The Beginning of American Agricultural Grants:

The AAA and Cotton Agriculture During the Great Depression

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Abstract

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The modern farm programs started during the New Deal of the 1930s. The most controversial of the farm programs have always been the payments to take land out of production for major crops. The Agricultural Adjustment Administration (AAA) began this process in 1933 for cotton, wheat, field corn, hogs, tobacco, rice, and milk in 1933 and reinstated the programs after the Supreme Court declared the 1933 Agricultural Adjustment Act unconstitutional in January 1936 under the Soil Conservation and Domestic Allotment Act of February 1936. The payments continue to this day. Using county level data from 1919, 1924, 1929, 1934, and 1939 we examine the impact of the AAA acreage reduction payments on a variety of output and input measures in cotton agriculture when the program was initially introduced. The results show that increases in the mean AAA cotton payments per county were associated with a large share of the changes in mean values for the following outcomes: the drop in cotton acreage harvested, the drop in cotton output, the rise in cotton output per acre, the rise in noncotton acres harvested, the drop in real cotton revenues, the drop in the number of farms, the drop in the farm population, the rise in the real value of machinery and implements, the rise in the number of tractors, the rise in the real value of fertilizer, the drop in the number of mules and horses, and the drop in the real value of farm products.

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There has been plenty of narrative discussion of the New Deal versions of the AAA during the 1930s.[1] Yet, there had been very little quantitative work measuring their impact at low levels of aggregation until Fishback, Horrace, and Kantor (2005, 2006) collected county level data and found that the AAA payments did not have positive effects on net migration or economic activity. The lack of positive impact was confirmed in a state panel study of personal income per capita and private employment by Fishback and Kachanovskaya (2015). Meanwhile Depew, Fishback, and Rhode (2013) found that the AAA contributed to sharp reductions in the numbers of tenants and croppers, particularly black tenants and croppers, in cotton agriculture in the South. This damage to labor opportunities was a significant reason for the lack of a positive

[1]For example, see Clarke 1991, Halcrow 1953, Nourse, et al. 1937, Fearon 2007, Volanto 1996 and 2005, and Whatley 1983a.

effect of the AAA on overall economic activity. On the other hand, Kitchens and Fishback (2015) found that Rural Electrification Administration (REA) loans that provided access to electricity had a number of positive effects on welfare in rural areas and Hansen and Libecap (2004) found that the AAA efforts to prevent soil erosion helped prevent a second occurrence of the Dust Bowl when drought hit the Midwest in the 1970s.[2]

This New Deal research has yet to address the direct impact of the AAA and of most of the farm lending programs on their central goals. The AAA was designed to reduce output of a crop as a means of raising farm prices and farm incomes from that crop. Total cotton output fell in the South in the 1930s, but it is hard to tell how much of the fall was due to the AAA program. Economists have long suspected that AAA recipients removed their least productive land from cultivation and more intensely farmed the remaining acres with fertilizer, new seeds, and new machinery, thus mitigating the reduction in output. The payments along with credit at subsidized interest rates may have allowed cotton farmers to raise cotton output per acre in the 1930s after several decades of flat trends.

Farm operators made a wide range of decisions that were likely affected by the AAA payments. The decisions included whether to continue farming, the size of the farm, how much acreage to plant for each crop, and the use of machinery, work animals, and fertilizer. These decisions fed into how much cotton was produced and measures of cotton yields per acre and farm. It is less commonly known that the AAA allowed cotton farmers to shift the land to non-commercial production with a potential rise in the number of acres harvested in other crops. All of these factors combined to change farm income in the year of production as well as have

[2] See Fishback (2017) for a survey of a broad range of studies of New Deal programs.

impact on the value of land and farm buildings as a measure of the capitalized expected value of future incomes.

We analyze the relationships between all of these variables and the AAA acreage reduction payments in cotton counties by developing a new panel data set of county level information from the U.S. agricultural censuses that covers the years 1919, 1924, 1929, 1934, and 1939. The identification of the impact comes through controlling for a variety of factors that influence the inputs and outputs, as well as the use of an instrumental variable based on the policy design of the AAA. The panel data set allows us to control for New Deal farm loan and relief and public works expenditures and a variety of demographic features, as well as measures of temperature, rainfall, drought and excess wetness, the Dust Bowl, and the 1927 Mississippi Flood.[3] County fixed effects control for time-invariant geography and soil quality. State-by-year fixed effects to control for state regulations and for crop prices and the prices of inputs, which varied relatively little within each state except through distance from markets, which was unchanged over time. In addition, we estimate the model with an instrumental variable strategy, using the insight that the policy for distributing AAA funds was based on measures of the average base output of cotton between 1928 and 1932 in reports in the USDA archives.

The results show that increases in the mean AAA cotton payments per county were associated with a large share of the changes in mean values for the following outcomes: the drop in cotton acreage harvested, the drop in cotton output, the rise in cotton output per acre, the rise in noncotton acres harvested, the drop in real cotton revenues, the drop in the number of farms, the drop in the farm population, the rise in the real value of machinery and implements, the rise

[3] For discussions of these other New Deal programs see Appendix C.

in the number of tractors, the rise in the real value of fertilizer, the drop in the number of mules and horses, and the drop in the real value of farm products.

II. AAA Cotton Program

Plans for programs to employ a government agency to control crop output had been passed by Congress in the 1920s but vetoed by the President. These were followed by some attempts at voluntary programs to limit output during the Hoover years. When they entered office in 1933, the Roosevelt administration and Democratic Congress established Agricultural Adjustment Administration payments to take land out of production of designated crops.[4] The AAA payments we use in the analysis are the cotton rental and benefit payments made for the period from May 12 1933 through June 30, 1936 for each county contained in a mimeographed "Memorandum to the Administrator from the Division of Finance received August 11, 1936" (Agricultural Adjustment Administration, Division of Finance 1936), which we found in the National Agricultural Library. The grants were distributed to farmers who agreed to participate in a program of controlled production. Farmers signed production agreements in which they would curtail the acreage they planted. The program was said to be voluntary, but various taxes and regulations made it costly not to join the program. In the original AAA the benefit payments were financed from special processing taxes on the commodity being curtailed. There was a general belief that most of the burden of the processing taxes would be passed on to consumers of farm products.

[4] The original list of crops eligible for AAA adjustment in 1933 included wheat, cotton, corn and hogs, milk and its products, tobacco, rice, and cattle. In 1934 sugarbeets and sugarcane, peanuts, rye, flax, barley, grain, and sorghums were added. Potatoes were added in 1935. See Agricultural Adjustment Administration 1936, p. 19.

Under the Soil Domestic Allotment Act (SDAA) that was enacted after the AAA was declared unconstitutional, the processing taxes were eliminated and the funds were appropriated from the general budget.[5] [6] The goal of the program was to increase the incomes of farmers both through benefit payments and by raising the ratio of farm market prices to nonfarm prices to pre World War I levels (1920s levels for tobacco) through the curtailment of the output of specific crops.

The AAA was administered by the Department of Agriculture, which established state and local committees or associations of producers to help administer the act. The administration of the Act was often done through a series of programs specific to the individual crops.[7] Thus, the geographic distribution of the AAA funds across counties was determined by the crop

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[5] In *United States v. Butler, et. al* on January 6, 1935 the U.S. Supreme Court declared that the original Agricultural Adjustment Act "regulates agricultural production in violation of the tenth amendment to the Federal Constitution; that the (processing) tax is a mere incident of such regulation; that the benefit-payment plan…amounts to coercion by economic pressure; and that the act is accordingly invalid. The case came about when the U.S. government sued the receivers for the Hoosac Mills Corporation to collect certain processing and floor-stock taxes imposed by the AAA (Agricultural Adjustment Administration 1936, 99).

[6] In the South contracted acreage could not be used for cash crops. In five cotton states (Arkansas, Oklahoma, Texas, Georgia, and South Carolina) about three-fourths of the cotton acreage was planted to home food and feed crops, chiefly corn, wheat, and oats, soybeans, cowpeas, sorghums, Sudan grass, lespedeza and Mung beans. About one-tenth was planted to new seedings of permanent pasture and meadow crops. About one-eighth went to soil improvement crops to be turned over. About 2 percent was left idle. In Arkansas and Tennessee considerable acreage was moved to planting trees, primarily black locust (Agricultural Adjustment Administration 1936, 48).

[7] The description of the original AAA relies heavily on Nourse, Edwin G., Joseph S. Davis, and John D. Black (1937) and Agricultural Adjustment Administration (1936). Descriptions of the post 1935 AAA are based on Agricultural Adjustment Administration (1937). After 1935 under the Domestic Soil and Allotment Act, the AAA administrators claimed much greater flexibility. "In 1936 committees of representative farmers in 2400 counties worked out tentative over-all goals for agriculture in their counties." The AAA annual report suggested that the AAA expanded so that it could be applied to all farms and not just the specific crops under the pre-1935 AAA rules. The new goal shifted from reestablishing the pre-World War I parity between farm prices and the prices of goods farmers bought to reestablishing income parity for farmers and non-farmers to the pre-war levels (Agricultural Adjustment Administration, 1937, pp. 10-13.)

Under the original AAA, the state and county extension services played important roles in distributing information and gathering data on the program. There were 4000 county agricultural adjustment associations on the 1933-35 program. In 1936 there were 2711 county agricultural conservation associations, organized everywhere but in the Northeast, where they were appointed in 1936 but are being formed as the others were in 1937 (Agricultural Adjustment Administration, 1937, pp. 56-57) After 1935 the AAA state committees were appointed by the Secretary of Agriculture, the local county agricultural conservation association officers were elected by the producers. These officers recommended bases, productivity indexes, and normal yields for the farms in the community and assisted with paperwork and monitoring of the grants.

choices made prior to the AAA involvement and by the parameters set for each of the crops. For each crop the actual distribution of funds was determined by a complex interaction between federal administrators, local committees, local extension agents, and the farmers who had some degree of choice about whether they would join the program. For signing up to reduce acreage, a farmer's payments were based on multiplying the national price set for acreage reduction and their average yield per acre over a base period, typically the previous five years. The federal decision makers influenced the attractiveness of the program by the national price they set for acreage reduction and by the acreage that they asked the area to take out of production. In the case of tobacco and cotton the federal decision-makers added a degree of coercion to the system by levying heavy taxes on any production beyond designated limits.[8] The local administrators influenced the attractiveness of the program through their decisions upon issues like the base-year yields for the individual farmer and their decisions about the acreage the farmers had had in production. In addition, their actions to market the program and cajole their neighbors into joining helped determine the sign-up rates.

Nourse, et. al. (1937, pp. 120-21) describe substantial variations in sign-up rates for the initial AAA programs across crops and across regions.

> The major reasons for failure to secure sign-ups as high as 90 percent or more in some areas of concentration are that many of the farms are always involved in leasing arrangements, estate management, or the like in such a way as to make participation difficult, or have been so irregular in their production as to make provision of acceptable bases very difficult or are small farms using family labor

[8]The taxes were added under the Bankhead Cotton Control Act for cotton and the Kerr-Smith Tobacco Control Act. See Nourse et. al., (1937, pp. 39-40, 96-102).

> mainly or entirely and hence not able to curtail expenses in proportion to the reduction in acreage. The reasons for the smaller sign-ups in the regions where production is small and irregular are mainly the difficulties of providing satisfactory bases, the large number of small farms, lack of interest, and preference not to be bothered with the details of participation for the sake of the small benefit payment. Also sign-up campaigns were not prosecuted with the same degree of intensiveness in such areas.

Our sense from reading the documents is that the AAA offers were packages that involved the level of payments and the amount of acreage to be reduced. The package nature of the deal suggests that looking at the total receipt from the AAA is likely to give a good picture of the quality of the deals being offered. There was some variation in the take-up rates on the AAA offers. Cotton signups were 73.2 percent of base acreage in 1933 and then rose to 94.4 percent in 1935.[9]

The impacts of AAA payments on farmers' choices are complex. In the Appendix we develop a model of a representative farmer's choices about allocations of inputs between an AAA crop and a non-AAA crop in which tractors stand in for nonlabor/nonland inputs. The farmer faces price risk for the AAA crop and maximizes the expected utility of his profits. Since we are estimating changes over five year periods, this is a long run model with no fixed inputs. Given the general functional form of the model's production function, the model does not lead to many unequivocal comparative statics; therefore, the predictions below are intuitive ones that have commonly been made. One reason to write down the model is to show that the input

[9] For descriptions of the operations of the individual programs under the original AAA, see Nourse, et. al., (1937, pp. 92-114, 123-146, 287-323) and Agricultural Adjustment Administration (1936, pp. 119-278).

demands are functions of the probability of high and low prices for the AAA crop, the prices of the non-AAA crops, the wage rate for farm work, the price of tractors, the amount of land the AAA offers to take out of production and the payment per acre taken out of production.

Farmers were required to reduce the amount of acreage planted in cotton if they accepted AAA funds. In the South farmers were restricted to using the land taken out of cotton production to the production of noncash crops to feed themselves and animals as well as forage crops like clover. We might anticipate that they would shift acreage into those uses, although they might have just left the land fallow. It is commonly believed that the farmers took their less productive land out of cotton production and that they applied more inputs like fertilizer and machinery to the land that remained in production. Such applications would have increased cotton output per acre. If so, overall cotton output would not have fallen as much proportionally as the acreage planted in cotton. They might have increased the use of labor on that land, although Depew, Fishback, and Rhode (2013) found that there was a reduction in the number of share tenants and croppers in 1934 due to the AAA. The effects on total revenue from cotton depended on how the fall in cotton output increased cotton prices.[10] The current and future effects on cotton revenue likely also showed up in the value of land and buildings.

The AAA payments may have had conflicting effects on tractor adoption, the primary machine being adopted at the time. The AAA payments might have stimulated tractor adoption by providing more cash and income to farmers who were able to substitute tractors for workers. On the other hand, the production of feed and forage on the acreage released by the AAA payments made it less costly to feed plow mules and horses because the farmer could either

[10]The cotton market was an international market. Fox, Fishback, and Rhode (2011) found that prior to the New Deal programs from 1895 to 1932 that cotton prices at the state level were generally not influenced much by changes in weather and output at the state level.

avoid transport costs on the cash purchase of these products or because market prices were lower due to increased supply available. For farmers who took the land completely out of production or put it into production where tractors were less useful, the reduction of acreage under cultivation made tractors less appealing.

III. Empirical Analysis

We have county information from the Agricultural Censuses conducted in 1920, 1925, 1930, 1935, and 1940, which provide information on flows of activity for the prior year and stocks for the year stated. County-level evidence on the cotton payments under the AAA are compiled from mimeographed reports for the first three fiscal years of 1934, 1935, and 1936 (Agricultural Adjustment Administration. Division of Finance, 1935 and 1936).

Data availability on the New Deal programs causes us to perform two analyses. The first is a short run analysis that focuses on the impact of the AAA payments when comparing outcomes in 1934/35 to the earlier years. We then estimate a longer run analysis that allows us to examine the impact of the AAA in 1939 compared with the pre-New Deal years to show the adjustments made in response to New Deal policies after several years of activity.

Both analyses use panel data methods in which the equation is estimated first using Ordinary Least Squares with county, year, and state-by-year fixed effects. We then estimate the equation again with an instrument for AAA cotton spending in a Two-Stage Least Squares Analysis. Each observation is for a county i in state s in year t. The equation is

$$O_{ist} = \beta_0 + \beta_1 AAACot + \beta_2 OtherND_{ist} + \beta_3 Pop_{ist} + \beta_4 X_{ist} + \Delta_i + \Theta_t + \Theta_t * S_s + \varepsilon_{st}, \quad 1)$$

where O_{ist} is the outcome measure in year t and county i in state s. The outcome measures with information for 1919, 1924, 1929, 1934, and 1939 include cotton acres harvested, cotton output in bales, cotton output per acre harvested. The number of farms, the number of horses; the number of mules; the number of noncropper tenants; and the number of cropper tenants are available for 1920, 1925, 1930, 1935, and 1940. Non-cotton acres harvested are available for 1924, 1929, 1934, and 1939, and farm population is available for 1925, 1930, 1935, and 1940. The real value of implements and machinery on farms deflated by the wholesale price index for farm machinery (1926=100) is available for 1920, 1925, 1930, and 1940, while the real value of fertilizer on farms deflated by the wholesale price index for fertilizer inputs (1926=100) is available for 1919, 1924, 1929, and 1939. Outcomes with information for 1930 and 1940 include the number of tractors (1930, 1940); the number of autos (1930, 1940), and the number of trucks (1930, 1940), while the value of farm products sold, used, and traded deflated by the CPI is available for 1929 and 1939.

III.1 Right-Hand Side Variables in the Equation

The key variable of interest is the cotton AAA payments, $AAACOT_{ist}$. In the longer run 1939 analysis the cotton payments are the ones made between 1933 and June 1936, the last year for which we have data. In the short run 1934 analysis the payments were made from July 1, 1933 to June 30, 1934. In the longer run analysis, $OtherND_{ist}$ is a vector that includes total non-cotton AAA payments from July 1, 1933 through June 30, 1936; the total farm loan amounts distributed from July 1, 1933 through June 30, 1939; total public works and relief payments from July 1, 1933 through June 30, 1939; and total RFC loan amounts from Feb 1932 through June 30, 1939. All of the New Deal values are deflated with the CPI (1967=1). In the short run analysis

through 1935, we estimate two versions of $OtherND_{ist}$. The first includes only AAA non-cotton payments during the period July 1, 1933 to June 30, 1934. The second adds the values of farm loans, public works and relief payments, and RFC loan amounts to reduce problems arising from omitting them from the analysis.[11] Because these measures include information from 1935 through 1939, there is a risk of bias arising from the response of these factors to the values of the dependent variables from 1934.

The analysis focuses on totals for all of these values rather than amounts per farm or per farm person because the number of farms is essentially a choice variable of interest in this process, as farmers decide to continue or not continue farming. We wanted to show the relationship between each of the dependent variables and the New Deal funds without them being influenced by including number of farms in the denominator for each. In essence, the county unit is being treated like a single large farm in which the number of farm operations is being chosen by an internal market. We include total population on the right hand side as a means of controlling for the different sizes of the populations over time in the counties.[12]

The X_{ist} vector contains a series of socio-economic correlates: percent illiterate, percent colored, percent urban, percent foreign born, and the shares attending school of children ages 7 to 13, 14 and 15, 16 and 17, and 18 to 20. Each of these are reported by the census in 1920, 1930, and 1940 and we used straight-line interpolations of the percentages to obtain the 1925 and 1935 values.

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[11]The potential for omitted variable bias from leaving out a New Deal variable likely would be associated with farm loans. The cross-sectional correlations between the totals we have for AAA cotton payments and the farm loans in the 1930s is 0.51. The correlations with the AAA cotton payments are much lower for noncotton AAA payments (0.036), relief and public works (0.088), and RFC loans (0.107).

[12]Had we performed the analysis by dividing the dependent variables and the New Deal variables by the number of farms or by the farm population, we would have used the 1930 values to avoid changes in farm population and number of farms influencing the impact. Since the 1930 values do not change over time, the county fixed effects actually control for the 1930 values of these factors; therefore, the results do not change much using those methods.

To control for weather in the year of production and in the year prior, we included the number of months of severe or extreme wetness, the number of months of severe or extreme drought, the average time-of-day adjusted temperature for the year and average monthly precipitation. The Dust Bowl in the 1930s and the Great Mississippi Flood of 1927 have been found to have significant effects on later economic behavior (Cunfer 2005, Hansen and Libecap 2004, Hornbeck 2012, and Hornbeck and Naidu 2014) in the counties where they occurred.[13] We used a measure of the Dust Bowl in the early 1930s and in the late 1930s developed by Fishback, et al. (2011) from information in Cunfer 2005, Hansen and Libecap 2004, and Hornbeck 2012). To control for the longer range effects of the 1927 flood we added an interaction term for the years following the flood.

To control for factors in each county that do not vary across time within the county but do vary across counties, a vector Δ_i of county fixed effects is included. Such factors might include the nature of the terrain and the soil, climate, access to rivers and oceans, and the extent of the rail network (which changed very little over the time period). A vector of year fixed effects controls for national shocks that hit all counties in the same year but varied across years, such as monetary policy, nationwide federal policies, and the introduction of new knowledge nationwide. The vector of year effects is also interacted with state fixed effects (S_s) to get state-by-year fixed effects ($S_s * \Theta_t$). The state by year fixed effects control for state-level shocks to crop prices, farm machinery prices, farm wages, expansions in state highways that expand market access, and state level regulations that would have influenced labor and other markets.

[13] Hornbeck and Naidhu (2014) examined the impact of the 1927 Mississippi River Flood on farm areas along the Mississippi delta over a long time frame, while Hornbeck (2012) studied the impact of the dust bowl. The coefficients show some powerful effects in those specific counties, but there are only two dust bowl counties and 34 flood counties in the sample of 622 cotton counties. Because these counties are such a small share of the counties, the share of the changes in the mean dependent variables for the entire sample explained by the dust bowl and 1927 Mississippi flood effects is relatively small.

Such information was typically not collected below the state level at this time, in part because the variation within states was not as large as across states because it mostly came from transport costs over short distances.

III.2 Endogeneity and Instruments

There is potential for endogeneity of the AAA cotton payments even after these controls are included. To reduce problems with the endogeneity we follow two strategies.

III.2.1 Placebo tests

The first is a set of placebo analyses in which we estimate OLS regressions using the 1920s portion of the data and then assume that the values for the New Deal programs for 1934 (and separately for 1939) were distributed in 1929. We then compare the placebo coefficients from 1929 to estimates for the correct OLS models for 1934 and again for 1939. If the placebo coefficient is the opposite sign from the correct coefficient or is the same sign but substantially smaller, it is less likely that selection bias or prior activity is driving the findings for the correct models.

The results of the placebo analysis for the 1934 study are shown in Table 1 for the 2 OLS estimations. When only the AAA cotton and non-cotton payments were included 10 out of the 11 placebo coefficients were either a different sign or substantially smaller than the actual coefficient when they were the same sign. The same is true when the other New Deal variables are incorporated in the equation. It appears that the OLS estimates were potentially subject to selection bias for the coefficients for Cotton bales per acre.

The placebo analysis for the 1939 study in Table 2 is performed for the OLS AAA cotton coefficients. All of the placebo coefficients for the AAA cotton payments were the opposite sign

of or substantially smaller than the actual coefficients in all cases except for the number of bales of cotton and the real value of land and buildings.

III.2.2 Instrumental Variable for the AAA Cotton Payments.

In the second strategy we develop an instrumental variable for the Cotton AAA payments. The AAA payments to farms, counties, and states were explicitly designed as a positive function of prior output. The national administration at the USDA in Washington determined the overall total of cotton acreage to be reduced and the nature of the payments. The distributions of payments to states and counties, and the initial offers made to individual farmers to take land out of production were based initially on a base composed of the five years of cotton output from 1928 through 1932. We collected the information from 1928 to 1932 used by the USDA from AAA cards at the National Agricultural Library's archives. The cards show the estimates for each county of the cotton output in bales and acreage harvested for each of the 5 years. A comparison of the 1929 census output measure with the AAA cards suggests that the AAA card measure for 1929 was very strongly correlated with the 1929 census reported measure. From this information we created an instrumental variable with the cotton output for the county from 1928 to 1932 for 1934/35 and 1939/1940 in their respective regressions and a value of 0 for the earlier years.[14]

[14] As alternatives, we tried a number of weather variables from 1928 through 1932 as instruments. These include the Davis, Hanes, and Rhodes 2009 difference in rainfall in May and difference in temperature in July and difference in temperature in August. These instruments were very weak. We also used the average number of months of extreme or severe wetness, average number of months of extreme or severe drought, average temperature adjusted for time of day and average precipitation for the 1928-1932 period. The typical F-statistic for the weather instruments was only around 3. We also experimented with combinations of average temperatures by month and precipitation by month in which we chose the factors that were most correlated with the AAA cotton payments while controlling for the other factors in the regression. The F-statistic for the weather variables was still only around 2 or 3.

We also added some robustness checks in the IV analysis, particularly for the shorter run 1934 estimation. There is a potential problem with serial correlation between the 1928-32 average cotton output instrument and the error term in the 2SLS final equation when the dependent variable is cotton bales harvested in 1934. To block the serial correlation, we performed three estimations: 1) added a one-year lag of the cotton output to the final stage equation; 2) changed the instrument to the average cotton output for the years 1928 and 1929; and 3) used the 1928-29 average instrument while also including the lagged cotton output to the final stage. Whenever the lagged cotton output measure was included the year 1919 was dropped from the panel because we do not have the measure for 1918.

The various forms of the instrument are strong. The F-statistics for the various specifications range from 177 to 402.

IV. AAA Cotton Results for 1934 and 1939

Table 3 is designed to show the magnitude of the introduction of the AAA cotton payments by comparing the predicted change in the dependent variable associated with the AAA payments to the change in the mean of the dependent variable between 1929 and 1934. The top three rows show the changes in the means of the dependent variable between 1919 and 1924, 1924 and 1929, and 1929 and 1934. Below these rows are two rows for each specification of the analysis. In the top row is the change in real AAA cotton payments between 1929 and 1934 of $534,364 multiplied by the estimated AAA cotton payment coefficient. The value in smaller type in italics below shows that value as a percentage of the change in the dependent value between 1929 and 1934. The values shown in bold are associated with coefficients that were statistically different from zero in two-tailed tests at the 90-percent level.

For the longer range 1939 analysis Table 4 shows the changes in the means for the dependent variables for 1919 to 1929 and 1929 to 1939 in the first two columns. The remaining columns report the predicted change associated with the mean AAA cotton spending from 1933 through 1936 in levels, and the predicted change as a percentage of the 1929-1939 change in the dependent variable for each of the three analyses.

IV.1 Acres Harvested, Output, and Output per Acre.

The stated goal of the original AAA payment program was to reduce the amount of acreage of cotton harvested. Between 1919 and 1924 and again from 1924 to 1929 the average cotton acreage harvested fell by around 7,300 acres. The average cotton acres harvested dropped even more dramatically in the 1930s, by 25 thousand from 1929 to 1934 and a total of 30,753 acres from 1929 to 1939. As expected, the AAA contributed strongly to the reduction in cotton acreage. All of the cotton AAA payment coefficients underlying the calculations in Tables 3 and 4 are negative and statistically significant in both the 1934 and 1939 analyses. When the coefficients are multiplied by the average rise in AAA cotton spending of $534,364 from 1929 to 1934, the AAA cotton spending is associated with an average decline in cotton acres harvested in Table 3 that ranges from -10,684 to -17,970, which accounts for between 42.6 and 71.7 percent of the 1929 to 1934 drop of 25 thousand cotton acres harvested. In the 1939 analysis in Table 4 the predicted reduction in cotton acres harvested associated with the mean AAA cotton payments ranged from 12,979 to 19,205, which were 42.2 to 62.4 percent of the drop of 30,753 in mean cotton acres harvested from 1929 to 1939.

The goal to reduce acreage was associated with a desire to reduce cotton output substantially.[15] The average cotton output in the cotton counties rose by 3,102 bales between 1919 and 1924 and 1,489 bales from 1924 to 1929, and then fell sharply from 1929 to 1934 by 7,995 bales. The 1934 results in Table 3 suggest that the program succeeded in reducing cotton output in the early stages of the program. The AAA cotton payment coefficients for the short run 1934 study were all negative and statistically significant. When the coefficients are multiplied by the change in AAA spending, the predicted change in average cotton bales associated with AAA cotton spending ranges from -3,308 to -7,232, which is roughly 41.4 to 90.5 percent of the average drop in cotton output of -7,955 between 1929 and 1934.

The effects of the AAA cotton payments were quite different by 1939 after farmers had more time to adjust. The 1929-1939 reduction in mean cotton output was only 5,370 bales, compared with the larger drop of 7,995 bales from 1929 to 1934. The predicted effects of the AAA cotton payments were all positive in Table 4, although out of the underlying coefficients only the IV coefficient was statistically significant. These positive predicted effects ranged from 2,402 to 7,822 bales of cotton, which were actually offsetting the drop in the number of bales from 1929 to 1939 by 44.7 to 145.7 percent of the 5,370 drop in the number of cotton bales between 1929 and 1939.

There was ample speculation at the time that cotton farmers would find ways to raise output per acre when they received the AAA payments. The mean cotton output per acre harvested in Table 3 rose by 0.013 bales per acre between 1919 and 1924 but remained largely

[15]The hope was that the reduction in output would cause the cotton price to rise. The national cotton price was 16.8 cents per pound in 1929, fell to a low of 5.7 cents in 1931 and then rose to 6.5 in 1932, 10.2 in 1933, and 12.4 in 1934. (See series DA757 in Carter, et al. 2006).

unchanged between 1924 and 1929. Between 1929 and 1934 the change in means rose again by 0.015 bales per acre, which is the equivalent of a rise of roughly 7.5 pounds of cotton per acre. The results suggest that the farmers likely succeeded in raising output per acre between 1929 and 1934. In every specification for the 1934 analysis AAA cotton spending was associated with higher output per acre. Five of the 7 AAA cotton coefficients were statistically significant. The impact of the spending ranged from a rise of 0.001 bales per acre to 0.028 bales per acre. As a percentage of the 0.015 rise in the mean, the predicted impact ranged from 9.2 percent to 185.7 percent.

Once the farmers had more time to adjust to the AAA by 1939, the impact on productivity was much higher. Cotton output per acre in Table 4 rose between 1929 and 1939 by 0.108 bales per acre, roughly 54 pounds of cotton per acre. The rise was nearly 10 times the rise from 1929 to 1934. The AAA cotton payments contributed a great deal to that rise with predicted increases in Table 4 that ranged from 0.050 to 0.059 bales per acre, 46.3 to 54.3 percent of the rise in bales per acre from 1929 to 1939.

IV.2 Changes in Usage of Machinery, Draft Animals, and Fertilizer

Some of this rise in productivity appears to have arisen due to changes in the technology used by cotton farmers. Warren Whatley found evidence that the AAA payments contributed to a shift in the technology in cotton toward tractors, which began to substitute for horses and mules. The county average real value of machinery and implements in Table 4 rose by only $21 thousand in the 1920s. Usage then exploded, rising by ten times that amount between 1930 and 1940. The predicted changes in the mean real value of implements and machinery

associated with AAA payments ranged from $473,413 to $553,782 in Table 4, which is a rise associated with 184 to 300 percent of the average rise in machinery and implements.

The agricultural Censuses of 1930 and 1940 collected information on several types of machines: tractors, automobiles, and trucks. Between 1929 and 1939 the average number of tractors rose by 150 and trucks rose by 46, while the number of autos fell by 223 in Table 4. All of the cotton AAA predicted effects for tractors are positive and the underlying coefficients are. statistically significant. They imply that the AAA cotton payments were associated with 93 to 95 percent of the rise in the mean number of tractors between 1930 and 1940. A similar story can be told for trucks, as the AAA cotton payments were associated with 47 to 112 percent of the rise in the average number of trucks.

The cotton AAA payments did not offset the decline in the average number of automobiles in cotton country between 1930 and 1940 in Table 4. In fact, they appear to have contributed to the declined with negative and statistically significant underlying coefficients. The predicted AAA effects ranged from drops of 143 to 164 autos, accounting for 63.8 to 73.4 percent of the 223 drop in the mean number of autos between 1929 and 1939.

The AAA cotton payments contributed to the continuation of a long run downward trend in the use of horses from the 1920s and helped reverse the positive trend in the number of mules from the 1920s. The average number of horses in Table 2 had already dropped in the 1920s by 1,333 and fell by another 296 between 1929 and 1934 with some recovery thereafter because the drop from 1929 to 1939 was only 215 horses. The results in Table 3 and Table 4 both assign a significant role in the drop to the AAA cotton payments. All of the predicted effects are negative and they are associated with changes of 58 to 135 percent of the drop in the mean number of horses in their relevant periods.

The average number of mules in Table 2 and 3 had risen by 535 in the 1920s but then fell by 473 between 1930 and 1935 and another 850 by 1940. The predicted effects of AAA payments for 1934 in Table 4 suggest that the AAA cotton payments did not contribute much to the decline because most of the effects are small and the underlying coefficients are not statistically significant. The longer run analysis for 1940, however, shows that the predicted cotton AAA effects in Table 4 contributed to a drop of between 508 and 740 mules, which contributed to 38 to 56 percent of the decline of 473 in the number of mules.

In the search for higher productivity per acre, contemporaries talked of increased use of fertilizer, but it turns out that most of the boom in fertilizer usage occurred in the 1920s. The mean real value rose by $67,035 dollars, but then the value rose by only 5,727 1967 dollars in the 1930s. The predicted AAA cotton effects in Table 3 were much larger than the actual rise in the mean usage, ranging from $7,841 to $17,714, but the underlying coefficients were statistically insignificant, raising doubts about the estimated effect.

IV.3 The Shift Toward NonCotton Acreage

The AAA rules for cotton allowed farmers to shift their production to other marketable crops not covered by the AAA and crops for personal use, or they also could fallow the land. This opened the door for a large increase in noncotton acres harvested. Following a rise in average noncotton acres in Table 2 of 2569 between 1924 and 1929, the average number of noncotton acres rose by 15,854 between 1929 and 1934. The average continued to rise afterward as the change in Table 3 from 1929 to 1939 was 21,552 acres.

The AAA cotton payments clearly contributed to the shift in noncotton acreage. All of the AAA cotton effects were positive and statistically significant in Tables 2 and 3. In the short

run 1934 study in Table 3, the predicted rise associated with the mean AAA cotton payments They led to predicted rises associated with the AAA cotton payments ranging from 10,711 to 16,044 noncotton acres, roughly 68 to 101 percent of the average rise of 15,854 from 1929 to 1934. In the 1939 estimation in Table 4, the predicted impact of the mean AAA cotton payment rise ranged from 13,944 to 15,010, 65 to 70 percent of average rise of 21,552 acres from 1929 to 1939.

IV.4 Farms, Farm Population, Croppers and NonCropper Tenants

Contemporaries were uncertain about the impact of the AAA on the number of farms and the farm population. Many believed that the AAA payments would help save farms from closing down. On the other hand, there were substantive complaints after the payments were introduced that landlords found ways to shift the AAA payments from their tenants and croppers, and that a significant number of croppers and tenants were dropped (Kester 1936; Myrdal 1944, Volanto 1996 and 2005; Whatley (1983). Depew, Fishback, and Rhode (2013) confirmed these claims for both black and white tenants and croppers, with black tenants experiencing a larger drop. Fishback, Horrace, and Kantor (2006) found that the AAA was associated with outmigration; and Fishback and Kachanovskaya found that the AAA was associated with slightly lower incomes.

The trends in Table 1 show that the average number of farms fell by 147 between 1919 and 1924. Both the average number of farms and the farm population then rose by 252 and 1,888, respectively between 1924 and 1929. Between 1929 and 1939 the mean number of farms and the mean farm population in Table 3 fell by 442 and 559, respectively.

The impact of the cotton AAA payments was generally negative, but the impact appears to have been much stronger after 1935. In the short run 1934 analysis in Table 3, all but one of the underlying coefficients for the effects were negative but only one was statistically significant. In

the longer run 1939 analysis in Table 4 the underlying AAA cotton coefficient for number of farms were all negative and statistically significant and the predicted effect of the mean payments contributed 64 to 90 percent of the mean decline in the number of farms of 442. The cotton AAA effect on the size of the farm population was less certain, as only one of the underlying coefficients was statistically significant.

The results for share croppers and noncropper tenants are consistent with claims that they were being driven out by landlords to some extent as a result of the AAA cotton payments. As was the case with the number of farms, most of the AAA effects were delayed until after 1934. In the 1934 study in Table 3, all of the AAA underlying cotton coefficients for the number of croppers and noncroppers are negative, but only 5 of the 14 are statistically significant. In the longer range 1939 study all of the underlying cotton AAA coefficients are statistically significant. The AAA cotton prediction at the mean in Table 4 accounts for 31 to 64 percent of the drop in the mean number of croppers of 341, while it accounts for 86 to 93 percent of the drop of 189 in the mean number of noncropper tenants.

IV.5 The Value of Land and Buildings and the Value of Farm Product

Average agricultural wealth in the form of the real value of land and buildings experienced a major drop of $4.7 million dollars just after World War I. The value recovered by $2.8 million between 1925 and 1930 but then dropped by $3.3 million from 1930 to 1935 in Table 2. The mean recovered again in the late 1930s so that the drop for the entire decade in Table 3 was only $2 million.

The AAA cotton payments contributed substantially to the drop in value in the 1934 analysis, as all of the underlying AAA cotton coefficients were negative and statistically

significant. The predicted drops associated with the mean AAA cotton payments ranged from $1.98 million to $4.85 million, values that were 60 to 147 percent of the $3.3 million drop in mean value between 1929 and 1934. The longer range analysis through 1939 also suggests that the AAA had negative impact on the value of land and buildings, but there is much less certainty because the underlying cotton AAA coefficients are not statistically significant.

The agricultural censuses for 1930 and 1940 were the only ones to report the value of all farm products at the county level for the prior year. Between 1929 and 1939 the mean value in the cotton area fell by $1.84 million. The results from this two-year panel suggest that the cotton AAA payments were a contributor to this fall. The underlying cotton AAA coefficients were negative and statistically significant and the predicted impact of the mean payments were associated with declines of $1.3 to $1.4 million, roughly 70 to 78 percent of the mean change of $1.84 million in the value of farm products.

Summary

The AAA payments to take land out of cotton production had wide-ranging effects on cotton farm activity when they were first introduced in the 1930s. There were many factors influencing the farm decisions and outcomes at the time, including the prices of outputs and inputs; declines in access to credit with federal responses with new types of farm loans; rampant unemployment combatted by federal public works and relief programs; droughts, floods, and other fluctuations in temperature and rainfall; and a variety of other factors. Multiple factors shifted in ways that increased the outputs and inputs, while others decreased them. Our goal has been to isolate the impact of the AAA payments to reduce cotton acreage, while controlling for the listed factors.

The acreage restrictions required by the AAA payments led to large drops in the mean cotton acreage harvested between 1929 and 1934 and 1939. The estimates here suggest that the payments roughly accounted for 35 to 71 percent of the reduction over the course of the decade.

A main purpose of the acreage restrictions was to limit cotton output with a goal of raising cotton prices enough to raise cotton farm incomes. The mean bales of cotton harvested fell by nearly 8 thousand bales between 1929 and 1934, and the estimates of the contribution of the AAA payments to that fall range from 41 to 90 percent. As the cotton farmers had more time to respond to the AAA policy, the mean for cotton bales produced in 1939 actually rose relative to 1934, although the average amount produced in 1939 still remained 5 thousand bales lower than in 1929. Over the course of the decade, the impact of the AAA payments shifted and became positive and served to work against the reduction in cotton output that was the goal of the AAA program.

The reason was a rise in cotton productivity that largely took place after 1934. Cotton output per acre rose by 0.015 between 1929 and 1934 and the AAA payments were associated with 70 to 186 percent of that rise. Between 1934 and 1939 cotton output per acre soared by 0.108, more than five times the change in the early 1930s, and the AAA payments were associated with about 50 percent of that rise.

Some of that rise was associated with an increase in the real value of the implements and machinery being used on farms, which rose 10-fold between 1929 and 1939 relative to the rise in the 1920s. The estimated AAA contribution to that rise was larger than the rise in the actual means. In the case of specific machines the AAA payments were associated with roughly 95 percent of the increase in the mean number of tractors between 1929 and 1939 and 47 to 74

percent of the increase in the mean number of farm trucks. On the other hand, the AAA contributed substantially to a reduction in the number of automobiles on farms that occurred in the cotton areas. The rise of machinery served to replace horses and mules on cotton farms and the AAA payments contributed substantially to the declines in the numbers of horses both early and late in the decade and to the decline in mules mostly after 1935. There had been speculation that farmers used more fertilizer to raise productivity. However, the major rise in fertilizer usage occurred in the 1920s with an increase more than 10 times the increase in the 1930s. The AAA may have contributed to the smaller rise in the 1930s but the estimates are not statistically significant.

The AAA also strongly influenced the structure of share cropping and tenancy (fixed rent or on shares). The AAA rules suggested that tenants should participate in the program but the rules for croppers were less certain and there are ample numbers of stories describing landlord restructuring their arrangements to get a higher AAA payment. The mean number of share croppers fell by 341 in the 1930s after rising by 309 in the 1920s, and the estimates of the AAA impact suggest that the payments contributed 31 to 64 percent of the decline. The decline in the mean number of noncropper tenants in the 1930s was smaller at 161, but the AAA payments were associated with up to 93 percent of that decline.

The AAA cotton program gave southern farmers more flexibility than provided by other AAA programs in how they used the land taken out of production. They could produce other restricted AAA crops for their farm's consumption and also other crops not restricted by the AAA. The mean non-cotton acres harvested thus rose by around 16 thousand acres between 1929 and 1934 and another 5 thousand between 1934 and 1939. The AAA cotton payments were associated with about 60 to 90 percent of that rise.

The major question is whether the cotton farmers benefited overall from the AAA cotton payments. Despite the efforts of the New Deal the mean real value of farm products fell by $1.8 million between 1929 and 1939. The estimates of the impact of the AAA Cotton payments suggest that they were associated with $1.3 to $1.4 million of that drop. This was offset, however, by the AAA cotton payments, which averaged $430,138 per year between July 1933 and June 30, 1939, and thus totaled $2.581 million for the period, more than enough to offset the drop in the overall value of farm products.

The most surprising result in our view was the effect of the AAA cotton payments on the farmers' estimates of the sales value of their land and buildings. The mean real value had declined by $4.7 million between 1920 and 1925, rose by $2.8 million from 1925 to 1930, fell by $3.3 million from 1930 to 1935, and then rose by $1.3 million from 1935 to 1940, which left the real value in 1940 still $2 million less than in 1930. Since farmers likely anticipated that the AAA program would continue, the likely benefits from the program would have been expected to be incorporated in the anticipated sales value of the land and buildings, particularly because the net effect on overall farm income when the AAA benefits are included was positive. Instead, the estimates of the AAA impact in Table 4 for land and building values suggest that the AAA cotton payments were associated with $835 thousand to $2 million of the decline in values between 1929 and 1939.

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Table 1
Comparing Actual and Placebo Coefficients for OLS Results in 1934 Short Run Analysis

Dependent Variable	OLS just AAA					OLS with other New Deal				
	Actual		Placebo		Ratio	Actual		Placebo		Ratio
	Coeff.	*t-stat.*	Coeff.	*t-stat.*		Coeff.	*t-stat.*	Coeff.	*t-stat.*	
Cotton Acres Harvested 1934	-0.02008127	*-4.73*	0.02294	*6.99*	**-0.88**	-0.021	*-5.5*	0.0163102	*4.59*	**-1.29**
Bales of Cotton Harvested 1934	-0.00758272	*-5.64*	0.01134	*6.01*	**-0.67**	-0.0062	*-3.95*	0.0101512	*4.65*	**-0.61**
Bales per Acre 1934	5.462E-09	*0.52*	1.9E-08	*2.2*	0.29	2.6E-08	*2.83*	1.801E-08	*2.15*	**1.45**
Noncotton Acres Harvested 1934	0.02170735	*10.12*	0.00484	*1.15*	**4.48**	0.02004	*7.33*	-5.72E-05	*-0.02*	**-350.48**
Number of Farms 1935	-0.00005488	*-0.81*	0.00048	*5.42*	**-0.11**	-0.0003	*-1.88*	0.0004522	*3.87*	**-0.56**
Farm Population 1935	-0.00019092	*-0.67*	0.00179	*5.53*	**-0.11**	-0.0007	*-1.59*	0.0015603	*3.58*	**-0.45**
Number of Croppers, 1935	-0.00004551	*-1.05*	0.00038	*5.52*	**-0.12**	-7E-05	*-1.21*	0.0004076	*4.98*	**-0.16**
Number of Noncropper Tenants, 1935	-0.00005405	*-1.51*	8.2E-05	*2.73*	**-0.66**	-0.0002	*-2.51*	4.621E-05	*1.14*	**-3.64**
Real Value of Land and Buildings 1935	-5.8252215	*-4.01*	-0.8881	*-0.62*	**6.56**	-9.0708	*-4.46*	-4.159195	*-2.2*	**2.18**
Number of Horses 1935	-0.00037464	*-2.52*	-0.0001	*-0.78*	**2.85**	-0.0005	*-3.34*	-0.000184	*-1.33*	**2.54**
Number of Mules 1935	-0.00007902	*-0.64*	0.0009	*5.74*	**-0.09**	-0.0002	*-0.96*	0.0008592	*4.26*	**-0.18**

Table 2

Comparing Actual and Placebo Coefficients for OLS Results in 1939 Long Run Analysis

Dependent Variable	Cotton AAA				
	Actual		Placebo		Ratio
	Coeff.	*t-stat.*	Coeff.	t-stat.	
Cotton Acres Harvested	-0.0101	*-5.13*	0.00888	6.02	**-1.1332**
Cotton Bales Harvested	0.00186	*1.31*	0.00545	5.88	0.34133
Cotton Bales per Acre	3.9E-08	*6.74*	6.1E-09	1.73	**6.32686**
Number of Farms	-0.0002	*-5.81*	0.00024	4.61	**-0.9269**
Farm Population	-0.0002	*-0.87*	0.00084	4.64	**-0.2757**
Noncotton Acres Harvested	0.01084	*11.35*	-0.0007	-0.7	**-15.325**
Real Value of Implements and Machinery	0.37152	*3.37*	0.04195	2.08	**8.85522**
Number of Tractors	0.00011	*7.69*	9.4E-06	1.07	**11.7266**
Real value of Fertilizer and Lime	0.01038	*1.34*	0.00346	1.12	**3.00298**
Real Value of Land and Buildings	-1.5434	*-1.56*	-1.782	-2.09	0.86608
Number of Autos on Farms	-0.0001	*-6.62*	0.00031	7.61	**-0.3784**
Number of Trucks on Farms	1.7E-05	*2.33*	3.2E-06	0.3	**5.22819**
Number of Horses and Colts	-0.0001	*-2.67*	-7E-05	-1.52	**1.96544**
Number of Mules and Colts	-0.0004	*-2.98*	0.00044	5.05	**-0.9295**
Value of Farm Product	-1.0832	*-5.66*	2.90267	9.86	**-0.3732**
Number of Croppers	-9E-05	*-3.36*	0.00022	6.12	**-0.4042**
Number of Noncropper Tenants	-0.0001	*-3.9*	2.4E-05	1.21	**-5.2156**

Table 3
Share of 1929-1934 Mean Change in Dependent Variable Associated with Rise in Mean AAA Cotton Payments

	Variable	Cotton Acres Harvested 1934	Bales of Cotton Harvested 1934	Bales per Acre 1934	Noncotton Acres Harvested 1934	Number of Farms 1935	Farm Population 1935
Changes in Means	1924 minus 1919	7,329	3,102	0.013	na	-147	na
Changes in Means	1929/30 minus 1924/25	7,258	1,489	-0.001	2,569	252	1,888
Changes in Means	1934/5 minus 1929/30	-25,077	-7,995	0.015	15,854	23	-55
OLS AAA only	Predicted Change	**-10,684**	**-4,036**	0.003	**11,550**	-29	-102
	% of Dep. Mean Chg.	***43***	***50***	*17.7*	***73***	*-128.2*	*183.9*
OLS Add 1933-39 other ND	Predicted Change	**-11,206**	**-3,308**	**0.014**	**10,711**	**-135**	-371
	% of Dep. Mean Chg.	***45***	***41***	***91.6***	***68***	***-592.5***	*669.6*
1928-32 IV AAA only	Predicted Change	**-13,222**	**-4,391**	**0.013**	**14,975**	1	-22
	% of Dep. Mean Chg.	***53***	***55***	***85.5***	***94***	*4.5*	*39.0*
1928-32 IV Add 1933-39 other ND	Predicted Change	**-14,471**	**-3,670**	**0.028**	**15,157**	-103	-265
	% of Dep. Mean Chg.	***58***	***46***	***185.7***	***96***	*-449.7*	*478.3*
1928-32 IV add lagged cotton output	Predicted Change	**-17,970**	**-6,966**	**0.011**	**15,295**	-84	-73
	% of Dep. Mean Chg.	***72***	***87***	***70.6***	***96***	*-367.1*	*131.7*
1928-29 IV Add 1933-39 Other ND	Predicted Change	**-15,700**	**-4,275**	**0.026**	**16,044**	-94	-348
	% of Dep. Mean Chg.	***63***	***53***	***172.1***	***101***	*-410.6*	*628.0*
1928-29 IV Add 1933-39 Other ND Programs and lagged cotton output	Predicted Change	**-17,751**	**-7,232**	0.009	**15,871**	-57	-39
	% of Dep. Mean Chg.	***71***	***90***	*58.2*	***100***	*-249.8*	*71.1*

Notes. Bolded Values have underlying coefficients that are statistically significant at the 90 percent level in a two-tail test. The coefficients and t-statistics for the cotton AAA payments and the other variables (but not the county fixed effects) are reported in the excel file "cotton.1935.results.2025.06.30.allnd," later to be an appendix. The predicted change is the AAA coefficient multiplied by the change in mean AAA cotton spending in the cotton counties when it rose from 0 in 1929 to $534,364 in 1934. The % of Dep. Mean Chg. is the predicted Change as a percentage of the change in the mean dependent variable from 1929 to 1934. Underlying regressions include the correlates described for equation 1.

Table 3 (continued)
Share of 1929-1934 Mean Change in Dependent Variable Associated with Rise in Mean AAA Cotton Payments (continued)

	Variable	Number of Croppers, 1935	Number of Non-cropper Tenants, 1935	Real Value of Land and Buildings 1935	Number of Horses 1935	Number of Mules 1935
Changes in Means	1925 minus 1920	94	-83	-4,700,000	-888	226
Changes in Means	1930 minus 1925	215	56	2,800,000	-444	309
Changes in Means	1935 minus 1930	-115	45	-3,300,000	-296	-473
OLS AAA only	Predicted Change	-24	-29	**-3,112,790**	**-200**	-42
	% of Dep. Mean Chg.	*21.2*	*-64.6*	***94***	***67.7***	*8.9*
OLS Add 1933-39 other ND	Predicted Change	-35	**-90**	**-4,847,089**	**-250**	-84
	% of Dep. Mean Chg.	*30.8*	***-200.9***	***147***	***84.7***	*17.8*
1928-32 IV AAA only	Predicted Change	-5	-31	**-3,012,425**	**-279**	16
	% of Dep. Mean Chg.	*4.2*	*-68.3*	***91***	***94.3***	*-3.3*
1928-32 IV Add 1933-39 other ND	Predicted Change	-5	**-98**	**-4,748,608**	**-369**	-9
	% of Dep. Mean Chg.	*4.2*	***-219.7***	***144***	***124.6***	*1.9*
1928-32 IV add lagged cotton output	Predicted Change	**-101**	-30	**-2,187,460**	**-177**	**-196**
	% of Dep. Mean Chg.	***88.2***	*-66.7*	***66***	***59.9***	***41.5***
1928-29 IV Add 1933-39 Other ND	Predicted Change	-1	**-107**	**-4,867,477**	**-401**	1
	% of Dep. Mean Chg.	*1.0*	***-238.9***	***147***	***135.5***	*-0.2*
1928-29 IV Add 1933-39 Other ND Programs and lagged cotton output	Predicted Change	**-89**	-28	**-1,976,420**	**-173**	**-154**
	% of Dep. Mean Chg.	***77.7***	*-63.2*	***60***	***58.4***	***32.6***

Notes. Bolded Values have underlying coefficients that are statistically significant at the 90 percent level in a two-tail test. The coefficients and t-statistics for the cotton AAA payments and the other variables (but not the county fixed effects) are reported in the excel file "cotton.1935.results.2025.06.30.allnd," later to be an appendix. The predicted change is the AAA coefficient multiplied by the change in mean AAA cotton spending in the cotton counties when it rose from 0 in 1929 to $1,290,414 over the period 1933 to 1936. The % of Dep. Mean Chg. is the predicted Change as a percentage of the change in the mean dependent variable from 1929 to 1934. Underlying regressions include the correlates described for equation 1.

Table 4
Share of 1929-1939 Mean Change in Dependent Variable Associated with Rise in Mean AAA Cotton Payments

Dependent Variable	1929/30 Mean minus 1919/20 Mean	1939/40 Mean minus 1929/30 Mean	OLS		IV		IV with Lagged Cotton Output	
			Predicted Change	*% of Chg. in Dep. Var.*	Predicted Change	*% of Chg. in Dep. Var.*	Predicted Change	*% of Chg. in Dep. Var.*
Cotton Acres Harvested	14,659	-30,753	**-12,979**	***42.2***	**-14,014**	***45.6***	**-19,205**	***62.4***
Cotton Bales Harvested	4,567	-5,370	2,402	*-44.7*	**7,822**	***-145.7***	**7,501**	***-139.7***
Cotton Bales per Acre	0.013	0.108	**0.050**	***46.3***	**0.059**	***54.3***	**0.100**	***47.4***
Number of Farms	106	-442	**-284**	***64.2***	**-291**	***65.9***	**-398**	***90.2***
Farm Population	na	-559	-300	*53.6*	-199	*35.6*	**-342**	***61.2***
Noncotton Acres Harvested	na	21,552	**13,994**	***64.9***	**15,010**	***69.6***	**14,854**	***68.9***
Real Value, Implements & Machinery	21,017	247,918	**479,413**	***193.4***	**553,782**	***223.4***	**520,819**	***210.1***
Number of Tractors	na	150	**142**	***94.8***	**143**	***95.2***	**139**	***93.0***
Real value of Fertilizer and Lime	67,035	5,727	13,393	*233.8*	17,714	*309.3*	7,841	*136.9*
Real Value of Land and Buildings	-1,900,000	-2,000,000	-1,991,569	*99.6*	-1,871,005	*93.6*	-834,689	*41.7*
Number of Autos on Farms	na	-223	**-153**	***68.4***	**-164**	***73.4***	**-143**	***63.8***
Number of Trucks on Farms	na	46	**22**	***47.1***	**28**	***60.4***	**34**	***73.8***
Number of Horses and Colts	-1,333	-215	**-172**	***80.0***	**-194**	***90.1***	**-125**	***58.2***
Number of Mules and Colts	535	-1,323	**-527**	***39.8***	**-508**	***38.4***	**-740**	***56.0***
Value of Farm Product	na	-1,842,741	**-1,397,726**	***75.9***	**-1,441,717**	***78.2***	**-1,285,584**	***69.8***
Number of Croppers	309	-341	**-113**	***33.2***	**-105**	***30.7***	**-219**	***64.3***
Number of Noncropper Tenants	-26	-189	**-161**	***85.6***	**-175**	***92.8***	**-174**	***92.3***

Notes. Bolded Values have underlying coefficients that are statistically significant at the 90 percent level in a two-tail test. The coefficients and t-statistics for the cotton AAA payments and the other variables (but not the county fixed effects) are reported in the excel file "results.cotton.to.1939.2025.06.30" later to be an appendix. The predicted change is the AAA coefficient multiplied by the change in mean AAA cotton spending in the cotton counties when it rose from 0 in

1929 to $534,364 in 1934. The % of Dep. Mean Chg. is the predicted Change as a percentage of the change in the mean dependent variable from 1929 to 1934. Underlying regressions include the correlates described for equation 1. We only instrumented for the AAA in the IV analysis.

Appendix A

A Model of a Representative Farmer

To develop the equation for estimating the impact of the New Deal programs on output and input decisions, we develop a theoretical model of a representative farmer. The model does not lead to unambiguous comparative statics but does have implications for what types of variables should be included in the estimation equation.

A risk averse farmer chooses the number of tractors and other farm inputs to maximize expected utility in a one period problem.[16] The farmer makes the input choices at the beginning of the period and does not discover the prices or harvest outcomes until the period has ended. We assume the farmer is risk averse in making decisions about farm inputs. We have couched the analysis in terms of numerical values, yet some features of Sally Clarke's analysis based on the non-cash part of the farm economy are easily incorporated. Her focus on non-cash opportunity costs might also be incorporated in the model based on whether cash or non-cash opportunity costs are considered to be the more relevant factor. Clarke strongly emphasizes that lowering interest rates and giving farmers more access to cash credit would make them more likely to accept risk.

We treat the choice of all farm inputs as endogenous in this model, which is consistent with Olmstead and Rhode's (2001) findings that tractors and farm size were simultaneously chosen.[17] In the model we use tractors as a representative of farm machinery. In the empirical

[16]Manuelli and Seshadri (2004) have developed a neoclassical dynamic model of the farmer's decision but do not incorporate the risk factors emphasized by Clarke.

[17] Alan Olmstead and Paul Rhode (2001) examined the diffusion of the tractor between 1910 and 1960 using a panel of state level data for the Census years. The key assumption that they challenged in the threshold model was the treatment of farm size as exogenous in the decision process. Farm size might be treated as exogenous

analysis, we also estimate an equation in which the number of farms is endogenous because that is essentially a choice variable as well. We can alter this assumption within the model by fixing the land size or adding credit constraints. Farmers are risk averse and have strictly monotonic preferences with diminishing marginal utility over income:

(1) $U^{`}(\cdot) > 0, U^{``}(\cdot) < 0$

Assume that the farmer traditionally produced one crop, the AAA designated crop. A farmer's profits can be represented as follows:

$$(2) \qquad \Pi(N_A, N,, T, CL) = s\, P_A\, Q^A(N_A, T, L_T - L_R, q) + s\, P_B\, Q^B(N - N_A, T, L_R, q)$$

$$- w\ N - p_T\ r\ T - p_L\ r\ L_T + s\ n\ L_R .$$

The farmer chooses the quantity of labor used in the production of the AAA designated crop (N_A), the total labor hired or used during the year (N), the total acreage of land the farmer chooses to cultivate (L_T), and the number of tractors (T).[18] Exogenous land quality is measured with q; we do not focus on investments in land quality to simplify the analysis, although we do incorporate it in the discussion of benefits from alternative crops below. L_R is the amount of land that the farmer removes from production of the AAA crop when he signs an AAA contract and n

during the growing season, or within time frame of a year or two if the individual farmer faces a borrowing constraint, the farmer can't move, or he is unable to expand because he is at the limit of his current farmable acreage and cannot find land to rent or purchase close enough to expand. In their state level panel study of Ag Census years they allow for both farm size and tractor choice to be endogenous and find that larger farm sizes contribute to more adoption of tractors but also that the adoption of the tractor leads farmers to choose larger farm sizes.

[18] The choice was often a choice of zero or one tractors since the vast majority of farms owned only one tractor.

is the benefit payment per acre removed. We treat L_R as exogenous because the AAA only offered a single contract option.

Under the AAA program the farmer was offered an all-or-nothing contract that specified both the benefit payment and the amount of land nL_R. The benefit payment varied geographically based on the crop and the prior productivity per acre of the land while the number of acres was determined by historical usage of the land relative to the national target quotas. P_A represents the price of the AAA designated crop, P_B is the benefit of the alternative crop that the farmer switches to with the land taken out of production of the AAA crop. The benefit of the alternative crop (P_B) might come in several forms. In the South, where the farmer could not switch to a cash crop, it might come in the form of a non-market value of feed or food produced or the anticipated future value of higher productivity of the soil. In the Midwest, the value also could include cash prices for the alternative crop. Since the farmers had not been using the land to produce the alternative crop prior to the AAA, our sense is that the long-term average benefits from the alternative use was lower than for the AAA crop ($P_A > P_B$). To account for the impact of tenancy and cropping, s is the share of the crop received by the farmer. The share is one for owners and fixed rent tenants and less than one for share tenants and lower still for croppers. We assume that the share croppers and tenants also get the appropriate shares of the AAA payments. This can be reconsidered later in light of the problems tenants and croppers faced in the South in obtaining the appropriate share (Depew, Fishback, and Rhode 2013).

$Q^A(.)$ is output of the AAA designated crop and $Q^B(.)$ is the output of the alternative allowed by the AAA, where both Q functions are strictly increasing at a decreasing rate in labor (N_A or $N - N_A$, respectively),the presence of a tractor T, the amount of land cultivated ($L_T - L_R$ or L_R), and q. On the cost side, w represents the wage paid to labor, r is the farmer's discount rate,

which is strongly influenced by the rate at which he can borrow, p_T is the purchase price of the tractor, and p_L is the purchase price of land. The annual rental price of a tractor or land would then be a multiplicative function of the interest rate and the purchase prices ($r\,p_T$ and $r\,p_L$). For share tenants and croppers we assume that the contract is written so that ultimately the value of the share of output going to the owner is equal to the rental value of the land. We assume that the output price, wages, rental prices of tractors, and land rent are set in markets over which the farmer has no control.

Farmers also faced significant uncertainty. Suppose there is a bimodal outcome in AAA crop production or prices. For example, prices of AAA designated crops can be either "high" with probability α, or "low" with probability $1-\alpha$, where $0 < \alpha < 1$.[19]

The objective function then becomes

$$(4) \qquad E[U(N_A, N, T, CL)] = \alpha(U(\pi_H) + (1-\alpha)(U(\pi_L) =$$

$$\alpha\ U(s\,P_A^H\,Q^A() + s\,P_B\,Q^B() - w\,N - p_T\,r\,T - p_L\ r\ L_T + s\,n\,L_R) +$$

$$+ (1-\alpha)\ U(s\,P_A^L\,Q^A() + s\,P_B\,Q^B() - w\,N - p_T\,r\,T - p_L\,r\ L_T + s\,n\,L_R),$$

where π_H and π_L represent profits in the high and low settings, respectively. To reduce the number of parameters we assume that there is no variation in the outcomes for the alternative crop. Thus, the risk for the AAA crop is the greater risk associated with the crop when compared with the alternative.[20]

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[19] We focus on price fluctuations here to capture some features of Sally Clarke's (1991, 1994) analyses. We could also recast this in a similar way for yield fluctuations.

[20] Since we do not have CCC loan data we have not explicitly modeled the features of that program. However, we believe it can easily be done by showing the impact of raising the low price, P_A^L.

If we work through the first-order conditions for a maximum in this context, the farmer's choice functions for labor, tractors, and cultivated land will all be functions of the exogenous variables in the equation.

$$(5) \quad N_A = N_A\ (\alpha, q, s, P_A^H, P_A^L, P_B, w, r, p_{T,}, p_L.\ n, L_R)$$

$$N = N(\alpha, q, s, P_A^H, P_A^L, P_B, w, r, p_{T,}, p_L.\ n, L_R)$$

$$L_T = CL(\alpha, q, s, P_A^H, P_A^L, P_B, w, r, p_{T,}, p_L.\ n, L_R)$$

$$T = T(\alpha, q, s, P_A^H, P_A^L, P_B, w, r, p_{T,}, p_L.\ n, L_R)$$

This combination of choice functions implies that the estimating equation for the number of tractors should be a function of only the exogenous variables, the output prices, the input prices, and the terms of the New Deal programs; therefore, the estimating equations should not include the input choices like farm size.

The comparative statics from this model turn into an untidy combination of a large number of marginal utilities, prices, and cross products in the productivity functions for the AAA crop (A) and the alternative crop (B). However, we can learn some basic lessons from looking at simplified versions of the model. For example, Consider a farmer who is risk neutral and can only choose the number of tractors. The effect of an increase in the AAA offer to remove land from production on the number of tractors produces will be positive if the sign of

$$P_B\ Q^B_{LT} - (\alpha\ P^H_A + (1-\alpha) P^L_A)\ Q^A_{LT}$$

is negative. The negative sign would result if using tractors raises the expected value of the marginal product of land for the AAA crop more than it raises the value of the marginal product of land for the replacement crop.

Appendix B

Data Sources (Incomplete)

New Deal funding information is from the U.S. Office of Government Reports (1940). For the case of the AAA farm payments, we had information for 1933 through 1937. The AAA grants and farm loans were divided by the number of farms in 1930. New Deal spending on public works and relief was divided by the overall population in 1930.

Population, unemployment, layoffs, percent black, percent illiterate, county land area, the farm size measures, average family size, percent of acres of farms run by cash tenants and by other tenants (including share croppers and share tenants), average annual manufacturing earnings, average farm size, and percent of cultivated acreage that experienced farm failures from 1929 and 1930 are from the 1930 files in ICPSR study number 0003, as corrected by Michael Haines in ICPSR dataset number. Manufacturing earnings were not reported separately for some counties in 1929 where there were few establishments. For those counties we inserted the average annual manufacturing earnings that were reported for the whole group of counties in that state for which information was not reported separately. These were reported in U.S. Bureau of Census mimeographed reports on manufacturing in counties for 1935.

The information on crop values, percent cotton, percent corn, percent wheat, and percent tobacco in 1929 are from the 1940 files in ICPSR study number 0003, as corrected by Michael Haines (undated). Information on tractors in 1929 and 1939 is from Table 11 in U.S. Census Bureau's Census of Agriculture (1942). The percentage nonfarm of the gainfully employed in each county was calculated from information loaded from Table 20 in Volume III parts I and II of the 1930 Population Census (1932). Information on cows, beef cattle, and swine in 1929 and 1930 is from the U.S. Bureau of the Census (1936). The number of cows milked during the

course of the year, is from County Table V, volume II; the number of cattle and calves of all ages and number of swine of all ages is from County Table II, volume I.

A series of price variables were created from information collected by Paul Rhode that was only available at the state level. To measure price changes for major crops influenced by the AAA, we calculated the change in natural logs of the average crop prices between the periods 1920-1929 and 1933-1939 for cotton, corn, wheat, and tobacco. We then created a summary price measure by weighting the percentage change for each crop by its share of the states' crop values as of 1929. To measure the change in price uncertainty, a factor that Sally Clarke (1991, 1994) identifies as important, we calculated the coefficient of variation (the ratio of standard deviation to the mean) of prices for each crop over the period 1933-1939 and again over the period 1920-1929 and then calculated the change in the natural log of the coefficient of variation for each crop. We then created a summary measure by weighting the coefficient of variation for each crop by its share of crop values as of 1929. The farm prices were provided to us by Paul Rhode from data that he had compiled from the USDA reports on prices that he downloaded from the National Agricultural Statistics Service website (http://www.nass.usda.gov/). To capture key input price effects, we included the growth rate in the average price of horses from 1920-1929 to 1933-1939, also obtained from Paul Rhode. Tractor prices were not as readily available across time periods; therefore, we included the level of tractor prices for the International Harvester Corporations Farmall tractor in 1934 (U.S. Bureau of Agricultural Economics, 1934). Farmers were also borrowing funds from private sources.

Information on average interest rates on state bank loans for the periods 1920-29 and 1930-39, measured as the value of bank loan earnings divided by bank loans, is from Bodenhorn

(2008) with discussions of the methods used available in Bodenhorn (1995). The CCC state level loan measures are from the Office of Government Reports, Report No. 9 (1940).

"Dust Bowl" counties were obtained from Hansen and Libecap (2004).

The climate data are available from the National Climatic Data Center (NCDR). Text files of the data were accessed from ftp://ftp.ncdc.noaa.gov/pub/data/cirs/ (August 2003). The NCDR reports historical monthly data by climate division within each state, so each county's climate information pertains to its respective climate division. In some cases a county was located within two or three divisions. In these cases, the county's climate information was calculated as the average across the climate divisions in which it was located.

Roger Paine and Joe Johnson of the U.S. Geological Survey gave us a list of all the "streams" listed in the GNIS names topographical map database with all of the counties in which each stream was currently located. This information also can be obtained stream by stream through query at http://geonames.usgs.gov/pls/gnis/web_query.gnis_web_query_form as of August 2003. Streams is a broad definition including creeks and rivers. There were over 100,000 stream names in the data base. Each stream name has a numeric feature code as well as the name. Using the numeric feature code, we performed frequencies on the number of counties in which each stream was listed. We then developed a series of variables showing access to streams that ran through different numbers of counties. The riv51up is the number of rivers running through the county that ran through over 50 counties. Only the Mississippi, Missouri, and Ohio Rivers, ran through as many as 50 counties, and they are the major rivers in the Eastern and Midwestern United States. We also experimented with a second variable (riv2150) for access to rivers passing through 21 to 50 counties (includes the Red, Arkansas, Tennessee, Snake, Rio Grande, Canadian, Chattahoochie, Columbia, Brazos, Cumberland, Colorado, White,

Cimarron, Des Moines, and James). Another dummy, riv1120, encompasses the next largest 53 rivers. Of the rivers passing through over 10 counties, most are considered navigable by modern definitions by the Army Corps of Engineers. The ones not listed as navigable are mostly western rivers and include the Niobrara, Sheyenne, Washita, Catawba, Cheyenne, North Canadian, Canadian, Smoky Hill, Alapaha, Big Sioux, Neches, Pecos, Wisconsin, Yellowstone, Des Moines, Rio Grande, Nueces, Platte, Big Black, Rio Brazos, Cimmarron, Wapsipinicon, and Sabine. The variable for riv0510 encompasses 384 rivers. The information on which waterways were navigable was provided by Amy Tujaque, who is a Survey Statistician for the Waterborne Commerce Statistics Center for the U.S. Army Corps of Engineers. We used a relatively coarse measure of access because the Geological Survey staff warned us that sometimes the same river might have multiple feature numbers. On the other hand, there are also quite a few stream names that appear multiple times but are clearly not connected. We examined the situation for the major rivers and found that this was not a significant problem for them.

The data set consists of 3,067 counties and county/city combinations in the United States. The New Deal program information was reported for some combined counties. For example, the New Deal information was reported for all of New York City. Thus, in New York state, Bronx, King, New York, Queens, and Richmond counties were combined into New York City. Similar situations developed in other states. In Missouri the city of St. Louis and St. Louis County were combined. In Virginia we combined the following districts that were reported separately in the Census: Albemarle County and Charlottesville city; Allegheny County and Clifton Forge city; Augusta County and Staunton city; Campbell County and Lynchburg city; Dinwiddie County and Petersburg city; Elizabeth City County and Hampton city; Frederick County and Winchester city; Henrico County and Richmond city; Henry County and Martinsville city; James City

County and Williamsburg city; Montgomery County and Radford city; Nansemond County and Suffolk city; Norfolk County with Norfolk city, South Norfolk city, and Portsmouth city; Pittsylvania County and Danville city; Prince George County and Hopewell city; Roanoke County and Roanoke city; Rockbridge County and Buena Vista city; Rockingham County and Harrisonburg city; Spotsylvania County and Fredericksburg city; Warwick County and Newport News city; Washington County and Bristol city; Arlington County and Alexandria city.

For latitude and longitude we used maps from the 1930s to determine which counties were contiguous to each other; the largest number of contiguous neighbors for a single county was 14. When developing the inverse distance spatial weighting scheme, we used the ICPSR data set 8159 created by Robert Sechrist. We found a number of errors in the latitudes and longitudes in ICPSR data set, which were corrected: Dutchess, NY latitude 41.45, Greene, PA longitude 80.12, Moultrie, IL latitude 39.35, Fulton IN latitude 41.07 longitude 86.15, Rock Nebraska longitude 99.32, Butte, SD latitude 44.38, Campbell, SD latitude 45.44, McCook SD latitude 43.39, Webster, GA latitude 32.04, Greene, NC latitude 35.28, longitude 77.45, Sampson NC latitude 35.0; Wake, NC latitude 35.45; Rains, TX latitude 32.52; Fulton, KY latitude 36.33; Custer, OK longitude 98.57; Carbon, MT longitude 109.2; Santa Fe, NM latitude 35.4; Mendocino, CA latitude 39.09, longitude 123.12; Multnomah, OR longitude 122.4.

We developed a series of variables to describe the elevation range and maximum elevation and information on the number of bays, lakes, beaches, etc., as reported in the USGS's Geographic Names Information System. The information was downloaded from http://geonames.usgs.gov/stategaz/index.html (August 2003). The data set describes features noted on small-scale topographical maps, including mouths of streams, lakes, valleys, summits,

cliffs, bayous, beaches, etc.[21] The Geographic Names Information System (GNIS) contains name and location information about almost 2 million physical and cultural features located throughout the United States and its Territories.GNIS was developed by the U.S.Geological Survey in cooperation with the U.S. Board on Geographic Names (BGN) to promote the standardization of feature names. GNIS is being compiled in phases. The first phase is complete for the entire U.S., and entailed the collection of names from Federal sources including large-scale USGS topographic maps, Office of Coast Survey charts, U.S. Forest Service maps, and digital datasets distributed by the Federal Communications Commission, the Federal Aviation Administration, and the U.S. Army Corps of Engineers. The second phase of data collection is complete or in progress for about 90% of the U.S., and captures names from State, locally, and other published current and historical maps, charts, and texts. The information was downloaded in August 2003 from http://geonames.usgs.gov/stategaz/index.html.

The data set describes features noted on small-scale topographical maps, including mouths of streams, lakes, valleys, summits, cliffs, bayous, beaches, etc. Elevation was listed for a significant number of features in each county. We used this information to determine the maximum and minimum elevation listed and the range between the two figures. We did not try to calculate an average elevation because many of the features did not include information on elevation. Because of the lack of full coverage there may be some measurement error, but our sense from spot checks around the country is that the maximum and minimum elevations are reasonable depictions of those figures.

[21] See Fishback, Horrace, and Kantor (2004, Appendix 1) for a more complete discussion of the creation of the geography variables and of our handling of county boundary changes since the New Deal.

From the data set we calculated the number of summits and valleys to get a sense of the degree to which there were fluctuations in terrain. The original database includes the number of airports, arches, areas, arroyos, bars, basins, bays, beaches, benchs, bends, buildings, canals, capes, cemeterys, churchs, civils, cliffs, craters, crossings, dams, falls, flats, forests, gaps, guts, harbors, hospitals, islands, lakes, locales, militarys, mines, oilfields, parks, pillars, plains, postoffs, populated places, ranges, rapids, reserves, reservoirs, ridges, schools, springs, mouths of streams, summits, swamps, towers, trails, tunnels, valleys, wells, woods. For the purposes of our research we sought to avoid using man-made features, so we used only summits, bays, lakes, summits, valleys, mouths of streams, swamps, beaches, forests, and woods. Even in these cases there may have been changes wrought since the 1930s, so there is likely to be some measurement error for the natural features as they stood in the 1930s.

When we were working with the geography measures and the river measures, there were some county boundary changes between 1940 and 2000. In situations where new counties were carved from older counties, we have merged the new county information back in with the older counties. La Paz in Arizona was merged back in to Yuma county and Cibola county in New Mexico was merged back into from Valencia. [Broomfield, Colorado was formed in 2001 but had no streams listed.] Virginia developed a new set of independent cities and their information was merged back into the county/city combinations that we developed for the New Deal. We did not pay close attention to situations where parts of some counties were annexed to others, but we do not believe this to be a serious problem. In South Dakota Washabaugh county had been combined into Jackson county and Washington County had been combined into Shannon after 1940. To determine the geographic features for Washabaugh we used any features above latitude of 4.372694 from Jackson county. This may overstate some features in

Washabaugh. For Shannon we took all features in Shannon county below latitude 43.30139. Information on county boundary changes since 1970 comes from http://www.census.gov/geo/www/tiger/ctychng.html#1970.

The various measures of soil quality in the database are from the 1990s from the State Soil Geographic (STATSGO) Data Base for the Conterminous United at http://water.usgs.gov/lookup/getspatial?ussoils. Mickey Lynn Reed and Todd Sorensen at the University of Arizona converted the information to county data by using ARC-GIS mapping software to layer county boundaries over the basic data set of 78,518 polygonal land areas and create averages weighted by land area.. When a county boundary split a polygon, they were able to determine the area of that polygon within each county. For each county they then developed weighted averages of the variables with the land area as the weight. This is modern data and there have been some mergers and additions of new counties since 1940. We merged new counties back into their original counties during the 1930s. Three counties in South Dakota, Armstrong, Washabaugh, and Washington had been merged into other counties. In those cases we gave Armstrong, Washabaugh and Washington the values of the counties into which they had been merged.

According to the U.S. Natural Resources Conservation Service, AWC is "the volume of water released from the soil between the time the soil is at field capacity (the maximum water held in soil against the pull of gravity) until the time it is at the wilting point (the amount of water held too tightly in soil for commonly grown crops to extract). Loamy soils and soils high in organic matter have the highest AWC." Clay is the percent of soil consisting of clay (in percent of material less than 2mm in size). Kffact is the actual k factor used in the universal soil loss equation to calculate soil loss by water. LL is the liquid limit of the soil layer (in percent

moisture by weight). OM is the organic material in the soil (in percent by weight). Perm is the permeability of the soil (in inches per hour). Thick is the depth of soil layers (in inches). Hygrp is a code identifying the hydrologic characteristics of the soil, converted into a numeric code by Bill Battaglin's methods, where 1 is high infiltration, deep soils, well drained to excessively drained sands and gravels, 2 is moderate infiltration rates, deep and moderately deep, moderately well and well drained soils with moderately coarse textures, 3 is slow infiltration rates, soils with layers impeding downward movement of water, or soils with moderately fine or fine textures, 4 is very slow infiltration rates, soils are clayey, have a high water table, or are shallow to an impervious layer. Battaglin subselected certain areas and assign values for hygrp based on the area type. Miscellaneous areas labeled as Dumps, and Gullied Land are assigned the hygrp = 2.5 if the hydgrp value is missing. Areas denoted as Pits, Rock Outcrops, Terrace Escarpments, and Urban land with missing hydgrp are assigned a hygrp of 4. See the documentation of the SAS program "setussoils.sas" at http://water.usgs.gov/lookup/getspatial?ussoils for additional details. The transformed data are averaged across components using the component percentage as weights.

Float is a code identifying the quality of soil drainage, where 1 is excessive, 2 is somewhat excessive, 3 is well drained, 4 is moderately drained, 5 is somewhat poorly drained, 6 is poorly drained, 7 is very poorly drained. Slope is the slope of the map unit in percent. Ifhydric is the shre of the map unit with hydric soils, where 1 means the entire map unit has hydric soils). Afldfreq is the annual flood frequency code, where 1 is greater than 50%, 2 is 5% to 50%, 3 is 0% to 5%, and 4 is flood. In all cases the values for each variable are averaged across components using the component percentage as weights. See http://soils.usda.gov/sqi/soil_quality/what_is/glossary.html for more detail.

Appendix C

New Deal Farm Loans and Public Works and Relief Programs

New Deal farm loan, RFC loans, and relief and public works grants also likely influenced farmers' decisions. We focus on the AAA program in the analysis for two reasons. First, the county information available allows us to have AAA measures in both 1934 and 1939, while the county information for measures of the other programs is aggregated to include information after 1934. Therefore, we can only measure their effects without significant bias from post-policy time effects for the year 1939. In the absence of endogeneity after controlling for the weather, county fixed effects, and state by year fixed effects in 1939, the coefficients of the farm loan, RFC loans, and relief and public works grants might be read as causal. Second, given the likelihood that the programs were endogenous, we experimented with instruments for these variables in addition to the instrument for the AAA. It proved too difficult to come up with four instruments for the AAA payments, the farm loans, the RFC loans, and the public works and relief grants that would separately identify the effect for all four in a satisfactory way. As a result, like many other papers, we focused on one policy, the AAA payments, and then controlled for measures of the other policies that influenced the outcomes. A description of the other New Deal policies follows. The Office of Government Reports (1940) distributed mimeographed information on the Farm Credit Administration loans to farmers, loans through the Farm Security Administration, and loans through the Rural Electrification Administration for the period March 1933 through June 1939, loans through the Reconstruction Finance Corporation from February 1932 through June 1939 as well as for New Deal relief and public works programs from March 1933 through June 1939.

C.1 Loan Programs

After the National Farm Act of 1916 the federal government worked to expand farm mortgage credit by providing seed money for 12 regional Federal Land Banks and supervision for the establishment of joint stock land banks. In 1923 Federal Intermediate Credit banks were established to rediscount farm loans from the commercial banking system. The regional Federal Land Banks through farm loan associations offered farm mortgages at lower interest rates and for longer periods than other farm loans. By 1930 roughly one-seventh of farm mortgages were provided through these institutions.[22] The sharp drops in both yield per acre and relative farm prices in the early 1930s led to a larger number of loan defaults and the ultimate demise of nearly all of the joint-stock banks by 1932. In 1929 the Hoover administration and Republican Congress experimented with a Federal Farm Board, which developed loan and purchase programs meant to counteract the declines in farm prices. As farm prices declined, the board increasingly held large stocks of wheat and corn, and the program was shut down in 1931 with losses totaling roughly $300 million (Halcrow 1953, 259-261).

During the first hundred days of the Roosevelt administration, the 1933 Farm Credit Act established the Farm Credit Administration, which reorganized and expanded the existing federal credit system. The Federal Land Banks received significant federal backing to finance farm mortgages at substantially lower interest rates, with longer repayment periods, and loan values

[22] In the 1920s the Federal Land Banks offered 40-year loans at 5 percent interest when private loan terms were typically for 5 years with typical interest rates of 6 to 7 percent but sometimes ranging to 10 percent in parts of the South and West. The land bank loans were made through national farm loan associations organized by farmers in the local community. A loan recipient was required to use 5 percent of the face value of the loan to purchase stock in the association. Once the farmer fully repaid the loan, he potentially could withdraw the funds he paid into the association if the association's capital reserve fund was in good shape (Halcrow 1953 344-5).

reaching 75 percent of the *normal* value of the land to be mortgaged instead of the contemporary depressed value during the Depression. Over $800 million was provided for making Land Bank Commissioner loans that reached beyond the ordinary first mortgage loan up to a maximum of $7500 per farmer. Between 1933 and 1936 interest rates on the first mortgage land bank loans fell from 5.4 to 3.5 percent and stayed at 3.5 percent into the 1940s, even though the deflationary pressures had ended in 1933. Meanwhile, rates on all farm loans declined from 6.1 to 5.1 percent.[23] The Land Bank System largely refinanced loans on the new terms and by 1936 held two-sevenths of the farm mortgage debt in the U.S.

The Farm Credit Act of 1933 also provided for a Production Credit System that distributed loans through more than 600 local credit production associations. By June 1934 88,388 loans averaging $792 had been made. In addition, Roosevelt provided funds to finance a series of Emergency Crop and Feed Loans in 1933 and 1934 that were targeted at persons unable to obtain credit from other sources. The small loans were a mixture of credit and relief and it was anticipated that many would not be repaid. A similar program was established for drought relief in 1935. These were joined by the Disaster Loan Corporation in 1937, which was established to provide aid to rehabilitate areas hit be natural disasters.[24]

The New Deal established another set of loan programs for farm families that had been receiving public relief under the FERA relief program. This program provided for small cash loans for low income or needy farm families. The program was eventually transferred to the Resettlement Administration in 1935 and ultimately found a home in 1937 in the Farm Security

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[23]Federal Land Bank mortgage rates from Halcrow 1953, 345; U.S. average mortgage rates calculated from USDA "Average Rates of Interest Charged on Farm-mortgage Recordings...", November 1940.

[24] See Farm Credit Administration, June 30, 1936, pp. 6-10; U.S. Department of Agriculture 1934, p. 18, 26; Arnold 1958, 23-35; Halcrow 1953, pp. 340-350. The FCA also provided for funding of cooperative marketing associations but we have no information on the size of that funding.

Administration. The loans were basically "character" loans to be repaid in cash and in kind by farmers who had no recourse to private or other federal loans but had put together a rehabilitation plan and received training to improve their farming practices. These loans were distributed on similar grounds to those used in distributing relief. Once the farmer's standing was improved, the FSA offered loans through a farm tenant purchase program that aided croppers, tenants, and farm laborers in purchasing their own land.[25]

The Rural Electrification Administration (REA) was established in 1935 to provide loans at subsidized rates to rural electrical cooperatives to be formed in rural areas where electrical lines had not yet reached. Electrification might have had conflicting effects on tractor adoption. Prior to electricity farmers without electricity were purchasing tractors as a source of motor power on the farm, so electrification might have reduced this incentive. On the other hand, electrification might have complemented the use of tractors.[26]

Finally, the Reconstruction Finance Corporation made a wide range of loans to banks, industry, and to areas hit by disasters between Feb 1932 through the rest of the 1930s. The loans to banks would have helped prop up credit from those banks that were involved in agricultural lending. Prior to the formation of the Disaster Loan Corporation, the RFC ended up providing a series of ad hoc loans when Congress faced pressure from constituents hit by floods. When testifying for continuation of the DLC in 1941 RFC head Jesse Jones argued that a primary reason that the DLC was originally created was to replace the ad hoc nature of the disaster lending (Committee on Banking and Currency. U.S. Senate. 1941, 3).

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[25]See U.S. Resettlement Administration 1936, 10-26; Fishback, Wallis and Kantor 2003. U.S. Department of Agriculture, 1938, 63-67. For discussions of the political economy of the Farm Security Administration, see Alston and Ferrie (1999).

[26] For a study of the broad-based impact of the Rural Electrification Administration, see Kitchens and Fishback 2013.

We have combined the FCA, FSA, DLC, and REA loans into one category of farm loans in this paper because it is difficult to find instruments that can be used to separately identify their effects [27] All of the loan programs had the effect of easing credit constraints, lowering interest rates, and offering access to cash in a period when rural areas were cash-constrained. We use the amounts of the loans to measure access rather than interest rates because farmers often faced limits on credit opportunities during the farm shakeout in the 1920s and the depths of the Depression. The increased availability of loans gave farmers the opportunity to increase the amount of land and machinery, which could have led to increased cotton production.[28]

C.2 Public Works and Relief

Labor markets in the farm sector was also likely to be influenced by the two largest New Deal grant programs, the public works and relief programs. Both programs had broadly similar goals of providing employment for a large number of workers and building a wide variety of public works and providing other public services. Relief grants were primarily distributed under the auspices of the Federal Emergency Relief Administration (FERA) from 1933 through mid 1935, the Civil Works Administration (CWA) from November 1933 through March 1934, the Works Progress Administration (WPA) from mid 1935 through 1942, and the Social Security

[27] The Commodity Credit Corporation (CCC) also provided commodity loans to farmers that set floors on the prices that they received for their crops. We do not have information on the CCC loans at the county level, nor is there good information available by state due to reporting glitches in the sources available. However, we can at least control for difference across states in CCC loans with the state by year fixed effects. In the CCC loan agreements if the market price of the crop fell below the specified floor, the farmer repaid the loan with the crop rather than with cash. The ratio of the value of the CCC loans to the value of crops produced was relatively small for all of the major crops except cotton. In cotton the ratio was relatively high at 0.215 in 1933, 0.536 in 1934, 0.202 in 1937 and 0.043 in 1938, but close to zero in other years. The corn loan ratio was 0.10 in 1933 but 0.02 or below in other years. Wheat loans were only made in 1938 with a ratio of 0.09 and 1939 with a ratio below 0.001. The highest tobacco loan ratio was .036 in 1935 and the ratios were 0.003 or below in other years.Ratios are constructed from statistics reported in Jones (1939, 5-7), U.S. Department of Agriculture (1939, 10, 44, 103, 144) and the ICPSR data set for the population census for 1939 as adjusted by Michael Haines (undated).

[28]See Alston (1981) and Clarke (1991, 1994) for discussions about loans and tractors.

Administration's Aid to the Blind, Aid to Dependent Children, and Old-Age Assistance programs after 1935. The principal goal of these programs was to provide immediate relief to the unemployed and low-income people, as 85 percent of the grants were used to hire the unemployed on work relief jobs. These relief jobs ranged from maintenance activities to the building of sidewalks, post offices, schools, local roads, and other additions to local infrastructure. The public works grants included expenditures by the Public Works Administration (PWA), Public Buildings Administration, and the Public Roads Administration. These grants were also used largely to employ workers. [29]

The relief and public works programs likely had conflicting effects on farming. For example, the building of roads by either program expanded market access, which would have raised the prices received at the farmgate for production and lowered the prices for goods purchased (Dhar 2024). The higher farmgate production prices would have given farmers more incentive to raise output, while the lower purchase prices potentially increased specialization in farming.

On the other hand, the programs increased the opportunity cost of farming to the operator as well as raised the cost of hiring farm labor. This rise could have led to reductions in acres planted and in production and a shift toward more use of tractors and farm machinery to the

[29] The two programs differed in the way that they dealt with the labor they employed. The relief programs were designed to provide minimum levels of income to households of the relief workers, while the public works programs employed workers in the same ways that they had before the Depression. As a result, the hourly earnings paid to work relief workers were typically half to two-thirds of the hourly earnings paid to public works employees. The work relief workers also faced limitations on the number of hours they could work each month that were not imposed on public works workers. Finally, the public works programs had more freedom to hire a broader class of workers who were not on relief. The public works programs were said to be more focused on building larger scale projects such as dams, roads, schools, and sanitation facilities. The work relief programs also built many major public projects, as relief administrators typically carved large-scale projects into several small projects that allowed them to avoid administrative limits (Clarke, 1996, pp. 62-68; Schlesinger, 1958, pp. 263-96).

extent that farm labor and machinery were substitutes in production. The public works programs likely had a stronger effect because they paid market wages for construction and were not limited in their hiring thus providing. The relief programs paid wages that were roughly half to two-thirds of the public works project wages, imposed limits on working time, and were required to hire from the unemployment rolls. Despite these limits, there is evidence that the availability of relief work raised the reservation wages of workers. Workers stated that they feared leaving relief work for private work that might last only a few weeks, while farmers complained of labor shortages in those areas. Some relief officials argued that the payments to farm workers were unacceptably low and therefore refused to encourage or force WPA workers to take such jobs, but others were willing to release workers temporarily during the harvest without prejudice against returning to relief work. [30] Estimates from models using fixed effects for earnings in cities and farm wages reveal a positive and statistically significant relationship between relief grants and earnings (Neumann, Fishback, and Kantor 2010; Fishback, Haines, and Rhode 2015).

[30]See for example, Howard (1943, 486-496), Coyle (1939), Brimhall (1937), and Works Progress Administration (1937). Margo (1991) and Neumann, Fishback, and Kantor (2010) have more detailed discussions with extensive citation of sources.