Farm Prices, Redistribution, and the Severity of the Early U.S. Great Depression

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Abstract

We argue that falling farm prices, incomes, and spending explain part of why the contraction in the first year of the U.S. Great Depression was so severe. Cross-state data show that more farm-intensive areas of the country—in particular areas growing traded crops whose real prices fell most—suffered more in the first year of the Great Depression. County auto sales data from Ohio generally support this finding. Farmers were heavily indebted in 1929; thus the negative shock to their income likely had large effects on their spending. Reasonable assumptions about the pass-through of farm prices to retail prices and the marginal propensity to spend of farmers relative to nonfarmers suggest that the collapse of farm product prices in 1930 was an important propagation mechanism worsening the Great Depression.

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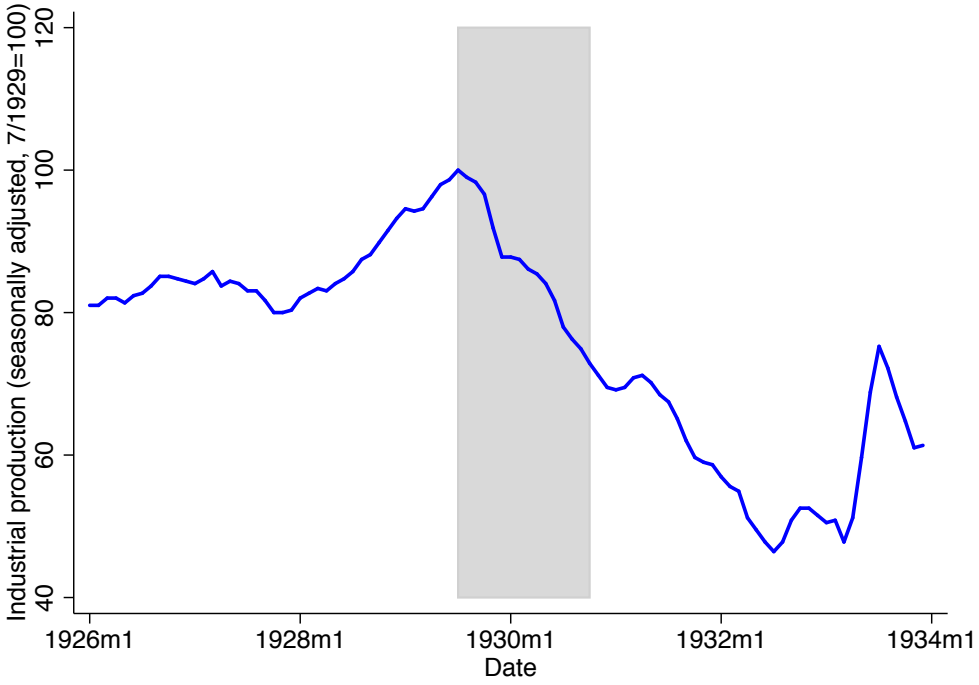
"The evils of deflation and liquidation through bankruptcy and default manifest themselves more malevolently in agriculture than in any other great industrial group." -Irving Fisher (Fisher, 1932, p. 32).

1 Introduction

The conventional narrative of the Great Depression emphasizes banking panics. Yet as shown in figure 1, even before the first banking panic in November 1930, the economy suffered a major recession. Industrial production fell 27 percent between July 1929 and October 1930; year-on-year, in 1930, real GDP fell 8.5 percent.[1] Had the Depression ended before the first banking panic, the contraction would still have been more severe than that in any post-1869 recession.[2]

Figure 1 – Industrial production



Note: Shading indicates July 1929 to October 1930, the period of the Great Depression before the first banking panic. Source: FRED series INDPRO.

We argue that the size and characteristics of the agriculture sector explain part of why initial, negative shocks resulted in a large downturn. The worldwide recession that began in

[1]Seasonally adjusted industrial production data are from FRED series INDPRO; GDP data are from NIPA table 1.1.1.

[2]This statement is based on a comparison with real GNP data from Romer (1989) for 1869-1928, and from NIPA table 1.1.1 thereafter.

summer 1929 quickly lowered the prices of farm products, particularly those of traded crops. These price declines in turn depressed farm incomes. As lower farm incomes interacted with fixed nominal debt burdens, farm spending collapsed. We estimate that absent this propagation through the agriculture sector, the U.S. downturn between 1929 and 1930 would have been at least 10 to 30 percent smaller.

To document the importance of farmers for the severity of the early U.S. Great Depression, we proceed in four steps. First, in the next section, we show that at the beginning of the Depression, farm prices fell rapidly in both absolute and relative terms, depressing farm incomes. These declines were particularly large for crops exposed to world demand. Entirely because of price declines, the combined dollar value of U.S. cotton, wheat, and tobacco production fell 38 percent between 1929 and 1930.

Next, in section 3, we show that these income declines led the spending of farmers to fall relative to nonfarmers in 1930. To examine farm spending, we use monthly auto sales data by state and newly-collected data on auto sales in Ohio counties. We find that in the first year of the Depression, spending fell more in states and counties more exposed to falling crop prices. The cross-sectional effect of exposure to farm product price declines was large: a one standard deviation increase in the share of a state's population living on farms is associated with a 5.5 percentage point larger decline in auto sales between the second and third quarter of 1929 and the second and third quarter of 1930. A small sample and noisy data prevent us from drawing firm quantitative conclusions from the county data. But qualitatively similar results in some (though not all) key specifications in the county and state data increases our confidence in the economic significance of the relationship between farming and the Depression. The similarity of the results across Ohio counties and across all U.S. states suggests that this relationship was not simply an idiosyncratic artifact of a few states' performance, but rather that there was a real economic mechanism through which more crop production was associated with a more severe beginning of the Depression.

A large cross-sectional effect of exposure to farm product prices need not indicate an important role for farmers in the aggregate. But redistribution away from farmers would have mattered for the aggregate economy if farmers had higher marginal propensities to consume

(MPCs) than the companies and workers benefiting from lower farm product prices.[3] In section 4, we show that this is plausible since farmers entered the Great Depression with very high nominal debt burdens, and since there was incomplete pass-through of lower farm product prices to lower retail prices.

In the final section of the paper, section 5, we use the structure of the model in Hausman, Rhode, and Wieland (2019) to obtain a quantitative sense of the effect of falling farm product prices on the severity of the early Great Depression. We ask the question: if relative farm prices had not declined before November 1930, how much less severe would the first year of the Depression have been? We find that lower farm product prices likely explain at least 10-30 percent of the pre-fall 1930 output decline. The large range is due to uncertainty about the relative MPC of farmers and nonfarmers, the pass-through of farm prices to final goods prices, and the aggregate multiplier.

This paper relates to several themes in the economic history and macroeconomics literatures. Most obviously, we contribute to the literature on the beginning of the Depression. Friedman and Schwartz (1963) (pp. 306-307) emphasize tight monetary policy as a cause of the initial output decline in 1930. But as noted by Temin (1976) and Romer (1993), the argument that monetary policy drove the initial downturn is problematic; over the fifteen months from July 1929 to October 1930, the real money supply grew 3.2 percent,[4] and nominal interest rates fell.[5] The literature points to the stock market crash (Romer, 1990) and consumer debt burdens (Olney, 1999) as causes of the large decline in U.S. output before the first banking crisis. And in a recent paper, Gorton, Laarits, and Muir (2019) argue that despite the lack of depositor runs, bank behaviour contributed to the output decline in 1930,

[3]Here and throughout we abuse terminology and use the "MPC" to refer to all spending by farmers, not just spending on consumption goods. From the perspective of the aggregate economy in the short-run, it was equally contractionary for a farmer to forgo a purchase of a car for investment purchases as it was for a farmer to forgo a purchase of a car for consumption purposes. In practice, it seems likely that farmers often purchased a car with the expectation that it would be used for both consumption and business purposes; surveys conducted in 1935-36 suggest that roughly one-third to one-half of farmers' car use was for business purposes (United States Department of Agriculture, 1940, p. 34, table 15).

[4]This refers to the seasonally adjusted broad nominal money supply (from Friedman and Schwartz (1963), table A-1, column 9, pp. 712-713) deflated by the CPI (FRED series CPIAUCNS).

[5]The 4-6 month prime commercial paper rate fell from 6 percent in July 1929 to 3 percent in October 1930 (Board of Governors of the Federal Reserve System (1943), table 120, pp. 450-451). Hamilton (1992) shows that inflation expectations likely did not turn sharply negative until the last trimester of 1930; thus over the first year of the Great Depression, ex ante real interest rates were also probably falling.

as banks cut back on loans in favor of safe assets. We add to this prior work by documenting substantial regional heterogeneity in the severity of the early Great Depression and by arguing that lower farm prices, income, and spending are a plausible propagation mechanism through which exogenous shocks (e.g. the stock market crash) led to a large output decline.

Relative to the literature on the U.S. Great Depression, the literature on the international Great Depression has put more emphasis on agriculture.[6] Kindleberger (1973) is concerned with how traded agricultural commodities helped to transmit economic distress across countries. He devotes a chapter to "The Agricultural Depression" and suggests that low farm prices could have contributed to the Depression. But he dismisses the effect of redistribution among agents with differing MPCs as a "a small and academic point" (p. 142). He is not entirely clear through what alternative mechanism(s) agricultural price declines could have mattered; he refers to the "conventional wisdom that price declines are deflationary in so far as they 'check confidence, provoke bank failures, encourage hoarding and in various ways discourage investment"' (Kindleberger, 1973, p. 142). Kindleberger (1973) does not elaborate on these possible channels, but references Lewis (1949). Lewis (1949) (p. 56) suggests that there were many possible channels through which low agricultural prices hurt the world economy in 1930, including increased uncertainty, lower confidence, bank failures, and protectionism. Interestingly, however, he does not consider the effect that we emphasize of a higher MPC among farmers translating lower farm prices into lower aggregate spending.

The more recent literature on agriculture and the international Great Depression is small. Most related to our work are Madsen (2001) and Federico (2005). Madsen (2001) examines the role of agricultural in transmitting the Great Depression across countries. Like us, he emphasizes that farmers probably had a higher MPC than nonfarmers. And using cross-country data, he concludes that falling agricultural prices likely account for a significant portion of the output decline during the Great Depression. Federico (2005) addresses a similar question but comes to quite different conclusions. He is interested in whether conditions in agriculture substantially contributed to the severity of the Great Depression. He concludes that

[6]Earlier work by the agricultural economists George Warren and Frank Pearson (Warren and Pearson, 1935) does discuss negative effects of lower commodity prices on agriculture. And Temin (1976) briefly considers whether developments in the agricultural sector might have contributed to the U.S. downturn in 1930. He concludes, however, that agriculture was too small a share of the economy for it to have been important in the aggregate.

they did not. His evidence comes from (1) an analysis of world farm product demand and supply which suggests little overproduction in the 1920s, and (2) a review of the literature which finds little support for the view that agricultural areas caused the banking panics in the U.S. Great Depression. Relative to Madsen (2001) and Federico (2005), we are focused more narrowly on one country (the U.S.) and one year (1929-1930). This allows us to look at detailed state and county data.

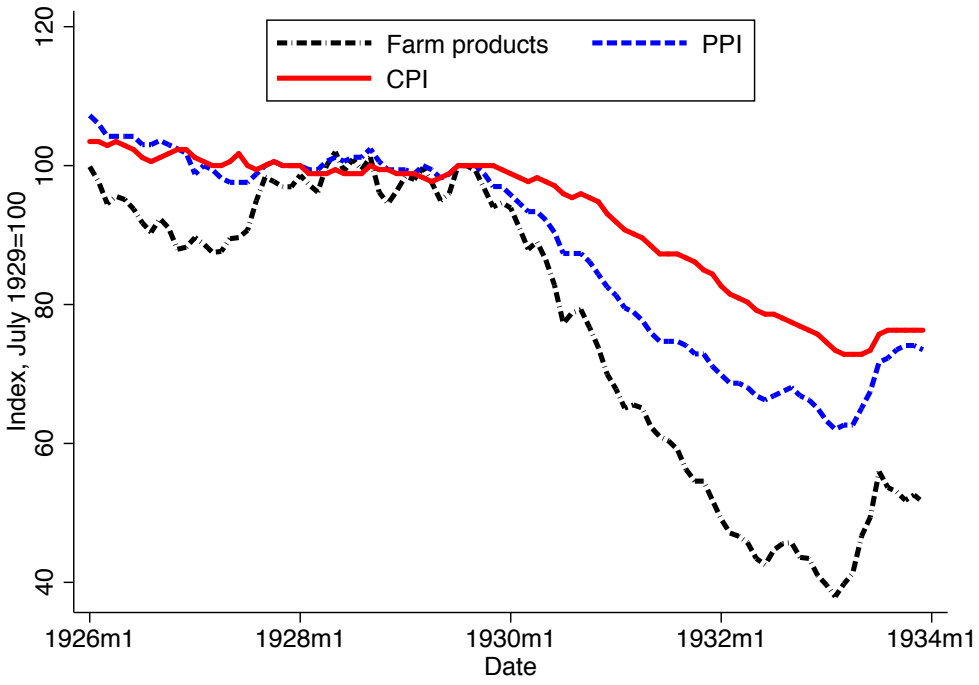
In addition to our findings' importance for understanding the aggregate U.S. economy at the beginning of the Depression, we also contribute to the literature on regional heterogeneity in the Depression's severity. We add to the findings in Garrett and Wheelock (2006), Rosenbloom and Sundstrom (1999), and Wallis (1989) in two ways. First, we quantify the large role of agriculture in explaining variations in state economic performance at the beginning of the Depression. Second, we show that it was traded crop production rather than agricultural activity as a whole that drove differences in state performance.

Recent work in macroeconomics has stressed the importance of redistribution and MPC heterogeneity for aggregate outcomes (Auclert, 2015; Broer, Hansen, Krusell, and Öberg, 2016; Cloyne, Ferreira, and Surico, 2016; Kaplan, Moll, and Violante, 2016; Krueger, Mitman, and Perri, 2015; McKay, Nakamura, and Steinsson, 2015; Werning, 2011). We show that these forces are also relevant to understanding the Great Depression.

2 Farm prices and income

Figure 2 plots the behaviour of an index of farm product prices and, for comparison, the producer price index and the CPI. It shows the extraordinary decline of farm product prices in absolute and relative terms after the summer 1929 business cycle peak. While the prices of all major farm products fell, the price decline was not uniform. Table 1 shows the prices of 12 major farm products early in the Depression. During the first year of the Great Depression, prices of wheat, cotton, and tobacco fell more than those of other crops. This is consistent with a role for recession abroad driving the price decline: cotton, tobacco, and wheat were the three most important traded crops. Of course, recession abroad may itself have been caused by recession in the U.S. So it is difficult to quantify the extent to which traded crop

Figure 2 – Prices



Note: The figure shows the level of farm product prices, producer prices (PPI) and consumer prices (CPI). Sources: Farm product prices: FRED series M04058USM350NNBR, originally from NBER series m04058 which was collected from BLS publications; PPI: FRED series PPIACO; CPI: FRED series CPIAUCNS.

price declines were an endogenous response to the U.S. recession. Large declines in the prices of mostly nontraded animal products (panel B) suggest that international factors were not the only driver of farm product price declines.

Since an individual farmer's income roughly equaled the price of their product times the quantity produced, the large decline in farm prices translated into a large decline in farm incomes. Farm incomes are shown in figure 3. Between July 1929 and October 1930, real, cpi-deflated farm income fell 29 percent; income from crops fell 42 percent. While individuals who became unemployed may have seen larger income declines, the decline in income for the typical farmer was far larger than that for the typical nonfarm worker. Annual data from the BEA (table SA04) show that cpi-deflated nonfarm personal income fell 6.3 percent between 1929-1930; over the same period, cpi-deflated farm income fell 25.1 percent.

Table 1 – Farm product prices

Panel A: Crops

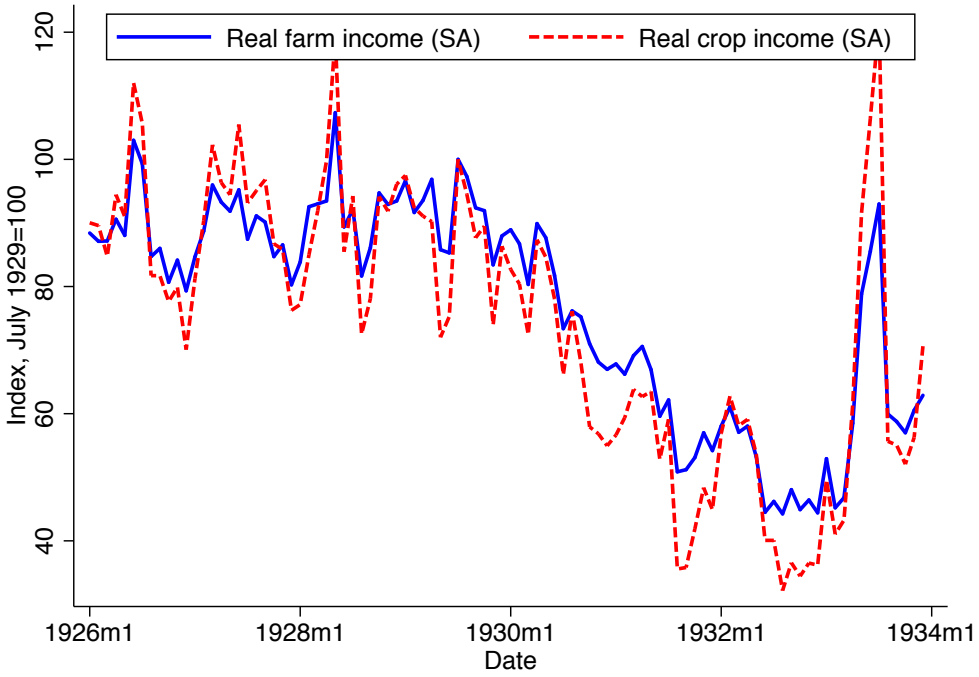
	Wheat	Corn	Oats	Cotton	Tobacco	Hay	Potatoes
Prices (SA, Index, 1928=100)							
1929 Q2	80	96	84	96		110	71
1929 Q3	98	98	97	93		107	138
1929 Q4	98	104	99	94		108	186
1930 Q1	85	88	80	79		100	165
1930 Q2	78	86	78	77		99	177
1930 Q3	65	89	78	57		110	131
1930 Q4	57	88	74	52		116	130
1928, average	100	100	100	100	100	100	100
1929, average	91	99	92	95	103	109	116
1930, average	71	88	78	66	79	106	151
Production							
1929 farm value ($, millions)	852	2024	468	1245	282	761	431
1929-30 change in quantity (%)	8	-19	14	-6	7	-4	2
1929, trade output share, (X+M)/Y (%)	20	0	1	50	43	0	3

Panel B: Animal products

	Cattle	Hogs	Milk	Chickens	Eggs
Prices (SA, Index, 1928=100)					
1929 Q2	102	117	101	109	106
1929 Q3	104	107	101	107	108
1929 Q4	98	105	100	101	104
1930 Q1	95	107	91	96	102
1930 Q2	89	107	91	90	86
1930 Q3	72	93	89	82	77
1930 Q4	73	98	88	81	69
1928, average	100	100	100	100	100
1929, average	101	108	100	106	106
1930, average	82	101	90	87	84
Production					
1929 farm value ($, millions)	1,247	1,482	3,021	524	794
1929-30 change in quantity (%)	0	-6	1	-3	4
1929, trade output share, (X+M)/Y (%)	2	7	N/A	N/A	N/A

Notes and sources: Prices are producer prices (prices received by farmers); annual prices are unweighted calendar year averages. Farm product value equals physical production times price. Farm product value and production figures are for the crop year, not the calendar year. For further notes and source details, see the appendix.

Figure 3 – Farm income



Note: The figure shows seasonally adjusted total farm income and income from crop production. Sources: Pre-1932- *Survey of Current Business*, May 1934, p. 19. 1932-33: 1936 Supplement - *Survey of Current Business*, p. 9.

3 Expenditure in farm areas

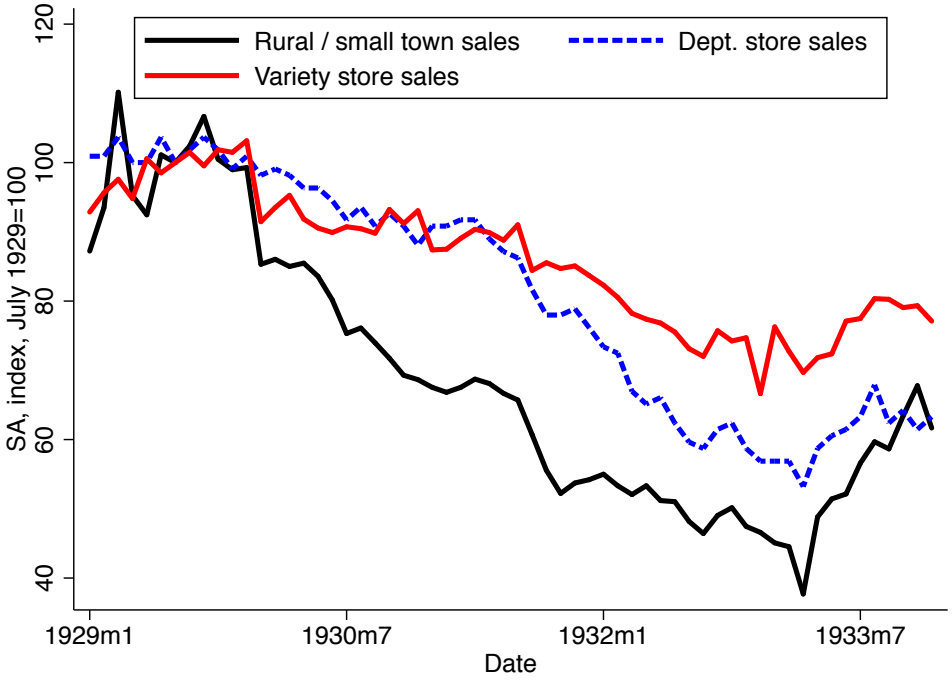
The large decline in farm prices and incomes led to a collapse of spending in farm areas. Initial evidence for this comes from a comparison of rural and small town retail sales with department store and variety store sales. Rural and small town retail sales are a Department of Commerce index (U.S. Department of Commerce, 1934a) that uses data on mail order and chain store sales to measure consumption in small towns (those with population less than 10,000) and on farms.[7] Department stores were located in urban areas and thus capture a part of urban consumption. They have the disadvantage, however, of being weighted towards higher-price goods. The Department of Commerce (U.S. Department of Commerce, 1934b) developed an index of variety store sales in part to correct for this bias. The variety store index has the disadvantage for our purpose, however, of being based on a sample that puts a heavy weight on relatively small cities, those with population less than 100,000. Still, the

[7]The underlying data for this index were provided by Chicago Mail Order House, Montgomery Ward & Co., Sears, Roebuck & Co., and J. C. Penney Co. For further details, see U.S. Department of Commerce (1934a).

Department of Commerce saw this series as at least somewhat representative of consumption in urban areas (U.S. Department of Commerce, 1934a).

Figure 4 graphs these series between 1929 and 1933. (The rural and variety store indices begin in January 1929.) The indices start to diverge in December 1929; between July 1929 and October 1930, seasonally adjusted department store and variety store sales fell 7 percent; rural and small town retail sales fell 28 percent.

Figure 4 – Rural and urban retail sales



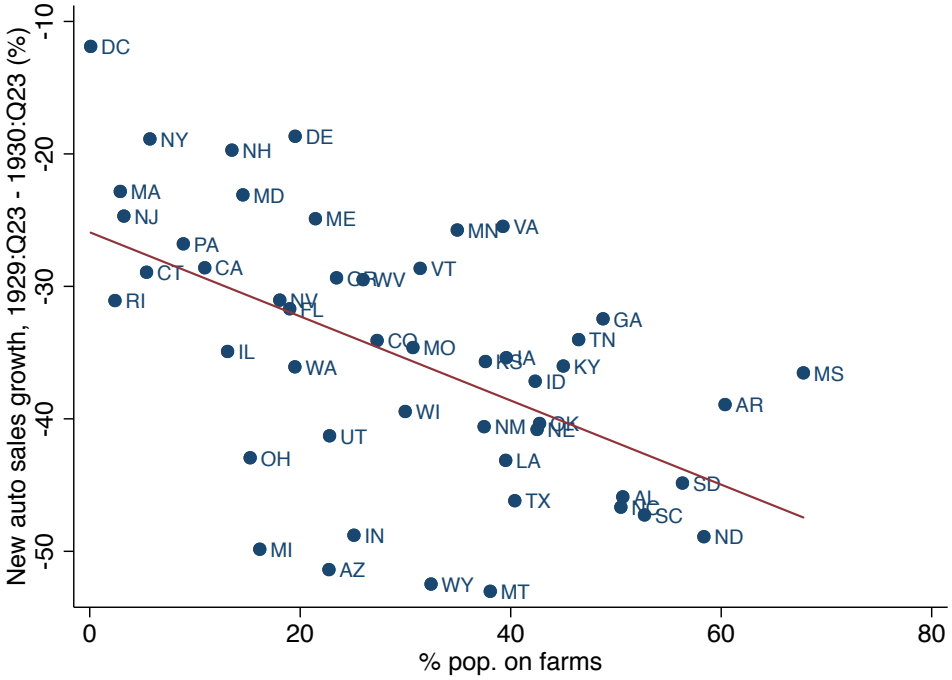
Sources: Pre-1932 department store sales - 9/1936 *Survey of Current Business*, p. 19; Pre-1932 rural sales - 12/1934 *Survey of Current Business*, p. 20; 1932-1933 department store and rural sales - 1936 *Survey of Current Business* Supplement, pp. 27-28; variety store sales - 3/1934 *Survey of Current Business*, p. 18.

While this is already strong evidence of a large relative decline in consumption in farm areas, we now turn to state and county data in order to more precisely quantify the evolution of spending in farm versus nonfarm areas. In particular, we focus on data on auto sales. Auto sales have three advantages. First, the data are available monthly by state and monthly for Ohio counties. We know of no other indicator of expenditure available by state or county at this frequency. Second, the data are likely to be relatively well-measured, given that car registration was required. Finally, while only one component of household spending, cars played an out-sized role in the initial year of the Great Depression. As emphasized by Romer

(1990), durables consumption fell much more than non-durables in 1930.

3.1 Evidence from U.S. States Monthly data on new automobile registrations (sales) comes from the 1934 *Automotive Daily News Review and Reference Book*.[8] Figure 5 shows a scatter plot of the percent change in auto sales between the second and third quarter of 1929 and the second and third quarter of 1930 and the share of a state's population living on farms. Here and in our regressions below we compare car sales between these six-month averages (1929:Q2-Q3 and 1930:Q2-Q3), since doing so filters out idiosyncratic noise in the monthly data. Figure 5 shows a clear negative relationship between car sales growth and farm share of the population during the first year of the Great Depression.

Figure 5 – Percent change in car sales and farm population share



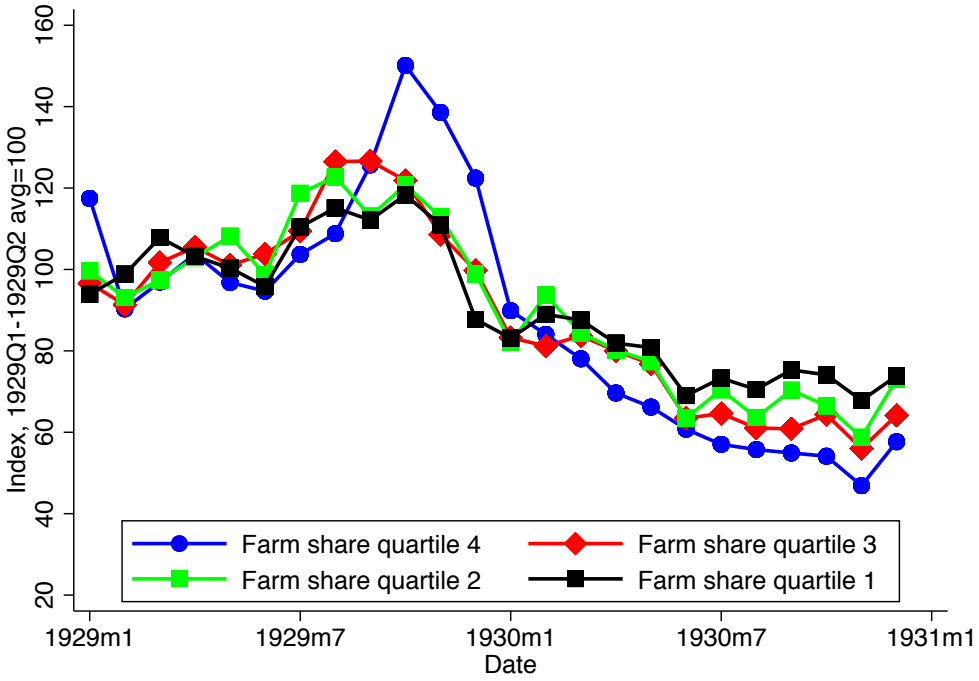
Sources: Auto sales - see text; farm share of the population - Haines and ICPSR (2010).

Figure 6 provides another way to see the relationship between farm share and economic performance. It graphs the average level of auto sales in each of four quartiles of states, where states are grouped by the share of their population living on farms. By the second half of 1930, a clear pattern emerges, in which auto sales had fallen most in the highest

[8]This was published as a supplement to the *Automotive Daily News*. The data are on pp. 22-23. The original source is listed as R.L. Polk & Co., New Jersey Motor Co., and Sherlock & Arnold.

farm share states (quartile 4) and least in the lowest farm share states (quartile 1). There is no evidence of divergence between the quartiles before early 1930, with the exception of a notable upward spike in auto sales in quartile 4 in late 1929. This upward spike is driven by very high auto sales in Alabama and Mississippi, numbers that we suspect may be errors. Appendix figure B.1 shows that when Alabama and Mississippi are excluded, this upward spike disappears, but the monotonic pattern in which 1930 car sales fell most in the highest farm share states remains.

Figure 6 – Auto sales by farm share quartile



Sources: Auto sales - see text; farm share of the population - Haines and ICPSR (2010).

Table 2 investigates the relationship between farm intensity and auto sales more carefully by estimating regressions of the form:

$$\%\Delta\text{Auto sales}_{i,\text{1929:Q2-Q3-1930:Q2-Q3}} = \beta_0 + \beta_1 \text{Agricultural exposure}_i + \gamma' X_i + \varepsilon_i, \qquad (1)$$

where $\%\Delta\text{Auto sales}_{i,\text{1929:Q2-Q3-1930:Q2-Q3}}$ is auto sales growth in state i at the beginning of the Depression, "Agricultural exposure" is a measure of a state i's exposure to falling farm prices, and X is a set of control variables. Column 1 shows results for the single-variable regression analogous to the scatter plot in figure 5. The coefficient is both economically and

Table 2 – Cross-state regressions

	(1)	(2)	(3)	(4)	(5)	(6)
Right hand side variables:						
% pop. on farms	−0.32***	−0.34***	−0.36***			
	(0.064)	(0.082)	(0.10)			
Crops sold p.c.				−0.12***	−0.080**	−0.067*
				(0.031)	(0.033)	(0.038)
Population (millions)		−0.48	−0.52		−0.097	−0.037
		(0.54)	(0.55)		(0.51)	(0.52)
1928 car sales p.c. (1000s)		−0.098	−0.13		0.23	0.25
		(0.23)	(0.24)		(0.29)	(0.28)
Drought			−0.83			1.94
			(2.79)			(2.73)
Region Fixed Effects	No	Yes	Yes	No	Yes	Yes
R^2	0.30	0.49	0.50	0.24	0.39	0.40
Observations	49	49	49	49	49	49

Notes: The dependent variable is the percent change in non-seasonally adjusted auto sales from the 1929:Q2-Q3 average to the 1930:Q2-Q3 average. p.c. means per capita. Robust standard errors in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ Sources: New auto sales - see text; population and percent of the population on farms - the 1930 Census as reported in Haines and ICPSR (2010); value of crops sold per capita - the 1940 Census as reported in Haines, Fishback, and Rhode (2015); 1928 car sales - *Automovite Industries*, 2/23/29, p. 271; drought dummies - National Climate Data Center.

statistically quite significant (the t-statistic equals 4). The coefficient of -0.32 implies that a one standard deviation change in farm population share (17 percentage points) is associated with a 5.5 percentage point decline in auto sales growth. For comparison, nationwide auto sales fell 34 percent over this period.[9] Note also that the R^2 is 0.30: as measured by auto sales, the farm share of the population alone explains 30 percent of the cross-state variation in the severity of the early Great Depression.

In interpreting the results in table 2, it is worth emphasizing that specification 1 is not directly measuring the change in purchases of cars by farmers themselves; the difference we see between the change in car sales in more and less farm intensive states is likely due not only to the purchasing behaviour of farmers but also to the purchasing behaviour of parts of the population whose livelihood was linked to that of farmers. When farmers' spending fell, the owner of the local general store may have also foregone an auto purchase.

Column 2 adds control variables to address the most obvious omitted variable bias con-

[9]Nationwide new auto sales are from NBER macrohistory series m01109.

cerns. We control for population to assure that the percent of state's population living on farms is not simply proxying for a small versus large state effect;[10] we control for the per-capita number of cars sold in 1928 to assure that estimates are not biased by greater propensities to purchase cars in some states; and we control for region fixed effects to isolate the effects of farm intensity within regions. These control variables have essentially no effect on the coefficient. Column 3 controls for drought with a dummy variable equal to 1 in states that suffered a moderate drought or worse in the second and third quarters of 1930.[11] With the control for drought, the coefficient of interest on farm share of the population is again little changed.

Column 4 of table 2 uses an alternative indicator of a state's agricultural exposure: the value of crops sold per capita in 1929. The coefficient is again economically and statistically significant (t-statistic equal to 4). The coefficient of -.12 implies that a one-standard deviation increase in crops sold per capita in a state ($39.70) results in a 4.8 percentage point larger decline in auto sales in the first year of the Depression. This is very similar to the decline in auto sales associated with a one standard deviation change in farm share of the population. Column 5 adds control variables and region fixed effects. The coefficient shrinks by one third, but remains economically and statistically significant. Column 6 adds a control for the drought dummy. This results in a somewhat further shrinking of the coefficient on crops sold per capita.

Taken together, the results in table 2 show that agricultural-intensive states did worse during the first year of the Great Depression. This is consistent with a story in which lower agricultural prices depressed farm incomes and farm consumption and investment. We are, however, interested not only in whether farm states did worse, but in exactly what farm products were most affected. If spending declined most in areas growing crops whose prices declined most, this would buttress our argument that lower farm prices and income lowered farm area spending. To investigate this, we look at how state performance varied with the

[10] As a further check for the influence of small versus large states on our results, appendix table C.1 replicates table 2, but weighting by population. Estimates are qualitatively similar.

[11] These are states with an average Palmer drought index of -2 or below between April and September 1930. The states meeting this criteria are AL, CT, DC (assigned MD's drought values), DE, IL, IN, MA, MD, MO, NC, NV, OH, OR, RI, SC, TN, VA, and WV. For a narrative account of this drought and its impact on agriculture, see United States Department of Agriculture (1931).

Table 3 – Cross-state regressions by farm product type

	(1)	(2)	(3)
Right hand side variables:			
Cotton, tobacco, cereals, wool p.c.	-0.15^{***}	-0.12^{***}	-0.11^{***}
	(0.034)	(0.038)	(0.040)
Nontraded farm p.c.	−0.0025	0.024	0.027
	(0.012)	(0.023)	(0.023)
Population (millions)		−0.016	0.059
		(0.49)	(0.51)
1928 car sales p.c. (1000s)		0.13	0.15
		(0.31)	(0.31)
Drought			1.66
			(2.60)
Region Fixed Effects	No	Yes	Yes
R^2	0.34	0.48	0.49
Observations	49	49	49

Notes: The dependent variable is the percent change in non-seasonally adjusted auto sales from the 1929:Q2-Q3 average to the 1930:Q2-Q3 average. Corn is included in nontraded crops because of its use in hog production. p.c. means per capita. Robust standard errors in parenthesis. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$ Sources: farm product categories – the 1940 Census as reported in Haines et al. (2015); all other variables – see table 2.

type of agricultural products produced.

3.1.1 Results by crop Table 3 looks at the relationship between the auto sales growth in the first year of the Depression and the production of two categories of farm products: traded crops and nontraded farm products. We define traded crops to be the value of cotton, tobacco, cereals, and wool production. While not all cereals were traded, their substitutability means that their prices often moved together (Hausman et al., 2019). Nontraded farm production equals nontraded crop production plus the value of dairy and livestock sold. Nontraded crop production is equal to the value of total crop production minus the value of traded crops. We also include corn in the nontraded crops category. Corn is a cereal and corn prices may have moved with other cereals prices; but movements in corn prices did not necessarily directly impact farm incomes, since large amounts of corn were used to feed hogs living on farms. Thus an increase in the market price of corn had no effect on many corn farmers' incomes.

The first column of table 3 show that traded crop production had much more influence on

state auto sales than did nontraded farm product production. The coefficient on traded crop production of -0.15 implies that a one-standard deviation increase in traded crop production ($39) would have resulted in 5.7 percentage points lower auto sales growth. The coefficient is estimated precisely, with a t-stat of 4.2 and a 95 percent confidence interval of [-0.21,-0.08]. Thus we can be confident that there was an economically significant relationship between traded crop production and economic performance.

By contrast, conditional on traded crop production there is no evidence of a negative association between nontraded farm product production and auto sales in the first year of the Great Depression. The conclusion remains the same in columns (2) and (3) when we add the control variables and the drought indicator used in table 2. In sum, the cross-state results show that it was traded crop production more than agricultural production in general that was associated with a more severe beginning of the Depression.

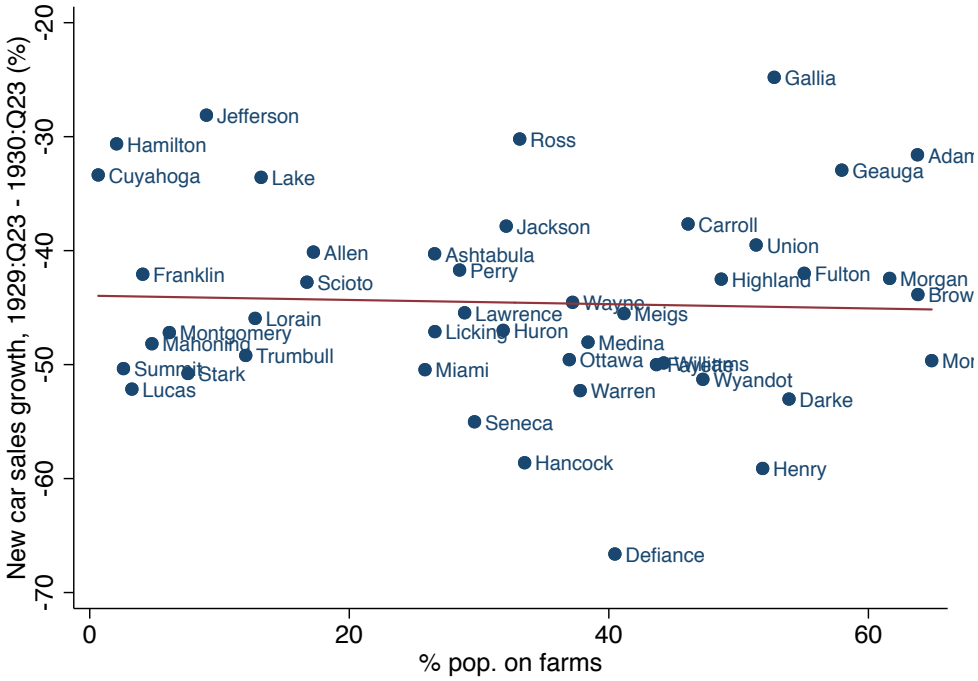
3.2 Evidence from Ohio counties To obtain further evidence on the relationship between agriculture and the severity of the early Great Depression, we collected data on auto sales in Ohio counties. To our knowledge, these are the only available data on auto sales at the county level at an annual or higher frequency in 1929-30. The data for Ohio come from the *Bulletin of Business Research* prepared by the College of Commerce and Administation of the Ohio State University. The data are monthly and are presented as "Registrations of New Automobile Bills of Sales in Ohio Counties" with the source specified as "Clerks of Courts of Listed Counties."[12] Unfortunately, the data do not cover all counties: we have data on 45 of the 88 counties in Ohio. But these counties accounted for most auto sales; pre-Depression, in 1928, more than 78 percent of all new car sales in Ohio occurred in these 45 counties.[13]

The *Bulletin of Business Research* presents data on both new passenger car sales and new truck sales. Unfortunately, however, there are too few counties with substantial truck sales to make the truck sales data useful for understanding the early Great Depression. Thus we confine ourselves to an analysis of the new passenger car sales. This has the added advantage of easy comparability with the our cross-state results, which are also only for passenger cars.

[12]See, for example, *Bulletin of Business Research*, May 1930, table II, p. 6.

[13]County sales are from *Industrial and Commercial Ohio Yearbook* (1930), table XVI, p. 104; the state total is from *Automotive Industries*, 2/23/29, p. 271.

Figure 7 – Ohio counties: Percent change in car sales and farm population share

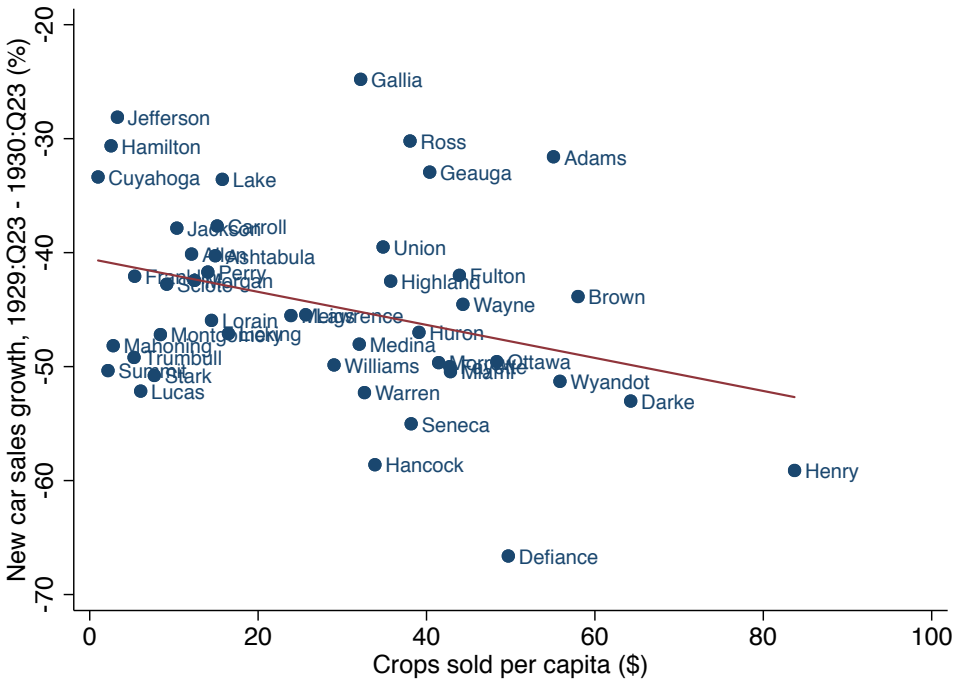


Sources: Auto sales - see text; farm share of the population - Haines and ICPSR (2010).

Figure 7 presents a cross-county scatter plot analogous to the cross-state scatter plot in figure 5. Across Ohio counties, there is no clear relationship between farm population share and new car sales growth. Closer inspection of the data, however, reveal that the null result is driven by a few counties, in particular, Gallia, Geauga, and Union. These three counties had large portions of their population living on farms but relatively low values of crop production. As discussed above, it is crop producing areas that we expect to have suffered most at the beginning of the Depression, since crop prices fell more than farm product prices as a whole. Figure 8 thus shows a similar scatter plot, but with the value of crops sold per capita rather than the proportion of the population living on farms on the x-axis. As expected, here there is a more obvious negative relationship. This results in part from the shift of Gallia, Geauga, and Union counties from the far right of the graph to near the middle, reflecting their mid-range crop production despite large farm population shares.

To more formally investigate the relationship in Ohio between agricultural intensity and performance early in the Depression, we run regressions across counties like those estimated

Figure 8 – Ohio counties: Percent change in car sales and value of crops sold per capita



Sources: Auto sales - see text. Crops sold per capita - Haines et al. (2015).

across states in the previous section. Specifically, we estimate

$$\%\Delta\text{Auto sales}_{j,\text{1929:Q2-Q3-1930:Q2-Q3}} = \beta_0 + \beta_1 \text{Agricultural exposure}_j + \gamma' X_j + \varepsilon_j, \qquad (2)$$

where $\%\Delta\text{Auto sales}_{j,\text{1929:Q2-Q3-1930:Q2-Q3}}$ is auto sales growth in county j at the beginning of the Depression, "Agricultural exposure" is a measure of a county j's exposure to falling farm prices, and X is a set of control variables.

Columns (1) and (2) of table 4 show the single variable regressions corresponding to the scatter plots in figures 7 and 8. Columns (3) and (4) add controls for population and 1928 car sales per capita. With these controls, the coefficient on the farm share of the population remains small and insignificant; that on crop sales per capita loses statistical significance, but remains economically significant. Its magnitude (-0.08) is exactly the same as that in the cross-state regression with these controls (column 5 of table 2). Thus while there is too much noise among counties in Ohio to obtain a precise estimate, the results support the cross-state findings of an economically large relationship between the importance of crops in a county and the depth of the initial depression.

Table 4 – Cross-county regressions

	(1)	(2)	(3)	(4)	(5)	(6)
Right hand side variables:						
Farm share 1930 (%)	−0.024		0.014			
	(0.074)		(0.087)			
Crop value sold p.c. 1929 ($)		−0.15**		−0.084		
		(0.063)		(0.062)		
Cotton, tobacco, cereals, wool p.c.					−0.21*	−0.13
					(0.12)	(0.11)
Nontraded farm p.c.					0.019	0.017
					(0.032)	(0.031)
Population (millions)			9.11*	4.22		5.81
			(5.18)	(4.73)		(4.85)
1928 car sales p.c. (1000s)			−0.44***	−0.41**		−0.39**
			(0.15)	(0.15)		(0.16)
R^2	0.00	0.11	0.29	0.31	0.14	0.32
Observations	44	44	44	44	44	44

Notes: The dependent variable is the percent change in non-seasonally adjusted auto sales from the 1929:Q2-Q3 average to the 1930:Q2-Q3 average. p.c. means per capita. While we observe monthly auto sales in 1929-30 in 45 counties, there are only 44 obserfvations since 1928 car sales were not reported for Morgan county. Robust standard errors in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ Sources: New auto sales - see text; population and percent of the population on farms - the 1930 Census as reported in Haines and ICPSR (2010); value of crops sold per capita and farm product categories - the 1940 Census as reported in Haines et al. (2015); 1928 car sales - *Industrial and Commercial Ohio Yearbook* (1930), table XVI, p. 104.

Columns (5) and (6) explore the impact of traded versus nontraded farm products on the auto sales in Ohio counties. As in the cross-state results in table 3, the negative impacts of agriculture appear to be driven by the cultivation of traded crops.

Unlike the state results which change little when weighted by population (appendix table C.1), some of the cross-county specifications are quite sensitive to population weighting. Specifically, appendix table C.2 shows that the univariate results (specifications (1) and (2)) become stronger, with more evidence of a negative relationship between farm share / crops sold per capita and auto sales in the first year of the Great Depression. But the results with controls (specifications (3) and (4)) become weaker. When weighted, there is no longer a negative coefficient on crops sold per capita. Reassuringly, however, weighting does not affect the finding in columns (5) and (6) that traded crop production drove worse economic performance while nontraded crop production did not.

Taken together, the cross-county data are supportive of the findings from the cross-state data. The county sample is too small and noisy for precise, statistically significant conclusions, but most specifications support the robust message from the cross-state data that areas producing traded crops suffered most in the first year of the Depression.

4 Redistribution

Lower farm product prices transferred income from the farm sector to the rest of the economy. We have shown that this negatively affected spending in farm relative to nonfarm areas. But this does not establish that low farm prices had a negative impact on the economy as a whole. Like Madsen (2001), we believe that a mechanism through which the transfer of income away from farmers was on net contractionary is that farmers likely had a higher MPC than the agents benefitting from lower farm prices.

Unlike the econometric evidence of the previous sections, the evidence for a relatively high MPC among farmers is fragmentary. The first piece of evidence is farmers' debt burden. As the quote from Irving Fisher that begins this paper suggests, low farm prices and incomes posed particularly severe problems for farmers because of large nominal debt burdens. In 1930, farm mortgage debt was 190 percent of net farm personal income.[14] By comparison, residential mortgage debt was just 39 percent of nonfarm personal income.[15] High farm debt burdens were reflected in large numbers of farm foreclosures. In 1929 and 1930, there were 14.7 and 15.7 foreclosures per 1000 farms. This indicates a severe level of distress relative to more normal times; foreclosures per 1000 farms averaged just 3.2 in both the 1913-20 period and the 1941-1950 period (Alston (1983), table 1, p. 888).

These debt problems were long in the making. Farmers acquired large amounts of debt during World War I as farm product prices and farm land values rose. And nominal debt continued to rise during the 1920s even as farm prices and asset values fell. This put farmers in a perilous position on the eve of the Great Depression; hence when farm prices fell in 1929-1930, real farm debt burdens rose to very high levels. Table 5 shows that the ratios of

[14] Nominal mortgage debt data are from U.S. Department of Commerce (1975), series K157, p. 466; income data are from BEA table SA4.

[15] Snowden (2006) and BEA table SA4.

farm debt to gross income and farm debt to assets roughly doubled between 1910 and 1930.

Table 5 – Farm Debt

year	Debt / Gross income (%)	Debt / Assets (%)
1910	50	9
1920	58	13
1928	81	20
1930	98	21
1932	162	25

Notes: Debt is farm mortgage debt. Assets are the value of farm land and buildings.
Source: Clark (1933), table 5, p. 28.

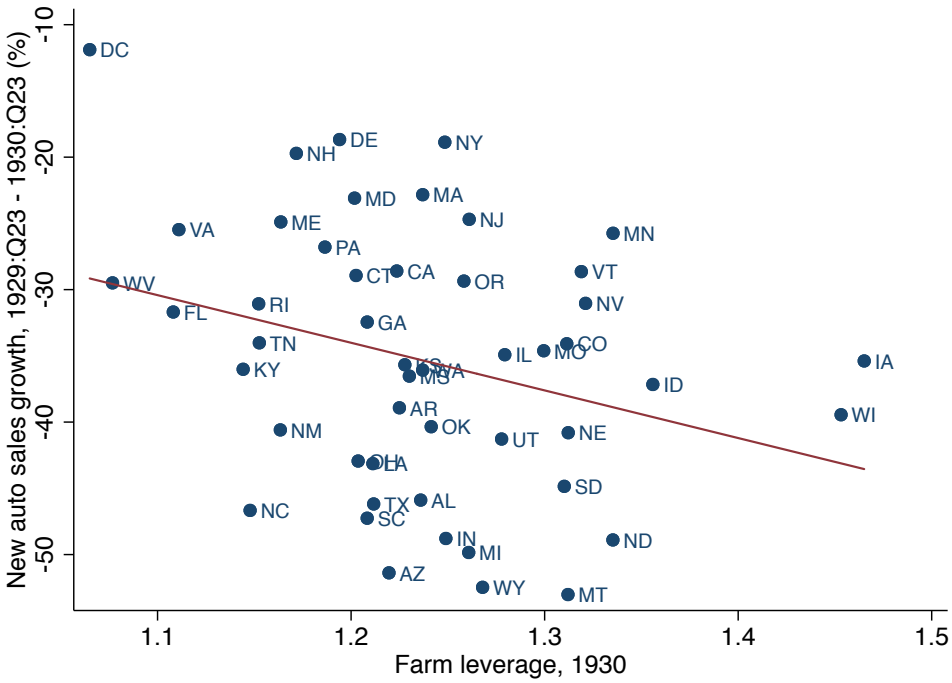
One would expect these large nominal debt burdens to have increased the difficulties farmers faced from lower farm prices in 1930. As farmers' incomes fell, debt service absorbed more of their income, squeezing their spending. Olney (1999) argues that a similar mechanism affected households burdened by consumer debt, contributing to the economy-wide collapse of spending in 1930. To understand the contribution of farm mortgage debt to the collapse of spending in farm states we start by examining the univariate relationship between auto sales over our sample period (1929:Q2-Q3 to 1930:Q2-Q3) and farm leverage in a state, with leverage is defined as $\frac{\text{assets}}{\text{assets}-\text{debt}}$, in which debt is farm mortgage debt and assets are the value of farm land and buildings.

Figure 9 shows a scatter plot of this relationship. There is some evidence of a negative relationship, though it is not statistically significant when Washington D.C. (an obvious outlier with little agriculture) is excluded. Of more interest than this bivariate relationship is whether the *interaction* of traded crop production and farm leverage was an important determinant of auto sales in 1930. (We focus on traded crops because those are the farm products whose prices fell most.) The hypothesis—consistent with Olney (1999)—is that the negative effect of traded production on auto sales would have been largest in those areas with the most farm leverage. In other words, we expect farmers to cut back most on spending in response to farm product price declines in places where their debt burdens were heaviest.

To test this hypothesis we would like estimate:

$$\begin{aligned}\%\Delta\text{Auto sales}_{i,\text{1929:Q2-Q3-1930:Q2-Q3}} = \beta_0 + \beta_1 \text{Traded crop p.c.}_i + \beta_2 \text{Leverage}_i \\ + \beta_3 \text{Traded crop p.c.}_i \times \text{Leverage}_i + \gamma' X_i + \varepsilon_i.\end{aligned} \tag{3}$$

Figure 9 – Percent change in car sales and farm leverage



Source: Auto sales - see text; farm leverage - Haines et al. (2015).

The problem is that with 49 observations, we lack the statistical power to do this estimation; in our 49 observation sample, there is essentially no variation in the interaction term that is not explained by the level of traded crop production and leverage. The R^2 of the regression of the interaction on the levels of traded crop production and leverage is 0.998. Thus we cannot plausibly identify β_3.

Despite our inability to estimate equation 3 on data in 1929-30, we have three reasons to believe that β_3 is negative, that more debt was associated with a larger decline in spending when farm product prices fell. First, a negative β_3 is predicted by theory. Second, in Hausman et al. (2019) we estimate a regression similar to (3) on nationwide county auto sales data in 1933, when farm product prices rose; we find that higher farm product prices had larger positive effects on spending where more farms were mortgaged. Third, recent evidence from the 2008 financial crisis suggests that more leverage was associated with larger declines in household consumption (Mian, Rao, and Sufi, 2013).

The second fact suggesting that farmers had a relatively high MPC concerns the distribution of the benefits of lower farm prices. Insofar as lower farm prices benefited urban

workers, many of whom were losing their jobs in 1930, it is not obvious that the difference between the MPCs of the winners and losers would be large. Limited pass-through meant, however, that it was businesses as well as workers who benefited from lower farm product prices. And it is quite plausible that the marginal propensity to spend of businesses was much below that of farmers.

Limited pass-through was driven by the stickiness of many final goods prices at the beginning of the Depression. For example, while the producer price of tobacco fell 23 percent from 1929-1930, the price of a pack of cigarettes rose 2 percent.[16] Retail bread prices fell 0.17 cents per pound while the price of the farm product input fell 0.26 cents.[17] And while the price of the wheat input to a 28-oz package of wheat cereal fell by 0.8 cents between 1929:Q2-Q3 and 1930:Q2-Q3, the retail price fell only 0.2 cents (United States Department of Agriculture (1945), table 42, p. 195). These (and other) examples suggest that in 1930 businesses producing final goods from farm products often benefited from lower farm prices.[18]

5 Aggregate effect

To obtain a quantitative sense of how farmers' relatively high MPC could have led to aggregate effects of lower farm prices, we follow Hausman et al. (2019). There we argued that the aggregate effect of a farm product price change on car sales can be approximated by

$$\%\Delta\text{Cars} \leq \underbrace{\beta \times \phi^f}_{\substack{\text{"naive"} \\ \text{extrapolation}}} \times \underbrace{\frac{\text{Farm area income per capita}}{\text{National income per capita}}}_{\text{Relative income p.c.}} \times \underbrace{\left(1 - \xi \frac{\theta^w}{\theta^f}\right)}_{\substack{\text{Redistribution from} \\ \text{high-MPC consumers}}} \times \underbrace{\mu_t}_{\substack{\text{Aggregate} \\ \text{spending} \\ \text{multiplier}}} + \underbrace{-\sigma d \ln(1 + r_t)}_{\text{Intertemporal Substitution}} . \tag{4}$$

[16] These are the average of cigarette prices in June and December of each year. See United States Department of Labor (1936) (table 13, p. 241).

[17] The is the change in the urban price of a pound of white bread, from United States Department of Labor (1938), table 7, p. 78; data on the cost of the farm input is from United States Department of Agriculture (1945), table 32, p. 162.

[18] For more discussion and data on pass-through from farm prices to retail prices, see United States Department of Treasury, Bureau of Internal Revenue (1937).

β is the coefficient from the cross-state regression of the percent change in car sales on the farm share of the population. From column 1 of table 2 this is -0.32. ϕ^f is the farm share of the U.S. population, which in 1930 was 24.8 percent. We call the product of β and ϕ^f a naive extrapolation, since it is what one would guess about the aggregate effect from assuming that the aggregate effect of farmers on economic performance was exactly equal to the cross-sectional effect.

As discussed above, this naive extrapolation is wrong since the cross-sectional coefficient measures both the negative effect of lower farm product prices on farmers and the positive effect of lower farm product prices on nonfarmers. We assume that there are two types of nonfarmers: capitalists and workers. By assumption, capitalists have a MPC of zero, so that gains from lower farm product prices absorbed by businesses have no effect on aggregate demand. Thus, for instance, we assume that the gains of cigarette manufacturers from lower tobacco prices do not lead to more investment spending by cigarette manufacturers. Nonfarm workers, by contrast, do have a positive MPC, and we assume that they spend a substantial fraction of their gains from lower farm product prices.

These assumptions are reflected in our adjustment for redistribution.[19] The adjustment factor, $\xi\frac{\theta^w}{\theta^f}$, equals the extent to which lower farm product prices were passed through to workers (ξ) times the ratio of the marginal propensity to consume of workers (θ^w) to the marginal propensity to consume of farmers (θ^f). As in Hausman et al. (2019), we consider a range of values for the redistribution factor, $\xi\frac{\theta^w}{\theta^f}$, of 0.3 to 0.7, and a range for the aggregate spending multiplier of 1 to 3. Also as in Hausman et al. (2019), we ignore the possible quantitative contribution of intertemporal substitution, i.e. the contractionary effect of lower inflation expectations caused by lower farm product prices.

The results of this exercise are shown in table 6. Columns (2) through (4) show the percent decline in car sales accounted for by lower farm product prices for given assumptions about the redistribution factor and the aggregate multiplier. Columns (5) through (7) divide these estimates by the total decline in new car sales growth from 1929:Q2-Q3 to 1930:Q2-Q3

[19]The adjustment for the ratio of farm area income per capita to national income per capita is a mechanical adjustment made necessary by the fact that farm areas tended to be poorer than nonfarm areas, and thus cross-sectional estimates exaggerate the aggregate effect of farmers on the national economy. See Hausman et al. (2019) for further discussion.

Table 6 – Implied aggregate effect

Redistribution from high MPC consumers, $\xi\frac{\theta^w}{\theta^f}$	Predicted %ΔCars: Aggregate Multiplier $\mu=1$	$\mu=2$	$\mu=3$	Fraction of actual %ΔCars: Aggregate Multiplier $\mu=1$	$\mu=2$	$\mu=3$
0.7	−1.6	−3.2	−4.7	4.7	9.4	13.8
0.6	−2.1	−4.2	−6.3	6.2	12.4	18.5
0.5	−2.6	−5.3	−7.9	7.6	15.6	23.2
0.4	−3.2	−6.3	−9.5	9.4	18.5	27.9
0.3	−3.7	−7.4	−11.1	10.9	21.8	32.6

Notes: Columns 2-4 display the implied new car sales growth rate from equation (4) given the indicated parameter values, and $\beta = -0.32$, $\phi^f = 0.248$, $\frac{Y_{p.c.,a}}{Y_{p.c.}} = 0.66$. Columns 5-7 show the fraction of actual new car sales growth (-34%) explained.

to show the fraction of the decline in new car sales growth explained by lower farm product prices. These estimates show that lower farm product prices had a significant effect on the downturn in the initial year of the Depression unless one believes: (1) that lower farm product prices were passed through to urban workers, and (2) that urban workers had an MPC similar to farmers, and (3) that the aggregate multiplier was low. For example, a mid-range estimate of the redistribution factor (0.5) and of the aggregate multiplier (2) suggests that had farm product prices not fallen, the downturn in the initial year of the Depression would have been 15 percent smaller.

6 Conclusion

Economists have often focused on the banking panics as a cause of the Great Depression. Less work considers the source of the Depression's severity before the banking panics began. This paper helps to fill this gap. We argue that the agriculture sector played an important rule in propagating negative shocks that hit the U.S. economy in 1929 and 1930. Declines in world demand translated into large declines in farm product prices and farmers' incomes. Income declines in turn lowered farmers' expenditure, a process likely intensified by farmers' large nominal debt burdens.

Evidence that spending in farm areas was an important part of the early U.S. Great Depression comes from cross-state data and cross-county data in Ohio. In both cases, we find that car sales fell most early in the Depression in areas most exposed to farm product price declines. This result is robust in the cross-state data. While less robust in the cross-county data, the rough consistency of the cross-county results with the cross-state results

is reassuring evidence that the effect we find is real and is not an artifact of a spurious cross-state correlation.

The cross-sectional results are themselves of interest; they show, for instance, that simply knowing the farm share of states' population in 1930 is quite predictive of the severity of the early Great Depression in that state. We are, however, ultimately interested in the aggregate implications of low farm product prices. To estimate these, we need a model. This section is necessarily more speculative. But a plausible range of parameters suggest that the mechanism through which farm product prices lowered spending by farmers explains 10-30 percent of the decline in U.S. output before the first banking crises.

Importantly, this may be a conservative, lower bound to the impact of lower farm product prices on the U.S. economy. Because of the difficulty in quantifying the effect, our model deliberately excludes the contractionary effect of lower farm product prices that operated through deflation and deflationary expectations. But this effect could have been large: plummeting farm product prices were one of the early indicators of the severe deflation that began in 1930.

This papers' concern is with a specific historical episode. But there are contemporary implications. A rapidly growing theoretical and empirical literature in macroeconomics shows the importance of redistribution as a propagation mechanism for macroeconomic shocks. Much of the empirical motivation for this literature comes from the experience of the 2008-2009 financial crisis and recession in which the costs of falling house prices were concentrated on indebted households. The large spending response of these households to this negative shock was a key driver of the recessions' severity (Mian et al., 2013).

Farmers in 1930 are the analog to mortgaged households in 2008. They had high levels of debt and their spending was sensitive to income declines. Just as declines in spending by mortgaged households explain a part of the 2008-09 recession, so declines in farmers' spending explain part of the early U.S. Great Depression. This result supports macroeconomists focus on redistribution. It is also a reminder of the value of a detailed understanding of an economy's structure. Redistribution effects depend on how income is distributed and the spending propensities of the affected groups. Thus our work also supports the long-standing concern of economic historians with agriculture in the interwar period.

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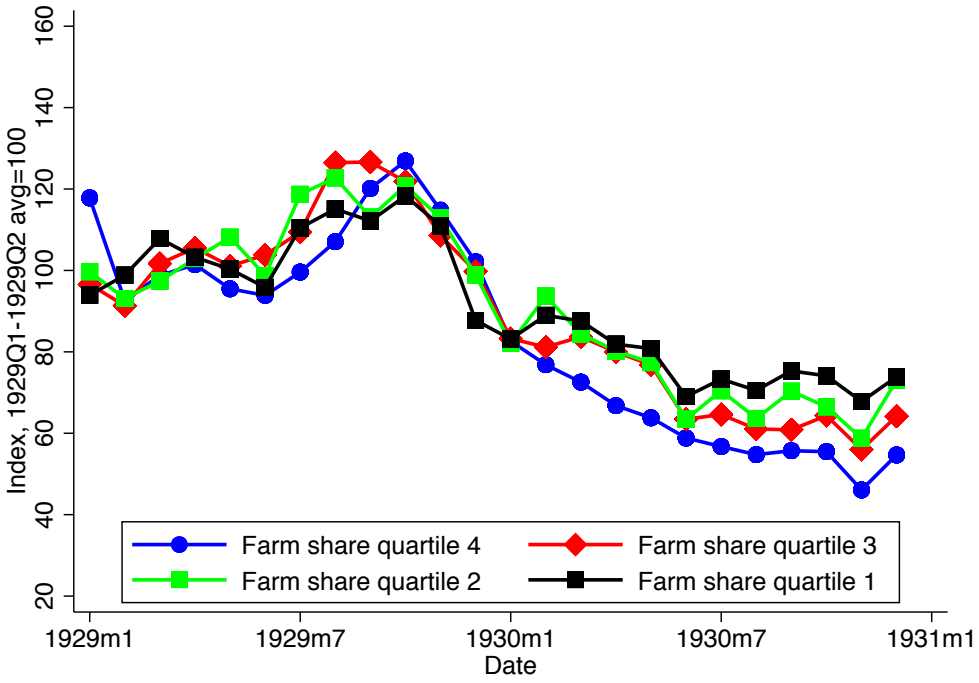
A Data appendix for table 1

[To be written.]

B Appendix figure

Figure B.1 – Auto sales by farm share quartile



Sources: Auto sales - see text; farm share of the population - Haines and ICPSR (2010).

C Appendix tables

Table C.1 – Cross-state regressions, population weighted

	(1)	(2)	(3)	(4)	(5)	(6)
Right hand side variables:						
% pop. on farms	-0.31^{***}	-0.23^{**}	-0.30^{***}			
	(0.083)	(0.094)	(0.11)			
Crops sold p.c.				-0.14^{***}	-0.061	-0.082^{**}
				(0.051)	(0.037)	(0.038)
Population (millions)		-0.079	-0.26		0.12	0.025
		(0.39)	(0.43)		(0.35)	(0.36)
1928 car sales p.c. (1000s)		-0.39^{*}	-0.54^{**}		-0.23	-0.40
		(0.22)	(0.25)		(0.25)	(0.25)
Drought			-3.15			
			(2.71)			
Region Fixed Effects	No	Yes	Yes	No	Yes	Yes
R^2	0.33	0.59	0.61	0.20	0.57	0.60
Observations	49	49	49	49	49	49

Notes: The dependent variable is the percent change in non-seasonally adjusted auto sales from the 1929:Q2-Q3 average to the 1930:Q2-Q3 average. p.c. means per capita. Robust standard errors in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table C.2 – Cross-county regressions, population weighted

	(1)	(2)	(3)	(4)	(5)	(6)
Right hand side variables:						
Farm share 1930 (%)	-0.17		0.066			
	(0.10)		(0.086)			
Crop value sold p.c. 1929 ($)		-0.22^{**}		0.027		
		(0.094)		(0.073)		
Cotton, tobacco, cereals, wool p.c.					-0.23^{*}	-0.18
					(0.12)	(0.12)
Nontraded farm p.c.					-0.00071	0.061
					(0.042)	(0.037)
Population (millions)			12.6***	11.6***		12.7***
			(2.42)	(2.07)		(2.24)
1928 car sales p.c. (1000s)			-0.64^{***}	-0.66^{***}		-0.63^{***}
			(0.21)	(0.21)		(0.21)
R^2	0.08	0.14	0.55	0.55	0.14	0.57
Observations	44	44	44	44	44	44

Notes: The dependent variable is the percent change in non-seasonally adjusted auto sales from the 1929:Q2-Q3 average to the 1930:Q2-Q3 average. p.c. means per capita. While we observe monthly auto sales in 1929-30 in 45 counties, N is 44 since 1928 car sales were not reported for Morgan county. Robust standard errors in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$