capital goods, such as cotton harvesters, did not replace older

[50] In a modified version of equation (6), the fraction of county flooded is interacted with a dummy variable for whether the county is a "plantation county" and a dummy variable for whether the county is a "non-plantation county."

[51] As in equation (6), the specification controls for per-capita spending through the AAA, public works, relief, loan, and guaranteed loan programs (Fishback, Horrace and Kantor, 2005). Note that New Deal spending is potentially endogenous to the flood, particularly as networks developed by local politicians to obtain flood relief could be later used to secure New Deal spending.

[52] Related alternative explanations are that the flood could have encouraged the coordination and consolidation of land holdings or induced a series of foreclosures that allowed new entrepreneurial farmers to enter. Land ownership was fairly concentrated and stable in this region, so we do not focus on these related alternative explanations. To the extent that land owners attempted to coordinate investments and production, this coordination was mainly in maintaining the status-quo labor-intensive system rather than coordinating over land assembly and increased mechanization.

[53] The lower Mississippi region had an unfortunate history of natural disasters in the early 20th century (Boustan, Kahn and Rhode, 2012); while none were as large as the 1927 flood, this was a volatile region that appears less likely to have settled into economic complacency.

capital goods until well-after the initial reconstruction.

Historically high levels of capital depreciation imply that post-flood capital reconstruction would have few persistent "vintage capital" effects. While tractors are among the more durable capital goods, an approximate annual depreciation rate of 12% implies that roughly 85% of investment in 1927 would have depreciated by 1935 (Hurst, 1933). Investment in agricultural buildings may be more durable; from estimating equation (6), however, the value of agricultural buildings in flooded counties declined slightly by 1930 and 1940.[54]

In the second case, by changing land productivity, the flood may directly impact land values and factor demand. While repeated historical flooding of the Mississippi contributed to the formation of productive soils, one isolated flood would have limited direct benefits for soil productivity. The flood also damaged land improvements, but these were generally rebuilt quickly and substantial new lands were improved and brought under cultivation in flooded counties.[55] It is difficult to know whether the 1927 flood and the subsequent 1928 Flood Control Act increased or decreased landowners' expected flood risk, though there should be less differential change in perceived future risk once controlling for distance to the Mississippi river or limiting the sample to counties near the Mississippi river.[56]

From estimating equation (6), flooded counties experienced little immediate change in cotton productivity or corn productivity.[57] In subsequent years, cotton and corn acreages expanded and there was little systematic change in productivity. These estimates are also consistent with literature on early mechanization being labor-saving but not yield-increasing (Hayami and Ruttan, 1985).

Finally, for interpreting the main results, the flood may have general equilibrium impacts on nearby non-flooded counties. The empirical estimates overstate the aggregate impact of the flood for particular outcomes that are affected oppositely in non-flooded counties. Our interpretation of the results focuses mainly on the flood's relative impacts, however, such as changes in the relative availability of black labor and the relative change in agricultural mechanization and modernization.

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[54] Data on land values and building values are available separately, by decade, from 1900 to 1940. The log value of building values, per farm acre or per county acre, is regressed on the fraction of the county flooded in 1927, state-by-year fixed effects, county fixed effects, and county outcome values in 1900, 1910, and 1920, interacted with each year.

[55] Red Cross efforts to introduce new varieties of crops and livestock were generally limited (Red Cross, 1928). Reconstruction efforts were focused on emergency needs and temporary relief.

[56] The 1928 Act was mandated to protect all of the potentially flooded counties, not just those that were actually flooded, and thus involved substantial upriver tributaries rather than a sole focus on levees. Further, reconstruction and modification of the levee system had little direct effect on available agricultural land, irrigation, or drainage.

[57] The log quantity of cotton or corn yielded per harvested acre is regressed on the fraction of the county flooded in 1927, state-by-year fixed effects, county fixed effects, and county outcome values in 1900, 1910, 1920, and 1925, interacted with each year.

The flood may be expected to have little indirect impact on non-flooded counties in subsequent years and decades, even if the flood initially disrupted non-flooded counties. There may even be small immediate impacts on non-flooded counties' output prices and return on capital, given the degree of integration in agricultural markets and the small share of agricultural output directly affected by the flood. As a test of the magnitude of local economic spillovers, Table 11 reports the estimated change in counties bordering the flooded region, relative to counties 100km from the flood border.[58] Consistent with small local economic spillovers, particularly in the immediate aftermath of the flood, there was little change in counties bordering the flooded region compared to further counties.

VII Conclusion

The Great Mississippi Flood of 1927 was a transformative event in Southern economic history. In a region infamous for oppressive racial institutions, the flood led to an exodus of black agricultural workers. The resulting decline in black labor availability led to change in agricultural practices. Agriculture in flooded counties became substantially mechanized and modernized relative to agriculture in nearby similar non-flooded counties.

The flood imposed immediate direct costs on both white planters and black agricultural workers, though black workers may have benefited in the long-run from coordinated large-scale out-migration. Landowners resisted black out-migration, with physical coercion when possible, in an effort to maintain labor availability and support a persistent system of labor-intensive agricultural production.

The Southern United States experienced a remarkable economic transition from 1940 to 1970, coinciding with large-scale black out-migration. Experiences from the 1927 flood illustrate the role of black out-migration in fostering the mechanization and modernization of agricultural production; indeed, flooded counties maintained their early lead in mechanization through 1970. In under-developed societies with substantial populations of low-wage agricultural laborers, rural out-migration may increase agricultural mechanization and modernization. Whether caused by "push factors," such as rural natural disasters, or caused by "pull factors," such as urban labor demand, decreased agricultural labor availability may promote structural economic development.

[58] Each outcome variable is regressed on the (negative) distance from the flooded region in 100km units, state-by-year fixed effects, county fixed effects, and county outcome values in 1900, 1910, 1920, and 1925 (when available), interacted with each year. An increase in distance from 0km to 100km is equivalent to an increase from the closest counties to the eightieth centile.

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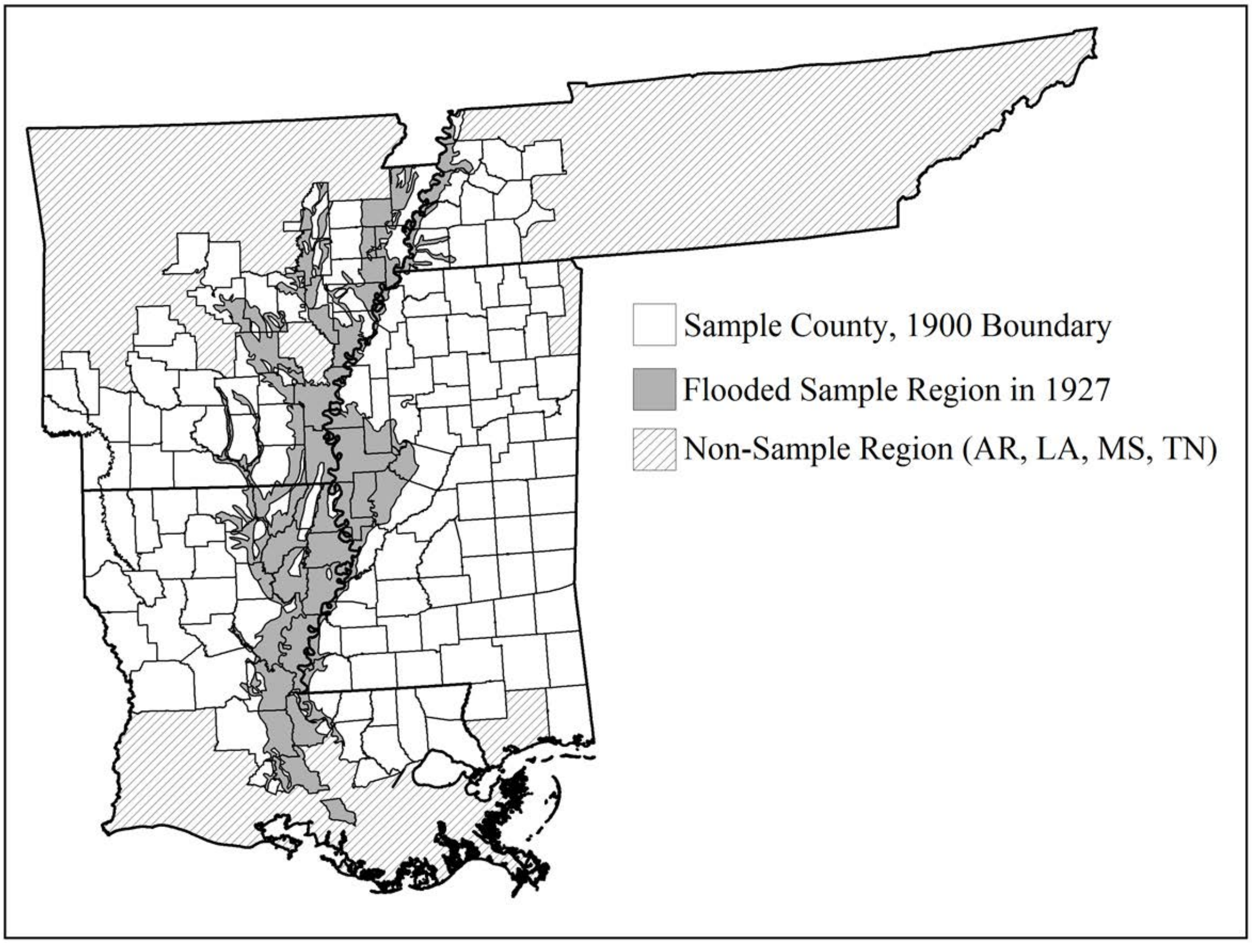
Figure 1. 1927 Flooded Region and Sample Counties (1900 Boundaries)



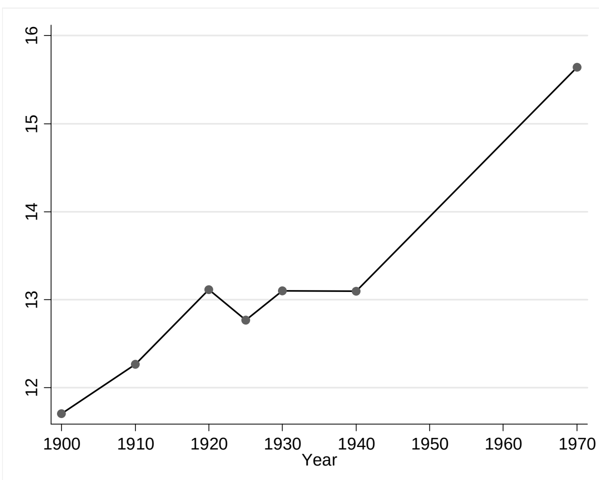
Notes: The 163 sample counties' boundaries are based on county definitions in 1900. County-level data are adjusted to hold these boundaries fixed through 1970. The sample region flooded in 1927 is shaded gray, based on a map compiled and printed by the US Coast and Geodetic Survey. The non-sample region is cross-hashed. Excluded counties are missing outcome data in one of the analyzed years, have less than 15% of reported cropland in cotton in 1920, or have a black population less than 10% of the total population in 1920.

Figure 2. Aggregate Changes in the Sample Region (AR, LA, MS, TN)

A. Log Black Population

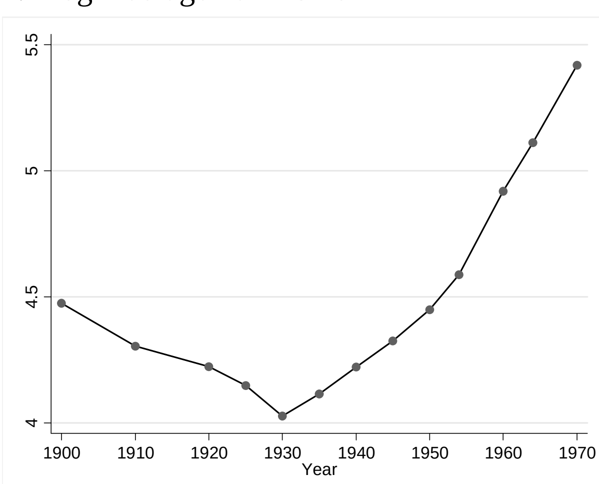
B. Log Population

C. Log Value of Agricultural Capital

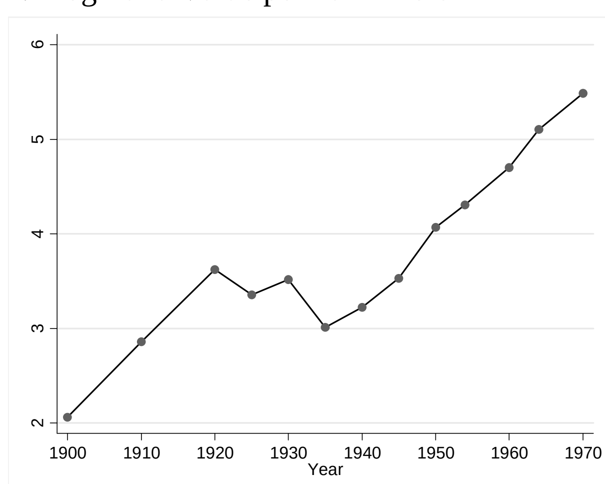


D. Log Number of Mules and Horses

E. Log Average Farm Size



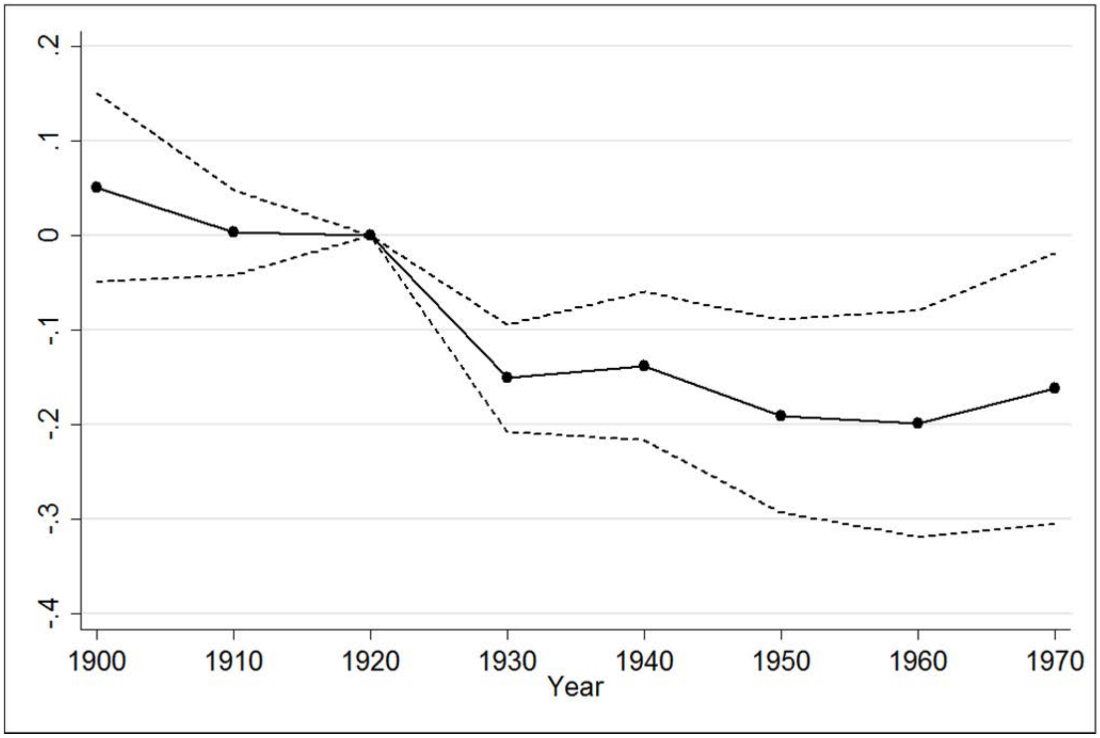
F. Log Land Value per Farm Acre



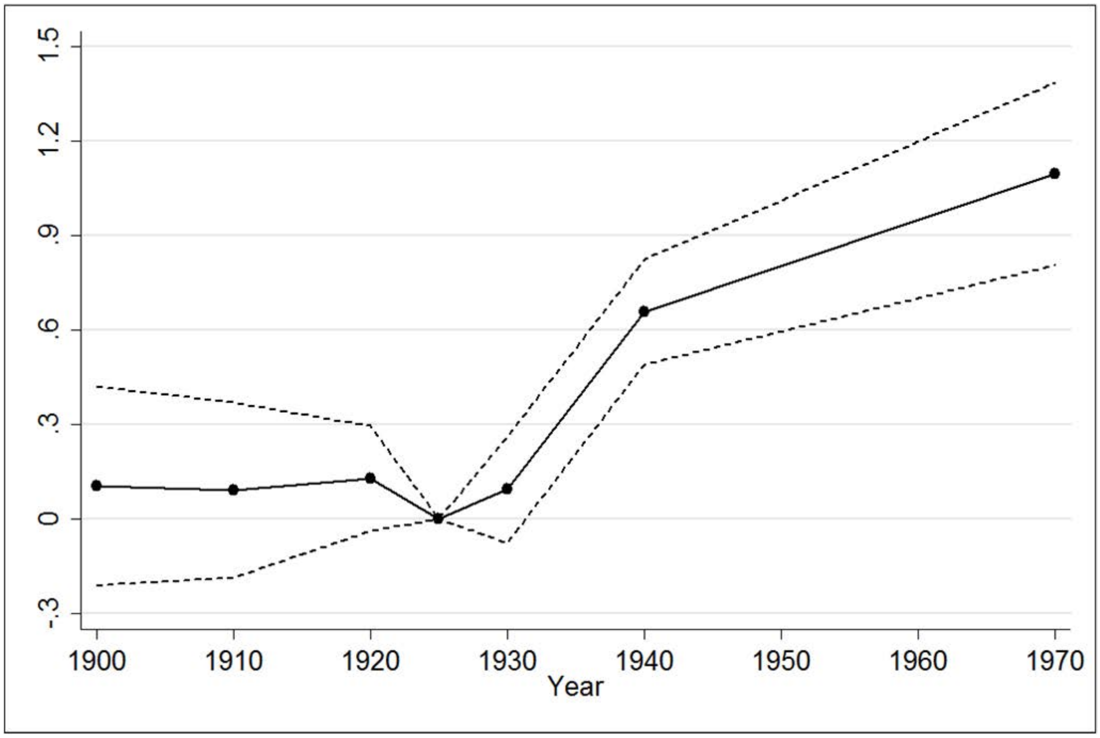
Notes: Panels A-F report aggregated outcomes for the 163 sample counties in each year (Figure 1). Data are from the US Census of Agriculture and the US Census of Population.

Figure 3. Estimated Differences in Black Population and Farm Capital, by Flood Share

Panel A. Log Black Population Share, Relative to 1920



Panel B. Log Value of Farm Equipment and Machinery, Relative to 1925



Notes: Panels A and B graph the estimated coefficients from column 1 of Table 2 and Table 4 (see the table notes for details). The dashed lines indicate 95% confidence intervals.

Table 1. Baseline County Characteristics, by 1927 Flood Share

		Log Difference by 1927 Flood Share:			
	Pre-Flood	Pre-Flood Levels:		Pre-Flood Changes:	
	Sample Mean	Within-State	Controls	Within-State	Controls
	(1)	(2)	(3)	(4)	(5)
Panel A. Population in 1920					
Black Population Share	0.461	0.782**	0.449**	-0.003	-0.055
	[0.201]	(0.101)	(0.133)	(0.022)	(0.029)
Black Population,	2.99	1.003**	0.526*	0.033	-0.052
per 100 county acres	[2.46]	(0.171)	(0.211)	(0.064)	(0.082)
Population,	6.24	0.220	0.077	0.037	0.003
per 100 county acres	[4.33]	(0.133)	(0.176)	(0.057)	(0.071)
Panel B. Agriculture in 1925					
Value of Farm Equipment,	95.0	0.554**	0.250	-0.129	0.044
per 100 county acres	[60.9]	(0.139)	(0.178)	(0.079)	(0.115)
Number of Mules & Horses,	1.56	0.422**	0.080	-0.080*	-0.048
per 100 county acres	[0.84]	(0.141)	(0.172)	(0.040)	(0.057)
Number of Tractors	0.008	1.139**	0.479		
per 100 county acres	[0.010]	(0.284)	(0.390)		
Average Farm Size	66.9	-0.618**	-0.417**	0.017	-0.076
	[21.4]	(0.094)	(0.101)	(0.050)	(0.065)
Farmland Acres,	47.4	-0.144	-0.244	-0.077	-0.135*
per 100 county acres	[17.3]	(0.102)	(0.127)	(0.045)	(0.060)
Value of Farm Land & Buildings,	1606	1.018**	0.702**	-0.272**	-0.065
per 100 farm acres	[1316]	(0.124)	(0.162)	(0.046)	(0.060)
Value of Farm Land & Buildings,	3370	0.875**	0.459*	-0.350**	-0.200*
per 100 county acres	[2094]	(0.168)	(0.197)	(0.061)	(0.081)
Number of Counties	163	163	163	163	163

Notes: Column (1) reports average baseline county characteristics in 1920 (Panel A) and 1925 (Panel B). All variables are reported in levels (not logs) and the standard deviation is reported in parentheses. Column (2) reports the within-state difference for each county characteristic (in logs) by the fraction of the county flooded in 1927: the coefficients are estimated by regressing the indicated county characteristic on the fraction of the county flooded in 1927 and a state fixed effect, weighting by county size. Column (3) reports the estimated difference when controlling also for each county's distance to the Mississippi river, geographic suitability for cotton and corn, terrain ruggedness, and longitude and latitude. Column (4) reports the within-state difference in pre-trends for each county characteristic (in logs): Panel A reports the change from 1910 to 1920 and Panel B reports the change from 1920 to 1925. The coefficients are estimated by regressing the change in the indicated county characteristic on the fraction of the county flooded in 1927 and a state fixed effect, weighting by county size. Column (5) reports the estimated difference in pre-trends when controlling also for the above six county-level variables. Robust standard errors are reported in parentheses: ** denotes statistical significance at 1%, * denotes statistical significance at 5%.

Table 2. Estimated Differences in Population by Flood Share, Relative to 1920

	Log Fraction Black		Log Black Population		Log Population	
Decade:	(1)	(2)	(3)	(4)	(5)	(6)
1900	0.051	-	0.063	-	0.011	-
	(0.051)		(0.116)		(0.098)	
1910	0.003	-	-0.033	-	-0.037	-
	(0.023)		(0.068)		(0.062)	
1920	0	0	0	0	0	0
1930	-0.151**	-0.133**	-0.137**	-0.137**	0.011	-0.018
	(0.029)	(0.028)	(0.050)	(0.045)	(0.047)	(0.054)
1940	-0.138**	-0.167**	-0.052	-0.075	0.086	0.044
	(0.040)	(0.040)	(0.066)	(0.059)	(0.053)	(0.065)
1950	-0.191**	-0.193**	-0.117	-0.153	0.074	0.045
	(0.052)	(0.066)	(0.086)	(0.083)	(0.078)	(0.096)
1960	-0.199**	-0.123	-0.160	-0.189	0.039	0.003
	(0.061)	(0.079)	(0.105)	(0.108)	(0.110)	(0.133)
1970	-0.162*	-0.110	-0.310**	-0.307*	-0.148	-0.045
	(0.073)	(0.093)	(0.116)	(0.131)	(0.131)	(0.153)
Counties	163	163	163	163	163	163

Notes: Each column reports estimated changes in the indicated outcome variable: changes in flooded counties relative to changes in non-flooded counties, relative to the omitted year of 1920. Columns (1), (3), and (5) report coefficients from regressing the outcome variable on the fraction of the county flooded in 1927, state-by-year fixed effects, and county fixed effects. Columns (2), (4), and (6) also control for county outcome values in 1900, 1910, and 1920, interacted with each year. All regressions are weighted by county size. Robust standard errors clustered by county are reported in parentheses: ** denotes statistical significance at the 1% level, * at the 5% level.

Table 3. Estimated Differences in 1920-1930 Migration Rates by Flood Share

	Fraction Moving Out-of-County (1)	Fraction Moving Out-of-State (2)	Fraction Moving Out-of-South (3)
Panel A. All Matched People			
Mean in Non-Flooded Counties	0.661	0.287	0.161
	[0.130]	[0.136]	[0.123]
Difference in Flooded Counties	0.118**	0.113**	-0.003
	(0.031)	(0.033)	(0.040)
Counties with Matched People	162	162	162
Panel B. Black Population Only			
Mean in Non-Flooded Counties	0.698	0.245	0.136
	[0.206]	[0.187]	[0.158]
Difference in Flooded Counties	0.139**	0.177**	0.068*
	(0.046)	(0.041)	(0.030)
Counties with Matched People	153	153	153
Panel C. White Population Only			
Mean in Non-Flooded Counties	0.629	0.296	0.166
	[0.152]	[0.183]	[0.162]
Difference in Flooded Counties	-0.069	0.034	-0.032
	(0.058)	(0.060)	(0.050)
Counties with Matched People	156	156	156

Notes: Column 1 reports the fraction of people, matched between the 1920 census and 1930 census, that appear in a different county. Column 2 reports the fraction of matched people that have left their state from 1920 to 1930, and Column 3 reports the fraction that have left the South from 1920 to 1930. Panel A includes all matched people, panel B limits the sample to those people known to be black, and panel C limits the sample to those people known to be white. Each panel and column reports the mean value in non-flooded counties and the standard deviation in brackets.

Each panel and column reports the difference in migration rate for flooded counties, relative to non-flooded counties, controlling for state fixed effects. All regressions are weighted by the fraction of matched people in each county. Robust standard errors are reported in parentheses: ** denotes statistical significance at the 1% level, * at the 5% level.

Table 4. Estimated Differences in Capital Intensity by Flood Share, Relative to 1925

	Log Farm Capital		Log Mules & Horses		Log Tractors		Log Avg Farm Size	
Decade:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1900	0.105	-	0.058	-			-0.081	-
	(0.161)		(0.099)				(0.081)	
1910	0.092	-	0.031	-			0.047	-
	(0.142)		(0.080)				(0.073)	
1920	0.129	-	0.080	-			-0.017	-
	(0.085)		(0.043)				(0.052)	
1925	0	0	0	0	0	0	0	0
1930	0.093	0.073	0.153**	0.130**	0.243	0.629**	0.060	-0.013
	(0.086)	(0.079)	(0.051)	(0.049)	(0.207)	(0.145)	(0.051)	(0.050)
1935			0.167**	0.150**			0.288**	0.078
			(0.052)	(0.050)			(0.060)	(0.061)
1940	0.657**	0.594**	0.181*	0.182**	0.954**	1.411**	0.264**	0.026
	(0.085)	(0.090)	(0.072)	(0.067)	(0.268)	(0.229)	(0.069)	(0.074)
1945					0.575*	1.097**	0.409**	0.136
					(0.239)	(0.185)	(0.075)	(0.077)
1950							0.566**	0.254**
							(0.085)	(0.092)
1954			-0.283	-0.250	0.188	0.846**	0.704**	0.342**
			(0.152)	(0.135)	(0.270)	(0.189)	(0.095)	(0.109)
1960			-0.663**	-0.610**			1.148**	0.498**
			(0.161)	(0.139)			(0.132)	(0.141)
1964							1.565**	0.733**
							(0.154)	(0.153)
1970	1.096**	1.104**			-0.003	0.711**	1.582**	0.581**
	(0.148)	(0.146)			(0.284)	(0.177)	(0.160)	(0.151)
Counties	163	163	163	163	162	162	163	163

Notes: Each column reports estimated changes in the indicated outcome variable: changes in flooded counties relative to changes in non-flooded counties, relative to the omitted year of 1920. Columns (1), (3), (5), and (7) report coefficients from regressing the outcome variable on the fraction of the county flooded in 1927, state-by-year fixed effects, and county fixed effects. Columns (2), (4), (6), and (8) also control for county outcome values in 1900, 1910, 1920, and 1925 (when available), interacted with each year. All regressions are weighted by county size. Robust standard errors clustered by county are reported in parentheses: ** denotes statistical significance at the 1% level, * at the 5% level.

Table 5. Estimated Differences in Farmland by Flood Share, Relative to 1925

	Log Farmland		Log Value of Farmland per farm acre		Log Value of Farmland per county acre	
Decade:	(1)	(2)	(3)	(4)	(5)	(6)
1900	-0.176*	-	0.310**	-	0.134	-
	(0.070)		(0.094)		(0.126)	
1910	0.021	-	0.019	-	0.040	-
	(0.063)		(0.086)		(0.110)	
1920	0.077	-	0.272**	-	0.350**	-
	(0.047)		(0.048)		(0.064)	
1925	0	0	0	0	0	0
1930	0.152**	0.071	-0.154**	0.012	-0.002	-0.026
	(0.039)	(0.042)	(0.049)	(0.052)	(0.051)	(0.054)
1935	0.239**	0.145**	-0.210**	-0.007	0.029	0.034
	(0.048)	(0.052)	(0.058)	(0.061)	(0.073)	(0.079)
1940	0.372**	0.277**	-0.149**	-0.031	0.223**	0.174*
	(0.048)	(0.059)	(0.046)	(0.057)	(0.063)	(0.072)
1945	0.507**	0.388**	-0.299**	-0.154*	0.208**	0.247**
	(0.067)	(0.074)	(0.055)	(0.074)	(0.068)	(0.083)
1950	0.561**	0.451**	-0.488**	-0.143	0.072	0.231*
	(0.072)	(0.084)	(0.075)	(0.074)	(0.098)	(0.099)
1954	0.632**	0.513**	-0.578**	-0.143	0.053	0.288**
	(0.082)	(0.094)	(0.078)	(0.073)	(0.112)	(0.108)
1960	0.804**	0.651**	-0.630**	-0.159	0.175	0.375**
	(0.093)	(0.113)	(0.085)	(0.093)	(0.126)	(0.133)
1964	0.925**	0.779**	-0.438**	-0.003	0.488**	0.646**
	(0.103)	(0.123)	(0.082)	(0.083)	(0.132)	(0.136)
1970	1.244**	1.079**	-0.574**	-0.075	0.670**	0.755**
	(0.125)	(0.154)	(0.082)	(0.070)	(0.145)	(0.152)
Counties	163	163	163	163	163	163

Notes: Each column reports estimated changes in the indicated outcome variable: changes in flooded counties relative to changes in non-flooded counties, relative to the omitted year of 1925. Columns (1), (3), and (5) report coefficients from regressing the outcome variable on the fraction of the county flooded in 1927, state-by-year fixed effects, and county fixed effects. Columns (2), (4), and (6) also control for county outcome values in 1900, 1910, 1920, and 1925, interacted with each year. All regressions are weighted by county size. Robust standard errors clustered by county are reported in parentheses: ** denotes statistical significance at the 1% level, * at the 5% level.

Table 6. Estimated Differences in Black Population Share and Farm Capital: Robustness to Alternative Specifications

		Controlling for Year-Interacted:					Treatment:	
	Baseline Estimates	Distance to MS River	Suitability for Cotton & Corn	Terrain Ruggedness	Longitude & Latitude	Controls in (2) - (5)	Population Flooded	Propensity Score
Decade:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Black Population Share								
1930	-0.133**	-0.139**	-0.127**	-0.142**	-0.132**	-0.144**	-0.106**	-0.120**
	(0.028)	(0.039)	(0.031)	(0.031)	(0.029)	(0.041)	(0.031)	(0.033)
1940	-0.167**	-0.150**	-0.157**	-0.165**	-0.153**	-0.165**	-0.149**	-0.147**
	(0.040)	(0.045)	(0.038)	(0.042)	(0.040)	(0.046)	(0.039)	(0.045)
1950	-0.193**	-0.185**	-0.196**	-0.184**	-0.174**	-0.202**	-0.181**	-0.166*
	(0.066)	(0.063)	(0.058)	(0.067)	(0.061)	(0.063)	(0.066)	(0.078)
1960	-0.123	-0.152*	-0.126	-0.124	-0.107	-0.170*	-0.128	-0.086
	(0.079)	(0.073)	(0.069)	(0.081)	(0.077)	(0.078)	(0.074)	(0.089)
1970	-0.110	-0.131	-0.122	-0.104	-0.081	-0.146	-0.117	-0.068
	(0.093)	(0.088)	(0.081)	(0.097)	(0.092)	(0.094)	(0.087)	(0.103)
Panel B. Log Value of Farm Capital								
1930	0.073	0.005	0.058	-0.033	0.028	-0.070	0.066	0.088
	(0.079)	(0.098)	(0.083)	(0.089)	(0.080)	(0.104)	(0.087)	(0.085)
1940	0.594**	0.463**	0.555**	0.452**	0.521**	0.378**	0.629**	0.580**
	(0.090)	(0.107)	(0.086)	(0.091)	(0.089)	(0.109)	(0.089)	(0.105)
1970	1.104**	0.818**	1.027**	0.998**	0.905**	0.807**	1.203**	1.124**
	(0.146)	(0.168)	(0.150)	(0.168)	(0.120)	(0.153)	(0.188)	(0.164)
Counties	163	163	163	163	163	163	163	157

Notes: Column 1 reports baseline estimates from Table 2 column 2 (panel A) and Table 4 column 2 (panel B): changes in flooded counties relative to changes in non-flooded counties, relative to the omitted year of 1920. The indicated outcome variable is regressed on the fraction of the county flooded in 1927, state-by-year fixed effects, county fixed effects, and year-interacted county outcome values in 1900, 1910, 1920, and 1925.

Columns 2 - 8 modify the baseline specification. Column 2 controls for counties' distance to the Mississippi river, interacted with each year. Column 3 controls for counties' suitability for cotton and corn, separately interacted with each year. Column 4 controls for counties' ruggedness, interacted with each year. Column 5 controls for counties' longitude and lattitude, separately interacted with each year. Column 6 includes all of the controls from columns 2 - 5. Column 7 instead measures flood intensity using the fraction of population affected by flooding in each county, as reported by the Red Cross. Column 8 controls for counties' estimated flood propensity score, interacted with each year, and limits the sample to counties with overlapping scores (estimated on a county's black population share and fraction of cropland allocated to cotton in 1920).

All regressions are weighted by county size. Robust standard errors clustered by county are reported in parentheses: ** denotes statistical significance at the 1% level, * at the 5% level.

Table 7. Estimated Differences in Black Population and Population: Robustness to Alternative Specifications

		Controlling for Year-Interacted:					Treatment:	
	Baseline Estimates	Distance to MS River	Suitability for Cotton & Corn	Terrain Ruggedness	Longitude & Latitude	Controls in (2) - (5)	Population Flooded	Propensity Score
Decade:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Log Black Population								
1930	-0.137**	-0.139*	-0.122*	-0.172**	-0.167**	-0.170*	-0.168**	-0.143**
	(0.045)	(0.070)	(0.053)	(0.054)	(0.047)	(0.076)	(0.044)	(0.049)
1940	-0.075	-0.060	-0.033	-0.125	-0.107	-0.107	-0.111	-0.071
	(0.059)	(0.074)	(0.069)	(0.067)	(0.059)	(0.083)	(0.063)	(0.064)
1950	-0.153	-0.194	-0.111	-0.181	-0.213*	-0.218	-0.227**	-0.092
	(0.083)	(0.106)	(0.092)	(0.098)	(0.084)	(0.115)	(0.087)	(0.087)
1960	-0.189	-0.286*	-0.141	-0.199	-0.272*	-0.277	-0.302**	-0.089
	(0.108)	(0.135)	(0.114)	(0.126)	(0.106)	(0.141)	(0.111)	(0.112)
1970	-0.307*	-0.385*	-0.273*	-0.278	-0.380**	-0.344*	-0.432**	-0.146
	(0.131)	(0.164)	(0.128)	(0.151)	(0.129)	(0.165)	(0.136)	(0.136)
Panel B. Log Population								
1930	-0.018	-0.015	-0.011	-0.029	-0.030	-0.024	-0.062	-0.022
	(0.054)	(0.066)	(0.062)	(0.058)	(0.050)	(0.072)	(0.056)	(0.061)
1940	0.044	0.038	0.061	0.026	0.026	0.029	0.012	0.055
	(0.065)	(0.075)	(0.070)	(0.069)	(0.062)	(0.078)	(0.070)	(0.073)
1950	0.045	-0.038	0.051	0.027	-0.001	-0.042	-0.009	0.070
	(0.096)	(0.106)	(0.099)	(0.104)	(0.091)	(0.110)	(0.095)	(0.103)
1960	0.003	-0.118	0.006	-0.018	-0.065	-0.112	-0.070	0.020
	(0.133)	(0.148)	(0.131)	(0.145)	(0.131)	(0.149)	(0.131)	(0.138)
1970	-0.045	-0.192	-0.063	-0.067	-0.126	-0.186	-0.129	-0.049
	(0.153)	(0.180)	(0.148)	(0.167)	(0.152)	(0.176)	(0.148)	(0.153)
Counties	163	163	163	163	163	163	163	157

Notes: Column 1 reports baseline estimates from Table 2 column 4 (panel A) and column 6 (panel B): changes in flooded counties relative to changes in non-flooded counties, relative to the omitted year of 1920. The indicated outcome variable is regressed on the fraction of the county flooded in 1927, state-by-year fixed effects, county fixed effects, and year-interacted county outcome values in 1900, 1910, 1920, and 1925 (when available).

Columns 2 - 8 modify the baseline specification, as described in notes to Table 6. All regressions are weighted by county size. Robust standard errors clustered by county are reported in parentheses: ** denotes statistical significance at the 1% level, * at the 5% level.

Table 8. Estimated Differences in Mules and Horses, Tractors, and Farm Size: Robustness to Alternative Specifications

		Controlling for Year-Interacted:					Treatment:	
	Baseline Estimates	Distance to MS River	Suitability for Cotton & Corn	Terrain Ruggedness	Longitude & Latitude	Controls in (2) - (5)	Population Flooded	Propensity Score
Decade:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Log Number of Mules and Horses								
1930	0.130**	0.092	0.128**	0.080	0.106*	0.048	0.110	0.080
	(0.049)	(0.055)	(0.047)	(0.054)	(0.047)	(0.057)	(0.058)	(0.057)
1940	0.182**	0.185*	0.200**	0.126	0.148*	0.155*	0.179*	0.224**
	(0.067)	(0.078)	(0.068)	(0.068)	(0.065)	(0.075)	(0.089)	(0.075)
1954	-0.250	-0.364*	-0.199	-0.218	-0.328**	-0.242	-0.252	-0.164
	(0.135)	(0.159)	(0.138)	(0.140)	(0.111)	(0.127)	(0.155)	(0.151)
1960	-0.610**	-0.672**	-0.553**	-0.469**	-0.675**	-0.460**	-0.590**	-0.507**
	(0.139)	(0.166)	(0.142)	(0.143)	(0.118)	(0.135)	(0.146)	(0.158)
Panel B. Log Number of Tractors								
1930	0.629**	0.589**	0.571**	0.566**	0.597**	0.473*	0.666**	0.396*
	(0.145)	(0.182)	(0.158)	(0.175)	(0.146)	(0.193)	(0.169)	(0.188)
1940	1.411**	1.254**	1.177**	1.184**	1.372**	0.951**	1.451**	0.776**
	(0.229)	(0.282)	(0.213)	(0.259)	(0.208)	(0.261)	(0.259)	(0.252)
1954	0.846**	0.596*	0.712**	0.607**	0.783**	0.403	0.838**	0.694**
	(0.189)	(0.230)	(0.175)	(0.210)	(0.189)	(0.209)	(0.240)	(0.220)
1970	0.711**	0.574**	0.553**	0.595**	0.659**	0.455*	0.722**	0.600**
	(0.177)	(0.220)	(0.169)	(0.197)	(0.177)	(0.204)	(0.226)	(0.209)
Panel C. Log Average Farm Size								
1930	-0.013	0.015	-0.025	0.012	0.025	0.037	0.031	-0.013
	(0.050)	(0.058)	(0.050)	(0.054)	(0.053)	(0.058)	(0.054)	(0.046)
1940	0.026	0.130	0.087	0.024	0.116	0.185*	0.071	-0.033
	(0.074)	(0.076)	(0.073)	(0.079)	(0.074)	(0.082)	(0.083)	(0.072)
1954	0.342**	0.463**	0.465**	0.354**	0.473**	0.609**	0.345**	0.226*
	(0.109)	(0.108)	(0.097)	(0.116)	(0.097)	(0.106)	(0.114)	(0.105)
1970	0.581**	0.532**	0.775**	0.521**	0.760**	0.723**	0.540**	0.374**
	(0.151)	(0.167)	(0.139)	(0.160)	(0.140)	(0.160)	(0.165)	(0.139)
Counties	163	163	163	163	163	163	163	157

Notes: Column 1 reports baseline estimates from Table 4 column 4 (panel A), column 6 (panel B), and column 8 (panel C). Columns 2 - 8 modify the baseline specification, as described in notes to Table 6. Panel B includes 162 or 156 counties. All regressions are weighted by county size. Robust standard errors clustered by county are reported in parentheses: ** denotes statistical significance at the 1% level, * at the 5% level.

Table 9. Estimated Differences in Farmland and Value of Farmland: Robustness to Alternative Specifications

		Controlling for Year-Interacted:					Treatment:	
	Baseline Estimates	Distance to MS River	Suitability for Cotton & Corn	Terrain Ruggedness	Longitude & Latitude	Controls in (2) - (5)	Population Flooded	Propensity Score
Decade:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Log Farmland								
1930	0.071	0.022	0.060	0.014	0.050	-0.023	0.093*	0.052
	(0.042)	(0.047)	(0.042)	(0.047)	(0.039)	(0.046)	(0.047)	(0.049)
1940	0.277**	0.251**	0.276**	0.216**	0.242**	0.203**	0.315**	0.256**
	(0.059)	(0.062)	(0.053)	(0.064)	(0.055)	(0.058)	(0.070)	(0.063)
1954	0.513**	0.438**	0.499**	0.460**	0.437**	0.408**	0.540**	0.471**
	(0.094)	(0.114)	(0.095)	(0.104)	(0.079)	(0.100)	(0.126)	(0.104)
1970	1.079**	0.946**	1.026**	1.043**	1.002**	0.943**	1.185**	0.947**
	(0.154)	(0.198)	(0.152)	(0.176)	(0.141)	(0.177)	(0.218)	(0.183)
Panel B. Log Value of Agricultural Land and Buildings, per Farm Acre								
1930	0.012	-0.023	0.011	0.001	-0.029	-0.043	-0.027	0.004
	(0.052)	(0.058)	(0.053)	(0.057)	(0.057)	(0.064)	(0.049)	(0.051)
1940	-0.031	-0.089	-0.016	-0.062	-0.052	-0.110*	-0.050	-0.021
	(0.057)	(0.057)	(0.051)	(0.058)	(0.057)	(0.055)	(0.058)	(0.062)
1954	-0.143	-0.302**	-0.180*	-0.169*	-0.199**	-0.351**	-0.190**	-0.128
	(0.073)	(0.075)	(0.072)	(0.078)	(0.074)	(0.077)	(0.070)	(0.081)
1970	-0.075	-0.231**	-0.105	-0.119	-0.172*	-0.301**	-0.096	-0.057
	(0.070)	(0.081)	(0.072)	(0.074)	(0.073)	(0.080)	(0.069)	(0.074)
Panel C. Log Value of Agricultural Land and Buildings, per County Acre								
1930	-0.026	-0.090	-0.023	-0.059	-0.082	-0.119	-0.043	-0.046
	(0.054)	(0.061)	(0.052)	(0.060)	(0.051)	(0.065)	(0.056)	(0.061)
1940	0.174*	0.085	0.207**	0.115	0.109	0.055	0.183*	0.154
	(0.072)	(0.073)	(0.064)	(0.077)	(0.066)	(0.073)	(0.082)	(0.081)
1954	0.288**	0.015	0.274*	0.228*	0.065	-0.042	0.267*	0.280*
	(0.108)	(0.119)	(0.111)	(0.115)	(0.091)	(0.100)	(0.127)	(0.118)
1970	0.755**	0.452*	0.759**	0.681**	0.483**	0.401**	0.810**	0.752**
	(0.152)	(0.183)	(0.155)	(0.166)	(0.129)	(0.152)	(0.198)	(0.180)
Counties	163	163	163	163	163	163	163	157

Notes: Column 1 reports baseline estimates from Table 5 column 2 (panel A), column 4 (panel B), and column 6 (panel C). Columns 2 - 8 modify the baseline specification, as described in notes to Table 6. All regressions are weighted by county size. Robust standard errors clustered by county are reported in parentheses: ** denotes statistical significance at the 1% level, * at the 5% level.

Table 10. Estimated Relative Changes in Counties within 50km of other Major Southern Rivers

Decade:	Log Fraction Black (1)	Log Black Population (2)	Log Population (3)	Log Value of Farm Capital (4)	Log Mules & Horses (5)	Log Avg Farm Size (6)	Log Farmland (7)	Log Land Val per farm acre (8)	Log Land Val per county acre (9)
1930	0.009	0.018	0.008	-0.045	-0.012	0.052*	0.021	-0.013	0.001
	(0.012)	(0.026)	(0.021)	(0.038)	(0.022)	(0.023)	(0.016)	(0.027)	(0.024)
1935					-0.004	0.014	0.024	0.002	-0.003
					(0.023)	(0.030)	(0.018)	(0.036)	(0.031)
1940	0.025	0.025	0.001	-0.092	-0.035	0.041	0.029	-0.015	-0.023
	(0.016)	(0.032)	(0.026)	(0.057)	(0.028)	(0.031)	(0.020)	(0.037)	(0.034)
1945						0.065	0.002	-0.042	-0.071
						(0.037)	(0.022)	(0.041)	(0.039)
1950	0.016	0.007	-0.016			0.055	-0.008	0.016	-0.031
	(0.023)	(0.043)	(0.037)			(0.038)	(0.026)	(0.041)	(0.045)
1954					-0.077	0.043	-0.006	-0.028	-0.084
					(0.059)	(0.039)	(0.031)	(0.047)	(0.054)
1960	-0.010	-0.011	-0.011		-0.001	0.056	-0.011	-0.042	-0.095
	(0.030)	(0.054)	(0.054)		(0.066)	(0.043)	(0.043)	(0.047)	(0.064)
1964						0.078	-0.009	-0.054	-0.105
						(0.047)	(0.047)	(0.046)	(0.070)
1970	-0.016	0.003	0.003	-0.190*		0.091	-0.031	-0.020	-0.078
	(0.037)	(0.069)	(0.069)	(0.088)		(0.049)	(0.060)	(0.041)	(0.067)
Counties	243	243	243	243	243	243	243	243	243

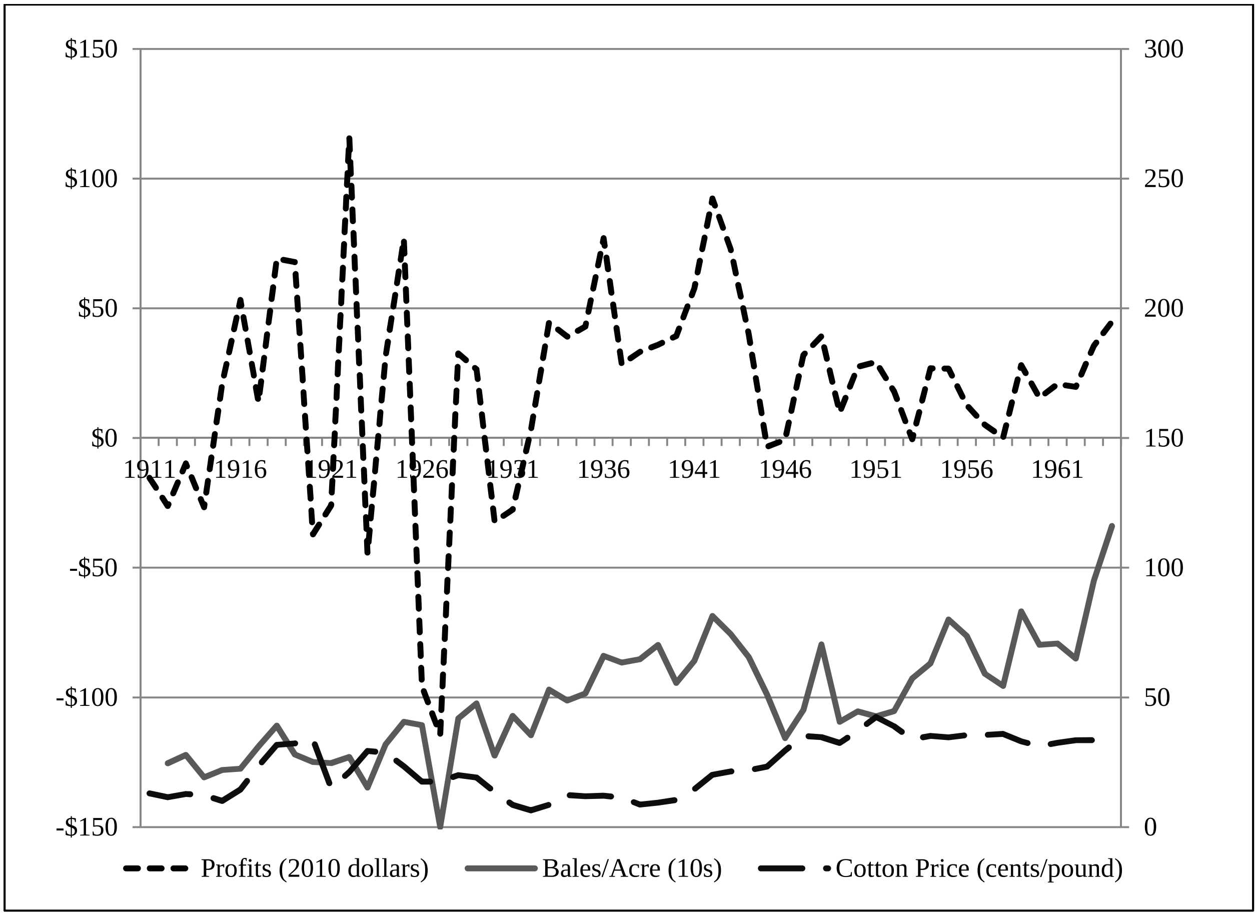
Notes: Each column reports estimated changes in the indicated outcome variable: changes in counties within 50km of a major river relative to changes in counties within 50km - 150km of a major river, relative to the omitted year of 1920 or 1925. The sample is restricted to Southern counties within 150km of a major river, excluding all counties in the main sample region (Figure 1). The indicated outcome variable is regressed on a dummy for whether the county is within 50km of a major river, state-by-year fixed effects, county fixed effects, and county outcome values in 1900, 1910, 1920, and 1925 (when available), interacted with each year. All regressions are weighted by county size. Robust standard errors clustered by county are reported in parentheses: ** denotes statistical significance at the 1% level, * at the 5% level.

Table 11. Estimated Changes in Counties Bordering the Flooded Region, Relative to Counties 100km Away

Decade:	Log Fraction Black (1)	Log Black Population (2)	Log Population (3)	Log Value of Farm Capital (4)	Log Mules & Horses (5)	Log Tractors (6)	Log Avg Farm Size (7)	Log Farmland (8)	Log Land Val per farm acre (9)	Log Land Val per county acre (10)
1930	0.019	0.003	0.003	0.010	-0.033	0.045	-0.022	-0.015	0.060	0.048
	(0.023)	(0.048)	(0.035)	(0.064)	(0.046)	(0.140)	(0.027)	(0.028)	(0.039)	(0.043)
1935					-0.045		-0.029	-0.014	0.022	0.004
					(0.042)		(0.030)	(0.037)	(0.050)	(0.059)
1940	0.035	0.007	0.010	-0.048	-0.078	0.260	-0.060*	-0.032	0.047	0.018
	(0.034)	(0.057)	(0.044)	(0.066)	(0.042)	(0.218)	(0.030)	(0.042)	(0.046)	(0.055)
1945						0.179	-0.035	-0.007	0.102*	0.106
						(0.158)	(0.040)	(0.053)	(0.051)	(0.064)
1950	0.075	0.050	0.050				-0.078	-0.048	0.129*	0.093
	(0.052)	(0.081)	(0.074)				(0.053)	(0.056)	(0.056)	(0.063)
1954					0.052	0.084	-0.112	-0.081	0.114*	0.035
					(0.067)	(0.117)	(0.057)	(0.061)	(0.053)	(0.068)
1960	0.101	0.068	0.064		0.077		-0.105	-0.130	0.076	-0.055
	(0.064)	(0.107)	(0.113)		(0.078)		(0.064)	(0.073)	(0.055)	(0.062)
1964							-0.070	-0.116	0.151**	0.034
							(0.068)	(0.082)	(0.053)	(0.074)
1970	0.102	0.077	0.094	-0.036		0.046	-0.001	-0.111	0.118**	0.027
	(0.076)	(0.127)	(0.140)	(0.084)		(0.121)	(0.064)	(0.111)	(0.042)	(0.099)
Counties	94	94	94	94	94	94	94	94	94	94

Notes: Each column reports estimated changes in the indicated outcome variable: changes in counties bordering the flooded region relative to changes in counties 100km from the flooded region, relative to the omitted year of 1920 or 1925. The sample is restricted to the 94 main sample counties with no flooding (Figure 1). The indicated outcome variable is regressed on the (negative) distance from the flooded region in 100km units, state-by-year fixed effects, county fixed effects, and county outcome values in 1900, 1910, 1920, and 1925 (when available), interacted with each year. All regressions are weighted by county size. Robust standard errors clustered by county are reported in parentheses: ** denotes statistical significance at the 1% level, * at the 5% level.

Appendix Figure 1. Delta Land and Pine Company Profits and Cotton Production



Notes: Delta Land and Pine Company Profits and Bales per Acre are from Dong 1993. Cotton prices are from Historical Statistics of the United States. On the left axis are profits, measured in 2010 dollars. On the right axis are: cotton prices, measured in cents per pound; and cotton bales per acre, measured in units of 10.