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RECOVERY FROM THE GREAT DEPRESSION:
THE FARM CHANNEL IN SPRING 1933

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ABSTRACT

In the four months following the trough of the Great Depression in March 1933, industrial production rose 57 percent. We argue that an important source of recovery was the direct effect of dollar devaluation on farm prices, incomes, and consumption. We call this the farm channel. Using daily spot and futures crop price data, we document that devaluation raised prices of traded crops and their close substitutes (other grains). And using novel state and county auto sales data, we document that recovery proceeded much more rapidly in farm areas. These cross-sectional effects are large, explain a substantial fraction of cross-state variation in auto sales growth, and are concentrated in areas growing traded crops or close substitutes. We also find that given the same exposure to farm price changes, spending rose more in counties with more farm debt. We aggregate our cross-sectional results using a simple incomplete markets model in which indebted farmers have high MPCs. It implies that the farm channel accounts for 30% or more of the spring recovery.

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"[T]he depression in the manufacturing industry of the country is due chiefly to the fact that agricultural products generally have been selling below the cost of production, and thereby destroyed the purchasing power in the domestic market of nearly half of all our people. We are going to restore the purchasing power of the farmer." - Franklin D. Roosevelt, campaign speech in Atlanta, Georgia, 24 October 1932.[1]

1 Introduction

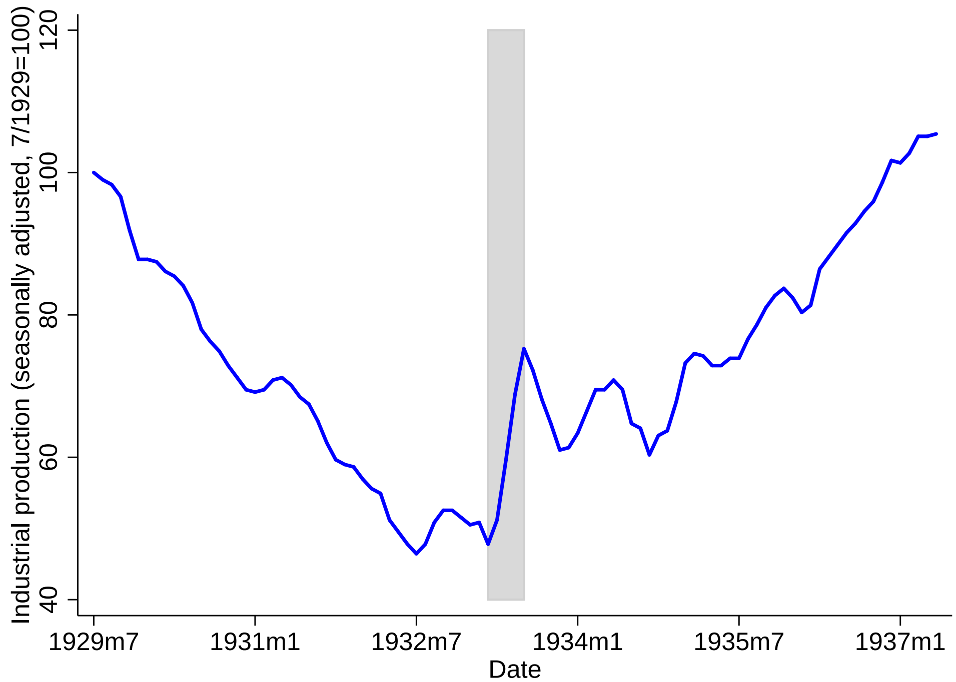
From its low point in March 1933, seasonally adjusted industrial production rose 57 percent in four months,[2] the most rapid four months of industrial production growth on record. As shown in figure 1, in these four months the U.S. economy recovered from two years of the Depression.[3] We argue that an important driver of this extraordinary recovery was the effect of devaluation on farm prices, incomes, and consumption. We call this mechanism the farm channel.

As the quote beginning the paper suggests, the importance of farmers for recovery was much emphasized in the 1930s. But with the exception of Temin and Wigmore (1990)—which inspired this paper—it has not figured prominently in the modern literature. Our goal is to document the farm channel's operation and its relevance to the aggregate economy's recovery. We do so in three steps. First, we show that crop prices rose rapidly in spring 1933, and that this increase was in part caused by devaluation. Second, we show that auto sales and income grew much more in farm areas of the country, particularly in those areas most burdened by farm mortgage debt. Finally, we build an incomplete-markets model to translate our cross-sectional estimates into an aggregate effect.

We start our analysis of the farm channel in section 2 by examining the 1933 path of prices and production of all major farm products. The data show a large increase in crop prices after devaluation, with much smaller price increases for livestock and dairy products. An analysis of daily farm spot and futures prices around the announcement of the U.S. departure from

[1] See http://teachingamericanhistory.org/library/document/campaign-speech/ for the complete speech.
[2] FRED series INDPRO, accessed on 10/3/2016.
[3] We verify in appendix A that rapid recovery is a feature not only of the industrial production data, but also of other aggregate economic indicators. Our conclusion that the economy indeed grew extraordinarily rapidly in spring 1933 matches that of Taylor and Neumann (2016).

Figure 1 – Industrial production, 1929-1937



Note: Shading indicates March-July 1933. Source: FRED series INDPRO.

the gold standard provides evidence for a causal role of devaluation in driving crop price increases. Importantly, this was an increase in real crop prices, since the CPI rose only modestly from March to July 1933.

In section 3, we examine consumption choices in farm relative to nonfarm areas. Using monthly state and annual county auto sales data, we find that new auto sales in spring 1933 grew much more in farm areas of the country. Our baseline estimates imply that a one standard deviation increase in the share of a state's population living on farms was associated with nearly a 30 percentage point increase in auto sales growth in spring 1933. The effect is driven by areas benefitting from higher farm prices in spring 1933, not agricultural areas in general; conditional on 1932 farm value per capita in a state, a $1 larger change in farm value in spring 1933 is associated with 1.5-2 percentage points more rapid auto sales growth. This result holds both within and across states and is robust to a battery of controls. We focus on new car sales because we observe these data at a monthly frequency for U.S. states and annual frequency for U.S. counties, allowing for a much sharper analysis of the farm channel in the crucial spring 1933 window than would be possible with other economic indicators.

But we obtain quantitatively similar results from annual state-level data on new truck sales and electric refrigerator sales.

Given small contributions of net exports to GDP growth in 1933 and 1934, higher farm product prices primarily redistributed income to farmers from nonfarm households and corporations. It is not a priori obvious that this transfer would be beneficial for the aggregate economy. A plausible way that higher farm prices could have had aggregate benefits is if they redistributed income from low marginal propensity to consume (MPC) agents to high-MPC agents. A long-standing theoretical literature (e.g., Bewley, 1986; Aiyagari, 1994) and more recent empirical work, e.g. Mian, Rao, and Sufi (2013), suggest that debtors are likely to have a higher MPC than creditors. Since farmers had large mortgage debt burdens in early 1933, a transfer of income to farmers could well have raised aggregate demand. Consistent with this hypothesis, in section 4 we estimate that the farm channel's effect on consumption was largest in those counties most encumbered by farm mortgage debt. This is possible because our newly-collected county data give us sufficient power to detect these interaction effects.

Guided by the empirical evidence for a redistribution effect, in section 5 we build a simple incomplete-markets model that explicitly takes into account the farm channel's benefits to farmers and its costs to those purchasing farm goods. In our model, farmers are liquidity constrained, so their MPC is high relative to that of capitalists. Therefore, a redistribution of income from capitalists to farmers raises aggregate demand. There are no offsetting general equilibrium effects because, as in the data, final goods prices are sticky and the nominal interest rate is at the zero-lower bound. Under these conditions, the model translates the cross-sectional estimates into an output effect of 27% or more. Over the estimation window of our cross-sectional regressions, auto sales and production rose roughly 85%. Thus the model suggests that the farm channel accounted for at least 30% of the recovery (at least as measured by auto production). Given the simplicity of the model, we interpret this figure as an indicator of the possible magnitude of the farm channel's aggregate effects, rather than as a precise quantitative estimate.

Like us, Friedman and Schwartz (1963), Edwards (2015), and Rauchway (2015) emphasize the priority that the Roosevelt administration put on raising the price of agricultural goods. According to Edwards (2015) p. 20, Henry Morgenthau, head of the farm relief administration and later treasury secretary, "believed that uncoupling the value of the dollar from gold was a requisite to increase agricultural prices and, in that way, bring relief to farmers. His main concern was not gold itself, but relative prices; for him the goal of policy - and a required step towards recovery - was increasing the price of agricultural products relative to manufacturing goods." This is consistent with the view of George Warren and Frank Pearson (Warren and Pearson, 1935), the former of whom was an important economic advisor to Roosevelt. Bessler (1996) summarizes Warren's views, and using VAR analysis, he estimates a tight link between the exchange rate and crop prices. Edwards (2017) shows that expectations of dollar devaluation were an important determinant of agricultural prices in 1933. That crop prices responded more – and more rapidly – than the overall price level to devaluation also fits with the current understanding that commodity prices are particularly flexible (Nakamura and Steinsson, 2008), a view that was formalized in Bordo (1980).

Temin and Wigmore (1990) were the first (and have remained the only) authors in the modern economics literature to emphasize the importance of farmers in 1933. They argue that a weaker dollar led to higher expected inflation and was also expansionary through its effect on current and expected farm incomes. But they are only able to provide circumstantial evidence for the importance of higher farm incomes (the farm channel).[4] We build on their work by providing econometric evidence for each stage of the farm channel's operation, and by explicitly considering the general equilibrium implications of higher farm product prices.

Recent papers on the initial recovery in spring 1933 include Eggertsson (2008), Jalil and Rua (2015), Taylor and Neumann (2016), and Sumner (2015). All argue that a regime change played a positive role. By taking the U.S. off the gold standard and explicitly voicing his desire for higher prices, these papers credit Roosevelt with inducing inflation expectations and reducing ex-ante real interest rates, thus stimulating demand for investment goods and consumer durables. The farm channel we emphasize is distinct from this expectations

[4] Temin and Wigmore's principal evidence comes from a state-level regression of the level of auto sales in all of 1933 on farm income and other income in 1933. They interpret a larger coefficient on farm income as evidence in support of their hypothesis. While suggestive, this regression has three limitations: first, the left-hand side variable is the level of auto sales, while their hypothesis is about the *growth* of auto sales. Second, the farm income regression coefficient is positive and large for all years from 1932 to 1940, suggesting that these results are not necessarily informative about events in 1933 *per se*. Third, the regression uses annual data, hence it conflates auto sales in the period of interest, spring 1933, with sales later in the year.

channel, although higher farm incomes could have reinforced economy-wide expectations of higher future prices and income.

While not focussed specifically on the turn-around in spring 1933, Fishback, Horrace, and Kantor (2005) and Fishback and Kachanovskaya (2015) examine the effect of Agricultural Adjustment Administration (AAA) payments on recovery.[5] They find small or negative effects of AAA payments on county-level retail sales and state-level income between 1929 and 1939.[6] That the AAA had negative effects on local areas is not in contradiction to our finding of positive effects from higher farm product prices. This is for two reasons. First, while devaluation encouraged farm production by raising the price of farm products, AAA payments were given to farmers in exchange for *lower* production. An important consequence was that the AAA, unlike devaluation, provided incentives for farmers to displace sharecroppers and tenants (Depew, Fishback, and Rhode, 2013). Second, while we focus specifically on 1933 when farmers were suffering from severe debt-deflation, Fishback et al. (2005) and Fishback and Kachanovskaya (2015) look over the entire decade. Over this longer period, supply-side responses may have become more important and farm debt problems less important.

Our emphasis on the importance of farmers' debt positions in spring 1933 aligns with the literature emphasizing debt deflation as a cause of the Great Depression. Fisher (1932) and Fisher (1933) first argued for this mechanism as a cause of the Great Depression, and Fisher (1933) credits Roosevelt's policies with ending the debt-deflation cycle. Hamilton (1987, 1992) provides evidence that the deflation during the Great Depression was unanticipated, concluding that the contraction was caused by debt-deflation and bank failures rather than high ex-ante real interest rates. And Mishkin (1978) emphasizes the general importance of debt as a determinant of consumption in the 1930s, though he does not specifically focus on farmers or the MPC.

An older literature emphasized the core mechanism of our model in which devaluation has real effects by redistributing income between groups with different MPCs (e.g., Diaz Alejandro, 1965; Krugman and Taylor, 1978), but this literature did not consider the recovery

[5] The industry equivalent of the AAA, the National Industrial Recovery Act (NIRA), encouraged firms to collude and raise prices and wages. The NIRA has been credited both with slowing recovery (Cole and Ohanian, 2004) and with accelerating it (Eggertsson, 2012). Regardless, the effects of the NIRA were likely primarily felt after spring 1933, since the law was not enacted until June 16, 1933.

[6] Fishback and Kachanovskaya (2015)'s sample period is 1930 to 1940.

from the Great Depression. Prominent recent research has emphasized the importance of income redistribution and MPC heterogeneity for the propagation of monetary policy shocks (a partial list includes Auclert, 2015; Broer, Hansen, Krusell, and Öberg, 2016; Cloyne, Ferreira, and Surico, 2016; Kaplan, Moll, and Violante, 2016; McKay, Nakamura, and Steinsson, 2015; Werning, 2015). Our results are consistent with this emphasis, although we stress the redistribution effect of an exchange rate movement rather than a monetary policy shock.

This paper is also relevant to our understanding of macro policy at the zero lower bound. In the U.S. in spring 1933, short-term interest rates were near zero, and hence conventional monetary policy was ineffective. Economists continue to debate the extent to which unconventional monetary policy can stimulate an economy in these conditions (e.g., Woodford, 2012). In these debates, the U.S. experience in 1933 serves as an example of what policy may be able to achieve (Romer, 2014). For instance, the governor of the Bank of Japan, Haruhiko Kuroda, has used 1933 as a reference point for his ongoing attempts at a regime change in Japan (Kuroda, 2015). To the extent that recovery in spring 1933 was helped along by redistribution to high-MPC farmers, however, the spring 1933 analogy may be an overly optimistic guide to the effect of a monetary regime change alone (Hausman and Wieland, 2014, 2015).

2 Spring 1933: Relative farm prices rose

Central to our argument for the importance of agriculture in 1933 is the behavior of agricultural prices. Figure 2 graphs the overall CPI and the BLS index of farm product prices. From 1932 to 1934, there was relatively little change in the CPI, though it did rise 3% between June and July 1933. By contrast, farm product prices rose 40% in the four months from March to July. The figure suggests a possible cause of this large price change: devaluation. In the three months following devaluation on April 19^{th}, the dollar depreciated by 30 percent relative to the British pound; a third (10 percentage points) of this weakening occurred in the 48 hours between noon on April 18^{th} and noon on April 20^{th} (*Commercial and Financial Chronicle*, 4/22/1933, p. 2667). The exchange rate vis a vis many other currencies behaved similarly: against the French franc, the dollar depreciated 34%; against the German mark, 36%. Since prices of traded farm products were set in world markets, when the dollar depreciated, the dollar price of many farm products rose.

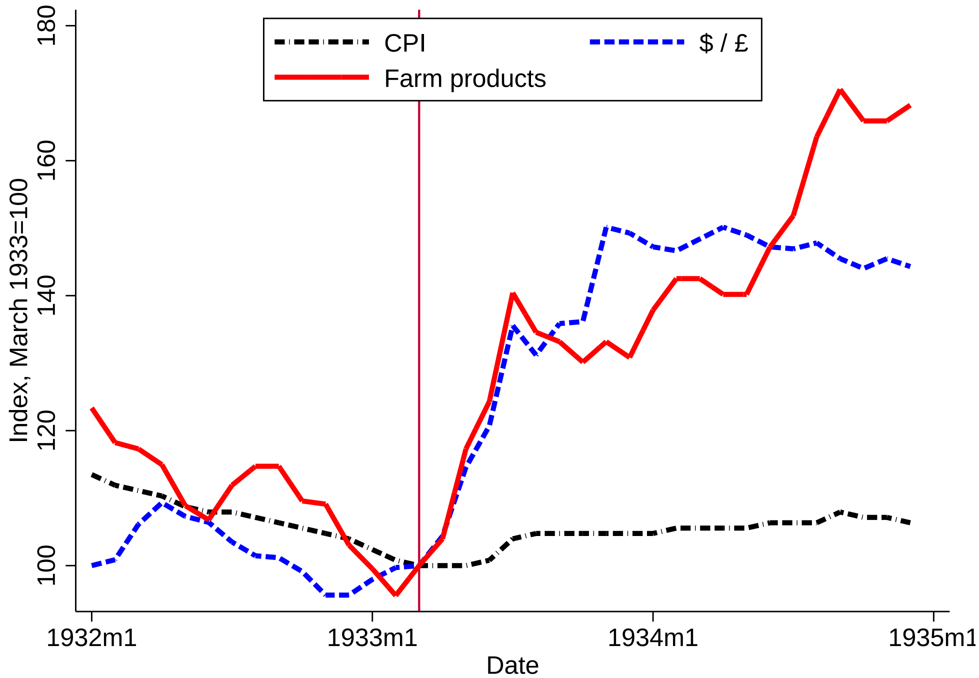
This effect of devaluation on farm prices was no accident; as discussed in the introduction, raising the relative price of agricultural products was an explicit goal of the Roosevelt administration. Roosevelt himself frequently and publicly emphasized this. The quote beginning the paper comes from a campaign speech given by Roosevelt in October 1932. As president, he repeated this message. For instance, in a fireside chat in October 1933, Roosevelt said: "I do not hesitate to say in the simplest, clearest language of which I am capable, that although the prices of many products of the farm have gone up and although many farm families are better off than they were last year, I am not satisfied either with the amount or the extent of the rise, and that it is definitely a part of our policy to increase the rise and to extend it to those products which have as yet felt no benefit. If we cannot do this one way we will do it another. Do it, we will."[7] Weakening the dollar was part of this strategy. As Friedman and Schwartz (1963), p. 465 put it: "The aim of the gold policy was to raise the price level of commodities, particularly farm products and raw materials . . ."

We show that the administration succeeded in this goal; in other words we identify a causal effect of devaluation on farm prices. To do this, we examine the announcement effect of the U.S. departure from the gold standard on daily spot and future prices. This approach complements the analysis in Bessler (1996). Bessler (1996) conducts a VAR analysis with daily data on gold, cotton, corn, hog, and lard prices; he concludes that gold price movements explain most of the 1933 increase in cotton, corn, and lard prices. We use a narrower date range but a broader range of farm products. For the purpose of understanding the causal effect of devaluation on farm prices, this has the advantage that there are likely fewer confounding factors in a narrow time window, and that any product-specific shocks average out over a large number of products.

We examine daily data on the exchange rate and the price of wheat, cotton, corn, oats, lard, pork belly, hogs, steers, and lambs around the date of devaluation, April 19^{th}. These data are presented in figure 3. Between noon on April 18^{th} and noon on April 20^{th}, the dollar depreciated slightly more than 10%. Over this period, most crop prices rose by a similar

[7] Complete speech available at Fireside chat, 10/22/1933.

Figure 2 – The CPI, the exchange rate, and farm prices

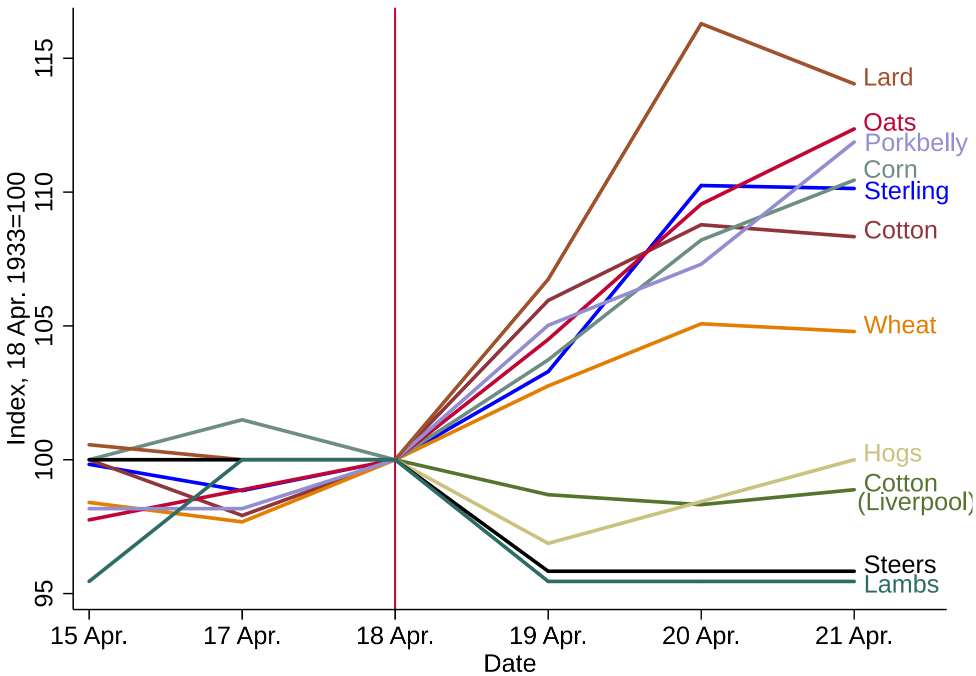


Note: The vertical line indicates March 1933, the month before the U.S. devalued. Sources: CPI data from FRED series CPIAUCNS; exchange rate from *Survey of Current Business*, 12/1932 p. 32, 12/33 p. 31, 12/34 p. 32, 12/35 p. 33; farm product price index from *Federal Reserve Bulletin*, 12/1932 p. 788, 12/1933 p. 783, 4/1935 p. 237.

amount. The exception was wheat, whose price was negatively affected by news on April 19^{th} of beneficial rains in winter wheat-growing areas (Wood, 1933).

Beyond the close co-movement of crop prices with the exchange rate over this narrow time window, three additional pieces of evidence suggest a causal role for devaluation. First, for cotton we observe Liverpool, England prices. As shown in figure 3, around the date of devaluation, Liverpool cotton prices expressed in sterling were nearly unchanged. This implies that the change in the dollar price of cotton was a causal effect of devaluation rather than a response to other shocks. Second, the prices of hogs, steers, and lambs did not respond to devaluation. This is likely because only small parts of these animals were traded internationally. So we would not expect their prices to be affected by devaluation despite the price response of tradable derivative products (e.g., lard, pork belly). Third, narrative evidence attributes the increase in crop prices to devaluation. The *Chicago Tribune* (Wood, 1933) wrote "Yesterday's [April 19^{th}'s] commodity price advances were attributed almost entirely to the administration's announcement of its inflation program and the consequent

Figure 3 – The exchange rate and farm prices after devaluation



Note: The vertical line indicates April 18, 1933, the day before the U.S. devalued. All prices are indexed to 100 on that day. Sources: The exchange rate is the noon buying rate in New York; the U.S. cotton price is the New York price for Middling Upland, and the wheat price is the New York closing price for No. 2 red. These are from the *Commercial and Financial Chronicle*, 4/22/1933, p. 2667 (sterling), p. 2821 (cotton), and p. 2823 (wheat). The corn, lard, pork belly ("dry salted bellies") and hog spot prices are the low prices from *Annual Report of the Trade and Commerce of Chicago* for the year ended December 31, 1933 (1934), p. 98-99.

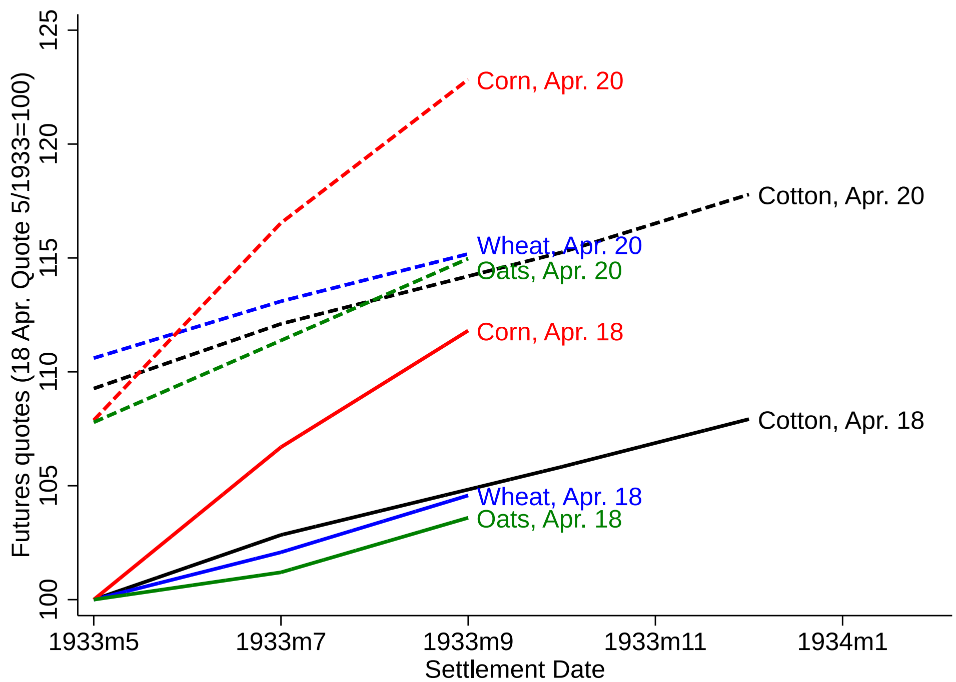
decline of the dollar in foreign exchange." Similarly, the *Commercial and Financial Chronicle* (4/22/1933, pp. 2820, 2823) credited the U.S. departure from the gold standard with raising cotton and wheat prices.

To see whether the price effect of devaluation was expected to persist, figure 4 shows the behavior of wheat, cotton, corn, and oats futures prices around the day of devaluation. These are the same data used by Hamilton (1992) to measure inflation expectations in the 1930s. Like their spot prices, wheat and cotton future prices rose significantly, even for the furthest dated contracts. This suggests that people believed the price effect of devaluation would persist.[8]

Thus far we have focused on an analysis of daily prices in a narrow window around de-

[8]Farm land prices rose 4% between March 1, 1933 and March 1, 1934, also suggesting that at least some of the increase in farm prices and incomes was expected to be long-lasting (Stauber and Regan, 1935, table 1, pp. 6-7).

Figure 4 – Devaluation and futures prices



Notes: Devaluation occurred on 19 April, 1933. Source: *Commercial and Financial Chronicle*, 4/22/1933, p. 2820 for cotton and p. 2823 for wheat; low prices from *Annual Report of the Trade and Commerce of Chicago* for the year ended December 31, 1933 (1934), p. 99 for corn and oats. Our use of low prices follows that in Hamilton (1992).

valuation, since this provides the best setting for identifying the causal effect of devaluation. But what mattered for farmers was the path of prices and production over the entire spring. Table 1 summarizes prices and production for the 12 farm products with greater than $100 million of farm value in 1932.[9] The top panel provides data for crops and the bottom panel for animal products. For reference, the first column shows the dollar / pound exchange rate. This makes clear that in the second and third quarters of 1933 crop prices rose as the dollar weakened.

The mechanism through which devaluation affected farm prices is clearest for the traded crops of cotton, wheat, and tobacco. As Friedman and Schwartz (1963), pp. 466 describe:

> The prices of [traded] commodities in foreign currencies were determined by world demand and supply and were affected by events in the United States only insofar as these, in turn, affected the amounts supplied and demanded by the United

[9] Farm value is physical production times the producer price. In addition to the products in the table, butterfat had a farm value of greater than $100 million. We exclude it from the table because it is a by-product of milk production.

Table 1 – Farm product prices

Panel A: Crops

	$ / £	Wheat	Corn	Oats	Cotton	Tobacco	Hay	Potatoes
Prices (SA, Index, 1932=100)								
1932 Q3	100	98	96	93	104		95	98
1932 Q4	95	88	78	79	107		88	91
1933 Q1	97	82	72	67	98		76	86
1933 Q2	111	138	124	105	131		81	102
1933 Q3	121	205	164	205	156		101	236
1933 Q4	131	179	159	182	171		105	184
1932, average	100	100	100	100	100	100	100	100
1933, average	120	150	130	136	139	137	90	152
1934, average	144	206	218	227	206	194	142	157
Production								
1932 farm value ($, millions)	-	284	925	195	424	108	516	141
1932-1933 change in quantity (%)	-	-29	-19	-41	0	34	-10	-11
1933, trade output share, (X+M)/Y (%)	-	9	0	0	62	39	0	1
AAA intervention in 1933	-	Yes	Yes	No	Yes	Yes	No	No

Panel B: Animal products

	$ / £	Cattle	Hogs	Milk	Chickens	Eggs
Prices (SA, Index, 1932=100)						
1932 Q3	100	108	108	97	99	96
1932 Q4	95	94	91	94	90	115
1933 Q1	97	82	85	85	80	86
1933 Q2	111	92	109	89	82	86
1933 Q3	121	93	103	111	84	94
1933 Q4	131	85	108	114	80	100
1932, average	100	100	100	100	100	100
1933, average	120	88	101	99	82	96
1934, average	144	95	122	117	96	115
Production						
1932 farm value ($, millions)	-	503	540	1,314	267	374
1932-1933 change in quantity (%)	-	8	8	3	1	-1
1933, trade output share, (X+M)/Y (%)	-	1	6	N/A	N/A	N/A
AAA intervention in 1933	-	Yes	Yes	Yes	No	No

Notes and sources: The exchange rate is not seasonally adjusted. Prices are producer prices (prices received by farmers); annual prices are unweighted calendar year averages. Farm value equals physical production times price. Farm value and production figures are for the crop year, not the calendar year. The presence or absence of AAA intervention is based on facts reported in Nourse, Davis, and Black (1937) and United States Department of Agriculture (1934a). For further notes and source details, see appendix B.1.

States. Even then, such prices were affected much less than in proportion to the changes in U.S. sales and purchases. Hence, the decline in the foreign exchange

> value of the dollar meant a roughly proportional rise in the dollar price of such commodities, which is, of course, what did happen to the dollar prices of cotton, petroleum products, leaf tobacco, wheat, and similar items.

It is less obvious how devaluation raised the price of other crops. A likely channel through which devaluation affected the prices of the principal nontraded grains, corn and oats, was through substitution. For instance, wheat, corn, and oats could all be used as animal feed (Davis, 1935, p. 23; Taylor, 1932, p. 129). Substitution between grains meant that as a weaker dollar increased the price of traded grains such as wheat, it would also have put upward pressure on the price of nontraded grains such as corn and oats. Indeed, Taylor (1932, p. 170) identifies the price of wheat as one of the determinants of the price of corn.

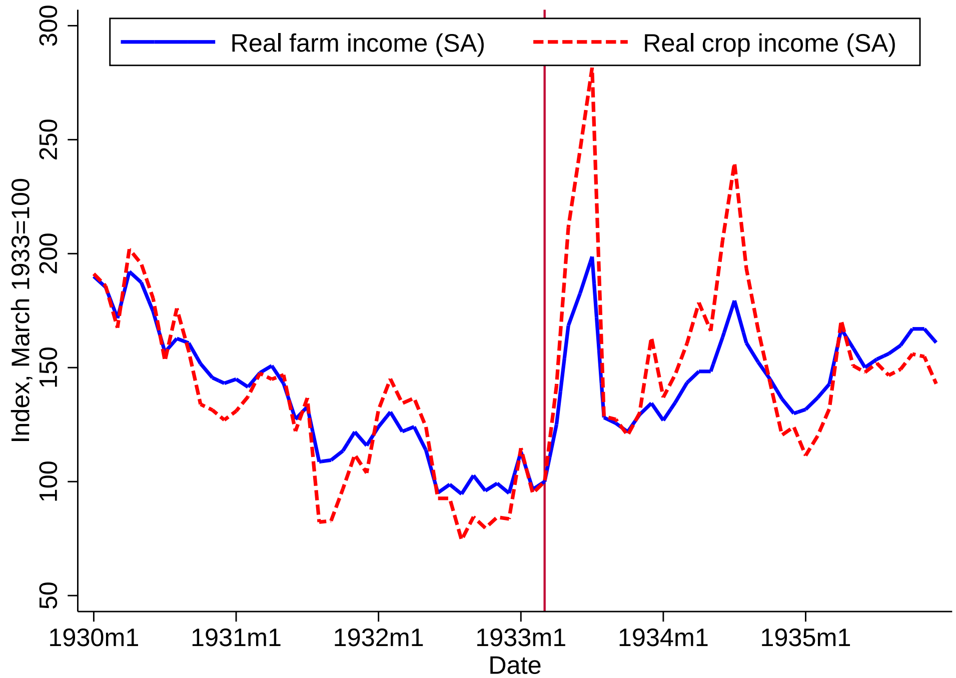
Accepting that substitution can explain the response of nontraded crop prices to devaluation, a puzzle remains: why did crop prices rise by more than the dollar weakened? Mechanically, this is in part explained by rising British pound prices of many crops. For instance, Liverpool prices in sterling of imported wheat rose 24% between March and July 1933, and the sterling price of Indian cotton rose 17%.[10] A further reason to credit international factors with the large increase in crop prices is the lack of response of nontraded animal product prices shown in panel B of table 1. Unlike crop prices, animal product prices rose only moderately in spring 1933. This fits with the lack of response of daily hog, steer, and lamb prices to devaluation shown in figure 3.

A likely contributing factor to the increase in international crop price was global economic recovery. Between 1932 and 1933, world industrial production rose 13% (Woytinsky and Woytinsky, 1953, table 427, p. 1002), and farm prices are expected to react quickly to aggregate demand (Bordo, 1980). In addition to international factors, two U.S. specific supply shocks may have contributed to higher prices of certain crops. First, drought reduced production of grains (United States Department of Agriculture, 1934b,a). This may explain why in spring 1933 the price of corn in the U.S. rose much more than the price of Argentinean corn in Liverpool.[11] (Recall that unlike wheat, U.S. corn was nontraded.) Second, even

[10] United States Department of Agriculture (1936), table 19, p. 21 and table 111, p. 85 converted to British Pounds using the exchange rate in *Federal Reserve Bulletin*, 12/1934, p. 765.

[11] Between March and July 1933, the wholesale price of corn in Chicago rose 115% (United States Department of Agriculture, 1936, table 46, p. 40), while the Liverpool price of La Plata corn in dollars rose 25% (United States Department of Agriculture, 1936, table 47, p. 40).

Figure 5 – Farm income



Note: The vertical line indicates March 1933, the month before the U.S. devalued. Sources: 1930-31 income: U.S. Department of Commerce, 1934, p. 19; 1932-35 income: U.S. Department of Commerce, 1936, p. 9. Deflated with FRED CPI series CPIAUCNS.

for those crops (like cotton) for which production did not decline, there may have been expectations of future production declines driven by Agricultural Adjustment Administration (AAA) intervention. However, we observe little change in Liverpool cotton prices when the AAA passed the House (3/22/1933), the Senate (4/28/1933), or was signed by Roosevelt (5/12/1933). (Domestic cotton prices rose by 5% on 4/29 in part reflecting a 2% decline in the dollar, but not on the other days.) In the following sections, we will go to substantial effort to control for the possible confounding effects of the drought and the AAA.

Figure 5 shows that higher real farm prices translated quickly into higher real farm incomes. The Department of Agriculture's seasonally adjusted index of income from crops deflated by the CPI rose 182% from March 1933 to July 1933; that of total farm income (crop and animal products) deflated by the CPI rose 99%. On a non-seasonally adjusted basis, total real farm income was higher in June and July 1933 than it had been in any month after October 1931 (U.S. Department of Commerce, 1936, p. 9, U.S. Department of Commerce, 1934, p. 19).

To sum up, the evidence strongly suggests that devaluation accounted for a significant part of the increase in crop prices, and thus the increase in farm income, in spring 1933.

3 Farm consumption

We now explore the effect of higher farm prices on farm consumption. This is a cross-sectional exercise in which we compare consumption in areas with more farmers or larger increases in farm income to areas with fewer farmers or smaller increases in farm income. In sections 4 and 5, we will consider national general equilibrium effects of higher farm product prices.

We estimate cross-sectional regressions of the form:

$$\%\Delta\text{Auto sales}_{i,\text{Spring 1933}} = \beta_0 + \beta_1 \text{Agricultural exposure}_{i,pre-1933} + \gamma' X_i + \varepsilon_i, \tag{1}$$

where $\%\Delta\text{Auto sales}_{i,\text{Spring 1933}}$ is auto sales growth in Spring 1933, "Agricultural exposure" is state or county i's exposure to the farm channel before spring 1933, and X is a set of control variables. Many models would predict $\beta_1 > 0$ when income is redistributed to farmers. More important for our purposes is the size of the coefficient β_1. β_1 measures how local spending was affected by the locally exogenous spring 1933 farm price increase. In our general equilibrium model, the magnitude of β_1 determines the aggregate importance of the farm channel.

We use new auto sales as our main outcome variable. Unlike other consumption measures, auto sales were reported at the state and county level and at reasonably high frequency: monthly at the state level and annually at the county level.

3.1 Cross-state results We collected data on new passenger car sales by state and month from the *Automotive Daily News Review and Reference Book* (1935, pp. 22-23). Appendix C provides further details on these data and their accuracy. We seasonally adjust the monthly state auto sales using twelve monthly dummies, excluding the year 1933 to avoid conflating the rapid recovery in spring with a seasonal effect.[12]

[12]Specifically, seasonally adjusted sales in month t are $e^{\hat{\varepsilon}_t + \sum_{j=1}^{12} \hat{\beta}_j / 12}$, where $\hat{\varepsilon}_t$ is the residual from the regression of the natural log of sales on monthly dummies, and $\hat{\beta}_j$ is the regression coefficient on the jth

The ideal independent variable would exactly measure the portion of the spring 1933 income change that was due to locally exogenous farm price increases. Since no such exact measure exists, we consider proxy variables. Simplest is the percent of local residents living on a farm. This measure has the disadvantage that many farmers were engaged in the production of livestock and dairy products whose prices moved relatively little in 1933. Thus, we also look at the value of crops sold per capita in 1929.

Figure 6a shows a scatter plot of the farm share of the population and the seasonally-adjusted percentage change in car sales from the October 1932-March 1933 quarterly average to the July-September 1933 average. We show the change between quarterly averages since single month values have large amounts of noise that is more likely due to idiosyncratic variation than it is to macro shocks. For the base period, we choose a longer, two-quarter period since real farm income and industrial production changed little over these months (figures 5 and 1), and since averaging over more months means filtering out more noise. We end the calculation in the third quarter of 1933, since this largely avoids contaminating the effect of higher crop prices on auto sales with the effect of AAA payments on auto sales.[13]

In figure 6a, there is a clear positive relationship, with the farm population share explaining a substantial fraction of the cross-state variation in auto sales growth ($R^2 = 0.31$). Column (1) of table 2 shows the corresponding regression. The slope of the regression line is 1.7, is statistically significant, and is economically large. It implies that a one standard deviation increase in the farm share (17%) raises auto sales growth in the 1933 recovery by 29.2 percentage points ($1.70 \times 17.2 = 29.2$). As another benchmark, a coefficient of 1.7 means that if a state's farm share rose from 11 percent (that in California) to 50 percent (that in North Carolina), then auto sales growth would be 66.3 percentage points higher ($(50 - 11) \times 1.70 = 66.3$).

Figure 6b replaces farm share with the per capita value of crops sold in 1929. Again, the relationship is positive and explains a large fraction of the variation ($R^2 = 0.36$). The regression coefficient of 0.79, shown in column (3) of table 2, means that a $1 increase in

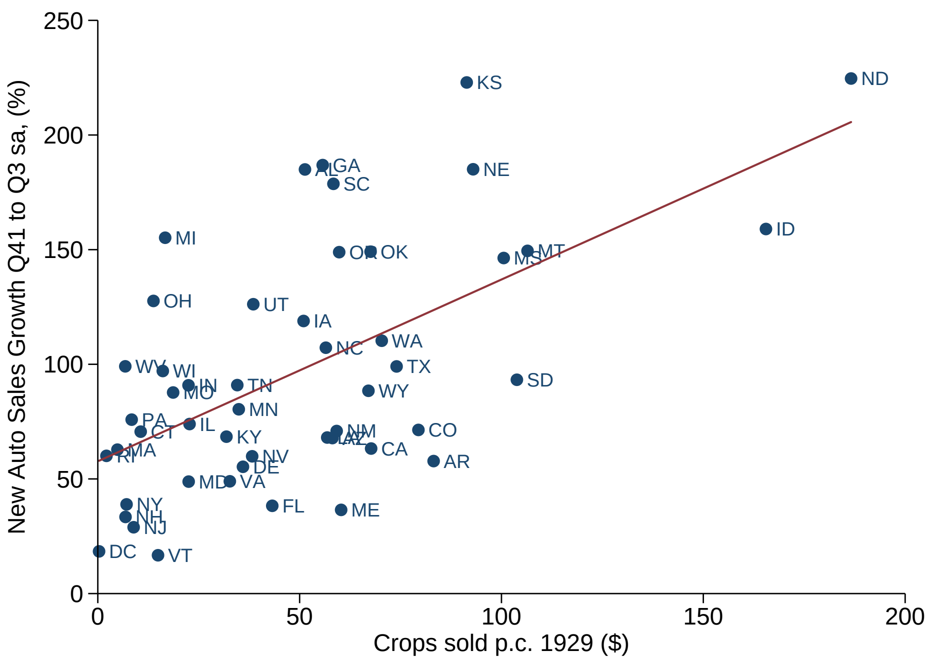
---

monthly dummy.

[13]Through September 1933, AAA expenditure totaled $80.8 million (Nourse et al. (1937), appendix C, table V, p. 588); this can be compared to total 1933 farm personal income of $2.8 billion (BEA regional data, table SA4).

Figure 6 – Percent change in car sales and farm channel exposure

(a) Farm population share



(b) Crops sold per capita

Notes: Auto sales growth is measured as the percent change in seasonally-adjusted auto sales from the October 1932-March 1933 average to the July-September 1933 average. The straight line is the OLS regression line. Sources: Auto sales - see text. Farm share - the 1930 Census as reported in Haines and ICPSR (2010). Crops sold - the 1940 Census as reported in Haines et al. (2015).

the value of crops sold per capita would increase car sales by 0.79 percentage points. The standard deviation of the per capita value of crops sold was $40, so a one standard deviation increase in crops sold per person raised spring 1933 auto sales growth by 31.6 percentage points. This is nearly identical to the effect of a standard deviation change in farm population share.

The scatter plots also highlight several features of the farm channel. First, with the exception of Michigan, the ten states with the most rapid auto sales growth were all either in the top quintile of wheat production per capita (North Dakota, Kansas, Montana, Idaho, Nebraska, and Oklahoma) or in the top quintile of cotton production per capita (Alabama, South Carolina, and Georgia). Relatedly, the most rapid auto sales growth was not concentrated in one specific region of the country, and there was substantial variation within regions. Second, farm share of the population and crops sold per capita do not strongly correlate with population; Texas was a large-population state highly exposed to the farm channel, whereas New Hampshire was a small-population state little exposed to the farm channel. The overall correlation between farm share and state population was -0.28; between crops sold per capita and state population, -0.34.

Columns (2) and (4) of table 2 include controls for state population levels, car registrations per capita in 1928, the black population share, and census region fixed effects. The fact that the coefficients in columns (2) and (4) are similar to those in columns (1) and (3) shows that we are not conflating the farm channel with other variables that could correlate with agricultural exposure.

Next we check that we are not wrongly extrapolating from pre-existing trends in agricultural states. We group states into quartiles based on their 1930 farm population share. We then base each states' auto sales at 100 for October 1932-March 1933 and average across all states in the quartile. Figure 7 plots the evolution of auto sales in each quartile in 1932 and 1933. While low farm-share states and high farm-share states followed roughly similar trends up to March 1933, thereafter there is a clear divergence, as auto sales in more agricultural states grew faster.

Farm share of the population and crops sold per capita are a proxy for the positive effect of higher farm prices on local income. To better measure the income effect of the price shock

Table 2 – New auto sales growth in spring 1933 (%, SA)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Right hand side variables:								
% pop. on farms	1.70***	1.50***						
	(0.38)	(0.50)						
Crops sold p.c. 1929 ($)			0.79***	0.71***				
			(0.13)	(0.13)				
Change farm value p.c. ($)					0.69***	0.71***	1.49**	1.69***
					(0.20)	(0.24)	(0.62)	(0.48)
Farm product value p.c. ($)							−0.55	−0.74*
							(0.42)	(0.37)
Population (millions)		1.42		0.81		1.41		0.71
		(1.70)		(1.74)		(1.77)		(1.71)
Car registrations p.c. 1928 (1000s)		−0.020		−0.25		−0.17		−0.035
		(0.19)		(0.17)		(0.19)		(0.21)
% pop. black		0.75		0.66		1.61**		1.68**
		(0.80)		(0.84)		(0.77)		(0.75)
1932 & 1933 drought interaction	No	No	No	No	No	No	No	No
Region Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
R^2	0.31	0.45	0.36	0.53	0.24	0.47	0.27	0.50
Observations	49	49	49	49	48	48	48	48

Notes: The dependent variable is the percent change in seasonally adjusted auto sales from the October 1932-March 1933 average to the July-September 1933 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; 1928 car registrations - *Automotive Daily News Review and Reference Book*, 1934, p. 32; percent of population on farms and percent of population black - the 1930 Census as reported in Haines et al. (2015); value of crops sold per capita - the 1940 Census as reported in Haines et al. (2015); population - 1930 Census figures as reported in Haines and ICPSR (2010); farm value - see text and appendix B.2.

in locality i we calculate:

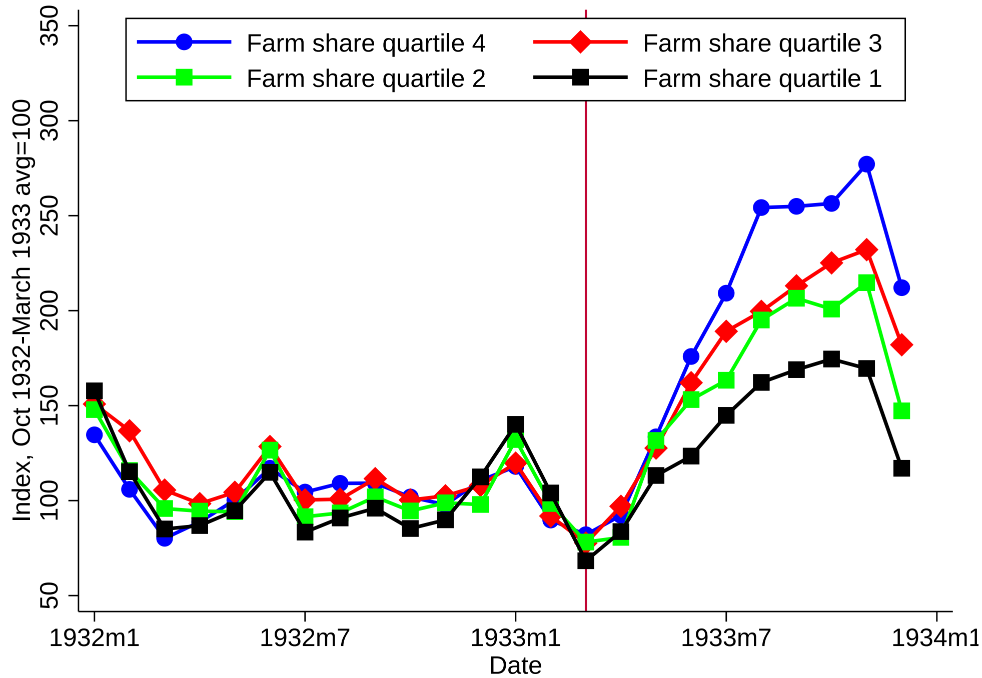
$$\text{Change farm value per capita}_i = \frac{1}{\text{population}_i} \sum_{j=1}^{16} \text{farm product value}_{i,j,1932} \times \%\Delta\text{price}_j. \quad (2)$$

Here 1932 farm product value in location i for farm product j equals the quantity of the crop produced in that locality times the national price ($Q_{i,j,1932} \times P_{j,1932}$). We define $\%\Delta\text{price}_j = \frac{P_{j,1933:Q3} - (P_{j,1932:Q4} + P_{j,1933:Q1})/2}{(P_{j,1932:Q4} + P_{j,1933:Q1})/2}$, consistent with our timing of auto sales growth.[14] In equation (2), we deliberately omit data on 1933 farm production, since local supply conditions are not locally exogenous. For the same reason, we use national prices throughout.[15]

[14]The data we use in calculating equation 2 are detailed in appendix B.2. Crop quantities are for the crop year.

[15]We also estimated the regression using state-level farm prices to construct our baseline measure of farm

Figure 7 – Auto sales by farm share quartile



Note: Quartiles are based on 1930 farm share. They are constructed by first indexing each state to 100 for October 1932-March 1933 and then averaging across states in a quartile. Sources: Auto sales - see text. Farm share - the 1930 Census as reported in Haines and ICPSR (2010).

Columns (5) and (6) examine the effect of this measure on the spring 1933 change in auto sales. The coefficients mean that a \$1 increase in per capita farm value is associated with a 0.7 percentage point increase in auto sales. We can obtain stronger evidence on the farm channel by also including the initial level of farm value in 1932 in the regression. Doing so means the regression compares two states similar in agricultural intensity but differentially treated by the spring 1933 farm price changes. Columns (7) and (8) show that the change in farm value alone accounts for the faster recovery. By contrast, holding the change in farm value fixed, higher agricultural exposure is associated with weaker car sales growth.

Using the estimates in columns (7) and (8) of table 2, one can perform a back-of-the-envelope calculation of the local dollar amount of spending on autos in response to a \$1 change in farm value. Spending in locality i on autos in response to a \$1 change in farm value is:

$$\text{Spending}_i = \beta_1 \times \text{Auto Sales}_{1932p.c.} \times P_{car}, \tag{3}$$

product value in 1932. Results are quantitatively similar and are available upon request.

where P_{car} is the average price of a car in 1933. Per capita U.S. car sales in 1932 were 0.0088, and the average retail value of a car sold was \$725.[16] Thus with the coefficient of 1.69 percentage points in column (8), $\text{Spending}_i = .0169 \times 0.0088 \times \$725 = \$0.11$; that is, we find spending of 11 cents on new autos for every \$1 dollar increase in farm value.

Unfortunately, a clean quantitative interpretation of the dollar spending response is limited by three factors. First, this spending response is *not* a marginal propensity to consume (MPC). It measures spending in a treated state relative to a non-treated state. Because of spillovers across households it will generally not be equal to a household MPC.[17] Second, since our measurement of the change in farm value includes only major crops and livestock products, it likely underestimates the actual dollar change in farm value. We use 16 farm products in equation 2, accounting for roughly 80% of total U.S. farm value, so we suspect that the resulting bias is likely small.[18] Third, and likely more important, the right hand side variable is the change in farm value, not the change in farm income. As stated above, the farm value of product j is $\text{price}_j \times \text{quantity}_j$. Across all farm products j, farm values need not sum to farm income. Consider, for example, the case of a farmer growing corn to feed pigs and then obtaining income from selling the pigs. If the price of corn rises, the income of the farmer will go up only insofar as the price of pigs also rises. But farm value will increase along with the price of corn. Since farm value exceeds farm income, the response of auto sales to a given change in farm value will be below the response of auto sales to a given change in farm income.

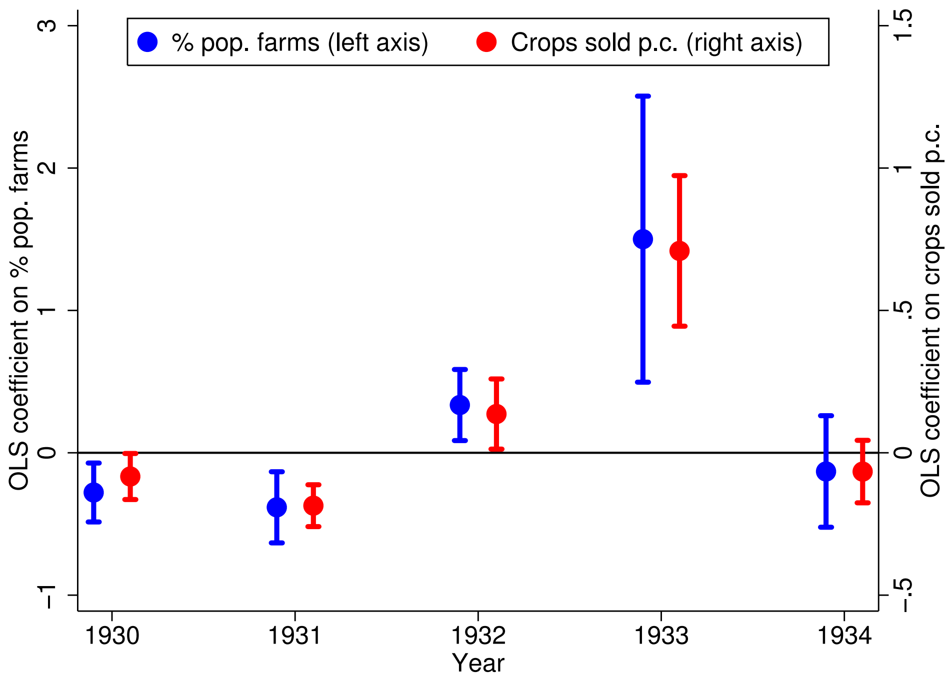
Acknowledging these difficulties in interpretation, two comparisons may help to illustrate the magnitude of the spending response we find. First, in 1932, total spending on new motor vehicles was 1.2% of all consumption spending (NIPA table 2.4.5, downloaded January 12, 2017), so spending of 11 cents on new cars is consistent with a quite substantial overall consumption response. Second, this response is also consistent with Hausman's (2016) estimates of the 1936 veterans' bonus' impact on new car spending. In a cross-state regression,

[16] Auto sales are from *Automotive Industries*, 2/25/1933, p. 224. 1932 population is from https://www.census.gov/population/estimates/nation/popclockest.txt. The retail value per car is from Suits (1958), table A-2, column 4, p. 279.

[17] For an algebraic exposition of this point, see Hausman (2016), online appendix G.

[18] The 80% figure is based on the data for 1934 in United States Department of Agriculture (1936), tables 437 and 440, pp. 330-331, 334.

Figure 8 – The farm channel in other years



Note: The figure plots the point estimate and 95% confidence interval from a regression of the percent change in auto sales on either the farm population share or crop value per capita. The specification is that in columns (2) and (4) of table 2. Source: See text.

Hausman (2016) estimates a local increase in new car spending of 25-35 cents per dollar of veterans' bonus received. That this number is larger than the 11 cent result for farm value is as expected given the mismeasurement of farm value relative to farm income discussed above, and given the much larger importance of autos in consumption in 1935-36 versus in 1932-33: in 1932 new motor vehicles were 1.2% of all consumption; in 1935 they were 2.7% (NIPA table 2.4.5, downloaded January 12, 2017).

3.2 Robustness We next address three potential concerns. First, a natural question is whether auto sales always grew more rapidly in spring in states with large populations living on farms or high crop values per person. If farm states saw more rapid auto sales growth in years when there was no dollar devaluation or change in crop prices, then the preceding results would not be evidence about the effects of these policies in spring 1933. Figure 8 shows coefficients and two standard error bands from regressions of spring auto sales growth on farm share or crops sold for each year from 1930 to 1934 using the specification in columns (2) and (4) of table 2. The large, positive, and statistically significant effect on auto sales growth is unique to 1933. This is strong evidence that the relationship between agriculture and auto sales growth reflects something specific to the 1933 recovery rather than a general relationship between agriculture and auto sales.

This finding is also consistent with our model in section 5, in which the cross-sectional estimates directly depend on the change in farm prices and farm income. In figure 5, spring 1933 stands out for the uniquely large increase in farm income; given this, the model predicts a large positive cross-sectional estimate like we see in the data. Similarly, when in 1930 and 1931 farm income falls, the negative estimates shown in figure 8 fit with the model's predictions.

A second potential concern is that the positive relationship between new car sales and agricultural exposure is only driven by small states. Based on a visual inspection of the scatter plots (figures 6a and 6b), we noted above that this was unlikely. A more formal test is to estimate specification (1) using population-weighted OLS. Appendix table 6 reports results: estimates are generally similar or moderately smaller.

Finally, one may be concerned about the effect of seasonal adjustment on our estimates. We have only five years to estimate seasonals (1929-32 and 1934),[19] and so our estimates of the seasonal factors are imprecise. In appendix table 7 we report estimates with the dependent variable measured as the percent change in auto sales from the fourth quarter of 1932 to the fourth quarter of 1933. This results in similar or larger effects.

3.3 Cross-county results The state-level regressions establish that there was a strong positive relationship between auto sales growth and farm exposure in spring 1933. But the small cross-state sample inevitably imposes limits on the analysis. In a cross-state sample, we cannot control for all possible state-specific confounders (state fixed effects), nor do we have the statistical power to examine the importance of farm debt in determining the spending response. The latter issue will be the focus of the following section. Here we repeat the state-level analysis of the previous section at the county-level, taking advantage of the much larger sample to both control for more variables and to consider alternative specifications.

[19] We do not have access to monthly data before 1929, and the seasonals are different after 1934, because in 1935 car manufacturers changed from introducing new models in January to introducing new models in October or November (Cooper and Haltiwanger, 1993).

County-level data on the percent change in car sales between 1932 and 1933 are provided in *Sales Management*, 4/20/1934, pp. 363-404. Data on the level of 1933 sales are provided in *Sales Management*, 4/10/1935, pp. 418-504. We calculate the level of 1932 sales by applying the percent change from 1932-33 to the level of 1933 sales.

These data allow us to estimate the effect of many covariates in a way that is not possible with the 49 observations in a cross-state regression, but the county data also come with three disadvantages. (1) They are annual rather than monthly, providing only an imperfect window into the crucial March-July 1933 period. (2) They suffer from some reporting error. We know this because uniquely for Wisconsin, we have official data on new car registrations by county to which we can compare the data in *Sales Management*. Across the 48 Wisconsin counties for which *Sales Management* provides data on 1932 sales, the correlation between the 1932-33 percent change in *Sales Management* and that in the official data is 0.85. This is high enough to reassure us that there is a strong signal in the *Sales Management* data, but it also indicates substantial reporting error.[20] Since the change in auto sales will be our dependent variable, not our independent variable, this error is more likely to increase our standard errors than it is to bias our estimates. (3) The third disadvantage of the county relative to the state data is that it is incomplete. *Sales Management* provided data on 1932 sales for 2158 counties[21] out of a total of 3100 U.S. counties.[22] Fortunately, the data cover most counties with substantial population and auto sales; they cover 86% of 1932 auto sales.

Figure 9a maps the county auto sales data. Blank areas are those with no data, while darker areas are those with more rapid auto sales growth. For comparison, figure 9b maps the change in farm value across the counties for which we observe auto sales. Farm value is calculated as in equation 2, with $\%\Delta\text{price}_j$ now equal to $\frac{P_{j,1933}-P_{j,1932}}{P_{j,1932}}$.[23]

The correlation is visually obvious: there was a swath of rapid car sales growth and large

[20] Official new car registration data for Wisconsin are from "Report of New Car Registrations for the Year 1932" and "Report of New Car Registrations for the Year 1933." Both are available at the Wisconsin State Historical Society. In our empirical work, we substitute the official data for the *Sales Management* data for Wisconsin.

[21] With the addition of the official new registrations data from Wisconsin, we cover 2181 counties.

[22] This is the number of counties in 1930, minus 2, because Campbell and Milton county Georgia merged with Fulton county Georgia at the end of 1931.

[23] For some crops and counties, we do not observe actual production in 1932. In these cases, we impute county production of crop j using the formula $Q_{\text{county},j,1932} = \frac{Q_{\text{county},j,1929}}{Q_{\text{state},j,1929}} \times Q_{\text{state},j,1932}$. See appendix B.3 for details.

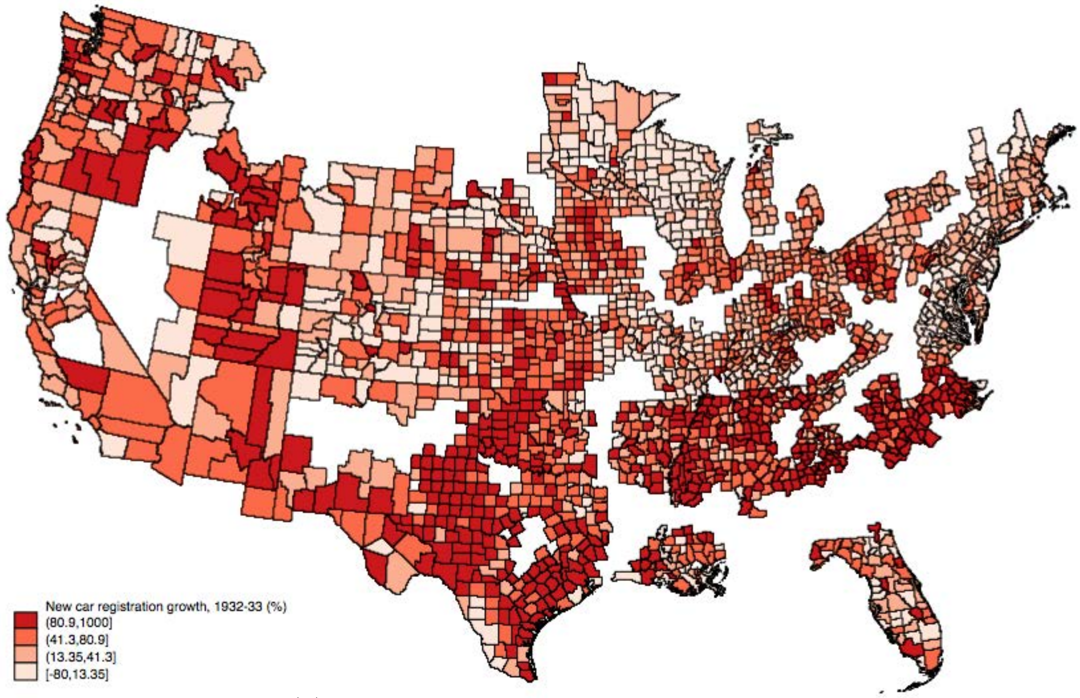
farm value increases running north from Texas, with pockets of high car sales and increasing farm value through the west. By contrast, in the northeast and mid-atlantic, car sales and farm value increased only modestly.

Before reporting county-level regression results, as a benchmark the first two columns of table 3 show state level results. In column (1), we repeat the specification in column (7) of table 2. For a direct comparison with the annual county data, in column (2) we rerun this specification using annual data. The dependent variable is now the growth rate of new auto sales from 1932 to 1933. The estimate is larger.

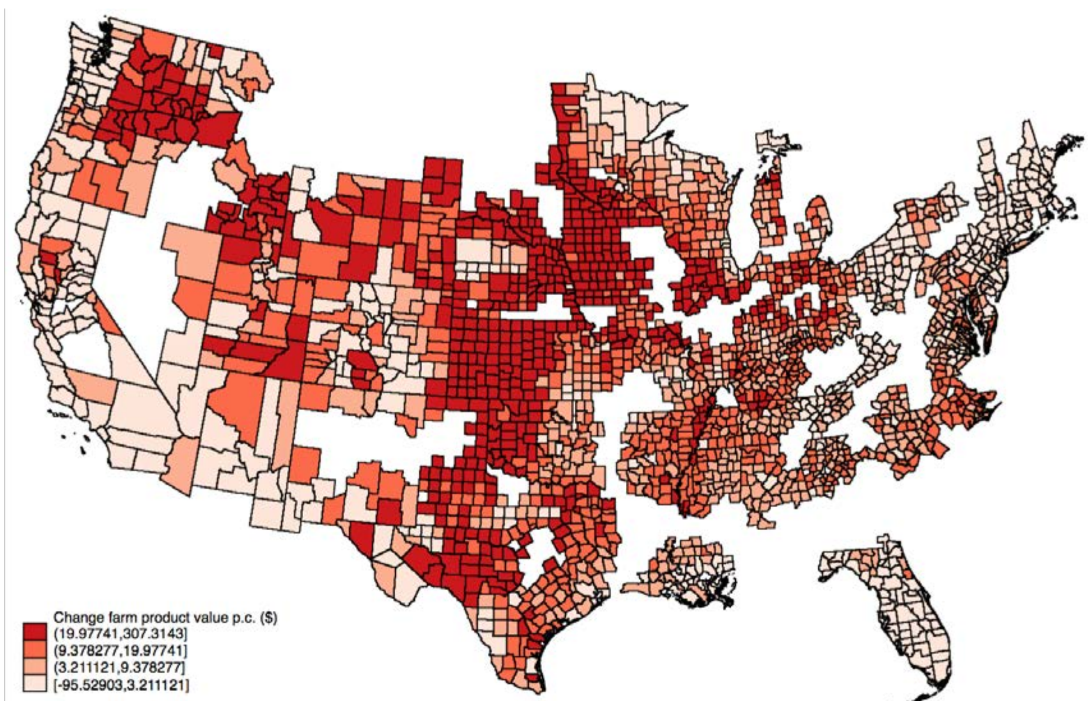
Column (3) reports the same specification with county data. The magnitude of the coefficient is similar, but the statistical significance is much higher (t-statistic equal to 3.3), despite our clustering of the standard errors at the state level. Figure 3 plots a binned scatter plot for this regression. It shows that new auto sales growth tends to monotonically increase with the change in farm value, and that this relationship is not driven by outliers. Column (4) adds controls for population, black population share, democratic vote share in the November 1932 election, rural nonfarm share, car registrations per capita in 1928, average percent of bank deposits suspended between 1930 to 1932, and the percent of farms mortgaged as of 1930. Importantly, in column (4) we also take advantage of the large number of observations to flexibly control for drought. As mentioned in section 2, drought was one factor pushing up grain prices in 1933. Insofar as drought conditions in a county were correlated with exposure to farm product price changes in 1933, this could be a source of bias. To address this, we follow Fishback, Troesken, Kollmann, Haines, Rhode, and Thomasson (2011) and use data from the National Climatic Data Center to construct an indicator for whether or not a county suffered from severe or extreme drought in each month of 1932 and 1933.[24] We then interact these 24 indicator variables with both farm product value and the change in farm product value. In doing so, the coefficient reported in column (4) on the change in farm product value shows the effect of a dollar increase in farm value on auto sales in a county that was *not* suffering from extreme drought. In practice, the addition of the drought and other control variables substantially increases the explanatory power of the regression (as

[24]Our drought data differ slightly from those in Fishback et al. (2011) because of a coding error made by the National Climatic Data Center which affected historical data downloaded before 2013 (https://www.ncdc.noaa.gov/sotc/national/2013/3/supplemental/page-7).

Figure 9 – Auto sales growth and change in farm value by county



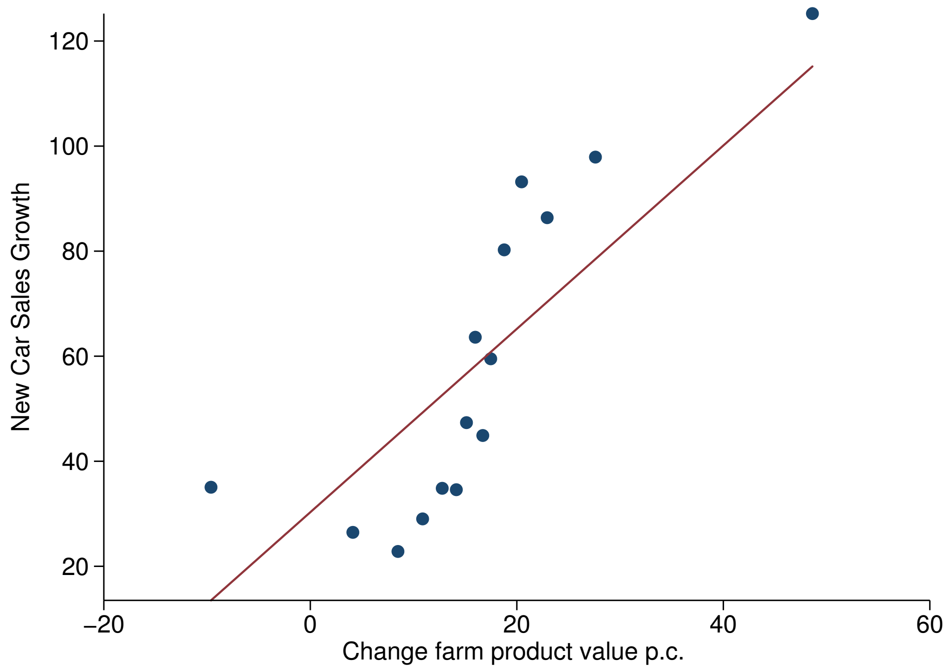
(a) County auto sales growth, 1932-33



(b) Change in farm value 1932-33

Note: Blank areas are missing data. Darker colors denote a larger percent change in auto sales or a larger dollar increase in farm value.
Sources: see text.

Figure 10 – Percent change in car sales and farm channel exposure at the county level



Binned scatter plot of 1932-33 county-level car sales growth against change in farm value value per capita, conditional on initial farm value per capita. This corresponds to column 3 of table 3. The straight line is the OLS regression line. Each point in the figure shows the mean percent change in auto sales in each bin of change in farm value per capita after orthogonalizing the controls. There are 15 bins. See Stepner (2014) for further details.

measured by the R^2), but only modestly shrinks the coefficient on the change in farm value.

In column (5), we add one further control variable: AAA transfer payments per capita in 1933. In the state data, effects of AAA payments were not a significant concern since monthly data allowed us to end the estimation in the third quarter of 1933, before substantial AAA payments had been made. But given sizable AAA transfers in late 1933, there is a concern that these, rather than higher crop prices, could be driving our results. AAA transfers were paid only to farmers of cotton, wheat, and tobacco,[25] traded crops whose prices rose rapidly in spring 1933. Thus the regression has difficulty fully disentangling the effect of these payments from the increase in farm value. Nonetheless, in column (5) we still see economically and statistically significant effects of the change in farm value.

[25] United States Department of Agriculture (1934a), appendix B, exhibit 7, p. 297.

Table 3 – County-level regressions 1932-1933

Dependent variable:	New auto sales growth (%)									Change p.c.
Geography:	State		County							County
Frequency:	Q41-Q3	1932-33	1932-33							1932-33
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Right hand side variables ($ p.c.):										
Change farm product value	1.54^{**}	2.00^{**}	1.75^{***}	1.51^{***}	1.15^{***}	1.02^{***}	1.06^{***}	0.90^{**}		6.08^{**}
	(0.61)	(0.93)	(0.53)	(0.41)	(0.34)	(0.33)	(0.37)	(0.34)		(2.43)
Farm product value 1932	-0.59	-0.40^{**}	-0.28^{***}	-0.32^{***}	-0.22^{***}	-0.030	-0.14^{**}	-0.14^{**}		-1.16^{**}
	(0.41)	(0.16)	(0.097)	(0.073)	(0.052)	(0.036)	(0.061)	(0.055)		(0.44)
AAA Transfers 1933					3.33^{*}			2.71		
					(1.67)			(1.98)		
Cotton, tobacco, and wool value 1932									2.36^{***}	
									(0.23)	
Corn, oats, and wheat value 1932									0.41^{***}	
									(0.12)	
Hay, potato, and fruit value 1932									0.16	
									(0.18)	
Livestock value 1932									-0.14	
									(0.16)	
Milk and egg value 1932									-0.44^{***}	
									(0.10)	
Control Variables	No	No	No	Yes	Yes	No	Yes	Yes	No	No
State Fixed Effects	No	No	No	No	No	Yes	Yes	Yes	No	No
Drought interactions	No	No	No	Yes	Yes	No	Yes	Yes	No	No
R^2	0.27	0.19	0.11	0.31	0.37	0.32	0.40	0.44	0.27	0.08
Observations	48	48	2,061	2,040	2,040	2,061	2,040	2,040	2,061	2,061

Notes: The dependent variable is the percent growth rate of new auto sales in columns (1) through (9) and the change in per capita new auto sales multiplied by 100,000 in column (10) over the frequency indicated in the table header. County regressions exclude counties with fewer than 500 car registrations in 1928. Control variables are population, the FDR vote share, the black population share, the rural non-farm share, car registrations per capita in 1928, deposits suspended from 1929-1932 as a fraction of 1929 deposits, and the fraction of farms mortgaged as of 1930. Drought interactions are based on monthly dummy variables for 1932 and 1933 whether a county was in a severe or extreme drought, per the Palmer drought index. These are interacted with both the change in farm value per capita and farm value per capita. Standard errors clustered at the state level in parenthesis.
$^{*}\ p < 0.1$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$

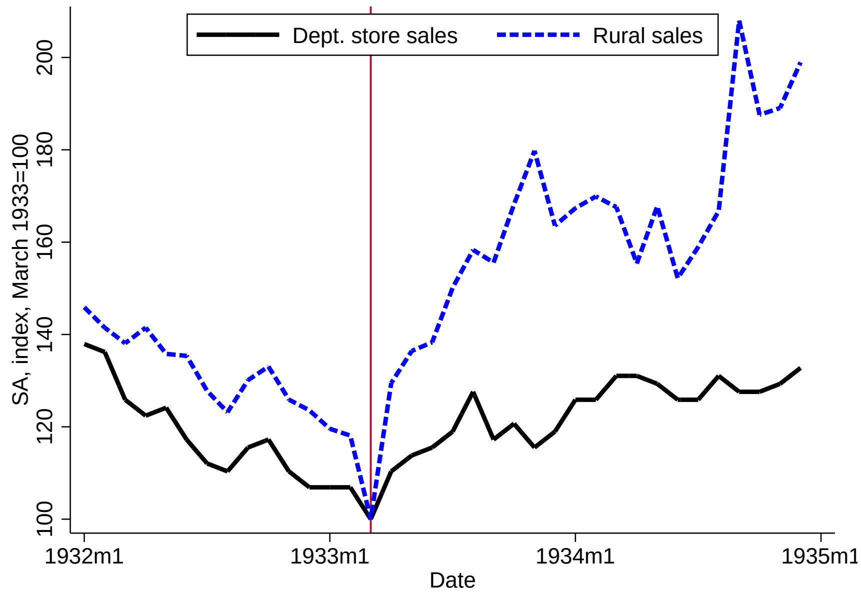
Sources: New auto sales - see text. Farm value (total and subcategories) - see text and appendix B.3. Population, and percent of population black - see table 2; 1928 car registrations - *Sales Management*, 9/21/1929; FDR vote percentage - ICPSR (1999); percent of population rural nonfarm - the 1930 Census as reported in Haines and ICPSR (2010); 1933 AAA transfers - United States Department of Agriculture (1934a), appendix B, exhibit 10; deposits suspended - Federal Deposit Insurance Corporation (2001); percent of farms mortgaged - Haines et al. (2015); drought indicators for U.S. climate divisions - see text.

Columns (6) to (8) add state fixed effects to the specifications of columns (3) to (5). The result is somewhat smaller but statistically indistinguishable coefficients. We do not view state fixed effects as necessary for identification. But the robustness of the results to their inclusion is useful evidence that the farm channel operated within states as well as across states.

We next show that these effects are concentrated in counties producing traded crops and close substitutes. In column (9), the right hand side variables of interest are (1) the 1932 value of cotton, tobacco, and wool grown per capita; (2) corn, oats, and wheat value per capita; (3) hay, potato, and fruit value per capita; (4) livestock value per capita; and (5) milk and egg value per capita. In each case, per capita value in county i is measured as $\frac{1}{\text{population}_i} \sum_j Q_{i,j,1932} \times P_{j,1932}$, where the sum is calculated over the crops j in each category (e.g. cotton, tobacco, and wool). Results show that auto sales grew fastest in counties with high per capita production of cotton, tobacco, and / or wool. Although smaller, we also see a significant relationship between the per capita value of grain grown in a county and auto sales in that county. By contrast, there is no relationship between auto sales growth and the production of hay, potatoes, and fruit or livestock. This fits with the fact that these were nontraded goods whose prices moved relatively little in 1933 as the dollar weakened (table 1). The coefficient on milk and egg value per capita is actually negative, likely reflecting the decline in milk and dairy prices in 1933 (table 1).

Thus far we have used a specification in which the dependent variable is the percent change in auto sales. A concern is that a high growth rates of auto sales may be driven by small counties with small initial levels of auto sales. For this reason, we already drop counties with fewer than 500 car registrations in 1928. As an additional robustness check, we specify the dependent variable in specification (1) as the change (not percentage change) in auto sales from 1932 to 1933 per 100,000 people. Column (10) shows the result. We again see a positive effect of the change in farm product value. In standard deviation terms, the magnitude is similar to that in column (3). A one standard deviation increase in the change in farm product value per capita is associated with a 0.48 standard deviation increase in new auto sales growth and a 0.41 standard deviation increase in the change in new auto sales per 100,000 people.

Figure 11 – Department store sales and rural general merchandise sales



Note: The vertical line indicates the month before devaluation, March 1933. Source: U.S. Department of Commerce (1936), pp. 27-28.

3.4 Other outcome measures A possible concern is that the behavior of new auto sales in spring 1933 is unrepresentative. Here we compare the auto sales response to changing farm value with the behavior of other measures of consumption and income. Unfortunately, this comparison is limited by the lower frequency and / or more limited geographical detail of these alternative series.

We start by comparing department store sales to rural sales of general merchandise (figure 11). We consider department store sales to be a rough proxy for urban consumption, since department stores were located in cities. Both department store and rural retail sales followed a similar downward path in 1932. Department store sales then rose 19% between March and July 1933, while rural sales of general merchandise rose 50%. The very rapid growth of rural sales was in part driven by a sharp drop in March that was reversed in April. But the relatively more rapid growth of rural sales does not depend on this single observation: February to July, department store sales grew 11% while rural sales grew 27%; April to July, department store sales grew 8% while rural sales grew 16%. The relatively rapid increase in rural consumption fits with the argument of this paper that recovery in spring 1933 was in part driven by farm demand.

Table 4 – Other state-level outcomes 1932-1933

Growth of	Durables			Empl.	Income	
	Cars	Trucks	Fridges	Manuf.	Total	# Tax Ret.
	(1)	(2)	(3)	(4)	(5)	(6)
Right hand side variables ($ p.c.):						
Change farm product value	2.00**	2.29*	1.44	0.40*	0.080	0.15**
	(0.93)	(1.15)	(1.25)	(0.24)	(0.12)	(0.066)
Farm product value	−0.40**	−0.46**	−0.19	−0.13***	−0.087***	−0.033***
	(0.16)	(0.20)	(0.20)	(0.039)	(0.028)	(0.0098)
R^2	0.20	0.13	0.08	0.26	0.35	0.01
Observations	48	48	47	48	48	2,183

Notes: The dependent variable is indicated in the table header. For refrigerator sales, DC and Maryland are combined. Column 6 excludes counties with fewer than 30 tax returns filed in 1932. Robust standard errors in parenthesis in columns 1 through 5, and clustered at the state level in column 6. Sources: Auto sales and farm value: see text. Truck sales: *Automotive Daily News Almanac for 1937*, p. 62. Refrigerator sales: *Edison Electric Institute Bulletin*, March 1936, Volume IV, no. 3, p. 80. Unfortunately, the refrigerator sales data lack documentation, and it is unclear whether they are retail or wholesale sales. Manufacturing employment: Wallis (1989). Total income: Bureau of Economic Analysis state personal income data, table SA04. Tax return counts: IRS Statistics of Income. $^{*}\ p < 0.1$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$.

Other than auto sales, we know of no monthly state-level consumption indicators. But in table 4 we do analyze annual, state-level data on truck sales, electric refrigerator sales, manufacturing employment, and income. We also look at county-level data on the number of tax returns filed, a proxy for income.

Results in columns (2) and (3) for truck sales and refrigerators are in line with those for auto sales (column 1) in suggesting a large spending response to the change in farm value.[26] In the employment and income regressions, coefficients are positive but imprecisely estimated. We conjecture that this is due to employment and income leakages outside farm areas. When a farmer in North Dakota bought a car, the car purchase showed up in North Dakota, but the employment and income response might have shown up in Michigan. Therefore, as a general indicator of farm income, we prefer the aggregate numbers shown in figure 5. As discussed in section 2, these numbers show a very large increase in farm income in spring 1933.

[26] The effect on refrigerator sales is imprecisely estimated, perhaps reflecting measurement problems in the underlying data. Unfortunately, the refrigerator sales data lack documentation, and it is unclear whether they are retail or wholesale sales.

4 Mechanisms

We find that in 1933 agricultural areas experienced faster consumption growth and income growth. But these cross-sectional effects do not necessarily imply that the farm channel was expansionary for the U.S. economy as a whole. The positive effects on farm consumption could have been offset by declines in nonfarm consumption. Insofar as higher farm product prices made farmers richer, they ought also to have made others poorer. If higher farm prices were passed through to higher food prices, they made urban workers poorer. If they were not passed through, they lowered the profits of food wholesalers and manufacturers. Whether through poorer urban workers or lower profits, higher farm income and consumption demand ought to have been matched by lower urban income and consumption demand. Thus the channel leading from farm prices to farm income could explain the much larger growth in car sales in farm areas without explaining *any* of the nationwide growth in car sales in spring 1933. Sales could have risen a lot in Iowa and fallen slightly in New York with no net aggregate effect.

In standard international macro models, devaluation is expansionary for the home country in part because foreign economies switch expenditure towards domestic goods. An extensive literature focusses on whether leaving the gold standard had beggar-thy-neighbor effects through such expenditure-switching (see Obstfeld and Rogoff, 1996, p. 626-630 for a survey). But changes in net exports only made small contributions to U.S. growth in 1933 (-0.11 percentage points) and 1934 (0.33 percentage points).[27] Thus, the farm channel is unlikely to have had large effects on aggregate GDP through this mechanism.

In this section we consider a second mechanism through which redistribution of income to farmers via higher crop prices could have been expansionary for the U.S. economy. Standard incomplete market models (Bewley, 1986; Aiyagari, 1994) predict that households in debt have a particularly high MPC out of income shocks. This occurs because consumers subject to a sequence of temporary negative income shocks (e.g., lower crop prices) run up against a borrowing constraint, which prevents them from smoothing consumption. At the borrowing constraint, consumers spend all of any increase in income in order to move closer to the

[27]NIPA table 1.1.2 accessed on 2 July 2016.

consumption smoothing solution. Consistent with this logic, Mian et al. (2013) estimate significantly higher MPCs for indebted households in the Great Recession. Thus, insofar as the farm channel redistributed from low-MPC nonfarmers to high-MPC farmers, it would have increased overall aggregate demand.

Data limitations make a precise comparison of farm and nonfarm household and corporate debt burdens difficult, but a comparison of mortgage debts suggests that debt problems were more severe among farmers. In 1933, total agricultural mortgage debt equaled $7.7 billion (Goldsmith, Lipsey, and Mendelson (1963), table Ia, pp. 80-81). This was 24% of the value of farm structures and land and 270% of farm personal income. Nonfarm residential mortgages totaled $23.1 billion (Snowden, 2006a) in 1933, or 29% of the value of nonfarm residential structures and land (Snowden, 2006d) and 52% of nonfarm personal income.[28]

Presumably because of the much more unfavorable debt-to-income ratios, foreclosure problems were far more severe among farmers than among nonfarmers. Between 15 March 1932 and 15 March 1933, foreclosures exceeded voluntary farm sales by a ratio of more than 2 to 1. There were 38.8 foreclosures per 1000 farms or nearly 100 per 1000 mortgaged farms.[29] No exact comparison exists for nonfarm residential housing. But among all nonfarm structures—residential and nonresidential—the foreclosure rate per 1000 mortgaged structures in 1933 was just 13.3, one-eighth that for farms (Snowden, 2006b).[30]

As noted above, redistribution towards farmers came not only from nonfarm households, but also from corporations. It is not obvious what the appropriate metric is for comparing corporate debt burdens with household debt burdens. But the available evidence suggests that the debt problems of nonfarm corporations were mild relative to those afflicting house-

[28] The value of farm structures and land is from Goldsmith et al. (1963), table Ia, pp. 80-81. Farm and nonfarm personal income data are from the Bureau of Economic Analysis, personal income data, table SA4, downloaded on 20 June, 2016.

[29] Stauber and Regan (1935), table 12, p. 38 document that between 15 March 1932 and 15 March 1933, there were 16.6 "voluntary sales or trades" and 38.8 "foreclosure of mortgages, bankruptcy, etc." per 1000 farms. The foreclosure percentage is approximate, since it uses the 1930 percentage of farms mortgaged (40%). Using the 1935 share of farms mortgaged (34%) results in a slightly higher ratio of foreclosures per 1000 mortgaged farms. Data on the total number of farms and the number of farms mortgaged are from U.S. Department of Commerce (1975) series K162 and K154. For more on farm foreclosures in the interwar period, see Alston (1983).

[30] Despite this large difference in foreclosure rates, mortgage delinquency rates were if anything higher in urban areas (Clark, 1933, p. 20). This points to the difficulty of making precise comparisons of farm and nonfarm debt burdens.

holds. In his treatment of U.S. debt problems Clark (1933) (p. 172) writes: "The facts show that the debt situation in industry, though serious, is not cataclysmic nor is it a mass problem." Quantitative support for this view comes from a comparison of business failures with farm and nonfarm foreclosures. Business failures in 1932 exceeded those in 1929 by 39%; by contrast, over this three-year period, farm foreclosures rose by 98%, and nonfarm foreclosures rose 84%.[31]

Our newly-collected county data give us sufficient power to detect whether, as hypothesized, higher farm debt burdens were associated with higher MPCs and thus a larger local spending response. In that case, the farm channel ought to have been stronger in counties with more farm debt. We measure this exposure using the percent of farms mortgaged in a county from the 1929 agricultural census (United States Department of Commerce, 1942). We interact the percent of farms mortgaged with the level and change in farm value per capita. We begin by estimating the linear regression

$$
\begin{aligned}
\%\Delta\text{Auto sales}_i = \beta_0 &+ \beta_1\Delta\text{farm value p.c.}_i \times \%\text{ farms mortgaged}_i \\
&+ \beta_2\text{farm value p.c.}_i \times \%\text{ farms mortgaged}_i + \beta_3\Delta\text{farm value p.c.}_i \\
&+ \beta_4\%\text{ farms mortgaged}_i + \beta_5\text{farm value p.c.}_i + \gamma' X_i + \varepsilon_i.
\end{aligned} \tag{4}
$$

The coefficient on the interaction term, β_1, shows how local farm debt conditions affected the strength of the farm channel.

As a second specification we relax the linear structure in equation (4), and instead group counties into quintiles based on the value of the farm debt variable. We then interact the level and change in farm value per capita (p.c.) with these quintiles,

$$
\begin{aligned}
\%\Delta\text{Auto sales}_i = \beta_0 &+ \sum_{j=2}^{5}\gamma_j\Delta\text{farm value p.c.}_i \times \text{Quintile } j\text{: }\%\text{ farms mortgaged}_i \\
&\sum_{j=2}^{5}\theta_j\text{farm value p.c.}_i \times \text{Quintile } j\text{: }\%\text{ farms mortgaged}_i + \beta_1\Delta\text{farm value p.c.}_i \\
&+ \beta_2\text{farm value p.c.}_i + \sum_{j=2}^{5}\delta_j\text{Quintile } j\text{: }\%\text{ farms mortgaged}_i + \lambda' X_i + \varepsilon_i.
\end{aligned} \tag{5}
$$

[31] Data on business failures are from Sutch (2006); farm foreclosures per 1000 farms are from Alston (1983), table 1, p. 888, and the total number of farms are from Olmstead and Rhode (2006a); nonfarm business failures are from Snowden (2006c).

Table 5 – Auto sales growth in spring 1933 (% changes) and farm debt

Panel A: Linear interaction with % farms mortgaged

	(1)	(2)	(3)	(4)
Linear Interaction	0.38**	0.80***	0.57**	0.73***
	(0.19)	(0.23)	(0.24)	(0.24)
Change farm product value p.c. ($)	1.43**	0.082	0.45	0.0081
	(0.61)	(0.50)	(0.53)	(0.51)
State Fixed Effects	No	Yes	No	Yes
Control Variables	No	No	Yes	Yes
Drought interactions	Yes	Yes	Yes	Yes
R^2	0.24	0.41	0.37	0.44
Observations	2,056	2,056	2,035	2,035

Panel B: Interaction with quintiles of % farms mortgaged

	(1)	(2)	(3)	(4)
Change farm product value p.c. × Quintile 2	1.11	1.29**	1.61**	1.38**
	(0.73)	(0.55)	(0.62)	(0.55)
Change farm product value p.c. × Quintile 3	0.31	1.58**	1.06	1.56**
	(1.10)	(0.64)	(0.84)	(0.62)
Change farm product value p.c. × Quintile 4	0.12	2.20***	1.88*	2.52***
	(1.28)	(0.80)	(1.12)	(0.87)
Change farm product value p.c. × Quintile 5	0.45	2.71***	2.05*	2.78***
	(1.14)	(0.76)	(1.03)	(0.74)
Change farm product value p.c. ($)	1.52	−1.25**	−0.75	−1.61**
	(0.98)	(0.61)	(0.99)	(0.69)
State Fixed Effects	No	Yes	No	Yes
Control Variables	No	No	Yes	Yes
Drought interactions	Yes	Yes	Yes	Yes
R^2	0.24	0.40	0.37	0.44
Observations	2,056	2,056	2,035	2,035

Notes: In panel A, % of farms mortgaged is scaled to be in standard deviation units. The coefficient of 0.17 in column (1), for instance, means that a 1 standard deviation increase in the % of farms mortgaged increases the effect on auto sales of traded crop value per capita by 0.17. All regressions exclude counties with fewer than 500 1928 car registrations. In panel B, all specifications include dummy variables for each quintile. Control variables and drought indicators are the same as those in column (5) of table 3. Standard errors clustered at the state level in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. Sources:% of farms mortgaged from Haines et al. (2015). Other variables, see table 3.

In this specification, the effect of the farm channel is β_1 in the lowest quintile, $\beta_1 + \gamma_2$ in the second quintile, $\beta_1 + \gamma_3$ in the third quintile, and so on. Using quintiles allows us to assess whether the farm channel becomes monotonically weaker or stronger as local farm debt rises, without imposing that this relationship is linear. The cost is that it is less precise if the true relationship is indeed linear.

Panel A of table 5 shows the estimates of the linear interaction (equation (4)) with the percent of farms mortgaged and farm leverage. Panel B shows the estimates using quintiles of percent of farms mortgaged and farm leverage (equation (5)). For percent of farms mortgaged, we find a statistically significant and positive linear interaction coefficient in all specifications. In panel B, without state fixed effects (columns (1) and (3)), quintiles 2 through 5 exhibit stronger effects of the farm channel than quintile 1. However, within these quintiles the effect is not monotonic: quintile 2 shows particularly strong responses. This pattern reflects the following correlation: cotton counties tended to be less mortgaged but benefitted from a bumper crop in 1933. By contrast, wheat counties tended to more mortgaged but suffered poor crop yields. This induces a negative correlation between the error term and the *interaction* of farm mortgaged quintiles with changes in farm value, inducing the non-monotonic pattern and weakening the estimate of the linear interaction.

Since no principal wheat producer state was also a principal cotton producing state, state fixed effects will absorb this correlation. Thus, with state fixed effects (columns (2) and (4)), there is a monotonic increase in the farm channel's effect as one moves to higher quintiles of farm debt. Consequently, the linear interaction estimates also becomes larger and more significant. This suggests that the effect of debt on the spending response was higher within than it was across states. Overall, the results in table 5 suggest an important role for farm indebtedness in the propagation of the farm channel.

5 Aggregate implications

We next present a model that allows us to translate our cross-sectional estimates of the effects of higher crop prices into an aggregate effect on the U.S. economy. The model explicitly takes into account that the farm channel helped farmers but hurt agents purchasing farm goods. The key assumption of the model, one for which we provided some empirical evidence above, is that farmers faced more severe debt problems than corporations. To transparently highlight the importance of these features, we deliberately simplify the model along a number of dimensions. Thus, one should interpret our results not as a precise estimate, but rather as a guide to the farm channel's quantitative importance.

In the model, aggregate output growth, $\frac{dY_t}{Y_t}$, can be bounded below by the coefficient on farm population share in our cross-state regression β (panel A of table 2) multiplied by the farm population share, $\phi^f = \frac{\text{U.S. farm population}}{\text{U.S. total population}}$, and the ratio of per capita income in agricultural areas $Y_{p.c.,a}$ to U.S. per capita income $Y_{p.c.}$,

$$\frac{dY_t}{Y_t} \geq \beta \times \phi^f \times \frac{Y_{p.c.,a,t}}{Y_{p.c.,t}}. \tag{6}$$

To understand equation 6, note that the most basic way to capture the difference between a zero aggregate farm population share and the actual aggregate farm population share is to multiply the cross-sectional coefficient times the aggregate farm population share, $\beta \times (\phi^f - 0) = \beta \times \phi^f$. This calculation is only a first step for two reasons. First, a higher farm population share in the cross-section is not the same as a higher farm population share in the aggregate. This is because farm states tended to be poorer than non-farm states. In the model, we show that the correct scaling factor is the ratio of per capita income in farm states to per capita income in the U.S. as a whole, $\frac{Y_{p.c.,a,t}}{Y_{p.c.,t}} < 1$.

Second, the cross-sectional estimate β may not necessarily be informative about aggregate effects. This is first because monetary policy changes are differenced out in the cross-section but matter for the aggregate economy. Second, terms-of-trade changes redistribute income across states and counties but can have different effects for the aggregate economy. Third, leakages mean that the state and county local multipliers may be smaller than the aggregate multiplier. Since the U.S. was at the zero lower bound in spring 1933, the first force was not operational. Further, many non-agricultural prices moved little in spring 1933, so the non-agricultural terms-of-trade effects are small. Thus, only the third mechanism plays an important role in our model (and likely in the data), and therefore equation (6) gives a lower bound on the aggregate importance of the farm channel.

Our estimate of β in column (1) of panel A of table 2 is 1.7. Combined with $\phi^f = 25\%$ and $\frac{Y_{p.c.,a}}{Y_{p.c.}} = 0.63$,[32] this implies an increase in output of 27%. Therefore, the model suggests that the farm channel can explain at least 30% of the actual 86.5% increase in new auto sales between the October 1932 - March 1933 average and the July - September 1933 average. Auto production rose by 84.1% over this period, moving in tandem with

[32]This is based on BEA regional data, table SA4. The per-capita income in farm states is calculated by aggregating over all states with farm population share greater than or equal to the national average. These cover 77% of the farm population.

sales (appendix A). Thus we take this exercise to mean that the farm channel accounted for at least 30% of the increase in autos production. Alternatively, we can do an analogous calculation with our farm value change regressions. In that case, the formula becomes $\frac{dY_t}{Y_t} \geq \beta \times [\text{Aggregate farm value change p.c.}]_t \times \frac{Y_{p.c.,a,t}}{Y_{p.c.,t}}$. The aggregate change in farm value per capita is $[\text{Aggregate farm value change p.c.}]_t = 23.14\$$. Combining this value with our cross-sectional estimates from columns (7) and (8) in table 3, we get $1.49 \times 23.14 \times 0.63 = 22\%$ and $1.69 \times 23.14 \times 0.63 = 25\%$. These are very close to our result for farm population share (27%).

While necessarily more speculative, we also think it is reasonable to take 30% as an estimate of the share of overall recovery explained by the farm channel. We know from the data on rural retail sales, truck sales, and refrigerator sales (section 3.4) that cars were not the only good on which farmers spent their income. And while the MPC on cars may have been higher than that on other goods, autos production also grew more than industrial production as a whole.

5.1 Model set-up Time is discrete, running from 1 to infinity, and there is perfect foresight. There are three types of consumers: farmers (f), workers (w), and capitalists (c). Each consumer's type is fixed, and the respective population shares are ϕ^f, ϕ^w, and $1 - \phi^f - \phi^w$. There is no heterogeneity within types, so we solve the optimization problem for a representative consumer of each type.

Each representative consumer has the same utility function,

$$\sum_{t=1}^{\infty} \beta^{t-1} \left[\ln c_t + \psi \ln d_t \right],$$

where c_t and d_t are distinct consumption goods, β is the discount factor, and ψ is the relative weight on the d good. In our regional analysis below, c_t is a nontraded good, and d_t is a traded good, but this distinction can be ignored when analyzing aggregate quantities. We call these goods bread and cars respectively. Both goods are nondurable; in appendix D.4 we show that the same formula (6) holds when d_t is a durable good. There is no disutility of labor, in accord with the low opportunity cost of employment during the Great Depression.

The budget constraint for each type of agent is

$$a_t = (1 + r_{t-1})a_{t-1} + y_t - c_t - d_t - \frac{\zeta}{2} a_t^2 \mathbb{1}_{\text{capitalist}} + \Pi_t \mathbb{1}_{\text{capitalist}}.$$

a_t are real asset holdings, r_t is the real interest rate, and y_t is real income. In our model, consumer types differ by their income process. The only tradable asset is a one-period real loan, so financial markets are incomplete. To ensure that the wealth distribution is stationary, we also include a quadratic asset holding cost for capitalists, $\frac{\zeta}{2} a_t^2$, as in Schmitt-Grohé and Uribe (2003) and Broer et al. (2016). The asset holding cost is paid to a financial intermediary, which is owned collectively by capitalists and which rebates the profits $\Pi_t = \frac{\zeta}{2} a_t^2$.

The prices of the two consumption goods are fixed. In effect, we assume that nominal final goods prices are perfectly sticky, as in Caballero, Farhi, and Gourinchas (2015), Farhi and Werning (2012, 2014), and Korinek and Simsek (2016). We make this assumption because it simplifies the model, because final goods prices appear sticky in the data, and because it imparts no obvious bias to our estimate of the aggregate effects of the farm channel. Empirically, the CPI was unchanged from March to May 1933 and then rose only 0.7% in June (FRED series CPIAUCNS). Even the retail price of bread was unchanged from March 1933 to June 1933 despite a 49% increase in the price of wheat.[33] On the other hand, the retail price of lard rose 21% between March and June 1933.[34] An endogenous response of final goods price to farm prices would change the aggregate effects predicted by the model in two ways. (1) By reducing the income of constrained workers, it would lower output growth. (2) Consumers would expect higher inflation, which lowers real interest rates and raises output growth (Eggertsson, 2010; Wieland, 2015). Hausman (2013) documents narrative evidence from newspaper advertisements that higher farm product prices increased inflation expectations in spring 1933. Since the CPI did not rise for the first few months of spring 1933, we conjecture that the second channel was quantitatively more important than the first. Thus, the assumption of fixed final goods prices is likely conservative.

[33] NBER macrohistory series m04001a and m04022.

[34] NBER macrohistory series m04027. This can be compared to a 38% increase in the wholesale price of lard over the same period (NBER macrohistory series m04026a).

Each consumer $x \in \{f, w, c\}$ faces a limit on borrowing,

$$a_t^x \geq s^x \bar{a},$$

where $\bar{a} \leq 0$, and s^x is the consumers' steady-state income share. So the amount each type can borrow is commensurate with their income (in steady-state). Such a borrowing limit arises naturally in incomplete market models like Aiyagari (1994) and Bewley (1986), but here we simply exogenously impose it. The borrowing limit prevents consumption smoothing for the most-indebted consumers, making their consumption very sensitive to their current income.

The first order conditions for each consumer are

$$\begin{aligned} d_t &= \psi c_t; \\ \lambda_t &= c_t^{-1}; \\ \lambda_t &= \beta(1 + r_t)\lambda_{t+1} + \mu_t - \lambda_t \zeta a_t \mathbb{1}_{\text{capitalist}}, \end{aligned}$$

where λ and μ are the Lagrange multipliers on the budget constraint and on the borrowing constraint. Log preferences mean that consumers' relative spending on cars and bread is given by ψ. If the borrowing constraint is not binding, then consumers follow a standard Euler equation, with the exception of capitalists who face a wealth holding cost.

Farmers earn income by selling farm products X_t to capitalists, workers earn income by selling labor L_t to capitalists, and capitalists earn profits by producing and selling bread and cars. The production function for each good is

$$\begin{aligned} C_t &= \min\{\alpha^{-1} X_t, (1-\alpha)^{-1} L_{c,t}\}; \\ D_t &= L_{d,t}, \end{aligned}$$

where $L_{d,t} + L_{c,t} = L_t$, and C and D denote aggregate quantities. Bread production requires farm products (e.g., wheat) and labor, whereas cars are produced using labor alone. Workers can supply labor up to a maximum (full-employment) amount $\bar{L}$, and farms can supply farm products up to a maximum (full-employment) amount $\bar{X}$. We assume that $\frac{\bar{X}}{\bar{L}} = \frac{\alpha}{1-\alpha+\psi}$, so that both inputs can be simultaneously fully-employed.

With fixed prices, the amount produced of each good, and thus the quantity of farm goods and labor in production, is demand-determined. This is meant to capture the situation in 1933 with high unemployment in which the marginal cost of providing labor was close to zero. Let $p_{x,t}$ be the real price of farm products, and $w < 1$ be the fixed real wage.[35] Then income for each consumer is

$$
\begin{aligned}
y_t^f &= p_{x,t}X_t = \frac{\alpha}{1+\psi} p_{x,t} Y_t \equiv s_t^f Y_t; \\
y_t^w &= wL_t = w\left[1 - \frac{\alpha}{1+\psi}\right] Y_t \equiv s^w Y_t; \\
y_t^c &= C_t + D_t - wL_t - p_{x,t}X_t = \left[1 - \frac{\alpha p_{x,t} + w(\psi + 1 - \alpha)}{1+\psi}\right] Y_t \equiv s_t^c Y_t,
\end{aligned}
$$

where s_t^x is the income share of type $x \in \{f, w, c\}$, and Y_t is total output in the economy:

$$Y_t = C_t + D_t = y_t^f + y_t^w + y_t^c.$$

We describe central bank decisions with an interest rate rule that respects the zero-lower bound constraint,

$$r_t = \max\{r_t^n - \phi(Y_t - \bar{Y}), 0\},$$

where $\bar{Y}$ is the level of output at which farmers and workers are fully-employed, $X = \bar{X}$ and $L = \bar{L}$. The variable r_t^n is the natural real rate of interest, so that when $r_t = r_t^n$, output is at full-employment $Y_t = \bar{Y}$. (Note that nominal and real interest rates are identical since there is no inflation in the model.)

Throughout, the real price of farm products $p_{x,t}$ is exogenous. This allows for a clean analysis of the effect of changes in farm product prices on economic activity. The importance of the farm channel can be analyzed by considering the effects of an increase in $p_{x,t}$. Of course, in practice the increase in $p_{x,t}$ was an endogenous response to devaluation. But by making $p_{x,t}$ exogenous, we can avoid modeling international trade explicitly and instead focus on the distributional consequences of changing farm prices.

[35] CPI-deflated average hourly earnings in manufacturing were roughly flat in spring 1933, with the exact percent change being quite sensitive to the time window used: between March and July 1933, they fell 4.4%, whereas measured between the first and third quarter of 1933, they rose 4.5%. (Average hourly earnings data are from NBER macrohistory series m08142; CPI data are from FRED series CPIAUCNS.) Neither of these measures adjusts for changes in the composition of the workforce.

5.2 Steady-state In steady-state, we let the real price of farm products be constant and equal to the wage, which is equal in turn to the inverse of the mark-up m, $p_x = w = m^{-1} < 1$. The zero-lower bound is not binding in steady-state, so output is $\bar{Y}$, and the steady state discount rate satisfies, $\beta(1+r) = 1$. Net asset holdings are then zero, and borrowing constraints are not binding. The steady-state income shares are

$$s^f = m^{-1}\frac{\alpha}{1+\psi}, \qquad s^w = m^{-1}\left[1 - \frac{\alpha}{1+\psi}\right], \qquad s^c = 1 - m^{-1},$$

and spending choices for each consumer $x \in \{f, w, c\}$ are

$$d^x = \psi c^x = \frac{\psi}{1+\psi} s^x \bar{Y}.$$

5.3 Timing Period $t = 1$ is meant to capture spring 1933. We set the real farm product price to a value sufficiently low for the zero lower bound on nominal interest rates and the borrowing constraint on all farmers and workers to bind.[36] (In appendix D.2 we extend the model to allow for a fraction of unconstrained workers and farmers.) Farmers and workers borrow from capitalists up to the borrowing limit. In setting up the model in this way, we do not intend to argue that a decline in farm prices caused the Great Depression (though it could have contributed). Rather, within the context of the model, this is a simple way of generating two key features of spring 1933: some consumers cannot borrow as much as they would like, and the central bank is constrained by the zero lower bound. What is important for our results are these characteristics of spring 1933, not what brought them about.

In periods $t \geq 2$, we assume real farm prices are at their steady state value, $p_{x,t} = m^{-1}$, and thus the borrowing constraints on farmers and workers are no longer binding. The zero-lower bound constraint is also no longer binding, so output is at its full-employment value $Y_t = \bar{Y}$. The distribution of income and consumption is, however, not at steady-state

[36]These condition arise when the real farm product price $p_{x,1}$ is low enough that

$$s_1^c > s^c \frac{\bar{Y}}{\bar{Y} + \beta\kappa_1\bar{a}},$$

where κ_1 is the stable root from the $t \geq 2$ problem in appendix D.1. The inequality is strict to ensure that the borrowing constraints are tight. Note that when the borrowing limits are zero, $\bar{a} = 0$, this expression simplifies to $s_1^c > s^c$ and thus $p_{x,1} < m^{-1}$. Allowing for borrowing, $\bar{a} < 0$, implies that the real farm product price must fall more to satisfy this condition.

since workers and farmers have to repay their debt. Thus, for $t \geq 2$ we have to solve for the transition path to the steady-state.

These timing assumptions are stylized, but we make them in order to simplify the dynamics of the model and in particular to make the outcome in period $t = 1$ (our period of interest) more transparent. By simplifying timing in this way, we are able to solve the model analytically while retaining the core elements needed to understand the macroeconomic effects of redistribution to farmers.

5.4 Solution: $t \geq 2$ We solve the model backwards, starting with $t \geq 2$. In these periods, the borrowing constraint will never bind. Further, the policy rule implies $Y_t = \bar{Y}$, the income paths are constant, $y_t^x = s^x \bar{Y},\ x \in \{f, w, c\}$, and the agricultural price is $p_x = 1 - s^c$. For farmers and workers to repay debt, it follows that they consume less than their income, while capitalists consume more than their income. An above steady-state real interest rate together with asset holding costs on capitalists induces this behavior.

The first order conditions for each consumer are

$$\begin{aligned}
\lambda_t^f &= \beta(1 + r_t)\lambda_{t+1}^f; \\
\lambda_t^w &= \beta(1 + r_t)\lambda_{t+1}^w; \\
\lambda_t^c &= \beta(1 + r_t)\lambda_{t+1}^c - \lambda_t^c \zeta a_t^c,
\end{aligned}$$

where consumption choices must add up to the full-employment level of output,

$$\bar{Y} = (1 + \psi)(c_t^f + c_t^w + c_t^c),$$

and the budget constraints of each agent must be satisfied.

We relegate the details of solving this problem to appendix D.1 and simply state the solution here:

$$\begin{aligned}
a_t^c &= \kappa_1 a_{t-1}^c; \\
c_t^c + d_t^c &= (\beta^{-1} - \kappa_1) a_{t-1}^c + s^c \bar{Y}; \\
c_t^f + d_t^f &= -\frac{s^f}{1-s^c}(\beta^{-1} - \kappa_1) a_{t-1}^c + s^f \bar{Y}; \\
c_t^w + d_t^w &= -\frac{s^w}{1-s^c}(\beta^{-1} - \kappa_1) a_{t-1}^c + s^w \bar{Y},
\end{aligned}$$

where $0 < \kappa_1 < 1$ if the asset holding cost, ζ, is small but positive. Thus, the economy gradually converges to the original steady-state. In the derivation we make use of several approximations, which are, however, exact when $\zeta = 0$. Thus, we can make the approximation error arbitrarily small by lowering ζ, which is why we state the equations as equalities.

The solution implies that high asset holdings by capitalists raise their consumption, and, through higher real interest rates set by the central bank, lower worker and farmer consumption. These results give us the information we need to link up to the capitalists' Euler equation at $t = 1$.

5.5 Solution: $t = 1$ At $t = 1$ we assume that each consumer has zero initial assets. Combining the Euler equation of the capitalist with the budget constraint $a_1^c = y_1^c - c_1^c - d_1^c$ yields,

$$c_1^c + d_1^c = mpc^c y_1^c + \beta^{-1}(1 - mpc^c) s^c \bar{Y},$$

where $mpc^c = \frac{\beta^{-1}(\beta^{-1} - \kappa_1 + \zeta)}{1 + \beta^{-1}(\beta^{-1} - \kappa_1 + \zeta)} < 1$ is the capitalists' MPC out of current income. As the asset holding cost parameter ζ converges to zero, this MPC converges to $mpc^c \to \frac{r(1+r)}{1+r(1+r)}$. For small discount rates, this is approximately equal to the steady-state net interest rate r. Thus, capitalists typically have a low MPC in the model. This is because they are not borrowing constrained, and thus they follow the permanent income hypothesis. Interpreting capitalists as owners of corporations, this result is in line with the above-cited view of Clark (1933) that debt problems were relatively less severe for corporations.

By contrast, farmers and workers are borrowing constrained and thus have a high MPC.

For each type $x \in \{f, w\}$, their consumption choices are given by,

$$c_1^x + d_1^x = y_1^x - s^x \bar{a}.$$

Thus, their MPC out of current income is 1. Intuitively, because their current income is relatively low, farmers and workers would like to smooth consumption by borrowing more. They will spend any additional income on current consumption in order to move closer to the consumption smoothing optimum. The historical interpretation is that farmers and workers in spring 1933 expected higher future income and had pent-up demand for consumption goods. Thus they were likely to spend a high proportion of income increases. Consistent with our model, Hausman (2016) documents that at least in 1936, recovery in the 1930s was associated with high MPCs.

Combining all consumption choices yields aggregate output,

$$Y_1 = \frac{1}{s_1^c(1 - mpc^c)} \left[-(1 - s^c)\bar{a} + \beta^{-1}(1 - mpc^c)s^c \bar{Y} \right]. \tag{7}$$

The intuition for this equation is the Keynesian cross. The denominator is one minus the income-weighted MPC, $1 - s_1^c \times mpc^c - (1 - s_1^c) \times 1$. The numerator is autonomous consumption by workers and farmers $-(1 - s^c)\bar{a} \geq 0$ plus autonomous consumption by capitalists $\beta^{-1}(1 - mpc^c)s^c\bar{Y}$.

From equation (7), it follows that output rises if farm product prices increase.

$$\frac{dY_1/Y_1}{dp_{x,1}/p_{x,1}} = \frac{s_1^f}{s_1^c} > 0 \tag{8}$$

Higher farm product prices redistribute income from capitalists to farmers. This raises output because the MPC of a farmer is higher than that of a capitalist. This aggregate effect is entirely a function of (1) the importance of farming in the economy, s_1^f, and (2) the importance of high-MPC consumers in the economy, $s_1^c = 1 - s_1^f - s^w$. The MPC of capitalists drops out because the decline in their income share is exactly offset by the increase in aggregate income, leaving their total income $s_1^c Y_1$ unchanged per equation (7).

5.6 Cross-section We next show how our cross-sectional regressions are informative about the aggregate effect of higher farm prices. To do so, we consider an agricultural location a

and a manufacturing location m. Farm products X and cars D are fully tradable across the two locations, but bread C is nontraded. We then distribute the mass of consumers over two locations, splitting workers into bakers (b) producing the nontradable bread C and laborers (l) producing tradable cars D. The agricultural area has farmers, bakers, and capitalists. The manufacturing area has bakers, laborers, and capitalists. The fraction of capitalists living in the agricultural area is $\nu \in [0,1]$. We assume that the location of capitalists is proportional to the steady-state area income shares, $\nu = s_a = \frac{Y_a}{Y}$ and $1-\nu = s_m = \frac{Y_m}{Y} = 1 - s_a$.

The incomes of each type of consumer are

$$y^f_{a,t} = s^f_t Y_t, \qquad y^b_{a,t} = s^b s_{a,t} Y_t, \qquad y^b_{m,t} = s^b s_{m,t} Y_t, \qquad y^l_{m,t} = s^l Y_t, \qquad y^c_t = s^c_t Y_t,$$

where $s_{a,t} = \frac{Y_{a,t}}{Y_t}$ and $s_{m,t} = \frac{Y_{m,t}}{Y_t}$ are the local income shares, and $s^b = w(\frac{1-\alpha}{1+\psi})$ and $s^l = w(\frac{\psi}{1+\psi})$ are the income shares of bakers and laborers (so $s^w = s^b + s^l$). By combining incomes within the same location we derive local income shares,

$$\begin{aligned} s_{a,t} &= \frac{1}{1-s^b}\left[(1-s_a)s^f_t + s_a(1-s^b-s^l)\right] \\ s_{m,t} &= \frac{1}{1-s^b}\left[s_a s^l + (1-s_a)(1-s^f_t-s^b)\right]. \end{aligned}$$

Note that higher farm prices redistribute towards the agricultural area by raising the farm income share s^f_t.

Expenditure on cars at $t=1$ for each consumer type is then analogous to our aggregate solution, where borrowing-constrained consumers have a high MPC, and unconstrained capitalists have a low MPC.

$$\begin{aligned} d^f_{a,1} &= \frac{\psi}{1+\psi}(y^f_{a,1} - s^f \bar{a}), & d^b_{a,1} &= \frac{\psi}{1+\psi}(y^b_{a,1} - s^b s_a \bar{a}) \\ d^b_{m,1} &= \frac{\psi}{1+\psi}(y^b_{m,1} - s^b s_m \bar{a}), & d^l_{m,1} &= \frac{\psi}{1+\psi}(y^l_{m,1} - s^l \bar{a}) \\ d^c_{a,1} &= s_a \frac{\psi}{1+\psi}\left[mpc^c y^c_1 + \beta^{-1}(1-mpc^c)s^c \bar{Y}\right] & d^c_{m,1} &= \frac{1-s_a}{s_a} d^u_{a,1}. \end{aligned}$$

Summing over all consumers' local car expenditure and substituting the solutions for income we can derive a simple expression for total car expenditure,

$$D_{a,1} = \frac{\psi}{1+\psi} s_{a,1} Y_1; \qquad\qquad D_{m,1} = \frac{\psi}{1+\psi} s_{m,1} Y_1.$$

This implies that locally, a fraction $\frac{\psi}{1+\psi}$ of income is spent on cars, and another fraction $\frac{1}{1+\psi}$ is spent on bread. Thus, total local spending equals total local income.

We capture the redistribution effect of devaluation with an increase in real farm prices $dp_{x,1} > 0$. We then compare car sales in the equilibrium with higher farm prices at $t = 1$ with car sales in the equilibrium with lower farm prices at $t = 1$, analogous to Werning (2011) and Wieland (2015). Thus, the effect on car sales in each area of higher farm prices is,

$$\frac{\frac{dD_{a,1}}{D_{a,1}}}{\frac{dp_{x,1}}{p_{x,1}}} = \frac{1}{1-s^b} \left(1 - s_a\right) \frac{s_1^f}{s_{a,1}} + \frac{\frac{dY_1}{Y_1}}{\frac{dp_{x,1}}{p_{x,1}}};$$

$$\frac{\frac{dD_{m,1}}{D_{m,1}}}{\frac{dp_{x,1}}{p_{x,1}}} = -\frac{1}{1-s^b}(1 - s_a)\frac{s_1^f}{s_{m,1}} + \frac{\frac{dY_1}{Y_1}}{\frac{dp_{x,1}}{p_{x,1}}}.$$

The first term in each expression captures the redistribution effect: it is positive for the agricultural area and negative for the manufacturing area, and it exactly cancels out at the aggregate level after weighting by local income shares. The size of the redistribution effect depends on the size of the farm sector s_1^f, the presence of capitalists in area a means only a fraction $1 - s_a$ represents redistribution across areas, and a local income multiplier from nontraded goods $\frac{1}{1-s^b}$. The second term is the aggregate output effect from higher farm prices. Note that this effect is symmetric in the two areas and will therefore be differenced out in a cross-sectional regression.

Specifically, the model counterpart of our cross-sectional regression is,

$$\frac{dD_{i,1}}{D_{i,1}} = \alpha + \beta \frac{\phi_i^f}{\phi_i}, \qquad i = a, m$$

where $\frac{\phi_i^f}{\phi_i}$ is the steady-state farm population share in location i. To match the difference in auto sales growth across locations, the coefficient β in the model is,

$$\begin{aligned}
\beta &= \frac{dp_{x,1}}{p_{x,1}} \frac{\frac{\frac{dD_{a,1}}{D_{a,1}}}{\frac{dp_{x,1}}{p_{x,1}}} - \frac{\frac{dD_{m,1}}{D_{m,1}}}{\frac{dp_{x,1}}{p_{x,1}}}}{\frac{\phi_a^f}{\phi_a} - \frac{\phi_m^f}{\phi_m}} \\
&= \frac{dp_{x,1}}{p_{x,1}} \frac{1}{1-s^b} \frac{\frac{s_1^f}{s_{a,1}}}{\frac{\phi^f}{\phi_a}} \frac{1-s_a}{1-s_{a,1}} \\
&\leq \frac{dp_{x,1}}{p_{x,1}} \frac{s_1^f}{s_{a,1}} \frac{1}{1-s^b} \left(\frac{\phi^f}{\phi_a}\right)^{-1},
\end{aligned}$$

where the last inequality follows from the fact that farmers and farm areas did worse during the Great Depression, $s_{a,1} < s_a$.[37] Importantly, the cross-sectional estimate is a function of the change in farm product prices. If farm prices fall, then the cross-sectional estimate ought to be negative and vice-versa. Intuitively, if real farm product prices fall then farm areas ought to do worse, but if farm product prices rise then farm areas ought to do better. The last expression shows that the cross-sectional estimate multiplied by the local farm population share $\beta \times \frac{\phi^f}{\phi_a}$ is informative about (1) the overall size of the local farm income shock, $\frac{dp_{x,1}}{p_{x,1}} \frac{s_1^f}{s_{a,1}}$, and (2) the local income multiplier $\frac{1}{1-s^b}$. In particular, it is a lower bound on the product of the two.

This property makes our cross-sectional estimate informative about aggregate effects. From equation (8) it follows that the aggregate output effect is bounded by equation (6),

$$\begin{aligned}
\frac{dY_1}{Y_1} &= \frac{dp_{x,1}}{p_{x,1}} \frac{s_1^f}{1-s_1^f-s^w} \\
&\geq \frac{dp_{x,1}}{p_{x,1}} \frac{s_1^f}{1-s^b} \\
&\geq \beta \times \phi^f \times \frac{s_{a,1}}{\phi_a} \\
&= \beta \times \phi^f \times \frac{Y_{a,1}/\phi_a}{Y_1}.
\end{aligned}$$

The lower bound follows from the fact that the cross-sectional estimate is only informative about the local multiplier effect $\frac{1}{1-s^b}$ as opposed to the larger aggregate multiplier $\frac{1}{s_1^c} = \frac{1}{1-s^b-s_1^f-s^l}$. Further, as shown above, the coefficient β is also a lower bound on the local farm

[37] The share of farm business GDP in total business GDP fell from 9.9% in 1929 to 8.2% in 1932 (NIPA table 1.3.5, downloaded on 9/29/2016).

channel multiplier.

In appendix D.2 we show that we obtain the same formula (6) when we allow some fraction of farmers and workers to be unconstrained. In that extension, we also show that more indebted areas respond more strongly in line with our results in table 5. In appendix D.3 we also derive the same formula (6) after moving all capitalists to the manufacturing region and eliminating any risk sharing across regions that we have in the baseline model.

6 Conclusion

This paper provides evidence on the sources of U.S. recovery in spring 1933. We document the importance of the farm channel: devaluation raised prices of traded crops and close substitutes, raising income and consumption in agricultural areas. We estimate the importance of the farm channel for recovery using newly-collected state and county auto sales data. Our estimates imply that a one standard deviation increase in the share of a state's population living on farms was associated with a 28–29 percentage point increase in auto sales growth between the October 1932 - March 1933 average and the July - September 1933 average. These cross-sectional effects explain a substantial fraction of cross-state variation in auto sales growth and are concentrated in areas growing traded crops or close substitutes. The additional statistical power of the county data reveals that the spending effects from a given increase in farm value were larger in counties with more farm debt.

Together with evidence that farmers were among the most indebted agents in the economy, this suggests that higher crop prices could have been expansionary for the U.S. economy as a whole by redistributing income to indebted, high-MPC farmers. We build an incomplete-markets model incorporating this redistribution effect; the model explicitly recognizes that some agents (businesses processing farm goods) lost when farmers gained. Disciplined by our cross-sectional estimates, the model implies that the farm channel raised aggregate auto sales by 27%. This corresponds to 30% of auto sales growth between the October 1932 - March 1933 average and the July - September 1933 average, suggesting that the farm channel played an important role in spring 1933's rapid growth.

To the extent that the farm channel contributed to overall recovery in the U.S., it means that the lessons of 1933 for macroeconomic policy are more nuanced than often assumed. In particular, our work points to the importance of redistribution as a channel for macroeconomic policy. Japan's recent efforts to raise inflation expectations and end two decades of output stagnation (so-called "Abenomics") provide an illustrative example. When Japan embarked on Abenomics, the U.S. success in 1933 was invoked to predict success in Japan (Romer, 2014; Kuroda, 2013). Just like the U.S. in 1933, Japan in 2013-14 weakened its currency and raised inflation expectations. But whereas devaluation in 1933 redistributed income to indebted farmers with a high MPC, the weakening of the yen may have redistributed income from workers to large, exporting corporations with a low marginal propensity to spend.[38] Thus an appreciation of the farm channel may help economists understand why Abenomics has (as of 2017) failed to produce sustained, rapid growth.

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[38] Hausman and Wieland (2014, 2015) document a decline in real wages in Japan under Abenomics. Kato and Kawamoto (2016) argue that the weakening of the yen contributed to record high corporate profits, but that these higher corporate profits translated into little business investment.

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A Checking data consistency in spring 1933

Rapid growth rates over a short period naturally lead to questions of data quality: should one believe that seasonally adjusted industrial production rose 57 percent in spring 1933 or might this reported increase be a result of data construction problems? We argue the former. Since our conclusion is in line with Taylor and Neumann (2016), our analysis in this appendix is brief.

The first check is to consider the behavior of non-seasonally adjusted production. This is shown in figure 12a. The rapid increase in industrial production is also present in the raw, non-seasonally adjusted data and is not a regular seasonal phenomena. Only in 1933 does one see such a dramatic increase in spring. A second check on data quality is to see whether the rapid production increase is driven by outliers. It appear not. Of the 19 individual industry production series comprising durable manufacturing published in Federal Reserve (1940), eight saw seasonally adjusted production rise more than 100% between March and July 1933; all but one (railroad car production) of the 19 saw production rise more than 20%.

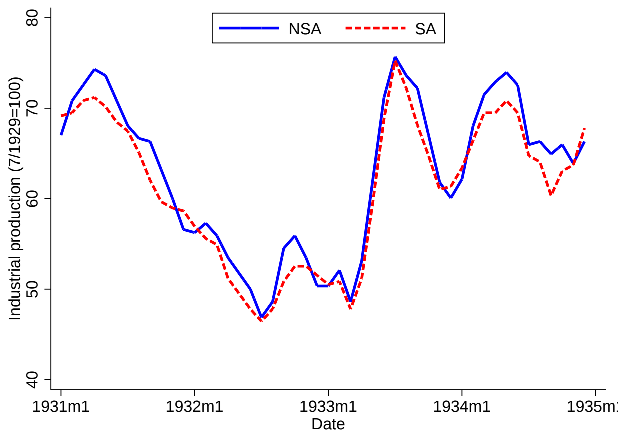
A.1 Other production indicators A further check on the industrial production data is to consider alternative indicators of economic activity. Figure 12b shows two such indicators: the Federal Reserve index of freight car loadings and nonagricultural employment (Federal Reserve, 1941). Freight car loadings measure the real quantity of shipments by rail, with underlying data from the railroads themselves. The broad picture is similar to that for industrial production. After reaching a trough in March 1933, seasonally adjusted freight car loadings grew rapidly through July. In these four months, the seasonally adjusted series rose 40 percent.

It is also natural to examine the evolution of employment. Caution is necessary since the employment data are not entirely independent of the industrial production data. For some industries, the industrial production figures rely heavily on the Bureau of Labor Statistics establishment survey, which is the employment data's source (Federal Reserve, 1940, p. 761). Nonetheless, it is reassuring that, like industrial production, employment rose rapidly in spring 1933. Total, seasonally adjusted, nonagricultural employment grew from 26.7 million in March 1933 to 28.4 million in July.[39] Seventy-three percent of this employment increase was accounted for by an astonishing 20 percent increase in manufacturing employment.[40]

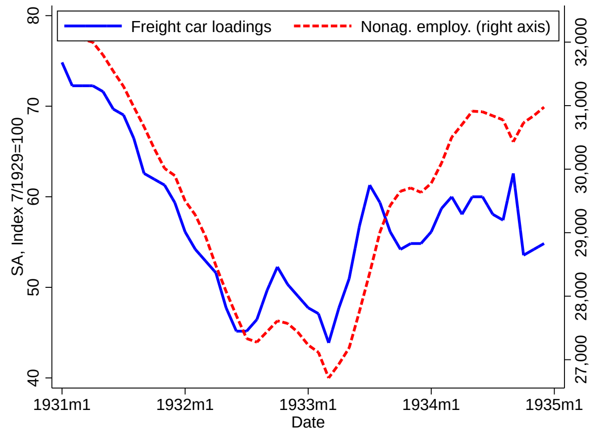
A.2 Sales Together, the data on industrial production, employment, and freight car loadings leave little doubt that output rose rapidly in spring 1933. But was the recovery of production due to contemporaneous consumer demand or to expectations of future demand? If the former, the historians' task is to explain the increase in consumption. If the latter, to explain why firms expected higher future sales. Therefore we examine the behavior of sales in spring 1933. Figure 12c shows seasonally adjusted passenger car sales and produc-

[39] Note that these employment data exclude relief workers. Data are from Federal Reserve (1941) p. 534.

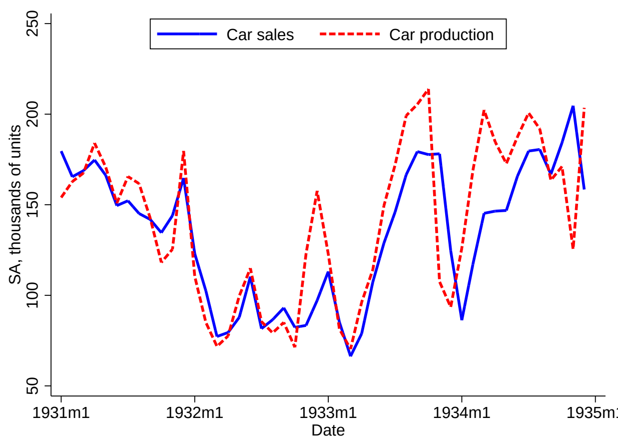
[40] Manufacturing employment rose from 6.12 million in March to 7.36 million in July (Federal Reserve, 1941, p. 534).



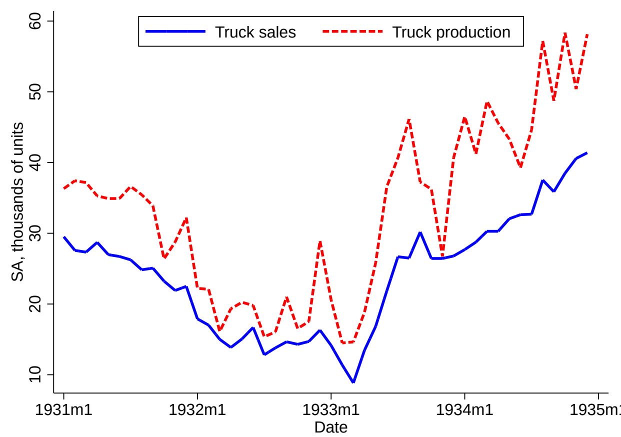
(a) Non-seasonally adjusted and seasonally adjusted industrial production



(b) Freight car loadings and employment



(c) Car sales and production



(d) Truck sales and production

Figure 12 – Notes: See text for details on the seasonal adjustment of car and truck sales / production. Sources: Industrial production: Federal Reserve Board, G.17 data release. Freight car loadings and employment: Federal Reserve (1941). Cars: Sales data are from NBER macrohistory series m01109; production data are from NBER series m01107a. Trucks: Sales data are from NBER macrohistory series m01146a; production data are from NBER series m01144a.

tion from 1931 through 1934.[41] Seasonally adjusted sales behave similarly to production in spring 1933, roughly doubling from March to July. Figure 12d presents the analogous data for trucks. Interestingly, the recovery of truck sales is even more rapid than that of car sales in spring 1933: they rise 202 percent from March to July.[42] Unfortunately, the more rapid growth of truck sales does little to distinguish between the overall inflation expectations channel and a farm specific channel. It is consistent both with high demand for trucks from businesses and from farmers.

As with cars, the difference between truck production and sales is not obviously anomalous in spring 1933. Figures 12c and 12d suggest a roughly parallel movement in production and sales of cars and trucks. Thus explanations of the recovery, at least of this important sector, must explain a rise not only in production, but also in consumer and investment demand.[43] This mirrors the finding of Taylor and Neumann (2016) that manufacturing inventories behaved normally in spring 1933.

B Notes and sources for farm product data

B.1 Table 1

- The exchange rate: The source is *Survey of Current Business*, 12/1932 p. 32, 12/33 p. 31, 12/34 p. 32, 12/35 p. 33.

- Wheat: Monthly U.S. producer prices are from United States Department of Agriculture (1936), table 15, p. 19. We seasonally adjust these prices using the same procedure as for auto sales (footnote 12). Production, farm value, and trade data are from United States Department of Agriculture (1936), table 1, p. 6. Trade quantities are for the trade year beginning July.

- Corn: Monthly U.S. producer prices are from United States Department of Agriculture (1936), table 45, p. 39. We seasonally adjust these prices using the same procedure as for auto sales (footnote 12). Production, farm value, and trade data are from United States Department of Agriculture (1936), table 37, p. 33. Trade quantities are for the trade year beginning July.

- Oats: Monthly U.S. producer prices are from United States Department of Agriculture (1936), table 60, p. 50. We seasonally adjust these prices using the same procedure as for auto sales (footnote 12). Production, farm value, and trade data are from United

[41] Sales data are from NBER macrohistory series m01109; production data are from NBER series m01107a. Neither series was seasonally adjusted by the source. We seasonally adjust the series by regressing the natural logarithm of each series on monthly dummies for the period January 1929-December 1934, excluding 1933. We use this narrow sample to align with the seasonal adjustment procedure used for the monthly state auto sales. The series graphed in figure 12c is $e^{\hat{\varepsilon_t}} \times \frac{\bar{y}}{\bar{x}}$, where $\hat{\varepsilon}_t$ are the residuals from the regression of the natural log of sales or production on the monthly dummies, $\bar{y}$ is the mean of non-seasonally adjusted sales over the period, and $\bar{x}$ is the mean of $e^{\hat{\varepsilon_t}}$.

[42] Sales data are from NBER macrohistory series m01146a; production data are from NBER series m01144a. The seasonal adjustment procedure is identical to that for passenger cars. See footnote above.

[43] This casts doubt on Kindleberger's (1973) statement that recovery in spring 1933 was "[b]ased on inventory accumulation rather than long-term investment" (p. 233).

States Department of Agriculture (1936), table 53, p. 44. Trade quantities are for the trade year beginning July.

- Cotton: Monthly U.S. producer prices are from United States Department of Agriculture (1936), table 106, p. 82. We seasonally adjust these prices using the same procedure as for auto sales (footnote 12). Production, farm value, and trade data are from United States Department of Agriculture (1936), table 98, p. 76. Trade quantities are for the trade year beginning August.

- Tobacco: Annual calendar year U.S. producer prices are from Strauss and Bean (1940), p. 69, table 27. Production, farm value, and trade data are from United States Department of Agriculture (1936), table 143, p. 104. Trade quantities are for the trade year beginning July.

- Hay: Monthly U.S. producer prices are from United States Department of Agriculture (1936), table 274, p. 190. We seasonally adjust these prices using the same procedure as for auto sales (footnote 12). Production and trade data are from United States Department of Agriculture (1936), table 270, p. 187. Trade quantities are for the trade year beginning July. Production of hay is the sum of tame hay and wild hay production. Farm value is tame hay production multiplied by the December 1 price (given in United States Department of Agriculture (1936), table 270, p. 187) plus wild hay production multiplied by the December 1 price (also given in United States Department of Agriculture (1936), table 270, p. 187).

- Potatoes: Monthly U.S. producer prices are from United States Department of Agriculture (1936), table 229, p. 162. We seasonally adjust these prices using the same procedure as for auto sales (footnote 12). Production, farm value, and trade data are from United States Department of Agriculture (1936), table 222, p. 157. Trade quantities are for the trade year beginning July.

- Cattle: Monthly U.S. producer prices are from United States Department of Agriculture (1936) table 307, p. 213. We seasonally adjust these prices using the same procedure as for auto sales (footnote 12). Production data are from United States Department of Agriculture (1934b), table 324, pp. 590-591, and United States Department of Agriculture (1935), table 327, pp. 562-563. We calculate farm value as production multiplied by the producer price. Trade data are from United States Department of Agriculture (1936) table 312, p. 217. Trade quantities are for the calendar year. The trade data are for beef and beef products; thus they are an upper bound on trade in beef itself.

- Hogs: Monthly U.S. producer prices are from United States Department of Agriculture (1936), table 321, p. 224. Production data are from United States Department of Agriculture (1934b), table 340, p. 601, and United States Department of Agriculture (1935), table 342, p. 572. We seasonally adjust these prices using the same procedure as for auto sales (footnote 12). Farm value is from United States Department of Agriculture (1934b), table 340, p. 601. Trade data are from United States Department of Agriculture (1936) table 331, p. 229. Trade quantities are for the calendar year.

The trade data are for hog products; thus they are an upper bound on trade in pork itself.

- Milk: Monthly U.S. producer prices are from United States Department of Agriculture (1936), table 376, p. 267. Production data are from United States Department of Agriculture (1934b), table 383, p. 628, and United States Department of Agriculture (1936), table 368, p. 259. We seasonally adjust these prices using the same procedure as for auto sales (footnote 12). Farm value is production multiplied by the producer price. These USDA publications provide no trade data, presumably because little milk was traded.

- Chickens: Monthly U.S. producer prices are from United States Department of Agriculture (1936), table 410, p. 286. We seasonally adjust these prices using the same procedure as for auto sales (footnote 12). Production and farm value data refer to the number of chickens raised; data are from United States Department of Agriculture (1936), table 403, p. 281. United States Department of Agriculture (1936) provides no trade data, presumably because little chicken was traded.

- Eggs: Monthly U.S. producer prices are from United States Department of Agriculture (1936), table 419, p. 291. We seasonally adjust these prices using the same procedure as for auto sales (footnote 12). Production and farm value data are from United States Department of Agriculture (1936), table 403, p. 281. United States Department of Agriculture (1936) provides no trade data, presumably because few eggs were traded.

B.2 Farm value for U.S. states Except as noted below, we compute the price for 1932 production using a weighted average of monthly, non-seasonally adjusted prices. We compute the percent change in prices from the October 1932 - March 1933 average to the July-September 1933 average using seasonally adjusted, unweighted monthly prices.

- Wheat: Raw price data are the same as listed in section B.1. To compute annual 1932 and 1933 prices, we weight the monthly prices using monthly wheat receipts, United States Department of Agriculture (1936), table 11, p. 15. Production data for 1932 by state are from United States Department of Agriculture (1934b), table 4, p. 389. For the states Colorado, Illinois, Indiana, Kansas, Maryland, Missouri, Montana, North Dakota, Ohio, Oklahoma, South Dakota, Virginia, and Wyoming we use 1932 production data from the National Agricultural Statistics Service (NASS).[44] For Illinois, we take data on winter wheat only from NASS and add to it the data on spring wheat production reported in Illinois Cooperative Crop Reporting Service (1951).

- Corn: Raw price data are the same as listed in section B.1. To compute annual 1932 and 1933 prices, we weight the monthly prices using monthly marketings by farmers, United States Department of Agriculture (1935), table 48, p. 385. Production data for 1932 by state are from United States Department of Agriculture (1934b), table 41, p.

[44] This and all other NASS data were downloaded on June 10, 2007. See https://www.nass.usda.gov/Quick_Stats/.

415. For the states Delaware, Illinois, Indiana, Iowa, Kentucky, Maryland, Missouri, Nebraska, North Carolina, Ohio, and Wisconsin we use 1932 production data from NASS.

- Oats: Raw price data are the same as listed in section B.1. To compute annual 1932 and 1933 prices, we weight the monthly prices using monthly marketings by farmers, United States Department of Agriculture (1935), table 64, p. 396. Production data for 1932 by state are from United States Department of Agriculture (1934b), table 59, p. 427. For the states Illinois, Minnesota, Montana, North Dakota, Ohio, South Dakota, and Wisconsin we use 1932 production data from NASS.

- Cotton: Raw price data are the same as listed in section B.1. To compute annual 1932 and 1933 prices, we weight the monthly prices using monthly marketings by farmers, United States Department of Agriculture (1935), table 117, p. 429. Production data for 1932 by state are from United States Department of Agriculture (1934b), table 112, p. 460. For the states California, Georgia, Mississippi, and North Carolina we use 1932 production data from NASS.

- Tobacco: No monthly prices are available over a long enough time horizon to make seasonal adjustment possible; thus we use the calendar year, annual price reported in Strauss and Bean (1940), p. 69, table 27. Production data for 1932 by state are from United States Department of Agriculture (1934b), table 155, p. 486.

- Hay: Price data are the same as listed in section B.1. No monthly weights are available, so the annual price is a simple average of the monthly prices. Production data for 1932 by state are from United States Department of Agriculture (1934b), table 287, p. 564, for tame hay and from United States Department of Agriculture (1934b), table 288, p. 565, for wild hay. For the states Illinois, Minnesota, Missouri, North Dakota, and South Dakota we use 1932 production data from NASS.

- Potatoes: Price data are the same as listed in section B.1. To compute annual 1932 and 1933 prices, we weight the monthly prices using monthly potato shipments, United States Department of Agriculture (1936), table 227, p. 161. Production data for 1932 by state are from United States Department of Agriculture (1934b), table 237, p. 534-535. For the states Minnesota and North Dakota we use 1932 production data from NASS.

- Cattle: Monthly and weighted-average calendar year producer prices are taken from United States Department of Agriculture (1936) table 307, p. 213. Production data for 1932 by state are from United States Department of Agriculture (1934b), table 324, pp. 590-591.

- Hogs: Monthly and weighted-average calendar year producer prices are taken from United States Department of Agriculture (1936), table 321, p. 224. Production data for 1932 by state are from United States Department of Agriculture (1934b), table 340, p. 601.

- Milk: Monthly and weighted-average calendar year producer prices are taken from United States Department of Agriculture (1936), table 376, p. 267. Production data for 1932 by state are from United States Department of Agriculture (1934b), table 383, p. 628.

- Chickens: Monthly and weighted-average calendar year producer prices are taken from United States Department of Agriculture (1936), table 410, p. 286. Production data for 1932 by state are from Pirtle and Slocum (1937), table 18, p. 16, for chickens sold and table 19, p. 17, for chickens consumed on farms. To match production data on number of chickens to price data on the value of a pound of chicken, we assume that each chicken weighs 3.7 pounds. We obtain this number by taking the ratio of the figures on price per chicken and price per pound of chicken reported in United States Department of Agriculture (1935).

- Eggs: Monthly and weighted-average calendar year producer prices are taken from United States Department of Agriculture (1936), table 419, p. 291. Production data for 1932 by state are from United States Department of Agriculture (1934b), table 432, p. 655.

- Apples: Monthly producer prices are from United States Department of Agriculture (1936), table 155, p. 116. Weights for annual prices are based on monthly carlot shipments, United States Department of Agriculture (1936), table 158, p. 118. Production data for 1932 by state are from United States Department of Agriculture (1934b), table 168, p. 499.

- Oranges: Annual producer price data and production data for 1932 by state are from United States Department of Agriculture (1936), table 180, p. 131. No monthly producer prices are available, so we use the annual price for each month of the corresponding year. We follow the convention in Olmstead and Rhode (2006b) of making the price in calendar year t equal to the price for the crop year beginning in year $t-1$.

- Grapefruit: Annual producer price data and production data for 1932 by state are from United States Department of Agriculture (1936), table 180, p. 131. No monthly producer prices are available, so we use the annual price for each month of the corresponding year. We follow the convention in Olmstead and Rhode (2006b) of making the price in calendar year t equal to the price for the crop year beginning in year $t-1$.

- Wool: Monthly and weighted-average producer prices are from United States Department of Agriculture (1936), table 347, p. 244. Production data for 1932 by state are from United States Department of Agriculture (1934b), table 362, p. 616.

B.3 Farm value for U.S. counties Since we use national prices, all prices are identical to those described above for the state data. County-level production data are constructed as follows:

- Wheat: we calculate the county's share in 1929 state wheat production from the 1930 agricultural census (Haines et al., 2015). We then multiply 1932 state production by that share to impute 1932 county production. For the states Colorado, Illinois, Indiana, Kansas, Maryland, Missouri, Montana, North Dakota, Ohio, Oklahoma, South Dakota, Virginia, and Wyoming we use county-level 1932 production data from NASS. For Illinois, we take data on winter wheat only from NASS and add to it the data on spring wheat production reported in Illinois Cooperative Crop Reporting Service (1951).

- Corn: we calculate the county's share in 1929 state corn production from the 1930 agricultural census (Haines et al., 2015). We then multiply 1932 state production by that share to impute 1932 county production. For the states Delaware, Illinois, Indiana, Iowa, Kentucky, Maryland, Missouri, Nebraska, North Carolina, Ohio, and Wisconsin we use county-level 1932 production data from NASS.

- Oats: we calculate the county's share in 1929 state oats production from the 1930 agricultural census (Haines et al., 2015). We then multiply 1932 state production by that share to impute 1932 county production. For the states Illinois, Minnesota, Montana, North Dakota, Ohio, South Dakota, and Wisconsin we use county-level 1932 production data from NASS.

- Cotton: we calculate the county's share in state cotton production from the 1930 agricultural census (Haines et al., 2015). We then multiply 1932 state production by that share to impute 1932 county production. For the states California, Georgia, Mississippi, and North Carolina we use county-level 1932 production data from NASS.

- Tobacco: we calculate the county's share in 1929 state tobacco production from the 1930 agricultural census (Haines et al., 2015). We then multiply 1932 state production by that share to impute 1932 county production.

- Hay: we calculate the county's share in 1929 state hay production from the 1930 agricultural census (Haines et al., 2015). We then multiply 1932 state production by that share to impute 1932 county production. For the states Illinois, Minnesota, Missouri, North Dakota, and South Dakota we use county-level 1932 production data from NASS.

- Potatoes: we calculate the county's share in 1929 state potato production from the 1930 agricultural census (Haines et al., 2015). We then multiply 1932 state production by that share to impute 1932 county production. For the states Minnesota and North Dakota we use county-level 1932 production data from NASS.

- Cattle: we calculate the county's share in 1929 state cattle numbers from the 1930 agricultural census (Haines et al., 2015). We then multiply 1932 state production by that share to impute 1932 county production.

- Hogs: we calculate the county's share in 1929 state hog numbers from the 1930 agricultural census (Haines et al., 2015). We then multiply 1932 state production by that share to impute 1932 county production.

- Milk: we calculate the county's share in 1929 state milk production from the 1930 agricultural census (Haines et al., 2015). We then multiply 1932 state production by that share to impute 1932 county production.

- Chickens: we calculate the county's share in 1929 state chicken numbers from the 1930 agricultural census (Haines et al., 2015). We then multiply 1932 state production by that share to impute 1932 county production.
- Eggs: we calculate the county's share in 1929 state egg production from the 1930 agricultural census (Haines et al., 2015). We then multiply 1932 state production by that share to impute 1932 county production.
- Apples: we calculate the county's share in state apple production from the 1930 agricultural census (Haines et al., 2015). We then multiply 1932 state production by that share to impute 1932 county production.
- Oranges: we calculate the county's share in state oranges production from the 1930 agricultural census (Haines et al., 2015). We then multiply 1932 state production by that share to impute 1932 county production.
- Grapefruit: we calculate the county's share in state grapefruit production from the 1930 agricultural census (Haines et al., 2015). We then multiply 1932 state production by that share to impute 1932 county production.
- Wool: we calculate the county's share in state wool production from the 1930 agricultural census (Haines et al., 2015). We then multiply 1932 state production by that share to impute 1932 county production.

C Monthly state auto sales data

Our monthly state auto sales data come from the *Automotive Daily News Review and Reference Book* 1935, pp. 22-23. The source is given as "R. L. Polk & Co., New Jersey Motor List Co. and Sherlock & Arnold."

To check the accuracy of these data, we computed annual totals by state for 1932 and 1933 and compared these to the numbers reported in *Automotive Industries*, 2/25/33, p. 224 (for 1932) and 2/24/34, p. 220 (for 1933).

In 52 of 98 cases, these sources exactly agree, and in all but two cases, the two sources are within 0.2% of each other. The two larger discrepancies are in Indiana in 1932, where *Automotive Industries* records 29,202 cars sold while *Automotive Daily News Review and Reference Book* records 28,505 cars sold, and in Iowa in 1932 where *Automotive Industries* records 18,971 cars sold and *Automotive Daily News Review and Reference Book* records 19,525 cars sold.

When these sources differ, it may be due to misreporting / typos in the monthly data. In a few cases, these typos were obvious, and we fixed them by using reported totals to compute a residual. *Automotive Daily News Review and Reference Book* always reported the total by month and state for the years 1929-1934, e.g. they reported the sum of sales in Alabama for January 1929 + January 1930 . . . + January 1934. This allows us fill in months in which there is an obvious typo. Specifically:

- January 1932, Indiana: *Automotive Daily News Review and Reference Book* reports car sales equal to 5180. As reported, this means car sales for the six Januarys from 1929 to 1934 total to 25,260, much more than the reported total of 22,563. Furthermore, the 5180 figure for January 1932 is suspect because it is larger than Indiana sales in January 1930, 1931, 1933, or 1934, and it is larger than Illinois sales in January 1932. Thus we replace it with the difference between the reported six-January total (22,563) and the sum of the reported figures for all Januarys except January 1932. The resulting number is 2,483 cars sold.

- July 1932, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, and Missouri: In these states, the reported figure for July 1932 sales is identical to that for July 1933 sales. Since on average summer 1932 sales were below summer 1933 sales, we replace the July 1932 figure with the reported six-July sum and sales in all Julys except July 1932. In all cases, this results–as expected–in a number that is less than the July 1933 number.

- February 1929, Nebraska: *Automotive Daily News Review and Reference Book* reports 470 cars sold in Nebraska in February 1929. This is implausibly low (e.g. 3986 cars were sold in Nebraska in the more depressed conditions of February 1930). So we replace it with the difference between the 6-February sum and the sum of all February sales except February 1929. The resulting number is a more plausible 4705 cars sold.

D Model appendix

D.1 Consumption choices $t \geq 2$

Taking logs of each consumers Euler equation yields,

$$\begin{aligned}
\ln \lambda_t^f &= \ln \beta + \ln(1 + r_t) + \ln \lambda_{t+1}^f \\
\ln \lambda_t^w &= \ln \beta + \ln(1 + r_t) + \ln \lambda_{t+1}^w \\
\ln \lambda_t^c + \ln(1 + \zeta a_t^c) &= \ln \beta + \ln(1 + r_t) + \ln \lambda_{t+1}^c
\end{aligned}$$

We next multiply each equation by the consumers steady-state income share and sum over the consumers, using the approximation $\sum_{x \in \{f,w,c\}} s^x \ln \frac{c_t^x}{c^x} \approx \ln \frac{C_t}{C} = 0$,

$$\begin{aligned}
& s_c \ln(1 + \zeta a_t^c) = \ln \beta + \ln(1 + r_t) \\
\Rightarrow \qquad & \beta(1 + r_t) \approx 1 + s_c \zeta a_t^c
\end{aligned}$$

So the real interest rate is increasing in the asset holdings of the capitalist. We note that these derivations are exact when $\zeta = 0$, for then the economy immediately settles at the new steady-state where $\frac{c_t^x}{c^x} = \frac{C_t}{C} = 0$. Thus, we can make the approximation error arbitrarily small by choosing a sufficiently small asset holding cost ζ.

Substituting the solution for the interest rate back into the Euler equation yields,

$$\begin{aligned}
c_t^f &\approx c_{t+1}^f - c^f s_c \zeta a_t^c \\
c_t^w &\approx c_{t+1}^w - c^w s_c \zeta a_t^c \\
c_t^c &\approx c_{t+1}^c + c^c (1 - s_c) \zeta a_t^c
\end{aligned}$$

Again these equations are exact when $\zeta = 0$.

The asset accumulation equation for capitalists is approximately,

$$a_t \approx \beta^{-1} a_{t-1} - (1+\psi) c_t^c + s^c \bar{Y}$$

which is also exact when $\zeta = 0$.

This yields a system of two equations,

$$\begin{aligned} a_t &= \beta^{-1} a_{t-1} - (1+\psi) c_t^c + s^c \bar{Y} \\ c_{t+1}^c &= -c^c (1-s_c) \zeta a_t^c + c_t^c \end{aligned}$$

which we can solve using standard Eigenvalue-Eigenvector decomposition.

The Lagrange multipliers are:

$$\kappa_{1,2} = \frac{1+\beta^{-1}}{2} \pm \sqrt{\left(\frac{1+\beta^{-1}}{2}\right)^2 - \beta^{-1} + (1+\psi) c^c (1-s_c) \zeta}$$

For small but positive $\zeta > 0$, $0 < \kappa_1 < 1$ and $\kappa_2 > 1$. The transversality condition then selects the initial condition to eliminate the explosive root κ_2. Thus, the solution to the system of equations is,

$$\begin{aligned} a_t^c &= \kappa_1 a_{t-1}^c \\ c_t^c &= \frac{\beta^{-1} - \kappa_1}{1+\psi} a_{t-1}^c + \frac{1}{1+\psi} s^c \bar{Y} \\ c_t^f &= -\frac{s^f}{1-s^c} \frac{\beta^{-1} - \kappa_1}{1+\psi} a_{t-1}^c + \frac{1}{1+\psi} s^f \bar{Y} \\ c_t^w &= -\frac{s^w}{1-s^c} \frac{\beta^{-1} - \kappa_1}{1+\psi} a_{t-1}^c + \frac{1}{1+\psi} s^w \bar{Y} \end{aligned}$$

D.2 Fraction of unconstrained workers and farmers

We first modify the aggregate deviations before turning to the cross section.

D.2.1 Aggregate economy We group all unconstrained consumers together. This implicitly assumes perfect risk sharing among the unconstrained, but the upshot is that we only have to change the income processes and not solve again for the policy functions,

$$\begin{aligned} y_t^{cf} &= \frac{\theta^{cf} \alpha}{1+\psi} p_{x,t} Y_t \equiv \theta^{cf} s_t^f Y_t \\ y_t^{cw} &= \theta^{cw} w \left[\frac{\psi + 1 - \alpha}{1+\psi}\right] Y_t \equiv \theta^{cw} s^w Y_t \\ y_t^u &= \left[1 - \frac{\alpha p_{x,t}(1-\theta^{cf}) + w(1-\theta^{cw})(\psi + 1 - \alpha)}{1+\psi}\right] Y_t \equiv s_t^u Y_t \end{aligned}$$

We now only need to substitute these new expressions into the aggregate income equation,

$$\begin{aligned} Y_t &= (1+\psi)(c_t^{cf} + c_t^{cw} + c_t^u) \\ &= (1-s_t^u)Y_t + mpc^u s_t^u Y_t - (1-s^u)\bar{a} + \beta^{-1}(1-mpc^u)s^u\bar{Y} \end{aligned}$$

which implies aggregate output is equal to

$$Y_t = \frac{1}{s_t^u(1-mpc^u)}\left[-(1-s^u)\bar{a} + \beta^{-1}(1-mpc^u)s^u\bar{Y}\right]$$

This is the same equation as before, but with a different group of unconstrained consumers. The aggregate effect of raising p_x is then,

$$\frac{dY_t/Y_t}{dp_{x,t}/p_{x,t}} = \frac{\theta^{cf}s_t^f}{s_t^u}$$

D.2.2 Cross-section As in our baseline model, farm products (X) and cars (D) are fully traded, but bread (C) is nontraded. As in extension I, we denote by θ^x the fraction of constrained farmers cf, bakers cb, and laborers cl. We assume that these fractions are identical in both location a and m. We denote by ν the fraction of capitalists living in area a.

Then the incomes of each type of consumer are,

$$\begin{aligned} y_{a,t}^{cf} &= \theta^{cf}\frac{\alpha}{1+\psi}p_{x,t}Y_t \equiv \theta^{cf}s_t^f Y_t \\ y_{a,t}^{cb} &= \theta^{cb}\left(\frac{1-\alpha}{1+\psi}\right)wY_{a,t} \equiv \theta^{cb}s^b s_{a,t}Y_t \\ y_{m,t}^{cb} &= \theta^{cb}\left(\frac{1-\alpha}{1+\psi}\right)wY_{m,t} \equiv \theta^{cb}s^b s_{m,t}Y_t \\ y_{m,t}^{cl} &= \theta^{cl}\left(\frac{\psi}{1+\psi}\right)wY_t \equiv \theta^{cl}s^l Y_t \\ y_t^u &= \left[1-\theta^{cf}s_t^f - \theta^{cb}s^b - \theta^{cl}s^l\right]Y_t \equiv s_t^u Y_t. \end{aligned}$$

The total share of unconstrained income going to areas a and m is,

$$\begin{aligned} \frac{s_a^u}{s^u} &= \frac{\nu(1-s^l) + (1-\nu-\theta^{cf})s^f + (1-\nu-\theta^{cb})s^b}{1-\theta^{cf}s^f - \theta^{cb}s^b - \theta^{cl}s^l} \\ \frac{s_m^u}{s^u} &= 1 - \frac{s_a^u}{s^u}. \end{aligned}$$

We set ν such that the share of unconstrained income in each area is commensurate to the steady-state area income share, $\frac{s_a^u}{s_u} = s_a$ as in our baseline model.

The corresponding solutions for area income shares are,

$$s_{a,t} = \frac{1}{1-\theta^{cb}s^b}\left\{\theta^{cf}\left(1-s_a\right)s_t^f + s_a[1-\theta^{cb}s^b-\theta^{cl}s^l]\right\}$$
$$s_{m,t} = \frac{1}{1-\theta^{cb}s^b}\left\{\theta^{cl}s_a s^l + (1-s_a)[1-\theta^{cf}s_t^f-\theta^{cb}s^b]\right\}$$

where $s_{a,t}+s_{m,t}=1$. Higher farm prices again redistribute towards the agricultural area as in our baseline model.

The car expenditure functions for each type of worker are now,

$$d_{a,t}^{cf} = \frac{\psi}{1+\psi}(y_{a,t}^{cf}-\theta^{cf}s^f\bar{a})$$
$$d_{a,t}^{cb} = \frac{\psi}{1+\psi}(y_{a,t}^{cb}-\theta^{cb}s^b s_a\bar{a})$$
$$d_{m,t}^{cb} = \frac{\psi}{1+\psi}(y_{m,t}^{cb}-\theta^{cb}s^b s_m\bar{a})$$
$$d_{m,t}^{cl} = \frac{\psi}{1+\psi}(y_{m,t}^{cl}-\theta^{cl}s^l\bar{a})$$
$$d_{a,t}^{u} = \frac{s_a^u}{s^u}\frac{\psi}{1+\psi}\left[mpc^u y_t^u+\beta^{-1}(1-mpc^u)s^u\bar{Y}\right]$$
$$d_{m,t}^{u} = \frac{s_m^u}{s_a^u}d_{a,t}^u$$

Combining all expenditure and income expressions, we can again write local durable car expenditure as

$$D_{a,t} = \frac{\psi}{1+\psi}s_{a,t}Y_t$$
$$D_{m,t} = \frac{\psi}{1+\psi}s_{m,t}Y_t$$

The growth in durables in the agricultural area is

$$\frac{\frac{dD_{a,t}}{D_{a,t}}}{\frac{dp_{x,t}}{p_{x,t}}} = \frac{\theta^{cf}}{1-\theta^{cb}s^b}\left(1-s_a\right)\frac{s_t^f}{s_{a,t}} + \frac{\frac{dY_t}{Y_t}}{\frac{dp_{x,t}}{p_{x,t}}}$$
$$\frac{\frac{dD_{m,t}}{D_{m,t}}}{\frac{dp_{x,t}}{p_{x,t}}} = \frac{\frac{dY_{m,t}}{Y_{m,t}}}{\frac{dp_{x,t}}{p_{x,t}}} = -\frac{\theta^{cf}}{1-\theta^{cb}s^b}(1-s_a)\frac{s_t^f}{s_{m,t}} + \frac{\frac{dY_t}{Y_t}}{\frac{dp_{x,t}}{p_{x,t}}}$$

Relative to the baseline model, the main difference is that the local income multiplier effect is now $\frac{\theta^{cf}}{1-\theta^{cb}s^b}$ as opposed to $\frac{1}{1-s^b}$.

Now following exactly the same steps as in our baseline model, we can bound our cross-sectional estimate of the farm channel by,

$$\beta \leq \frac{\Delta p_{x,t}}{p_{x,t-1}} \frac{\theta^{cf}}{1-\theta^{cb}s^{b}} \frac{\frac{s_t^f}{s_{a,t}}}{\frac{\phi^f}{\phi_a}}$$

which in turn implies that the aggregate effect is bounded below by,

$$\frac{dY_t}{Y_t} \geq \beta \times \phi^f \times \frac{s_{a,t}}{\phi_a}$$

This is the same formula as in our baseline model.

D.3 No risk sharing across regions

A possible concern in our baseline set-up is that the unconstrained agents share the income changes across areas. Since they are proportionally represented, this decline in income gets differenced out. To show that this is not what is driving our results, we solve the model when there are no capitalists in the agricultural area, $s_a^u = 0$. In this case, we set the borrowing limit to $\bar{a} = 0$, so there is no borrowing across areas. A simple interpretation is that consumers cannot borrow now since lending markets are local and there are no unconstrained agents to borrow from.

The new area income shares are now,

$$s_{a,t} = \frac{s_t^f}{1-s^b}$$
$$s_{m,t} = \frac{1-s_t^f-s^b}{1-s^b}$$

Further, given $\bar{a} = 0$, we can again write car expenditure as a function of local income only,

$$D_{a,t} = \frac{\psi}{1+\psi} s_{a,t} Y_{a,t}$$
$$D_{m,t} = \frac{\psi}{1+\psi} s_{m,t} Y_{a,t}$$

Thus, relative to our baseline set-up, we now push all losses on the manufacturing area, but do not otherwise change the marginal propensity to consume out of local income.

The implied coefficient in our regressions is

$$\begin{aligned}
\beta &= \frac{\frac{\frac{dD_{a,t}}{D_{a,t}}}{\frac{dp_{x,t}}{p_{x,t}}} - \frac{\frac{dD_{m,t}}{D_{m,t}}}{\frac{dp_{x,t}}{p_{x,t}}}}{\frac{1}{\frac{\Delta p_{x,t}}{p_{x,t-1}}}\frac{\phi_a^f}{\phi_a} - \frac{1}{\frac{\Delta p_{x,t}}{p_{x,t-1}}}\frac{\phi_m^f}{\phi_m}} \\
&= \frac{\Delta p_{x,t}}{p_{x,t-1}} \frac{s_t^f}{1-s^b} \frac{\left[\frac{1}{s_{a,t}} + \frac{1}{s_{m,t}}\right]}{\frac{\phi^f}{\phi_a} - 0} \\
&= \frac{\Delta p_{x,t}}{p_{x,t-1}} \frac{\frac{s_t^f}{s_{a,t}}}{\frac{\phi^f}{\phi_a}} \frac{1}{1-s^b} \frac{1}{1-s_{a,t}} \\
&= \frac{\Delta p_{x,t}}{p_{x,t-1}} \frac{\frac{s_t^f}{s_{a,t}}}{\frac{\phi^f}{\phi_a}} \frac{1}{1-s^b} \frac{1}{1-\frac{1}{1-s^b}s_t^f} \\
&= \frac{\Delta p_{x,t}}{p_{x,t-1}} \frac{1}{1-s^b-s_t^f} \frac{\frac{s_t^f}{s_{a,t}}}{\frac{\phi^f}{\phi_a}}
\end{aligned}$$

The local multiplier $\frac{1}{1-s^b-s_t^f}$ is again a lower bound on the aggregate multiplier. So we can use the same bounds as before,

$$\frac{dY_t}{Y_t} \geq \beta \times \phi^f \times \frac{s_{a,t}}{\phi_a}$$

D.4 D as durable good

We now modify the baseline model such that cars D are durable. We assume they depreciate at a rate δ. The optimization problem for each consumer then becomes,

$$\max_{c_t,d_t,z_t,a_t} \sum_{s=0}^{\infty} \beta^s \left[\ln c_t + \psi \ln d_t\right]$$

$$\begin{aligned}
\text{s.t. } \lambda: &\quad a_t = (1+r_{t-1})a_{t-1} + y_t - c_t - z_t - \frac{\zeta}{2}a_t^2 \mathbb{1}_{\text{capitalist}} \\
\xi: &\quad d_t = z_t + d_{t-1}(1-\delta) \\
\mu: &\quad a_t \geq s\bar{a}
\end{aligned}$$

where z_t are now car expenditures and d_t is the effective value of the car.

The new first order conditions are

$$\begin{aligned}
\zeta\lambda_t &= \frac{1}{c_t} \\
\lambda_t &= \xi_t \\
\xi_t &= \psi\frac{1}{d_t} + \beta(1-\delta)\xi_{t+1} \\
\lambda_t &= \beta(1+r_t)\lambda_{t+1} + \mu_t - \zeta a_t \mathbb{1}_{\text{capitalist}}
\end{aligned}$$

The new steady-state durable and non-durable consumption choices are now,

$$\begin{aligned}
d^x &= \frac{\psi}{1-\beta(1-\delta)}c^x \\
z^x &= \frac{\psi\delta}{1-\beta(1-\delta)}c^x \\
c^x &= \left[1 + \frac{\psi\delta}{1-\beta(1-\delta)}\right]^{-1} s^x\bar{Y}
\end{aligned}$$

where s^x is again the steady-state income share.

Following the same steps as in appendix D.1 we arrive at the linear difference equations for capitalists,

$$\begin{aligned}
a_t &= \beta^{-1}a_{t-1} - \left[1 + \frac{\psi\delta}{1-\beta(1-\delta)}\right] c_t^c + s^c\bar{Y} \\
c_{t+1}^c &= -c^c(1-s_c)\zeta a_t^c + c_t^c
\end{aligned}$$

This system is very similar to our baseline set-up, but with $\delta < 1$.

The Lagrange multipliers are:

$$\kappa_{1,2} = \frac{1+\beta^{-1}}{2} \pm \sqrt{\left(\frac{1+\beta^{-1}}{2}\right)^2 - \beta^{-1} + \left[1 + \frac{\psi\delta}{1-\beta(1-\delta)}\right] c^c(1-s_c)\zeta}$$

For small but positive $\zeta > 0$, $0 < \kappa_1 < 1$ and $\kappa_2 > 1$. The transversality condition then selects the initial condition to eliminate the explosive root κ_2. Thus, the solution to the system of equations is,

$$\begin{aligned}
a_t^c &= \kappa_1 a_{t-1}^c \\
c_t^c + z_t^c &= (\beta^{-1} - \kappa_1)a_{t-1}^c + s^c\bar{Y} \\
c_t^f + z_t^f &= -\frac{s^f}{1-s^c}(\beta^{-1} - \kappa_1)a_{t-1}^c + s^f\bar{Y} \\
c_t^w + z_t^w &= -\frac{s^w}{1-s^c}(\beta^{-1} - \kappa_1)a_{t-1}^c + s^w\bar{Y}
\end{aligned}$$

Relative to the baseline model, the introduction of $\delta < 1$ only affects the fraction of income going to car expenditures $\frac{\psi\delta}{1-\beta(1-\delta)}$ and the change in the convergence rate κ_1.

Following the steps in the baseline model, we can now calculate total spending by capitalists at $t = 1$,

$$c_t^c + z_t^c = mpc^c y_t^c + \beta^{-1}(1 - mpc^c)s^c\bar{Y}$$

where $mpc^c = \frac{\beta^{-1}(\beta^{-1}-\kappa_1+\zeta)}{1+\beta^{-1}(\beta^{-1}-\kappa_1+\zeta)} < 1$.

For farmers and workers $x \in \{f, w\}$, the consumption choices are

$$\begin{aligned} z_t^x &= \frac{\psi\delta}{1-\beta(1-\delta)}c_t^x \\ c_t^x &= \left[1 + \frac{\psi\delta}{1-\beta(1-\delta)}\right]^{-1}(y_t^x - s^x\bar{a}) \end{aligned}$$

Combining these choices for all consumers yields an expression analogous to equation (7),

$$Y_t = \frac{1}{s_t^c(1 - mpc^c)}\left[-(s^f + s^w)\bar{a} + \beta^{-1}(1 - mpc^c)s^c\bar{Y}\right]$$

So durability in itself does not add to the propagation or amplification.

E Appendix Tables

Table 6 – New auto sales growth in spring 1933 (%, SA), population weighted

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Right hand side variables:								
% pop. on farms	1.49***	1.48**						
	(0.36)	(0.55)						
Crops sold p.c. 1929 ($)			0.75***	0.67***				
			(0.21)	(0.23)				
Change farm value p.c. ($)					0.73***	0.50*	1.01	1.68**
					(0.23)	(0.29)	(0.67)	(0.73)
Farm product value p.c. ($)							−0.17	−0.79
							(0.45)	(0.53)
Population (millions)		−0.11		−1.08		−0.82		−1.03
		(1.43)		(1.53)		(1.55)		(1.59)
Car registrations p.c. 1928 (1000s)		0.16		−0.054		0.067		0.16
		(0.18)		(0.22)		(0.23)		(0.23)
% pop. black		1.16		1.04		1.84**		1.86**
		(0.80)		(0.85)		(0.77)		(0.75)
1932 & 1933 drought interaction	No	No	No	No	No	No	No	No
Region Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
R^2	0.32	0.47	0.25	0.48	0.19	0.44	0.19	0.47
Observations	49	49	49	49	48	48	48	48

Notes: The dependent variable is the percent change in seasonally adjusted auto sales from the October 1932-March 1933 average to the July-September 1933 average. "p.c." means per capita. Robust standard errors in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Sources: see text.

Table 7 – New auto sales growth Q4 1932 to Q4 1933 (%, NSA)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Right hand side variables:								
% pop. on farms	1.71***	1.84***						
	(0.38)	(0.61)						
Crops sold p.c. 1929 ($)			0.91***	0.92***				
			(0.16)	(0.22)				
Change farm value p.c. ($)					0.95***	1.35***	2.69***	3.06***
					(0.30)	(0.43)	(0.63)	(0.72)
Farm product value p.c. ($)							−0.90***	−0.98***
							(0.32)	(0.35)
Population (millions)		1.38		0.83		1.90		0.77
		(2.03)		(1.81)		(2.16)		(1.90)
Car registrations p.c. 1928 (1000s)		−0.057		−0.34*		−0.30		−0.12
		(0.23)		(0.19)		(0.20)		(0.22)
% pop. black		0.70		0.55		1.66**		1.72**
		(0.83)		(0.84)		(0.82)		(0.77)
1932 & 1933 drought interaction	No	No	No	No	No	No	No	No
Region Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
R^2	0.29	0.38	0.44	0.53	0.25	0.45	0.31	0.49
Observations	49	49	49	49	48	48	48	48

Notes: The dependent variable is the percent change in non-seasonally adjusted auto sales from the the fourth quarter of 1932 to the fourth quarter of 1933. "p.c." means per capita. Robust standard errors in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Sources: see text.