"Innovation" in U.S. Agriculture: a Role for New Deal Regulation

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Since the 1930s new sources of scientific and mechanical technology have touched off a so-called "revolution" in U.S. farm productivity. While farmers recorded few gains in productivity in the three decades prior to 1930, from 1935 through the 1970s total factor productivity increased at a 3 percent annual rate, and labor productivity increased at a 4.6 percent rate [11, p. 161; 12, p. 366].

The dynamics of this revolution in productivity dictated, however, that not all farmers would survive. Instead, they typically charted two different strategies. Some sought to expand rapidly -- they acquired new fertilizers and pesticides; they bought efficient machinery; and they reduced labor and machinery costs by "spreading" the equipment's fixed charges over more and more acres. But as they increased the size of their farms, thousands of other farmers gave up their livelihood. Between 1950 and 1960 one-quarter of all farms in the United States disappeared; in the next decade, another quarter disappeared. Even for those who still farmed, most did not depend on agriculture for their main source of income. By 1975, of all individuals who called themselves farmers 82 percent earned more than half their total income by commuting to work [19, pp. 21-23; 27, pp. 40, 43].

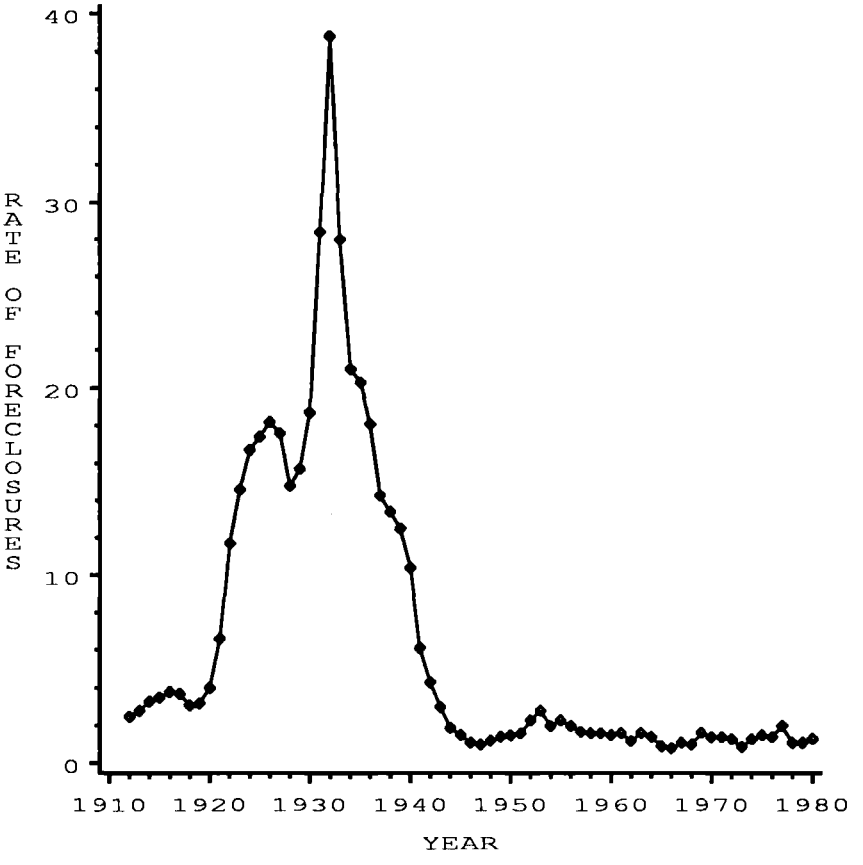
What is striking about this disappearance of farmers is not only that it proceeded so quickly but that it also took place so quietly. As some three million families quit farming, one might have anticipated a surge in foreclosures. But this did not happen. From 1946 through the 1970s farm foreclosures averaged roughly two farms in a thousand per year (Figure 1). One might attribute this low failure rate to a low rate of debt financing. But in fact farmers developed an enormous appetite for credit: from 1940 to 1970 total farm debt (in deflated dollars) tripled to $116 billion in 1970 (Table 1). What needs to be explained, then, is why this sorting out process -- with some farmers leveraging their enterprises but most giving up their livelihood -- proceeded so quickly and with such little financial stress.

My account is found in the nature of regulation. This regulation dated from the 1930s when Franklin D. Roosevelt's administration created three programs. The first two sought to raise farmers' income. The Agricultural

BUSINESS AND ECONOMIC HISTORY, Second Series, Volume Twenty-one, 1992.
 ISSN 0849-6825.

FIGURE 1

THE RATE OF FARM FORECLOSURES IN THE UNITED STATES, 1912-1980



NOTES: The rate of foreclosures is measured as the number of foreclosures per 1,000 farms. The U.S. Department of Agriculture stopped collecting data after 1980.
SOURCES: From 1912 to 1954, [31, p. 11]; for 1955 to 1966, [23, p. 517]; and for 1967 to 1980, [25, p. 421].

TABLE 1
MEASURES OF FINANCIAL LEVERAGE FOR U.S. AGRICULTURE, 1946-1987

Date	Total Farm Debts (Deflated $billions)	Percent Change in Debt	Ratio of Interest to Gross Cash Income	Ratio of Total Debts to total Assets	Ratio of Cash Expenses to Gross Cash Income
1946	$38.1	–	1.4	8.0%	48.9%
1950	45.6	19.7%	1.9	9.0	55.8
1955	55.5	21.7	2.7	11.1	59.2
1960	72.8	31.2	3.6	12.9	63.4
1965	105.9	45.5	4.7	16.2	65.2
1970	116.2	9.7	5.9	17.5	66.5

NOTES: Farm debts are deflated using the GNP implicit price deflator. Figures are reported in 1982 dollars. Interest expense includes payments for real estate and non-real estate debt. Farm income is cash receipts plus government payments plus other farm-related cash receipts. Figures are calculated excluding operators' households.
SOURCE: [28, pp. 12, 14, 16, 19, 58].

Adjustment Administration (AAA) paid farmers to restrict the output of cash crops in the hopes of boosting prices. By the end of its first year, 1933, the AAA was reinforced by a second program: the Commodity Credit Corporation (CCC) established a system of short-term loans in which the loan rate acted as a minimum price for cash crops. Finally, in the same year, the Farm Credit Administration (FCA) consolidated existing federal loan programs which offered new loans with low rates of interest and long terms for repayment.

Insofar as these regulatory programs persisted long after the Depression had ended, I argue that their consequences were tied to a pattern of market prices: that is, as long as prices tended to fall -- which they did from 1946 through the 1960s -- price and credit regulation helped sustain a financial climate suited to long-term investment in land and technology. This did not mean that regulation provided stability at the expense of competition. From farmers' individual perspective, their markets had always been highly competitive and remained so after the coming of the New Deal. But regulation shifted the terms under which this competition played itself out. That is, regulation revised markets such that farmers who undertook financial

risks associated with investment in land and technology were more likely to survive and more likely to account for gains in productivity.

Credit Markets and the FCA

Farmers who wanted to borrow money found better terms for loans in the years after World War II thanks to a prolonged rivalry that developed between public and private creditors. Among public lenders, the FCA sponsored a national system of long-term lenders, known as Federal Land Banks, as well as a nation-wide system of short-term lenders, called Production Credit Associations (PCAs). Although created in 1916, Federal Land Banks gained importance in the 1930s when they refinanced thousands of farmers and acquired nearly 40 percent of outstanding farm mortgage debt [22, p. 721]. In doing so, these public lenders offered farmers loans at better terms -- that is, loans with interest rates of 3.5 to 4 percent and maturities that ran for 30 to 40 years. Aside from these long-term loans, PCAs played a similar role in offering farmers short-term credit at lower rates and with longer terms than loans offered by most banks or other short-term lenders [9, 15].

By the end of the Depression, PCAs and Land Banks constituted a major source of competition for private lenders, notably banks and life insurance companies. Private creditors objected to this competition by pointing to special subsidies that reduced interest rates on Federal Land Bank loans. Because Land Banks' subsidies lasted into the 1940s, one might have anticipated that private lenders responded simply by leaving the farm loan market. A few did so, but the majority retaliated. They first adjusted their lending policies in line with public lenders: they reduced interest rates and lengthened the terms of their loans [4, p. 173]. They also developed what might be called "organizational tactics." Equitable Life Assurance Society of New York, for instance, took advantage of the division between banks and insurance firms within the farm loan market. Insurance firms concentrated on long-term mortgages, while banks focused on short-term loans. Equitable developed a formal plan by which a bank could work with the insurance firm to provide farmers both short- and long-term credit. In this fashion, farmers would not need to visit different creditors; rather, they would only need to work with their local banker [17, pp. 40-43; 18].

Private lenders' tactics worked: they recaptured market share from federal creditors as well as from private individuals [22, 26]. But from the farmers' perspective, lenders' rivalry meant that borrowers could obtain better loans from either public or private lenders. Consider the change in credit markets during the years before and after the Great Depression. In the 1920s, except for Federal Land Banks, lenders rarely wrote loans with terms of ten or more years. Furthermore, all farmers paid effective rates of interest of roughly 6 percent. After 1948, by contrast, both federal lenders and insurance firms offered loans that averaged 15 or more years, and nearly all loans carried interest rates that in nominal terms were a point less than those of the 1920s, and if adjusted for inflation, would be even lower. Finally, larger numbers of farmers tapped these types of credit: whereas in the 1920s only

one in 12 farm loans was written for more than ten years, after World War II one in two mortgages fit this category. Thus, farmers could welcome credit reductions, or they could use debt financing to invest in expensive resources -- land, machinery, and biochemical inputs [4, pp. 157-8].

Many operators exploited debt financing. Total farm debts, as recounted at the outset of this paper, tripled in real dollars between 1940 and 1970. Farmers also boosted their financial leverage in terms of the portion of earnings spent for cash outlays: whereas in 1946 farmers devoted half their income for cash outlays, by 1970 the figure was up to 67 percent (Table 1).

Because farmers never satiated their desire for debt, one might have anticipated that they paid a price in terms of high rates of failure. But, as Figure 1 indicates, failure rates remained very low. In practical terms, to escape foreclosure, farmers needed to balance the liability of their debt obligations with more valuable assets, and similarly, to cover annual interest payments with operating profits. This balance came as no accident. Rather, in the years after World War II, regulation helped offset these financial risks. The primary agent was the Commodity Credit Corporation.

A Margin of Safety in the CCC

The CCC's role in commodity markets took shape in World War II. While prices rose sharply during the war, farmers -- and their lobbyists in Washington -- worried about what would happen once the fighting ended. That is, they worried that, like after World War I, a collapse in prices would spark a new credit crisis. Farmers sought protection from Congress, which complied with legislation to secure price supports for two years after the war. This was only the start, however. For the next 25 years, from 1946 through the late 1960s, as long as supply exceeded demand and prices tended to fall, Congress continued to employ the CCC to insure that prices would not collapse. It also used the program of acreage controls to reduce output and raise prices [5, 8, 14, 30, 32]. The consequences of this policy were counter-intuitive. One does not normally think of an era of falling prices as a stable period. But as long as prices tended to *fall*, the CCC slowed and steadied their decline, and thereby offset part of the risk of financial obligations with safer markets.

Regulation's direct effect came in subsidizing farm income. It is not possible to determine precisely the extent of the market subsidy. For the 1950s, depending on one's assumption of price-elasticity, the CCC is attributed with raising prices at least 15 percent and perhaps as much as 50 percent above market levels that would have prevailed without government interference [16]. In the 1960s, as the CCC lowered its loan rates, the USDA subsidized farm income directly. That is, the USDA paid farmers to divert land from cash crops to soil-conserving crops. These diversion payments offered handsome increases to the actual price of a crop. From 1963 to 1972 diversion payments boosted corn prices 14 to 42 percent, wheat prices 33 to 60 percent, and cotton prices 45 to 75 percent [23, pp. 17, 42, 76; 24, pp. 7, 37, 63].

As such subsidies boosted farmers' income, they mitigated the relative financial risks farmers undertook. In one obvious sense, they helped farmers pay interest fees. Direct government payments accounted for roughly 5.4 percent of farmers' gross cash income in the 1960s, and indirect subsidies no doubt raised farmers' profits by a larger amount. Or put another way, during the 1960s, direct payments alone amounted to the same percent of income that farmers devoted to annual interest payments [7, p. 59; 28, p. 14]. Subsidies also worked to reduce the burden of debts relative to farmers' assets. The largest component of assets was land, whose value was defined as a farmer's expected earnings discounted to the present. As regulation along with increases in productivity raised farmers' earnings, these gains were capitalized into the value of farm land. Higher land values meant higher assets. Put another way, higher assets balanced part of the increase in debts: while total farm debts tripled (in real dollars), farmers' leverage -- as measured by the debt-asset ratio -- doubled (Table 1).

Aside from the question of subsidies, price regulation reduced the consequences of financial leverage through the CCC's stabilization efforts. Technically, as farmers devoted a larger portion of their earnings to cash outlays, they increased their vulnerability to the ups and downs of market prices. Should prices drop sharply farmers would lack the cash to cover expenses. The smaller their margin of cash, the easier it was to suffer losses (or possibly failure). But farmers avoided this outcome insofar as the CCC prevented any severe drop in crop prices. Crop prices of course fell; indeed corn, cotton, and wheat prices (adjusted for inflation) fell more than 40 percent in the 25 years after World War II [7, pp. 50-55]. But the CCC insured that there was no abrupt or severe decline. Thus, while farmers reduced their safety in terms of the balance between earnings and cash outlays, the CCC helped ensure that there would be no abrupt drop in their cash earnings.

Together, then, the FCA and the CCC increased the capacity of individual farmers to leverage their operations in order to invest in land and technology. This question of financial leverage, in turn, increasingly distinguished what the USDA called "commercial" farmers from their "non-commercial" counterparts. By the 1970s, commercial farmers (those who earned more than $40,000 in sales each year) carried debt-asset ratios that were twice that of non-commercial operators. Similarly, they assumed greater risk in terms of the proportion of earnings devoted to cash expenses: while on average farmers spent 67 percent of their cash receipts on cash production expenses from 1960 through the 1970s, among farmers with sales of $100,000 or more, cash expenses ranged from 81 to 86 percent of cash receipts [19, p. 34].

This financial leverage played an important role in the farm productivity revolution. To achieve gains in productivity, farmers invested in expensive resources -- land, machinery, and biochemical inputs -- at rapid rates. For example, between 1940 and 1970, farmers tripled their consumption of fertilizers and pesticides. Capital expenditures for machinery and equipment rose at a 3.3 percent compound annual rate during the same period, reaching $11.7 billion in 1970 [2, pp. 11, 13]. Moreover, such gains

were concentrated among commercial farmers. While they represented fewer than a quarter of all farms by the 1970s, they produced three-quarters of all food. By accounting for such a large percentage of output, then, these farmers were responsible for most of the gains in farm productivity [27].

While farmers who assumed debt financing avoided failure and used their financing to achieve new gains in productivity, thousands of families nevertheless gave up during this time period. What happened in their cases? It is difficult to piece together the varied experiences. I cannot speculate on the welfare of tenants because in some regions, notably the South, they frequently were forced off the land. Whether they could locate better-paying occupations is difficult to say [6, 13, 33]. But for those who borrowed from bankers, the American Bankers Association (ABA) credit surveys give us a hint of what happened. In surveys conducted between 1962 and 1968, bankers expected that between 3 and 4 percent of farm borrowers would "discontinue business" in any given year because of "financial pressures." Over the course of a decade this amounted to a large number, perhaps 30 percent of farm borrowers. Why would farmers go out of business? Bankers cited different reasons, for which they included a "profit squeeze" or "price-cost squeeze." This analysis suggested that small farms were those particularly handicapped because their size prevented them from accumulating the capital needed for land or machinery. In its 1965 survey, the ABA followed this logic, finding that of those farms that would discontinue "74 per cent of them currently have gross incomes of under $10,000" [1, p. 10].

Still, to go out of business did not mean going bankrupt. A farmer could (as the USDA called it) "voluntarily" sell a farm. USDA figures indicate that many farmers took this route. While the rate of farm foreclosures dropped to 2 per 1,000 farms per year, voluntary sales averaged 30 per 1,000 farms each year throughout the postwar years, and 46 per 1,000 farms (or 4.6 percent of farms each year) in the 1940s [31, p. 11; 25, p. 421; 23, p. 517]. What was distinctive about the voluntary sales was that they occurred in an era of rising land prices. In previous eras, notably the 1920s and 1930s, large numbers of sales had been associated with financial crises. In such times, farmers sold or lost their land in periods of falling land values. But as we have seen, in the postwar years both gains in productivity and government subsidies were capitalized into the price of land. While a profit squeeze may have forced them to quit, these farmers could profit from the sale of their farms. This finding does not necessarily mean that farmers wanted to sell out. But it does help explain why the exodus attracted such little attention in the 1950s and 1960s -- in short, why it was so quiet.

Innovation in Agriculture

I want to use the experience of U.S. farmers to reflect on the notion of innovation. A glance at last year's proceedings offers a measure of the term's popularity: of 22 conference papers, 8 (or a third) used "innovation" in their titles. While topics varied, running through nearly every one was a focus on innovation *within* the firm. This, I suggest, represents a departure from the term's original intent, at least as presented by Joseph Schumpeter.

Schumpeter singled out two phases in the process of innovation. One concerned the creative energies of entrepreneurs who through their own resources introduced new products or processes. This phase was followed by a second, which Schumpeter called the "creative-destructive" cycle, and which he considered crucial to economic growth. It represented the process by which technology spread through the economy, and relatively efficient producers drove out their inefficient competitors [21, 10].

My sense is that business historians have preoccupied themselves with one of these two phases -- the first one. That is, they have been concerned with creative energies within large-scale corporations. To this end, scholars have revised the notion of the entrepreneur. They have examined how the development of institutions or the actions of management within corporations have sustained a firm's long-term growth, as well as that of the economy. One obvious example is the emergence of industrial research laboratories. But the idea follows different routes including how technology in general emerged within a firm, or how a firm altered its internal organization, or how a firm marketed products to consumers [3]. Symptomatic of this focus are phrases such as "technological innovation" or "organizational innovation."

My problem with this approach is not that the research is in any way flawed, but that it is incomplete. That is, it dwells on the creation of new products or processes, not the context of their diffusion beyond the firm. But in the case of agriculture it is precisely this context that mattered. "Innovation" in agriculture did not entail simply the development of a unique process or product, nor did it refer to a specific set of entrepreneurs. There existed a wide variety of technology that had emerged from land grant universities as well as from private manufacturers. The question of innovation in agriculture centered on the kind of markets and institutions that permitted the rapid diffusion of new products, and in turn, rapid gains in productivity.

This finding has prompted me to return to Schumpeter's notion of a creative-destructive cycle. While Schumpeter dwelled on the role of entrepreneurs in promoting this creative-destructive process, I assess how markets and institutions interacted so as to create (or fail to create) an environment suited to farmers' long-term investment patterns. Implicit in my analysis is the premise that while institutions are inherent in any process of technological change, not all institutions (or markets) are equally adept at promoting change. I therefore investigate the role of different historical actors that shaped the financial climate in which farmers made investments. They included not only farmers, but also their creditors, manufacturers, and regulators. Finally, I define a so-called "innovative" climate as one that aligned farmers' own investment calculus with the incentives to cut costs inherent in competitive markets.

Within this context, New Deal regulation revised farmers' investment climate during and after the Great Depression. Because private lenders retaliated against public lenders, the two enabled farmers to obtain new opportunities to use debt financing to invest in land and technology. The CCC reduced the volatility of markets, and hence, reduced the risk of losses associated with a farmers' financial leverage. Thus, while agriculture remained a highly competitive industry from the perspective of individual

farmers, regulation influenced markets such that farmers more readily responded to this competition by investing in technology.

This framework can account for the sorting out process among U.S. farmers in terms analogous to Schumpeter's "creative-destructive" cycle. Farmers who attained large gains in productivity initiated what Schumpeter would call the "creative" cycle for innovation. They did so through their capacity to leverage their farms -- both in terms of their debt holdings and the proportion of cash devoted to annual inputs. The "destructive" phase represented the thousands of farmers who exited the industry. Still, this process did not entail the kind of disruption Schumpeter anticipated. Farmers who increased their leverage avoided failure because they balanced larger debts with more valuable assets; they also were less at risk that prices would abruptly drop below their cost of production. For operators who charted a different course with their farms, they too avoided bankruptcy. Many funded smaller operations with the help of non-farm jobs, or switched to new occupations. Again, regulation appears to have played a role. While these small farmers in all likelihood found it more difficult to earn a profit, those who owned land "voluntarily" sold it. Moreover, unlike previous eras when farmers were forced to sell in a crisis characterized by falling land values, in the postwar years farmers sold out in years of rising land values. This sorting out process, then, had not been motivated by a unique entrepreneur (as Schumpeter defined it). Nor had it resulted simply from the introduction of technology. Rather, regulation had shaped a dynamic set of market conditions in which it spurred both the investment in technology and the exit of smaller farmers.

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