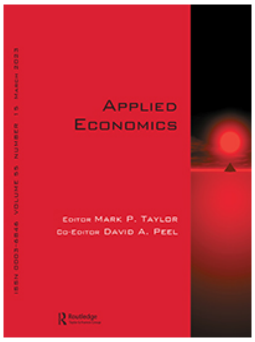

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Applied Economics

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/raec20

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To cite this article: Paul Lombardi & Amer Mriziq (2023) Saving lives one bale at a time: cotton production's connection to lynchings in the U.S. South during the early Twentieth Century, Applied Economics, 55:15, 1700-1712, DOI: 10.1080/00036846.2022.2099522

To link to this article: https://doi.org/10.1080/00036846.2022.2099522

Published online: 13 Jul 2022.

APPLIED ECONOMICS
2023, VOL. 55, NO. 15, 1700–1712
https://doi.org/10.1080/00036846.2022.2099522

Saving lives one bale at a time: cotton production's connection to lynchings in the U.S. South during the early Twentieth Century

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ABSTRACT
The extralegal lynching of innocent individuals from discriminated groups remains a dark, lasting mark on the United States' history. Following the conclusion of the Civil War, former slaves and their descendants were frequent targets for this form of violence. A significant existing literature finds various contributing factors to the pattern of violence. However, the current paper is the first to document a relationship between the weather and the lynching of African Americans in the U.S. South during the early twentieth century. Within affected communities, we find heavy May rains reduced cotton yields which raises the probability of a lynching during the subsequent year.

KEYWORDS
Lynchings, Cotton Production, Weather Fluctuations, Economic Shock

I. Introduction

Can a causal connection be drawn from the weather to conflict using economic factors? Local weather conditions are a key determinant of the output of crops. Fluctuations in crop output can lead to significant changes in prices and overall economic activity. The connection between output and economic activity is particularly strong in agrarian economies as crops are critical to many individuals' livelihood and survival. This threat to livelihoods is a potential basis of the conflict as individuals may seek to remedy the issue through violence—theft or removal of competition. Violence is likely to occur between dissimilar groups—including racial, religious, or political groups.

The current paper examines the connection between weather and conflict in the U.S. Cotton South during the early twentieth century. The Cotton South provides an ideal candidate to test the mechanism as these states' economies relied heavily on cotton production. Using cotton yields as a proxy for economic performance, we observe how communities respond to exogenous changes in the economy due to fluctuations in the weather. To measure the level of conflict in communities, we use data on the number of lynching incidents.

Lynchings[1] are a form of mob extrajudicial punishment that came to prominence in the U.S. South during the century following the Civil War. Without judicial review, lynching victims were publicly hung and shot by large groups as punishment for criminal acts. The public and extreme nature of lynchings led to the events being well documented. Between 1882 and 1968, the Tuskegee Institute documents 4,743 cases.[2] The extreme nature of lynchings has also led to speculation regarding their origins. Previous explanations range from psychological to political to economic. Based on an economic mechanism, the current paper considers the plausibility of lynchings being connected to weather fluctuations.

We find lynchings are correlated with local weather conditions in the Cotton South during the early twentieth century. In our first stage estimates, we show that rainfall during the month of May is a statistically significant determinant of changes in cotton yields. Using May rainfall as an instrumental variable for cotton yields, we find a negative statistically significant relationship between cotton yields and the probability of a lynching occurring for the year following the harvest. Cotton yields are a proxy for economic

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[1]We provide a more detailed history of lynchings in a later section—Historical Background on Southern Lynchings.
[2]Based on several studies, the number of documented lynchings varies between four and five thousand. The case evidence comes from newspaper articles. Therefore, researchers argue the estimates are a lower bound as rural lynching were not always documented by newspapers.

performance in the community. Therefore, we find a lynching is less likely to occur when the economy is doing well.

II. Literature review

The current paper contributes to an extensive literature that finds a correlation between the weather and conflict. Hsiang and Burke (2014) examine over fifty papers on the topic. The papers have spatial scales ranging from an individual building to the global and temporal scales, from an hour to a millennium. Researchers consistently observe a strong correlation between the weather and conflict measures. However, the actual mechanisms that link the weather with conflict are not uniform, and the researchers (Hsiang and Burke 2014) suggest that multiple mechanisms are potentially at work. Hsiang and Burke (2014) discuss eight potential mechanisms connecting weather fluctuations and conflict: government capacity, labour markets, inequality, food prices, migration and urbanization, logistics, misattribution, and psychology.

Of the eight mechanisms, the current paper fits within the group based on the misattribution mechanism. Individuals wrongly attribute deteriorations in the local economy to leaders (Hibbs 2006 and Miguel, Manacorda, and Vigorito 2011), the government (Hsiang 2010; Barrios, Bertinelli, and Strobl 2010; Melissa, Jones, and Olken 2012), or individuals (Miguel 2005; Beck and Tolnay 1990). For example, following droughts and flooding in rural Tanzanian farming villages, Miguel (2005) observes the number of 'witch' killings increases as individuals attribute the weather shocks to elderly female family members. Other weather-related witch trials include examples from Salem, Massachusetts (Mixon 2005), and Europe (Oster 2004). However, misattribution is not isolated to individuals. In pre-modern Europe, Anderson et al. (2015) found persecution of the Jewish minority increased following colder growing seasons. In the U.S. Cotton South, contemporary commentators and researchers (Beck and Tolnay 1990) frequently document whites blaming blacks for social and economic problems. We take this research further by connecting the economy to the weather.

Within the broader literature on the relationship between conflict and the weather, our research relates to a subset that uses rainfall as an instrumental variable to predict conflict in agrarian societies. After instrumenting for economic growth rates with rainfall, researchers find a negative shock of five percent increases intercounty conflict for the following six months (Miguel, Satyanath, and Sergenti 2004). At the micro-level, extreme levels of rainfall, drought or flooding, increases the probability of the killing of 'witches' in rural Tanzania (Miguel 2005).[3]

The current paper contributes to a growing literature on the economic consequences of shocks, weather and boll weevil, to cotton production in the U.S. South during the early twentieth century. Ager, Brueckner, and Herz (2017) use county-level data to measure the boll weevil's impact on farm size, number of tenant farmers, and labour force participation rates. The authors find the number of cash tenants and black female labour force participation rates decrease following the boll weevil's arrival. Bloome, Feigenbaum, and Muller (2017) find the decrease in tenancy following the boll weevil's arrival reduces the share of blacks marrying at young ages. Farmers switch agricultural production out of cotton and into corn as cotton yields decline due to the boll weevil (Fabian, Olmstead, and Rhode 2009). Black school attendance rates increase (Baker 2015). Lombardi (2019) found a similar pattern following drier Mays. The Great Mississippi Flood of 1927 led to African American out-migration and more capital-intensive cotton production (Hornbeck and Naidu 2014).

Our research directly contributes to the literature examining the link between cotton production and lynching in the U.S. Cotton South. Based on a time series analysis, Beck and Tolnay (1990) found a correlation between aggregate cotton prices and lynchings. However, the researchers only observed the pattern between 1882 and 1900. The authors suggest the lack of a correlation for lynchings occurring between 1900 and 1930 is due

[3]A consideration when using rainfall as an instrumental variable for crop production is irrigation systems. The presence of such systems can reduce or eliminate the correlation between local rainfall and crop production as farmers are able to water their crops through other means. The current paper is fortunate as the share of irrigated farmland in the U.S. South during the sample period is low (i.e., less than 1%).

to the declining role of agriculture, 'Jim Crow' laws, and the out-migration of whites and blacks. Using county-level data, Christian (2017) observes similar patterns.

The mismatch in findings between the current paper and Beck and Tolnay (1990) is likely related to differences in observation level. The use of aggregate price levels misses variation at the local level and poorly measures local economic activity. If overall supply is low, output in some areas may still be above average. The economy in these areas would be strong due to the combination of higher prices and output. The reverse case is feasible, too (i.e. low prices and output). Local yields are a better measure of local economic conditions, which is critical as local economic activity is the basis of the connection between rainfall and lynchings.

III. Historical background on Southern lynchings

While the targets evolved over time, lynchings' goal of punishing and threatening dissidents remained the same. Lynchings' namesake, Charles Lynch, ordered the extralegal punishment of Loyalists during the American Revolution. Prior to the Civil War, abolitionists were victims of Southern mobs. During the Reconstruction period, Southern mobs turned their focus to Southern Republicans and their supporters – blacks. Following the return of Southern Democrats to power, Southern blacks violating Jim Crowe or segregation laws were targeted. In western states, frontier justice led to the lynching of criminals.

Lynchings occurred across the U.S., but primarily in the southern states. Only four states in the contiguous U.S. do not have a documented lynchingMassachusetts, Rhode Island, New Hampshire, and Vermont. While widespread, lynchings are predominately a Southern institution. Ninety percent of documented lynchings occurred in Southern states. The Southern bias for lynchings led to blacks being the dominant race of lynching victims-seventy-two percent.[4] During the Reconstruction period, southern mobs targeted both black and whites. Following the resurgence of Southern Democrats, lynching victims were almost exclusively black. Outside of the South, other marginalized groups were targeted, including Chinese, Hispanics, and Italians.

Commentators and social scientists frequently agree lynchings have an economic basis but debate the exact mechanism. The majority of explanations for lynchings fall under the umbrella of 'threat models'. Blacks threaten different aspects of southern white supremacy (Beck and Tolnay 1990). Following the Civil War and emancipation of slaves, Southern blacks' voting rights threatened whites' political power. Therefore, lynchings were used to subvert black voting resulting in a positive correlation between lynchings and black population densities (Beck, James, and Stewart 1989). Breaking Jim Crowe laws and interracial marriages threatened caste boundaries (Inverarity 1976). Following disenfranchisement, Southern whites' greatest danger was the economic threat from blacks. Observers notice a clear connection between Southern economic activity and lynchings: ' … periods of relative prosperity bring reductions in lynching and periods of depression cause an increase'. (Raper 2017). Commentators frequently attribute the peak of lynchings in the 1890s to the arrival of the boll weevil and low cotton prices. Beck and Tolnay (1990) found Southern lynchings correlated with lagged cotton prices during their sample period. While agreeing on a connection between lynching and the economy, the exact mechanism is a source of disagreement. Raper (2017) argues lynchings results from employment competition between white and black farm labourers. Hovland and Sears (1940) argue the connection between lynchings and the economy results from goal frustration. Whites violently lash out against blacks, seeing them as the source of misfortune.

Beyond economic factors, researchers suggest southern lynchings have a psychosexual explanation. Williamson (1997) argues lynchings against African Americans were to deter interracial relationships, particularly between black men and white women. While allegations of rape predicated lynchings, Beck and Tolnay (1990) found only about a third of lynchings were motivated by sexual reasons. Given the disparity, Kousser et al. (1998) suggest both economic and psychosexual factors

[4]The percentage is based on the Tuskegee Institute's lynching records.

could play a role. Throughout the year, psychosexually motivated lynchings would occur to deter sexual relationships between blacks and whites; and economically motivated lynchings would be seasonal (i.e. tied to the cotton production) (Kousser et al. 1998). The current paper does not address the possibility of psychosexual motivations, but finds strong evidence supporting an economic explanation.

The prevalence of lynchings declined dramatically in the 1930s with significant changes to cotton production in the Southern United States. The Agricultural Adjustment Act incentivized landowners to switch from the current labour-intensive cotton production process to a capital-intensive version. The switch led to declines in demand for agricultural labour, and contracts moved away from tenant agreements to wage labour (Markovitz 2004 and Beck and Tolnay 1990). In addition to production changes, the rural South continued to experience out-migration by both whites and blacks and the spread of the boll weevil. These factors combined to reduce the significance of cotton to the southern economy and ability to incite lynchings.

IV. Data

The Historical American Lynching (HAL) dataset provides information on lynching victims. The dataset ranges from 1882 to 1930. The dataset has information on every reported lynching in the U.S. during this period. Critical to the current paper, each entry includes the date and location of the incident. The[5] information allows us to link the lynching to the appropriate weather division. After matching the event to the correct division, we generate an indicator variable equal to one if a lynching occurred between August and July of the following year. The intuition for choosing August is farmers could potentially predict yields by this point in the crop's development.[6]

Weather data comes from the National Oceanic and Atmospheric Administration's nClimDiv dataset. The dataset begins in 1895 and runs through the present. The level of observation is the climate division. Divisions are composed of several counties, and each state comprises six to ten divisions. Division boundaries generally follow county lines. NOAA groups counties within a division based on similarities in their respective weather patterns. Figure 1 shows a map of the contiguous United

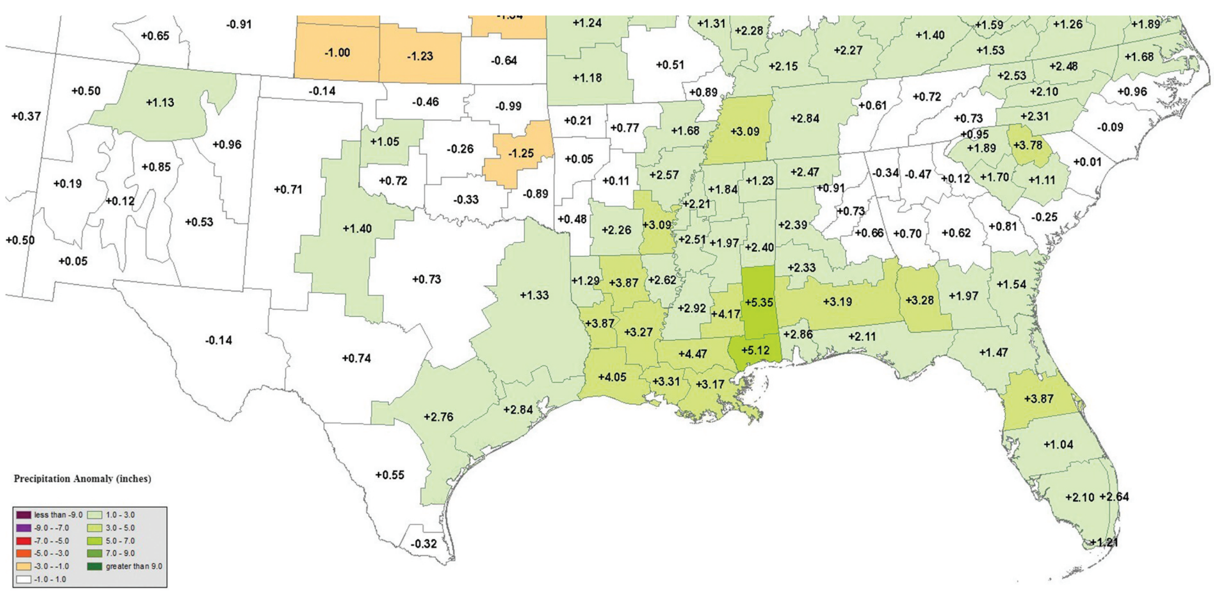

Figure 1. Map of the contiguous United States broken down into climate divisions. Source: National Oceanic and Atmospheric Administration/National Weather Service Prediction Center

[5]The dataset includes additional information on the victims including: name, gender, race, and alleged crime.
[6]The results are robust to choosing different months to start in. The critical period is the time in-between the harvest and the planting of the next crop.

States broken down by climate division. Following previous researchers (Lombardi 2019; Christopher and Rhode 2012; Moore 1917), we use May rainfall in inches to measure precipitation. Figure 2 provides the reader with a visual representation of the precipitation variation our identification strategy relies on.

We gather population controls from the U.S. Decennial and Agricultural Censuses. From the U.S. Decennial, we collect information at the county level on the local population. The measures include the totals for the overall, urban, and black populations. The Agricultural Census provides data on the farming community at the county level. We collect information on the total number of farms and tenants and land-owning farmers by race. Finally, we aggregate the county-level data from the two censuses to the division level. Table 1 provides the aggregated variables' descriptive statistics (i.e. number of observations, mean, standard deviation, minimum and maximum).

The Agricultural Census provides the data used to generate cotton yields for the divisions. We collect data on the total number of bales produced and the number of acres of cotton grown for each county. Based on the values aggregated to the division level, we generate division cotton yields by dividing the total number of bales by the total number of acres. The resulting unit of measure is the number of 500 lb. cotton bales per acre of cotton grown.

Table 2 provides the reader with the mean values for the independent variables included in our

Table 1. Descriptive statistics.

	N	Mean	SD	Min	Max
Population	199	257,841	151,951	61,316	892,286
Urban Population	199	61,030	76,243	0	487,094
Black Population	199	94,187	58,578	333	296,258
Farms	199	27,676	15,660	1,657	88,749
White Owners	199	6,756	8,289	0	48,178
White Tenants	199	4,423	5,411	0	29,522
Black Owners	199	1,363	1,529	0	6,718
Black Tenants	199	5,733	7,964	0	42,649
Cotton Yield	199	0.38	0.11	0.14	0.71
May Rainfall	199	6.19	1.86	2.56	12.54
Cotton Acres	199	285,189	233,185	150	1,084,338

All values are at the climate division level. The units for Cotton Yield is 500 lb bales per acre of planted cotton farmland. The May Rainfall measure is in inches of rain.

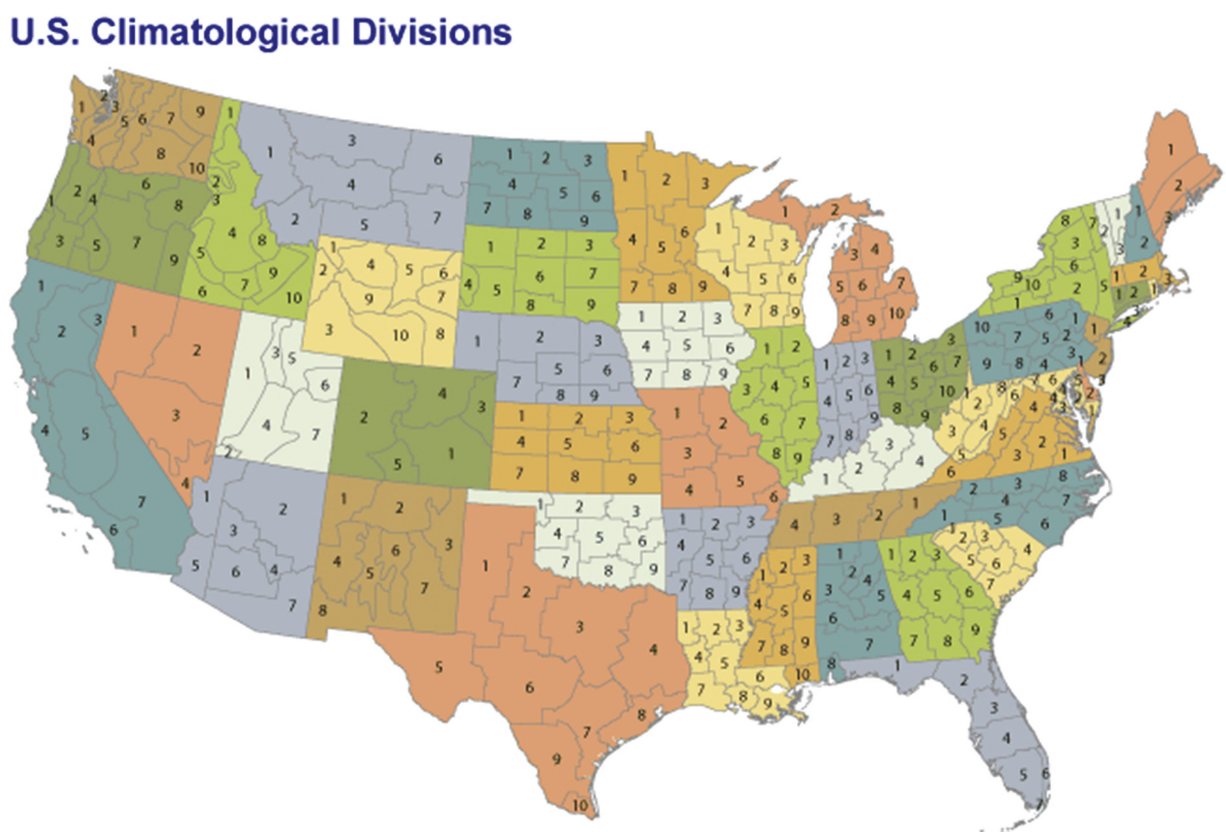

Figure 2. Map of the Southern United States with climate division precipitation anomalies in the 1920 sample year. Source: National Oceanic and Atmospheric Administration/National Weather Service Prediction Center

Table 2. Mean values for independent variables by full sample, lynching status, and differencing.

Total:	Full Sample	Divisions with No Lynchings	Divisions with Lynchings	Difference	P-Value
Population	257,841	259,823	252,781	7,042	0.77
Urban Population	61,030	66,482	47,108	19,373	0.11
Black Population	94,187	85,777	115,665	−29,888	0.00
Farms	27,676	26,947	29,536	−2,589	0.30
White Owners	6,756	6,511	7,380	−869	0.51
White Tenants	4,423	4,023	5,442	−1,419	0.10
Black Owners	1,363	1,123	1,974	−851	0.00
Black Tenants	5,733	4,440	9,037	−4,597	0.00
Cotton Yield	0.38	0.39	0.36	0.03	0.14
May Rainfall	6.19	6.18	6.22	−0.04	0.89
Observations	199	143	56		

All values are at the climate division level. The units for Cotton Yield is 500 lb bales per acre of planted cotton farmland. The May Rainfall measure is in inches of rain.

analysis based on several sampling levels. The first column shows the mean values for the full sample. The second and third columns show the mean values based on an indicator variable for divisions with and without a lynching in a given sample year. The final two rows show the difference in means for the two subsamples and if the difference is statistically significant. The size of the black population is positively correlated with the probability of a lynching. The mean number of blacks, black tenant farmers, and black farm owners are all strongly statistically higher in regions that experience a lynching. The mean values of the overall population, the total number of farms, number of white farm owners, and May rainfall are not significantly different in the two subsamples. The final group of borderline significant variables fit our expectations (i.e. lynchings are less likely in divisions with higher urban populations and cotton yields).

V. Empirical methods

We measure conflict with a dummy variable for a lynching happening in an area. Lynching is a particularly violent form of conflict perpetrated by multiple individuals, usually under the guise of false accusations. Due to the extreme nature of lynchings, their occurrence was well documented. However, the extreme nature also means the measure only captures information at a high level of conflict. A broader measure of conflict is preferable, but a uniformly available measure does not exist for the period of analysis.

Data limitations also dictate the usage of a proxy variable for economic output. The ideal variable to understand the economy's role in connecting weather fluctuations and conflict would capture just the changes to the overall economy due to the weather. Measuring economic output at the sub-state level is challenging even in the modern U.S., let alone in the early twentieth century. Therefore, we focus on cotton yields as a proxy for economic activity in the Cotton South. The cotton and the infrastructure associated with its production and sale represented a large share of the overall economy in the Cotton South during the early twentieth century. May rainfall can also extract the exogenous portion of changes in cotton yields.

As part of our estimates, we instrument for the potential endogeneity of cotton yields. We use May rainfall as an instrumental variable in the first stage of our two-stage least squares estimates. A valid instrument must be correlated with the endogenous variable but not directly with the dependent variable. Based on previous research, we know May rainfall is a strong determinant of cotton yields in the Cotton South (Lombardi 2019). Our first stage estimates confirm this finding as the f-statistics are over fifteen, and the variable is statistically significant with a *t*-statistic greater than three. For excludability, rain is unlikely to affect the propensity of individuals to perpetrate a lynching due to the timing. Our dummy variable for a lynching does not begin until closer to the October harvest (e.g. the measure goes from August to July of the subsequent year). If May rain directly caused lynching, unrelated to the economy, our estimates would be biased towards zero as our variable would link the lynching to the previous year's May rainfall.

To establish a correlation between weather and conflict, we regress our dummy variable for lynching on a measure of rainfall and controls using Ordinary Least Squares. The equation has the form:

$$Lynching_{td} = \alpha + \beta_1 Rainfall_{\boldsymbol{td}} + \boldsymbol{\beta X}_{td} + \delta_t + \gamma_d + \varepsilon_{td}$$

where *Lynching* is a dummy variable equal to one if a lynching occurs in the division during the period and zero otherwise. *Rainfall* equals the number of inches a division experiences during the month of May.[7] ***X*** is a matrix of controls for population and farming characteristics by division and year. We include year, t, and division, d, fixed effects.

When we estimate the connection between cotton yields on lynchings, we use two-stage least squares because of the potential endogeneity of cotton yields. In the first stage, we predict cotton yields with the amount of rainfall a division receives during the month of May:

$$Cotton\ Yield_{td} = \alpha + \beta_1 Rainfall_{td} + \boldsymbol{\beta X}_{td} + \delta_t + \gamma_d + \varepsilon_{td}$$

The model includes year and division fixed effects and a matrix of control variables from the second stage—*X*. We use the predicted cotton yields in the second stage:

$$Lynching_{td} = \alpha + \beta_1 \widehat{Cotton\ Yield}_{td} + \boldsymbol{\beta X}_{td} + \delta_t + \gamma_d + \varepsilon_{td}$$

The dependent variable is an indicator variable for a lynching occurring in a division. In addition, we include controls for the division's population and farming characteristics and fixed effects for division and year.

While coefficients in the Linear Probability Models (i.e. the reduced form and second stage) above are easier to interpret, the models can lead to biased and unrealistic estimates. Therefore, we also estimate nonlinear versions of the above models to verify our results are not driven by functional-form bias. Specifically, we re-estimate the reduced form model with a Probit model and two-stage least squares with an IV Probit model. We find the same relationships in terms of sign and significance in both our linear and nonlinear models.

One concern with our instrumental strategy is the excludability of weather (e.g. weather fluctuations affect the probability of lynchings through some other mechanism than cotton yields). If true, the weather variable cannot be used as an instrument. Researchers have observed a direct connection between high temperatures and violence (Kenrick and MacFarlane 1986; Jacob, Lefgren, and Moretti 2007). However, the several-month gap between our weather and lynching measures makes the issue unlikely. Previous studies only show a contemporaneous connection between high temperatures and violence—not lagged incidents (Hsiang and Burke 2014).

Another potential violation of the exclusion restriction deals with law enforcement. A wet May lowers cotton yields leading to low tax revenues. The lower tax revenues cause the local government to cut back on police force expenditures. Therefore, the change in policing capacity, not income, leads to a higher probability of lynchings. The explanation does fit the government capacity mechanism for connecting the weather with violence. However, the mechanism is unlikely as lynching perpetrators did not fear prosecution as many posed for photos with the body, and less than one percent were convicted of a crime. Local law enforcement members frequently participated in lynchings. From the criminal perspective, the extrajudicial threat of lynching was omnipresent. A gap exists between actual criminal activity and being targeted for lynching as historians and commentators frequently observe victims were innocent of their alleged crimes.

The rural historical environment of our analysis introduces another potential threat to establishing a causal relationship between cotton yields and lynchings. Cotton production is primarily occurring in rural agricultural regions. Rural regions may lack the state capacity or media coverage to observe and document lynchings, particularly during poor harvest periods. If true, the pattern causes rural regions to under or not report lynchings and introduces measurement error weakening the correlation between cotton production and lynchings. We cannot say this potential attenuation bias is not

[7]In the second set of estimates, we use the same approach but replace the rainfall measure with cotton yields.

Table 3. The probability of a lynching occurring in weather division regressed on may rainfall using OLS.

	(1)	(2)	(3)
May Rainfall	0.049**	0.058***	0.072***
	(0.021)	(0.021)	(0.021)
Total:			
Population		0.003	0.004
		(0.005)	(0.005)
Urban Population		−0.003	−0.004
		(0.005)	(0.005)
Black Population		−0.006	−0.005
		(0.008)	(0.009)
Farms		0.147	−0.006
		(0.24)	(0.022)
White Land Owning Farmers			−0.113
			(0.145)
White Tenant Farmers			0.243
			(0.254)
Black Land Owning Farmers			0.52
			(0.491)
Black Tenant Farmer			−0.187
			(0.117)
Statistics:			
Number of Divisions	67	67	67
Number of Observations	199	199	199
R^2	0.569	0.578	0.594

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Errors are clustered at the climate division level. All regressions include year and division fixed effects. The controls are divided by ten thousand.

Table 4. The Probability of a lynching occurring in weather division regressed on May rainfall using probit.

	(1)	(2)	(3)
May Rainfall	0.302	0.438**	0.973***
	(0.190)	(0.219)	(0.323)
Total:			
Population		4.35	−1.117**
		(4.08)	(0.498)
Urban Population		−10.88*	−1.650**
		(6.04)	(0.672)
Black Population		0.003	−1.158
		(0.007)	(0.886)
Farms		−0.002	0.857
		(0.021)	(2.168)
White Land Owning Farmers			5.516
			(5.348)
White Tenant Farmers			1.139
			(4.771)
Black Land Owning Farmers			−5.532
			(10.56)
Black Tenant Farmer			−0.306
			(0.149)
Statistics:			
Number of Divisions	32	32	32
Number of Observations	96	96	96
Pseudo R^2	0.343	0.455	0.559

standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Errors are clustered at the climate division level. All regressions include year and division fixed effects. The controls are divided by ten thousand.

present, but we still establish a statistically significant relationship between cotton yields and the probability of lynchings.

VI. Results

In Table 3, we present evidence that weather fluctuations correlate with violent conflict. We estimate our reduced form equation with Ordinary Least Squares.[8] The parameter of interest is the coefficient on the measure of May rainfall. As May rainfall increased, so did the probability of a lynching occurring during the next fourteen months. The model includes division fixed effects, so the coefficient suggests that every inch of May rain above a division's average increases the probability of a lynching by 5%. The correlation is statistically significant in all three specifications and increases with the addition of controls for the local population (column 2) and farming community (column 3). Surprisingly, none of the population and farming characteristics are significant.

The results in Table 3 show weather fluctuations are correlated with lynchings but do not provide the reader with an intuition for the connection. A possible mechanism is the weather affects the local economy. If economic hardship links the weather with conflict, we expect to observe a negative relationship between the economy and conflict (i.e. as economic output declines, the probability of violence increases). Due to their reliance on cotton production, we use cotton yields as a proxy for the local economic health of areas in the Cotton South.

Table 5 provides the reader with the OLS estimates for the correlation between a division's cotton yields and the probability of a lynching occurring.[9] The estimates show no apparent connection between yields and lynchings. The coefficient is statistically insignificant in all three specifics. A division's population and farming characteristics again fail to provide information on the probability of a lynching occurring.

A concern with the results in Table 5 is the potential endogeneity of cotton yields. Yields may be capturing information from a third variable that affects both yields and the propensity for violence.

[8]We re-estimate the relationship between weather changes and lynching with a probit model due to the binary outcome variable. We provide the results in Table 4. The results generally match the sign and significance of the estimates from the linear probability model.

[9]We re-estimate the relationship between cotton yields and lynching with a probit model due to the binary outcome variable. We provide the results in Table 6. The results surprisingly suggest a positive relationship between yields and lynching. However, as with the OLS estimates in Table 5, the potential endogeneity of yields reduces the informational value of the results.

Table 5. The probability of a lynching occurring in weather division regressed on a cotton yields using OLS.

	(1)	(2)	(3)
Cotton Yield	0.549	0.618	0.543
	(0.441)	(0.521)	(0.574)
Total:			
Population		0.342	0.363
		(0.476)	(0.472)
Urban Population		−0.398	−0.437
		(0.494)	(0.509)
Black Population		−0.225	−0.136
		(0.800)	(0.915)
Farms		−0.988	−1.27
		(2.51)	(2.50)
White Land Owning Farmers			−0.726
			(1.49)
White Tenant Farmers			1.01
			(2.61)
Black Land Owning Farmers			4.71
			(6.36)
Black Tenant Farmer			−0.842
			(1.31)
Statistics:			
Number of Divisions	67	67	67
Number of Observations	199	199	199
R^2	0.376	0.380	0.385

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Errors are clustered at the climate division level. All regressions include year and division fixed effects. The controls are divided by ten thousand.

Table 6. The probability of a lynching occurring in weather division regressed on a cotton yields using probit.

	(1)	(2)	(3)
Cotton Yield	8.004*	8.141*	17.96**
	(4.17)	(4.25)	(8.34)
Total:			
Population		0.694*	0.699*
		(0.385)	(0.416)
Urban Population		−1.26**	−1.65***
		(0.635)	(0.6409)
Black Population		0.289	1.12
		(0.553)	(0.754)
Farms		−2.06	−4.13**
		(2.51)	(2.50)
White Land Owning Farmers			14.2**
			(6.25)
White Tenant Farmers			−12.0**
			(5.36)
Black Land Owning Farmers			13.9*
			(8.40)
Black Tenant Farmer			0.766
			(1.01)
Statistics:			
Number of Divisions	32	32	32
Number of Observations	96	96	96
Pseudo R^2	0.341	0.436	0.550

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Errors are clustered at the climate division level. All regressions include year and division fixed effects. The controls are divided by ten thousand.

Due to historical events, including slavery and the Civil War, the direction of causality between violence and cotton production in the Cotton South is

Table 7. First stage estimates from cotton yields regressed on May rainfall using OLS.

	(1)	(2)	(3)
May Rainfall	−0.018***	−0.017***	−0.019***
	(0.003)	(0.004)	(0.004)
Total:			
Population		−0.003	−0.002
		(0.007)	(0.007)
Urban Population		0.011	0.011
		(0.007)	(0.005)
Black Population		−0.008	−0.011
		(0.012)	(0.012)
Farms		0.078**	0.073**
		(0.033)	(0.033)
White Land Owning Farmers			−0.001
			(0.026)
White Tenant Farmers			0.006
			(0.037)
Black Land Owning Farmers			0.170**
			(0.086)
Black Tenant Farmer			0.010
			(0.017)
Statistics:			
Number of Divisions	67	67	67
Number of Observations	199	199	199
R^2	0.738	0.762	0.776

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Errors are clustered at the climate division level. All regressions include year and division fixed effects. The controls are divided by ten thousand.

not apparent. Given these issues, we use weather fluctuations to extract the exogenous portion of cotton yields. The instrument variable approach also addresses the concern of simultaneous causality.

The first stage estimates from our two-stage least squares model are in Table 7. Similar to previous researchers (Lombardi 2019; Christopher and Rhode 2012; Moore 1917), we find that May rainfall is a powerful determinant of cotton yields. The coefficient is statistically significant at the one percent level and has a T-statistic over three in all three specifications. A one standard deviation increase in May rainfall leads to a ten percent decrease in cotton yields. Of the second stage control variables, the total number of farms and black land owning farmers are both positively correlated with cotton yields and statistically significant at the five percent level.

Table 8 shows the second stage estimates from two-stage least squares correlating predicted cotton yields with the probability of a lynching occurring in the subsequent period.[10] The final row of the table shows the amount of May rainfall is a strong predictor of cotton yields in October as the F-statistic is over twenty in all three specifications. We find

[10] The estimates based on a IVProbit model are presented in Appendix Table A1. The results generally fit the patterns observed in Table 8 in terms of sign and significance. Besides the function form, the modeling differs from Table 8 in terms of the instrumental variable. The IVProbit relies on an indicator variable for extremely wet Mays based on definitions from the National Ocean and Atmospheric Administration in place of the raw rainfall amounts. Convergence issues during the model estimation necessitated the modification.

Table 8. The probability of a lynching occurring in weather division regressed on a predicted cotton yields using 2SLS.

	(1)	(2)	(3)
Cotton Yield	−2.70***	−3.53***	−3.82***
	(0.946)	(1.32)	(1.14)
Total:			
Population		0.222	0.328
		(0.382)	(0.394)
Urban Population		0.022	0.034
		(0.418)	(0.425)
Black Population		−0.898	−0.930
		(0.671)	(0.721)
Farms		4.21*	3.73*
		(2.30)	(2.25)
White Land Owning Farmers			−1.18
			(1.47)
White Tenant Farmers			2.65
			(2.13)
Black Land Owning Farmers			11.7**
			(5.23)
Black Tenant Farmer			−1.50
			(0.962)
First Stage Statistics:			
R^2	0.738	0.762	0.776
F-Statistic	36.40	22.24	25.22
Second Stage Statistics:			
Number of Divisions	67	67	67
Number of Observations	199	199	199
Centered R^2	0.330	0.242	0.224
Uncentered R^2	0.518	0.455	0.442

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Errors are clustered at the climate division level. All regressions include year and division fixed effects. The controls are divided by ten thousand.

a negative statistically significant relationship between cotton yields and lynchings. The result suggests that conflict declines as the economy strengthens. The negative relationship is consistent with the reduced form estimates in Table 3.

The empirical estimates show a correlation between weather fluctuations and violent conflict based on an economic channel. The results in Table 3 show that wet Mays increased the probability of a lynching occurring in the subsequent year. However, the results do not provide information on why the correlation. Tables 5 and 8 consider an economic link between the weather and conflict. After using weather fluctuations to address the issue of endogeneity, we find increases in the cotton yields, a proxy for economic activity, lead to a decrease in the probability of a lynching. The finding shows the relationship between weather and conflict has an economic basis.

Table 9. The probability of a lynching occurring in weather division regressed on May rainfall using OLS by cotton intensity subsamples.

	Base Case	Total Cotton Acres	
Percentiles:	0 - 100	0 - 25	25 - 100
May Rainfall	0.072***	0.019	0.082***
	(0.021)	(0.049)	(0.026)
Total:			
Population	0.004	−0.007	0.032
	(0.005)	(0.133)	(0.062)
Urban Population	−0.004	−0.007	−0.018
	(0.005)	(0.102)	(0.074)
Black Population	−0.005	−0.171	−0.041
	(0.009)	(0.250)	(0.105)
Farms	−0.006	0.713	0.114
	(0.022)	(1.07)	(0.260)
White Land Owning Farmers	−0.113	.638	−0.233
	(0.145)	(0.606)	(0.245)
White Tenant Farmers	0.243	−1.88	0.428
	(0.254)	(1.80)	(0.347)
Black Land Owning Farmers	0.52	−1.31	0.530
	(0.491)	(3.33)	(0.600)
Black Tenant Farmer	−0.187	2.48	−0.223*
	(0.117)	(2.43)	(0.131)
Statistics:			
Number of Divisions	67	18	53
Number of Observations	199	49	150
R^2	0.594	0.751	0.599

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Errors are clustered at the climate division level. All regressions include year and division fixed effects. The controls are divided by ten thousand.

VII. Extension

Our main result of a strong correlation between Southern economic conditions and lynchings raises the question: Will the relationship be stronger in climate divisions with greater reliance on cotton production? While the base sample covers the ten states that produced about 95% of annual cotton, not all of the divisions within the sample rely heavily upon cotton. To measure cotton reliance, we ranked divisions by their total cotton acres and then split the sample at the 25th percentile into low and high-intensity divisions (i.e. 0 to 25th and 25 to 100 percentile) In[11] Table 9, we provide the results from re-estimating the reduced form model in column 3 of Table 3 with the two new subsamples. (We include the initial results in column 1 for reference.) For low-intensity divisions, we fail to find a statistically significant relationship between May rainfall and the probability of a lynching. For high-intensity divisions, the point estimate is higher than the base case (0.082 versus 0.072) and still statistically significant at the 1% level.[12] The

[11] Splitting the sample into high and low intensities regions represents a challenge as the majority of the sample produces large quantities of cotton. The 25th percentile division planted about 80,000 acres annually. The median division planted about 235,000 acres annually.

[12] While smaller, the estimate from base model falls within the 95% CI for the coefficient on May rainfall in the high intensity model, so we cannot say the coefficients are statistically different from each other.

results in Table 9's second and third columns provide evidence that greater cotton intensity causes regions to be more susceptible to economic fluctuations and lynchings caused by May rainfall.[13]

VIII. Conclusion

We use the Cotton South to examine the connection between weather fluctuations and conflict. We find May rainfall is a strong predictor of cotton yields. Using May rainfall to generate exogenous variation in cotton yields, we find cotton yields are negatively correlated with the probability of a lynching occurring in the subsequent year following the harvest. Cotton yields are a good proxy for local economic activity as communities in the Cotton South relied heavily on cotton production during the sample period. As communities experienced economic hardships due to weather fluctuations, the chance for violent conflict (e.g. lynchings) in the community grew.

Beyond connecting weather fluctuations to lynchings, the paper contributes to the literature by raising questions about the weather's ability to shape society in the Cotton South during the early twentieth century. Previous research on the region links lynchings with black disenfranchisement (Beck, James, and Stewart 1989) and migration (Beck and Tolnay 1990). During the Reconstruction period, white supremacy groups used lynchings and other forms of intimidation to prevent blacks from voting. After the election of Southern Democrats, violent intimidation mixed with legal barriers further excluded blacks from voting. Over six million blacks left the South during the first half of the twentieth century as part of the Great Migration. Researchers point to the lack of rights and the constant threat of violence, including lynchings, as 'push' factors for blacks to leave the South.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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[13]A dataset with county level variation or more observations would be better suited for disentangling the intensity effect from our main result. We found a similar pattern when re-estimating our 2SLS model in Table 8 with the two subsamples (i.e., a higher coefficient estimate in the high intensity sample versus the base case and an insignificant result with the low intensity sample). However, May rainfall becomes a weak instrument in the low intensity estimates due to sample size—49 observations and 18 clusters.

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Appendix A

Table A1. The probability of a lynching occurring in the weather division regressed on a predicted cotton yields using IVProbit.

	(1)	(2)	(3)
Cotton Yield	−6.77	−10.05***	−10.03***
	(4.44)	(3.61)	(3.64)
Total:			
Population		0.256	0.167
		(0.222)	(0.196)
Urban Population		−0.573	−0.254
		(0.363)	(0.299)
Black Population		0.048	−0.220
		(0.359)	(0.401)
Farms		0.24	0.745
		(1.09)	(1.05)
White Land Owning Farmers			2.90
			(2.48)
White Tenant Farmers			−1.42
			(2.18)
Black Land Owning Farmers			−2.58
			(4.18)
Black Tenant Farmer			0.001
			(0.558)
First Stage Statistics:			
Number of Divisions	67	67	67
Number of Observations	199	199	199
R^2	0.738	0.762	0.776
F-Statistic	36.40	22.24	25.22

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Errors are clustered at the climate division level. All regressions include year and division fixed effects. The controls are divided by ten thousand.