Regulation and the revolution in United States farm productivity

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1. Introduction

In the wake of the Great Depression, Franklin D. Roosevelt's administration launched several new regulatory programs as experiments intended to mitigate if not resolve the economic crisis. Although the New Deal failed to pull the economy out of the Depression, many of its programs became seemingly permanent elements in the nation's modern administrative state. Farm regulation fit this pattern. Three agricultural programs of the 1930s outlived the crisis and have persisted to the present: a voluntary system of acreage controls designed to cut production; a price-support loan system intended to raise prices; and a revised system of public lenders designed to provide special sources of long- and short-term credit.[1]

Viewed some sixty years later, farm regulation typically calls to mind its costs. Certainly, farm programs resulted in artificially high prices, sustained excess stocks of commodities, and saddled taxpayers with a large bill for annual subsidies and storage. If these problems were not enough, there was also the personal trauma and the special costs stemming from the farm crisis of the 1980s.

Yet, from a historical perspective, what is striking about the inherited system of regulation is its long-term relationship with farm productivity. Americans typically do not equate regulation with efficiency, but in the case of agriculture, the introduction of these farm policies coincided with the start of a "revolution" in U.S. farm productivity.[2] To be sure, the extraordinary gains in productivity would not have been possible without the availability of new sources of technology. Tractors, trucks, combines, mechanical corn and cotton

[1] The federal government first offered price supports for corn and cotton in 1933. In 1938 wheat and tobacco were added to the program, and in World War II a large number of commodities were put under the system of price supports.

[2] Wayne D. Rasmussen, "The Impact of Technological Change on American Agriculture, 1862–1962," *Journal of Economic History,* 22 (December 1962), pp. 578–91. Also see William N. Parker, "Agriculture," in Lance E. Davis, Richard Easterlin, William N. Parker, Dorothy S. Brady, Albert

pickers, and a series of larger and more complex implements gradually displaced farmers' older source of power, horses and the equipment used with them. So too, hybrid seeds, insecticides, herbicides, and chemical fertilizers downgraded, and then eliminated farmers' "rule of thumb" choices for seeds, fertilizers, and pest controls.

But technology alone provides an inadequate explanation of the revolution in productivity. For one thing, many of the technical innovations predate the 1930s, and yet the 1930s marked a long-term break in the pattern of productivity gains. In the three decades prior to 1930, labor productivity and total factor productivity in the farm sector increased at a rate of less than 0.5 percent per year. For the first two decades of the century these measures showed no gains. In the 1920s changes began to be felt as both indexes rose at a 1.2 percent annual rate. But after 1935, gains were striking. Total factor productivity increased at a 3 percent annual rate, or at twice the pace set in the 1920s, and at six times the rate recorded over the years from 1900 to 1930. Labor productivity showed similar results: from the middle of the 1930s through the 1970s, it rose at roughly a 4.5 percent annual rate, or almost four times the pace of the 1920s.[3]

These gains in productivity brought dramatic changes to the farm sector. From 1930 to 1965, as the number of labor hours needed to raise and harvest a field of corn or wheat (or many other crops) declined, more than thirty million individuals had no choice but to seek industrial or service sector jobs. In these thirty-five years, more

Fishlow, Robert E. Gallman, Stanley Lebergott, Robert E. Lipsey, Douglass C. North, Nathan Rosenberg, Eugene Smolensky, and Peter Temin, *American Economic Growth: An Economist's History of the United States* (New York: Harper and Row, 1972), pp. 369–417.

[3] Choosing the mid-1930s as a starting point, rather than 1940, does not significantly alter the growth rate because total factor productivity in the farm sector increased at a rate of 2.8 percent per year between 1933–5 and 1938–9. Labor productivity reflects increases in output per unit of labor. See John W. Kendrick, "Productivity," in Glenn L. Porter, ed., *Encyclopedia of American Economic History* (New York: Charles Scribner's Sons, 1980), vol. 1, p. 161; John W. Kendrick, *Productivity Trends in the United States,* National Bureau of Economic Research (Princeton: Princeton University Press, 1961), pp. 136, 152, 362–4; John W. Kendrick and Elliot S. Grossman, *Productivity in the United States: Trends and Cycles* (Baltimore: Johns Hopkins University Press, 1980), pp. 34–5; and John W. Kendrick, *Improving Company Productivity: Handbook with Case Studies* (Baltimore: Johns Hopkins University Press, 1984), pp. 87, 93.

Americans deserted the rural parts of the country than had come to this nation in the great immigration waves between 1820 and 1960.[4]

By the late 1980s only 2.7 percent of the civilian work force earned an income from raising livestock or growing crops. This did not mean that family farms vanished. As recently as 1990, the majority of farms were still operated by families. But by that date a "family farm" had become an extremely large, capital-intensive enterprise.[5] With highly mechanized operations and farms that were nearly three times larger than their counterparts of the 1930s, each farmer supplied food for ninety-seven individuals (farmers included) in 1989, up from eleven in 1940, and seven in 1900.[6]

This exceptional pace for gains in farm productivity remains striking when compared with other parts of the economy. The manufacturing sector recorded a 2.1 percent annual rate of increase in total factor productivity both from 1900 to 1930, and again from 1948 to 1976. Whereas in the first period, agriculture's rate of productivity growth was not even a third as fast as the manufacturing sector's, in the second period farmers achieved a rate nearly 50 percent higher. In the thirty years since World War II, out of twenty individual

[4] Rasmussen, "The Impact of Technological Change on American Agriculture, 1862–1962," pp. 578–91; for changes in farm population, see John L. Shover, *First Majority Last Minority: The Transforming of Rural Life in America* (DeKalb, Ill.: Northern Illinois University Press, 1976), p. 4.

[5] Based on the 1987 Census of Agriculture, families accounted for 86.7 percent of all farms and 65 percent of all farmland. Within the class of partnerships and corporations, "family-held corporations" accounted for 2.9 percent of farms and 11 percent of land in farms. This left 9.9 percent of farms as partnerships or nonfamily corporations; together they held 17.3 percent of all farmland. Put another way, as of 1978, 95 percent of all corporate farms were held by ten or fewer shareholders, indicating that they were most likely family-run operations. See U.S. Department of Agriculture, "Agricultural Outlook," AO-161 (March 1990), p. 28. Also see U.S. Department of Commerce, *Statistical Abstract of the United States: 1982–1983* (Washington, D.C.: U.S. Government Printing Office, 1983), p. 653.

[6] For the size of the agricultural labor force, see *The Economic Report of the President, 1988* (Washington, D.C.: U.S. Government Printing Office, 1988), p. 284; for the number of persons fed per farm worker, see U.S. Department of Agriculture, "Economic Indicators of the Farm Sector: Production and Efficiency Statistics, 1980," Statistical Bulletin No. 679 (January 1982), p. 63; and U.S. Department of Agriculture, "Economic Indicators of the Farm Sector: Production and Efficiency Statistics, 1990," ECIFS 10-3 (May 1992), p. 36.

manufacturing industries, only two (chemicals and electrical machinery) surpassed the farm sector.[7] For labor productivity, agriculture ranked first against mining, construction, durable and nondurable manufacturing, transportation, communications, electrical and gas utilities, trade and finance, and services – that is, all other major sectors.[8] Thus, by the standard of productivity growth, the farm sector represented one of the most dynamic parts of the U.S. economy in the years after it began to be actively regulated.

My purpose in this book is to assess the consequences of government regulation for the long-term changes in farm productivity, particularly in the years from World War I to the farm crisis of the 1980s. It is not intuitively evident how regulation affected farm productivity. It may have been that the productivity increases took place in spite of regulation. Alternatively, regulation may have been neutral, which is to say insignificant. But a third possibility is that the regulation was related positively to the productivity gains. This last choice, however, runs sharply counter to our prevailing concepts of government regulation. Indeed, in recent years, to pair "innovation" or "productivity" with regulation would seem paradoxical to the popular mind as well as to academic scholars.

This has not always been the case. It was not true more than a century ago, when Americans first began to advocate extensive government regulation of private markets. Fearing that large-scale corporations – because of their size and power – would undermine democratic principles of individualism and fair competition, many

[7] The communications sector also set a higher rate than the farm sector. See Kendrick, *Productivity Trends in the United States,* pp. 65–71, 136–7, 464. For the comparison of agriculture with the twenty individual manufacturing industries, see Kendrick, "Productivity," p. 162. Angus Maddison reports similar figures. In the years 1909 to 1948, agriculture and industry reported annual rates of labor productivity of 1.6 and 1.5 percent, respectively; by contrast, from 1950 to 1973 the rate of growth for agriculture was 5.4 percent as compared with 2.2 for industry. From 1973 to 1984, both sectors reported slower rates: 2.5 percent per year for agriculture and 0.8 percent for industry. See Angus Maddison, "Growth and Slowdown in Advanced Capitalist Economies: Techniques of Quantitative Assessment," *Journal of Economic Literature,* 25 (June 1987), p. 684; and Angus Maddison, *Dynamic Forces in Capitalist Development: A Long-run Comparative View* (Oxford: Oxford University Press, 1991).

[8] Edwin Mansfield, "Technology and Productivity in the United States," in Martin Feldstein, ed., *The American Economy in Transition* (Chicago: University of Chicago Press, 1980), p. 565.

Americans asked the government to control prices so as to curb monopoly power. Fear of monopoly figured in the regulation of railroads and, later, the regulation of various utilities, such as the electrical, gas, and telephone industries. A second, and different, wave of regulation occurred in the 1930s, this time in response to depressed markets. New Deal policies were introduced in an effort to shore up prices and restrict production not only for agriculture, but for other industries, including oil and gas, airlines, and trucking.[9] Policy makers hoped regulation would give a measure of stability to these troubled industries, and in turn help promote economic growth.

Many of these regulatory initiatives lasted long after the Great Depression ended. For nearly two decades after World War II, the economy performed quite well and calls for deregulation were rare. But beginning in the 1960s and gathering storm in the 1970s, elite and then public sentiment swung clearly against regulation. Markedly slow gains in productivity caused Americans to ask whether the policies they put into place to restore competition or to promote stability and economic growth were now to blame for the nation's economic malaise.[10] The historian Naomi R. Lamoreaux summarized Americans' skepticism by stating in 1984 that

[9] The literature on regulation is voluminous. For a sophisticated model relating changes in markets to the demand for and shape of regulation, see Richard H. K. Vietor, *Energy Policy in America since 1945* (Cambridge: Cambridge University Press, 1984); a model relating individual behavior to institutional change is developed in Peter Temin, *Taking Your Medicine* (Cambridge, Mass.: Harvard University Press, 1980); and a cultural analysis of regulation is found in Ellis Hawley, *The New Deal and the Problem of Monopoly* (Princeton: Princeton University Press, 1966), and Thomas K. McCraw, *Prophets of Regulation* (Cambridge, Mass.: Harvard University Press, 1984). Two overviews are Naomi R. Lamoreaux, "Regulatory Agencies," in Jack P. Greene, ed., *Encyclopedia of American Political History* (New York: Charles Scribner's Sons, 1984), pp. 1107–11; and Thomas K. McCraw, "Regulation in America: A Review Article," *Business History Review*, 49 (Summer 1975), pp. 159–83.

[10] Numerous scholars have studied the slowdown in productivity; an introduction to the varied perspectives is found in an issue of the *Journal of Economic Perspectives*. See, for instance, Zvi Griliches, "Productivity Puzzles and R&D: Another Nonexplanation," *Journal of Economic Perspectives*, 2 (Fall 1988), pp. 9–21; and Dale W. Jorgenson, "Productivity and Postwar U.S. Economic Growth," *Journal of Economic Perspectives*, 2 (Fall 1988), pp. 23–41. Also see Martin N. Baily, "What Has Happened to Productivity Growth?" *Science*, 234 (October 24, 1986), pp. 443–51. For a comparison of sources of productivity from 1913 to 1984 as well as a comparison of the performance of the U.S. economy with that of five

> mounting costs – both actual and threatened – caused by the late 1970's a tremendous backlash against regulation and the beginnings of what may prove to be the first great wave of deregulatory legislation. It became fashionable for both scholars and politicians to belabor the inefficiencies of regulation, to denigrate the abilities and ambitions of federal officials, and to denounce the menace posed by big government to the prosperity and growth of the economy.

Thomas K. McCraw delivered a similar message, saying that "the fact remains that in popular perceptions over the last three decades regulation has been regarded as a synonym for failure."[11]

This notion of failure is perhaps clearest in studies of the economic consequences of price regulation. Consider, for instance, the well-known experience of airlines.[12] In 1938 Congress created the Civil Aeronautics Authority, later renamed Civil Aeronautics Board (CAB), to protect firms in a new industry and a depressed market. In the years after World War II, regulators set airline fares, restricted competition between destinations, and predetermined the number of competitors. This caused airline companies to replace price competition with many unproductive strategies. They offered frills, like movies and fine meals, and added more flights between cities. As the number of flights increased, the load factor (passengers per flight) sank to just 56 percent by the 1970s. In an effort to prevent ruinous competition, regulators had created a cartel and reduced the efficiency of the entire industry.

In 1975 Congress began to respond. Senator Edward M. Kennedy directed hearings in which witnesses highlighted the ineffectiveness of airline regulation. Then in 1977 President Jimmy Carter appointed

other industrialized nations, see Maddison, "Growth and Slowdown in Advanced Capitalist Economies," pp. 649–98. Among business scholars the concern about recent economic growth finds a historical model in Paul Lawrence and Davis Dyer, *Renewing American Industry* (New York: Free Press, 1983).

[11] McCraw went on to note, "Even in some of the best scholarship on regulation, failure has often been applied not merely as a conclusion but also as a premise, a tacit assumption hidden behind apparently scholarly explanations presented in theoretical forms: the theories of capture, of public choice, of taxation by regulation, and several others." Lamoreaux, "Regulatory Agencies," p. 1108; and McCraw, *Prophets of Regulation*, p. 308.

[12] McCraw, *Prophets of Regulation*, pp. 261–2, and Richard H. K. Vietor, *Contrived Competition: Regulation and Deregulation In America* (Cambridge, Mass.: Harvard University Press, 1994), pp. 23–90.

the economist Alfred Kahn as chairman of the CAB. Kahn championed competition as a remedy for the airlines' problems, and in 1978, Congress took this advice when it passed the Airline Deregulation Act. The days of frills and price controls are gone, and many economists contend that the industry is more efficient as a result. Fares for most consumers are cheaper and flights are more diverse. If there are any less fortunate aspects of the competitive airline industry, they receive little emphasis from the supporters of deregulation.[13]

This economic critique of regulation is appealing, particularly in academic circles, because it fits closely with modern principles of competitive equilibrium. Economic theory teaches that in the short run, efficiency is achieved when market forces of supply and demand determine prices freely. Regulation of market prices, by its very nature, misallocates resources: any price fixed above the market equilibrium generates excess supply, and any price set below the equilibrium creates excess demand. In the long run such tampering with the market stymies economic growth because it distorts or eliminates entirely the price signals that tell producers when to increase or decrease output, and when to furnish new products or eliminate old ones. To sustain gains in productivity, economic theory suggests, one should increase competition.

Although this prescription is intuitively appealing, it long ago encountered a formidable challenge from the economist, Joseph Schumpeter. Writing in the interwar years, Schumpeter was among the first economists to theorize how entrepreneurs were vital to the dynamic growth of an economy. He began with the assumption that in the absence of entrepreneurial activity, the economy rested at a steady-state equilibrium in which there was neither productivity growth nor growth in producers' earnings. In order to achieve higher levels of productivity, entrepreneurs were needed. Although they typically did not invent new products or production processes, entrepreneurs had the ability to see beyond daily competitive routines, visualize how an

[13] Since the 1978 act, the airline industry has encountered various financial and operational problems that have caused different constituents – passengers, labor unions, and management – to rethink the consequences of a freely competitive market. My point here, however, is to recall that regulation of prices and entry contributed, as conventional economics would expect, to efficiency problems in the 1970s. For an analysis of both the regulated and deregulated eras, see for instance Vietor, *Contrived Competition, pp. 23–90.*

idea might change the economy, and fight entrenched interests to introduce a new product or process. When they succeeded, other competitors either had to copy the idea quickly or be forced out of business. Once the cycle of innovation and imitation played itself out, the economy would arrive at another stationary equilibrium, but this time at a higher level of productivity. Schumpeter called this process the "creative destructive" cycle. In the creative phase entrepreneurs introduced new ideas. In the destructive phase they cleared out unproductive firms, thus enabling the economy to attain a more efficient equilibrium.[14]

This dynamic view of the economy prompted Schumpeter to question the dominant concept of the relationship between market structure and economic growth – that is, he questioned the extent to which competition promotes growth. In the short run, Schumpeter acknowledged, perfect competition insures the most efficient allocation of resources. But, he argued, entrepreneurs need the promise of extraordinary profits to offset the risks they must assume. In a perfectly competitive market the entrepreneur's idea will be imitated as soon as it is introduced. All competitors will benefit from reduced costs of production, and as they pass on their benefits to consumers in the form of lower prices, the entrepreneur will go unrewarded. In a perfectly competitive economy, then, the entrepreneur has no incentive to introduce new productivity-enhancing ideas. By contrast, with monopoly power, an entrepreneur can limit imitation and reap large profits. In this way, the entrepreneur is rewarded for and willing to undertake the costs of developing and introducing a new product or process. Schumpeter concluded that monopoly power can benefit society in the long run through its stimulus to innovation and productivity growth.[15]

[14] Joseph Schumpeter, *Capitalism, Socialism and Democracy,* 3rd ed. (New York: Harper and Row, 1950; originally published, 1942), especially pp. 61–163.

[15] See Robert L. Allen, *Opening Doors: The Life and Work of Joseph Schumpeter* (New Brunswick, N.J.: Transaction, 1991); Morton Kamien and Nancy Schwartz, *Market Structure and Innovation* (Cambridge: Cambridge University Press, 1982), pp. 7–10; F. M. Scherer, "Schumpeter and Plausible Capitalism," *Journal of Economic Literature,* 30 (September 1992), pp. 1416–33; and F. M. Scherer and David Ross, *Industrial Market Structure and Economic Performance,* 3rd ed. (Boston: Houghton Mifflin, 1990), pp. 613–60. A recent revision of Schumpeterian competition is found in William Lazonick, *Business Organization and the Myth of the*

In the years since Schumpeter challenged existing theory, many economists have attempted to assess the ties among market structure, innovation, and economic growth. They sought to determine whether monopoly power stimulates innovation and productivity, as Schumpeter argued, or whether it restricts economic growth because, without competition, the monopolist feels no pressure to be creative. Results have been mixed. Some scholars have found market concentration to be closely tied to large research expenditures. Others have come to just the opposite conclusion. Still others have found that market concentration can stimulate innovation if some further condition is met. One scholar, for example, discovered that concentration could stimulate innovation if – despite the large size of firms – barriers to imitation were low (as was true in the consumer nondurable industries). Others have emphasized the importance of rivals, arguing that the threat of rivals can force dominant firms to pursue their own innovative efforts with greater vigor. Still, other scholars have tried to distinguish between different types of innovation, finding that large-scale enterprises may be better able to pursue certain projects that require process development. In combination, these economic studies suggest that some reduction in perfect competition may stimulate higher rates of innovation, but they warn that pure monopoly is not the optimal industrial structure.[16]

Other scholars have approached this problem from an institutional perspective. Business historians, in particular, have replaced Schumpeter's focus on the entrepreneur with studies of the structure of the firm and institutions inside the firm (such as research laboratories) or

Market Economy (Cambridge: Cambridge University Press, 1991), chap. 3.

[16] Wesley M. Cohen and Steven Klepper, "The Anatomy of Industry R&D Intensity Distributions," *American Economic Review,* 82 (September 1992), pp. 773–99; W. S. Comanor, "Market Structure, Product Differentiation, and Industrial Research," *Quarterly Journal of Economics,* 81 (1967), pp. 639–57; F. M. Scherer, "Market Structure and the Employment of Scientists and Engineers," *American Economic Review,* 57 (1967), pp. 524–31. Surveys of the field are found in William L. Baldwin and John T. Scott, *Market Structure and Technological Change* (Chur, Switzerland: Harwood Press, 1987); Kamien and Schwartz, *Market Structure and Innovation,* pp. 7–11, 22–33, 70–104; Jennifer F. Reinganum, "The Timing of Innovation: Research, Development, and Diffusion," in Richard Schumalensee and Robert Willig, eds., *Handbook of Industrial Organization* (Amsterdam: North-Holland Press, 1989), vol. 1, pp. 849–908; and Scherer, "Schumpeter and Plausible Capitalism."

outside the firm (such as regulatory agencies). How institutions operate, they argue, is an important element of our explanations of why some firms are more successful than others and, in turn, why some industries or economies are more dynamic than others.[17]

Consider, for example, the industrial research laboratory. David Mowery and Nathan Rosenberg contend that the standard neoclassical interpretation of research and development (R&D) "focuses largely on the incentives of firms to invest in R&D and views internal structure and process as unimportant."[18] By contrast, Mowery and Rosenberg reason that how research is organized may have very important consequences for innovation. They illustrate this point in their comparison of institutions for industrial research in U.S. and British firms. "The effectiveness of R&D within British firms was often limited by the incomplete rationalization of internal firm structure. In short, the structural development of American industrial enterprises allowed for a more effective exploitation of the complementarities between research activity and production activity."[19] In other words, British firms relied on independent subsidiaries and research organizations outside the firm. But because U.S. companies fully integrated research with other activities within the firm, they were better able to translate research into new products or pro-

[17] A large body of literature exists about the role of institutions inside the firm. An important study with theoretical insights about technological innovation is W. Bernard Carlson, *Innovation as a Social Process: Elihu Thomson and the Rise of General Electric, 1870–1900* (Cambridge: Cambridge University Press, 1991). An economist's revision of the role of the firm and the question of innovation is found in Lazonick, *Business Organization and the Myth of the Market Economy*. Other business historians have emphasized the importance of internal firm structure. See Alfred D. Chandler, Jr., *Scale and Scope* (Cambridge, Mass.: Harvard University Press, 1990); and Alfred D. Chandler, Jr., *The Visible Hand* (Cambridge, Mass.: Harvard University Press, 1977). Other important examples include Louis Galambos and Joseph Pratt, *The Rise of the Corporate Commonwealth* (New York: Basic Books, 1988); David Hounshell and John Kenly Smith, Jr., *Science and Corporate Strategy: Du Pont R&D, 1902–1980* (Cambridge: Cambridge University Press, 1988); and Leonard S. Reich, *The Making of American Industrial Research: Science and Business at GE and Bell, 1876–1926* (Cambridge: Cambridge University Press, 1985).

[18] David C. Mowery and Nathan Rosenberg, *Technology and the Pursuit of Economic Growth* (Cambridge: Cambridge University Press, 1989), pp. 7–8, 3–16.

[19] Ibid., p. 99.

cesses.[20] Although U.S. and British corporations faced similar market conditions, U.S. firms better utilized research and proved more innovative.

Taken together, these two bodies of scholarship – the first about market structure, the second about business institutions – qualify the conventional notion that competition will promote economic growth. The studies of market structure indicate that there is no clear and unambiguous relationship between a given market structure and an industry's economic performance. One reason for this is suggested by the studies of institutions. This scholarship indicates that although markets send signals to producers, much still depends on how firms respond internally to those messages. Put another way, within a given market structure, what needs to be understood is the nature of the institutions and the processes by which they promote or hinder innovation.

I find these two fields of research useful even though their focus is slightly different from mine. First, most research about business institutions or market structure has addressed highly concentrated industries in the manufacturing sector. My study, by contrast, concerns itself with agriculture – a sector characterized by highly competitive markets. Second, whereas most studies of business examine innovation as a source of productivity (by asking how firms create and introduce new products or processes), I study productivity in terms of the diffusion of technology (i.e., by asking how farmers invested in such things as tractors or hybrid seed).

Despite these differences, I have turned to these two bodies of scholarship because their conceptual insights about innovation complement my analysis of the diffusion of farm technology and the role of regulation. Studies about economic concentration indicate that market structure in itself does not allow us to predict the nature of innovation in a given industry or sector of the economy. In the case of agriculture, farmers' competitive markets may not alone explain changes in the pace or pattern of farm productivity. Why this would be the case is suggested in the work about institutions. These studies tell us that particular types of institutions are important for encouraging technological innovation, but even though they may have similar

[20] Mowery and Rosenberg note two other problems. One was the government's weak antitrust policy, the other the small number of engineers and scientists trained in British universities. Ibid., pp. 98–119.

forms they are not all equally adept at promoting change. Thus these two bodies of literature convinced me that regulation, while interfering with markets, could have acted to encourage gains in productivity. It did so, following this literature, by altering the institutional character of farms and related firms so as to spur investment. This investment in turn yielded gains in productivity.

My purpose in this study is to assess the plausibility of this proposition – that is, to examine how regulation could have stimulated productivity growth even though it interfered with farmers' markets. I break down this proposition into a set of systematic questions. First, I ask whether, despite their competitive markets, farmers delayed purchases of productivity-enhancing technology. Prior to 1930, did farmers achieve few gains in productivity simply because scientists and engineers had not developed new products? Or did farming lag because farmers delayed purchases? If farmers delayed purchases of productivity-enhancing inventions, why did they do so? What problems did they face, and did regulation address these problems? That is, did New Deal farm policies alter farmers' assessment of the profitability of investing in new machinery or scientific resources? Once established in the 1930s, did the farm policies continue to shape the diffusion of technology and stimulate gains in productivity in the years after 1940?

To answer these questions, we must investigate farmers' investment calculus, looking at when and why farmers adopted technology. Neoclassical theory would hold that competition was the most important factor shaping individuals' decisions. Simply stated, given that farmers had no control over prices, their one strategy to remain competitive was to reduce costs. If farmers followed this formula, then the diffusion of technology would proceed according to an invention's profitability; farm regulation, by implication, would distort this process.

This hypothesis is intuitively appealing, and I test its explanatory value by employing the so-called threshold model. Developed by the economist Paul David and used by many other economic historians, the model is designed to compare two different production techniques. It operates from the premise that given competitive markets, individual producers will select the technique that offers comparatively greater cost savings. The model goes one step further. Because the cost of an invention will vary with the size of the farm applying