Science & Society, Vol. 61, No. 2, Summer 1997, 216–228

The "Agricultural Revolution" in the United States: The Development of Capitalism and the Adoption of the Reaper in the Antebellum U. S. North

CHARLES POST*

ABSTRACT: The social and economic roots of the rapid mechanization of wheat harvesting in the U. S. midwest in the 1850s has been the subject of a long debate among economic and social historians. While the participants in this debate make important contributions, clarifying a variety of issues, their reliance on family farmers' subjective motivations ("utility" vs. "profit-maximization") to explain the adoption of the reaper ultimately undermines their explanatory power. An alternative explanation, based on a more realistic conception of competition and a recognition of the natural barriers to capitalist social relations in agriculture, is offered.

MARXISTS (BRENNER, 1977; 1985; HILTON, 1976; LENIN, 1956), beginning with Marx himself (1976, Ch. 30), have long recognized that the transformation of class relations and the labor process in agriculture is a necessary precondition for the development of industrial capitalism. The rapid mechanization of midwestern U.S. agriculture during the two decades preceding the Civil War, in particular the widespread adoption of the mechanical reaper in the harvesting of wheat in the 1850s, created the conditions for capitalist industrialization in the United States (Post, 1982; Pudup,

* I would like to thank Mary C. Malloy, Robert P. Brenner and the editors of *Science & Society* for their helpful comments on earlier drafts of this essay. A special thanks to Dr. Malloy for her help in calculating wheat prices in the 1850s.

1983). 0n the one hand, the replacement of human labor with machinery in the production of foodstuffs raised the productivity of agricultural labor, simultaneously "freeing" a portion of the rural population for wage labor in the burgeoning urban—industrial centers and lowering the costs of feeding the new industrial working class. On the other, the "agricultural revolution" of the 1840s and 1850s created a massive "home market" for industrially produced farm machinery and implements, promoting the transformation of the iron, steel and metalworking industries. Not surprisingly, economic historians from various theoretical perspectives have engaged in a vigorous debate on the social and economic conditions that shaped the adoption of the reaper in the antebellum midwest.

The contemporary discussion of the diffusion of the reaper began with Paul A. David's essay "The Mechanization of Reaping in the Antebellum Midwest" (David, 1966). For David, the family farmers' adoption of the reaper became a rational economic decision when they cultivated 35 or more acres of wheat or other small grains. At 35 acres, the savings in wages for workers using "hand cradles" in harvesting more than offset the increased cost of purchasing the reaper. According to David, a large proportion of the family farmers in the Ohio Valley and Great Plains reached this "threshold" in the later 1850s, when the average acreage in wheat and similar grains in Illinois (a "typical" midwestern state) reached 35 acres. The rapid and extensive adoption of the reaper in the "old northwest" in the late 1850s was a rational, cost-efficient decision for the "profit-maximizing" family farmers.

Alan Olmstead (1975) subjected David's thesis to a rigorous empirical reexamination and criticism. Adjusting David's calculations of the long-term costs of the reaper (interest rates on loans to purchase the machinery, life span of the machinery), Olmstead found the "profit-maximizing" threshold was closer to 60 acres in wheat and small grains, rather than David's estimate of 35 acres. The overwhelming majority of family farmers in Illinois and other parts of the midwest adopted the reaper at a scale of production that was less than optimally cost effective. However, Olmstead claimed that the farmers' ability to share the purchase and use of the reaper allowed them to achieve the scale of grain production that made the use of reaper a "profit maximizing" decision. Technical refinements in the 1850s, making the reaper more reliable and efficient, explained the timing of the new technology's massive adoption.

Haywood Fleisig (1976) offers an alternative explanation of the massive employment of the reaper on the family farms of the "old northwest" in the 1850s. For Fleisig, the key to understanding the mechanization of northern agriculture (and the technical stagnation of southern agriculture) was the relative scarcity of labor in the north (and its relative abundance, thanks to slavery, in the south). Harking back to early 20th century explanations of the mechanization of northern grain harvesting in the 1850s (Bidwell and Falconer, 1925, 281–294), Fleisig argued that the easy availability of land (to either purchase or rent) in the midwest limited the amount of labor available on the market. Faced with a constraint on the market supply of labor, "profit maximizing" family farmers responded to rising grain prices in the late 1850s by mechanizing the harvesting of wheat and other small grains.

Combining the systematic use of new and comprehensive data sources with a conceptual framework influenced by the debates on the European transition to capitalism, Sue Headlee's work (1991) marks a significant advance in the discussion of the forces shaping the diffusion of the reaper in the 1850s. Embracing the work of such Marxist economic historians as Maurice Dobb (1963) and Robert Brenner (1977; 1985), Headlee is the first participant in this debate to argue that agrarian class relations are the key to understanding technical change and economic development. Only specific forms of rural class relations engender "agricultural revolutions" that free labor for industry and provide a growing "home market" for industrial capitalism. Those rural social institutions (serfdom and slavery) which prevent agricultural mechanization are obstacles to the development of capitalism.

In the United States, Headlee argues, the development and expansion of family farming in the north in the 1840s and 1850s was the central precondition for the development of capitalism. This "family farm form of production" stimulated the development of what Headlee and others (Post, 1982, 42–44; Pudup, 1983, Ch. 1) have called an "agro-industrial" complex of capitalist industries providing machinery and tools to the northern farmers and processing their output (flour milling, meat processing). However, Headlee rejects the argument that the family farmers had become dependent upon the market for their economic survival in the two decades before the Civil War (Post, 1982, 38–44). The fact that northern family farmers

did not purchase labor-power on the market (hire wage workers) and continued to consume approximately 40% of their output as use-values meant that farmers were not subject to the "law of value" — were not compelled to successfully compete in the marketplace in order to maintain their landed property. The family farmers were neither petty commodity producers compelled to cut costs through mechanization so they could successfully compete in the market and maintain possession of their landed property; nor were they "profit maximizers" who adapted the reaper as a rational cost-cutting response to changes in the scale of production, alterations in the reapers' design, or a tight rural labor market.

The root cause of the family farmers' adoption of the reaper in the 1850s is to be found in the unique relations and dynamics of the "family farm system." The "family farm" was a medium-sized production unit (40 to 160 total acres) large enough to support the family, but not so large as to require hiring non-family labor (with the exception of harvest time). The family farms marketed only their "surplus," the output over and above what was required to meet the subsistence needs of the family, ensuring their independence from market forces. The family farmers were "risk adverse utility maximizers" who "derived utility not only from consumption but also from the benefits of farm ownership and family control of the farm" (Headlee, 1991, 48) such as social independence and control over the labor of female and juvenile members of the farm household. These "utility maximizing" farmers marketed their surplus product in order to secure consumer goods they or their neighbors could not produce, to pay mortgages, debts and taxes, and to purchase additional land for male heirs. While not dependent on the market for their survival, family farmers did attempt to increase their output of commodities in response to rising prices. They sought to avoid hiring wage laborers, preferring to rely on family members who worked many more hours and whose labor was of higher "quality" than that of "hired hands." The adoption of the reaper was a rational decision by these "risk adverse utility maximizers," who desired simultaneously to expand grain production in response to rising prices and avoid the hazards associated with hiring non-family labor.

Headlee thoroughly mines Fred Bateman and James Foust's (1976) sampling of the 1860 census of agriculture and rural households to test the "family farm" thesis. Headlee presents a comprehen-

sive statistical portrait of family farming in the antebellum United States, finding that the "profit-maximizing" threshold for the adoption of the reaper was 78 acres in wheat in 1860, rather than Olmstead's estimate of 60 acres in small grains. Headlee also constructs a new estimate of the total stock of reapers in the midwest, their distribution among various households, and the distribution of total acres and improved acres in wheat among the households adopting the reaper.

Contrary to the expectations of David, only 5.2% of the farmers adopting the reaper planted more than the 78 acres in wheat that would have made the machine's use a "profit-maximizing" decision in 1860. Headlee also finds that Olmstead's claims about farmers sharing reapers to achieve the "profit maximizing" threshold are without empirical foundation. Finally, she presents evidence that challenges Fleisig's claim that the adoption of the reaper was a "profit-maximizing" decision in a "tight" labor market, finding that Fleisig overestimated the number of "farmers" in the region and underestimated the number of people without access to sufficient land to support themselves. Headlee concludes that the farmers' "self-imposed labor constraint" led to reliance on family labor in northern agriculture (Headlee, 1991, Chs. 2–3). The midwestern family farmers' adoption of the reaper, despite the less than cost-effective scale of wheat cultivation and the availability of labor to hire, supports Headlee's thesis that the medium-sized family farmers were "risk averse utility maximizers."

Headlee asserts that the federal land system, which governed the distribution of the huge "public domain" seized from Native Americans, allowed easy access to land through relatively low prices. Easy access produced a relatively equitable distribution of land among a large class of medium landholders, who were secure in the possession of land. Free to be "utility maximizers," farmers in the Ohio Valley and Great Plains adopted the reaper and other labor-saving farm implements in the 1850s. This huge market for capital goods stimulated the reorganization and expansion of the capital goods industries (including iron and steel production), while increased agricultural productivity provided inexpensive food to the growing urban population.

Headlee's study helps clarify many of the central empirical issues in the debate on the diffusion of the reaper before the Civil War. However, her reliance on the subjective motivations of economic

actors to explain economic development, specifically the distinction between "profit maximizers" and "utility maximizers," is problematic. First, the notion that culture (norms and values) determines the actions of individual social actors is the foundation for all of mainstream social science, from Weberian sociology to neoclassical economics. Despite her desire to escape the stultifying grasp of conventional economics, Headlee remains trapped within its underlying paradigm. Second, and more important, the same goals and motivations may lead to very different outcomes depending on the *structural constraints* on economic behavior. These constraints are set not by values and norms, but by *social property relations*: the relations people enter into with one another and with nature, as mediated by the ownership and possession of objects and instruments of production, to produce goods and services necessary for human survival and reproduction. Specifically, *the changed relation of midwestern rural households to the possession of landed property in the 20 years before the Civil War created the conditions for the "agricultural revolution" in the United States generally, and the diffusion of the reaper specifically.*

The goal of preserving "the benefits of farm ownership and family control of farms" has been common to small and medium landowners throughout the world for most of the last 400 years. Depending upon the social property relations in agriculture, particularly whether or not rural households can obtain and keep landed property at costs low enough to avoid engaging in commodity production, this goal produces very different social and economic dynamics. In France in the 17th century (Brenner, 1985, 54–62), or the U. S. midwest before 1840 (Post, 1995), farmers were able to secure land at a relatively low cost. Secure in their landholding (*i.e.*, without large mortgages, debts and taxes), these farmers were able to market only their surplus products and devote the bulk of their households' labor to producing items of consumption. When land is "free" or "cheap," as it was in different regions of the United States before the 1830s, there was no compulsion for farmers to introduce labor-saving technology. As a result, "independent household production" (Friedmann, 1980, 176–177) hindered the development of capitalism, blocking the development of a rural home market for industrial capital and allowing large portions of the population to escape wage labor.

When the social conditions for obtaining and maintaining possession of land change, as they did in the midwest between 1830 and

1840, pursuing the goal of preserving "the benefits of farm ownership and family control of the farm" produced very different results. In order to pay growing mortgages, debts and taxes, family farmers were compelled to specialize production toward cash crops and to market more and more of their output, until they were no longer able to produce most or all of their consumption needs. Family farmers in the midwest marketed approximately 60% of their output in 1860, well over the 40% of output that would have made them market dependent for their means of subsistence (Danhoff, 1979). When the continued ownership of land became dependent upon successful competition on the market, family farmers were obliged to search for ways to increase productivity through mechanization. "Petty commodity production" (household production subject to the "law of value") promoted capitalist development, creating and deepening a home market for industrial capital and freeing portions of the population for wage labor.

Headlee presents important evidence that midwestern farmers were subject to the "dictates of the market" in the 1850s. She argues that growing debts led to the commercialization of the medium-sized family farm system (1991, 104), citing the strong correlation between reaper adaptation and the farms' increasing specialization in wheat production. Her confusion stems from a fundamental misunderstanding of the workings of the federal land system. Headlee's claim that federal land policy made the acquisition of land relatively easy and created a relatively egalitarian distribution of land (1991, 110–114) is not supported by most of the historical research on the distribution of the public domain in the 19th century (Atack and Bateman, 1987, Ch. 8; Bogue, 1963, Chs. 2–3; Opie, 1991; Swierenga, 1968).

Federal land law in the 19th century provided for the sale of most of the public domain at public auction to the higher bidder. No maximum prices or lots were ever set, encouraging the speculative purchase of large blocks of land. Actual settlers were forced to buy land from land speculators, at prices considerably above the federal minimum price of $1.25 per acre. According to one estimate, approximately 80% of prospective farmers in Iowa in the 20 years before the Civil War bought their land from speculators, rather than directly from the federal government (Swierenga, 1968, 48–50). By 1860, improved farm land in the midwest averaged $27.94 per acre, while unimproved farm land averaged $3.39, almost three times the federal

minimum price (Atack and Bateman, 1987, 138). Unimproved land, though less expensive than improved land, required tremendous investments of human labor (clearing the forested land of the Ohio Valley and "breaking" the root systems of grasslands of the Prairies) and the purchase of fencing, seed, animals and implements before production could begin.

The costs of purchasing land and "farm building" led the prospective farmers into debt. Frequently, land speculators provided loans to "settlers" for the purchase of land at very high rates of interest. The most common form of credit for the purchase of land before the Civil War was the "time entry" system, in which "the moneylender purchased the land in his own name, giving the settler a bond for a deed that obligated the capitalist to deed all or a portion of the squatter's claim back to him if he paid the purchase price and substantial interest within six months or a year" (Bogue, 1963, 171). Estimates of interest rates on "time entry" loans vary from 20% to 40% per year in the 1840s and 1850s (Bogue, 1963, 170–173; Swierenga, 1968, 11–12). Farmers often took five-year mortgages on their land to purchase livestock, tools, fencing and other supplies, often paying between 5% and 10% annual interest (Bogue, 1963, 173–179).

Land speculation in the midwest reached its antebellum zenith in the 1830s, with tens of millions of acres of public land sold at public auction. When the speculative bubble burst with the depression of 1837–1841, farmers were faced with large mortgages for the purchase of their land, heavy debts for livestock and equipment, and rising state property taxes that could only be paid by specializing production and increasing the portion of output sold as commodities. The federal land system, by transforming land into a commodity and stimulating land speculation, made the midwestern farmers dependent upon the market for the continued possession of their farms in the two decades before the Civil War. The midwestern family farmers were compelled, by the logic of their social property relations, to seek ways to increase the productivity of labor and cut costs. Replacing "living" with "dead" labor through the adoption of the reaper allowed farmers to become or remain competitive in the 1850s.

If the midwestern family farmers of the 1840s and 1850s were compelled to "sell to survive," how do we explain Headlee's unassailable empirical finding that 95% of the farmers adopting the reaper cultivated far less than the 78 acres of wheat that would make the

mechanization of harvesting a "profit maximizing" decision? First, we have to recognize that competition among capitalist or petty-commodity producers gives rise to a variety of conditions of production (and different rates of return) among producers in a given branch of production. Contrary to the neoclassical economists' idealized world of "perfect competition," the long turnover periods of existing fixed capital in industrial capitalism and the costs of obtaining contiguous land (through purchase or improvement) in agrarian petty-commodity production prevent all producers in a market from rapidly adopting the same technique or scale of production. While producers with less than the "state of the art" technique and scale of production are faced with eroding market shares and declining revenues, they are able to survive, particularly during periods when the market for their commodity is growing (Botwinick, 1993, 124–133; Shaikh, 1980).

The 1850s were years of rapidly rising wheat prices (the results of numerous crop failures in Europe, the Crimean War and the growth of the U. S. urban population) for midwestern farmers. Between 1850 and 1854, real (inflation adjusted) prices for wheat jumped nearly 60%. Despite a sharp drop after 1855, the real price of wheat remained over $1.50 per bushel through the decade (U. S. Department of Commerce, 1975, Series E123, 209; Series E53, 201). According to Paul Gates (1960, 287), "with wheat prices well above the dollar mark from 1853 to 1858, Illinois, Wisconsin, Iowa and Minnesota farmers enjoyed real prosperity and were in a position to buy and pay for reapers." Specifically, the high price of wheat allowed those farmers who adopted the reaper at less than the cost-efficient threshold of 78 acres in wheat to pay their mortgages and debts, and to purchase or improve additional land for wheat production. In other words, the growing market for wheat enabled farmers whose conditions of production were not "state of the art" (reaper adopted, with 78 acres or more in wheat) to survive the competitive battle and possibly achieve a "profit maximizing" scale of production in the future.

While the growing wheat market made the diffusion of the reaper by farmers with less than 78 acres in wheat *possible*, the natural obstacles to capitalist social relations in agriculture made the adoption of the reaper *necessary*. As Susan Mann (1990, 28–46) points out, the natural features of agriculture make the widespread use of wage labor

difficult and risky. Specifically, the disjunction between labor time (planting and harvesting) and "production time" (the naturally determined growing season) creates a situation where "labor is forced to be idle during the excess of production time over labor time" which "gives rise to serious labor supply and recruitment problems" (Mann, 1990, 39). The longer the "slack season" and the shorter the planting and harvest seasons, the greater the problems in securing adequate labor at the necessary times, as potential wage workers migrate to areas where employment is more steady (urban–industrial centers, transportation, construction, etc.) and farmers compete fiercely for a finite pool of labor during the relatively brief planting and harvest seasons. As a result, farmers, even when compelled "to sell in order to survive," tend to avoid the use of wage labor.

The disjunction between labor and production time is particularly conspicuous in wheat cultivation. Wheat has one of the longest growing ("slack") seasons of any crop, averaging 40–44 weeks for midwestern winter wheat. Most of the labor requirements in wheat planting and harvesting are concentrated in a ten- to twelve-week period, September for planting and July or August for harvesting (Mann, 1990, 56–58). The harvesting period for wheat is especially short. According to Gates (1960, 287), "wheat, when ripe, could not stand for long before it began to shed its grain, it had to be harvested at the right time or the loss would be heavy."

In August and September, tens of thousands of poorer farmers and unemployed urban workers (including many recent immigrants who came to the midwest to build the canals and railroads) would travel from the "lower" to the "upper" midwest, following the ripening wheat. Despite this seasonal migrant labor system, midwestern wheat farmers continually complained of shortages of "hands" during the crucial, two-week "window of opportunity" during which all the wheat must be harvested or the crop would be lost (Schob, 1975, 78–92). While the supply of labor-power might swell in August and September, all of the farmers in a location would compete for the available pool of labor-power to bring in their harvest. If the grain was left standing too long and spoiled, the farmers' major source of cash to pay mortgages and debts and to buy or clear additional land disappeared.

The adoption of the reaper, even by those farmers cultivating less than the optimal 78 acres or more of wheat, reduced the risks associ-

ated with the use of wage labor during the harvest. With the reaper, wheat farmers could expand their acreage beyond what their family could harvest to take advantage of rising prices, without the fear than an entire year's labor would be wasted because they were unable to hire sufficient labor-power at the precise time their wheat crop ripened. In sum, the social requirements of successful commodity production and the natural requirements of wheat production, not the subjective preferences and goals of the producers, compelled farmers producing at less than the cost-efficient scale of 78 acres of wheat to adopt the reaper in the 1850s.

The transformation of social property relations in northern agriculture set the stage for the "agricultural revolution" of the 1840s and 1850s. As rising debts and taxes forced midwestern family farmers to compete as commodity producers in order to maintain their landholding, they were compelled to seek various ways to increase the productivity of labor through mechanization. Rising wheat prices made possible, and the natural obstacles to using wage labor in agriculture made necessary, the adoption of the reaper by farmers whose scale of production did not make this decision immediately "profit maximizing." The transformation of the northern countryside in the two decades before the Civil War was the central precondition for the development of industrial capitalism in the United States. In sum, the source of technological change and economic development is found in the objective structure of social property relations, rather than in the subjective motivations of economic actors.

Department of Social Science
Borough of Manhattan Community College/CUNY
199 Chambers Street
New York, NY 10007

REFERENCES

Atack, Jeremy and Fred Bateman. 1987. *To Their Own Soil: Agriculture in the Antebellum North.* Ames, Iowa: The Iowa State University Press.

Bateman, Fred and James Foust. 1976. *Agricultural and Demographic Records for Rural Households in the North, 1860.* Ann Arbor, Michigan: Inter-University Consortium for Political and Social Research/Computer Tape No. 7420.

Bidwell, Percy W. and John I. Falconer. 1925. *The History of Agriculture in the Northern United States,* Volume I. Washington, D. C.: Carnegie Institution.

Bogue, Allan G. 1963. *From Prairies to Corn Belt: Farming on the Illinois and Iowa Prairies in the 19th Century.* Chicago, Illinois: University of Chicago Press.

Botwinick, Howard. 1993. *Persistent Inequalities: Wage Disparity Under Capitalist Competition.* Princeton, New Jersey: Princeton University Press.

Brenner, Robert P. 1977. "The Origins of Capitalist Development: A Critique of Neo-Smithian Marxism." *New Left Review,* No. 104.

———. 1985. "Agrarian Class Structure and Economic Development in Pre-Industrial Europe." In T. H. Aston and C. H. E. Philpin, ed., *The Brenner Debate: Agrarian Class Structure and Economic Development in Pre-Industrial Europe.* Cambridge, England: Cambridge University Press.

Danhof, Clarence. 1979. "The Farm Enterprise: The Northern United States, 1820–1860s." *Research in Economic History,* 4.

David, Paul. 1966. "The Mechanization of Reaping in the Antebellum Midwest." In Henry Rosovsky, ed., *Industrialization in Two Systems: Essays in Honor of Alexander Gerschenkron.* New York: John Wiley and Sons.

Dobb, Maurice. 1963. *Studies in the Development of Capitalism.* New York: International Publishers.

Fleisig, Heywood. 1976. "Slavery, the Supply of Agricultural Labor and the Industrialization of the South." *Journal of Economic History.* 36:3.

Friedmann, Harriet. 1980. "Household Production and the National Economy: Concepts for the Analysis of Agrarian Formations." *Journal of Peasant Studies,* 7.

Gates, Paul W. 1960. *The Farmer's Age: Agriculture 1815–1860.* New York: Holt, Rinehart and Winston.

Headlee, Sue E. 1991. *The Political Economy of the Family Farm: The Agrarian Roots of American Capitalism.* Westport, Connecticut: Praeger Publishers.

Hilton, Rodney, ed. 1976. *The Transition from Feudalism to Capitalism.* London: New Left Books.

Lenin, V. I. 1956. *The Development of Capitalism in Russia: The Process of the Formation of a Home Market for Large-Scale Industry.* Moscow: Progress Publishers.

Mann, Susan A. 1990. *Agrarian Capitalism in Theory and Practice.* Chapel Hill, North Carolina: University of North Carolina Press.

Marx, Karl. 1976. *Capital: A Critique of Political Economy,* Volume I. Harmondsworth, England: Penguin Books.

Olmstead, Alan L. 1975. "The Mechanization of Reaping and Mowing in American Agriculture, 1833–1870." *Journal of Economic History,* 35:2.

Opie, John. 1991. *The Law of the Land: Two Hundred Years of American Farmland Policy.* Lincoln, Nebraska: University of Nebraska Press.

Post, Charles. 1982. "The American Road to Capitalism." *New Left Review,* No. 133.

———. 1995. "The Agrarian Origins of U. S. Capitalism: The Transformation of Northern Agriculture Before the Civil War." *Journal of Peasant Studies,* 22:3.

Pudup, Mary Beth. 1983. "Packers and Reapers, Merchants and Manufacturers: Industrial Structuring and Location in an Era of Emergent Capitalism." M. A. Thesis, University of California–Berkeley.

Schob, David. 1975. *Hired Hands and Plowboys: Farm Labor in the Midwest, 1815–1860.* Urbana, Illinois: University of Illinois Press.

Shaikh, Anwar. 1980. "Marxian Competition Versus Perfect Competition: Further

Comments on the So-Called Choice of Technique." *Cambridge Journal of Economics*, 4.

Swierenga, Robert P. 1968. *Pioneers and Profits: Land Speculation on the Iowa Frontier.* Ames, Iowa: The Iowa State University Press.

U. S. Department of Commerce, Bureau of the Census. 1975. *Historical Statistics of the United States: Colonial Times to 1970,* Part I. Washington, D. C.: Government Printing Office.