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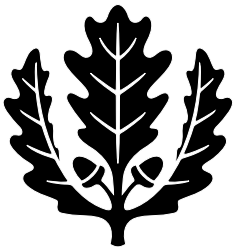

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Introduction

In our late twentieth century experience, survival of an economy seems critically dependent on well established rights to private property and a return to labor that rewards greater effort. But that need not be so. History provides examples of micro-socialist economies that internally, at least, allow for little private property for participants and a constant return to labor that is independent of effort. Some such economies may even be termed "successful," if success is taken to mean survival over several generations. If these communities survived without conditions that are generally thought to be necessary for success, a question worth asking is how this occurred, for we can then shed some light on what really is necessary for economic survival. Addressing this issue emphasizes the critical role of time, for even if the microsocialist economies that we study here eventually became the merest shadow of their former selves, the fact that they did flourish for so long makes them a valuable counterexample, and hence, a phenomenon in need of explanation. We consider here the dairy industry of the Shakers, which was characterized by intensive efforts to increase productivity, in part through the use of market signals, but efforts that were also limited by the ideological goals of the community.

The Shakers were (and are, but since it is the historical Shakers that concern this paper, the past tense will be used) a Christian communal group. Some of their distinctive beliefs included the existence of a male and female Godhead, from which followed sexual equality, and active communication between Believers (a Shaker term for members of the sect) and denizens of the spirit world. Practices of the Society (their official name is the United Society of Believers in Christ's Second Appearing, the second appearing being in the body of their foundress, an illiterate Englishwoman named Ann Lee) included pacifism, celibacy, confession of sins to elders, and joint or communal ownership of the Society's assets. Each Shaker received the same return for his or her labor: room, board, clothing, and the experience of divine proximity in a community of like minded Believers (Stein 1992).

The Shakers created their communes in order to live separately from the World, a Shaker term for everywhere outside their villages. To remain truly untouched by the World, however,

implies an economic self-sufficiency that would spare them from having to trade with outsiders for various necessities. This ideal was never quite realized (Stein 1992, pp. 98, 142). Like any other set of economic agents, to obtain what they wanted but could not (or chose not) to make themselves, the Shakers produced goods that others would accept in trade, in addition to producing goods that were for their own consumption. In their dairying, the Shakers lavished considerable effort to expand production through careful breeding of livestock and ingenious design of dairy barns.

Most of what they produced, of course, they consumed themselves. Even so, they responded to changes in relative prices of butter and cheese in ways that were consistent with an upward sloping supply curve of these goods. In fact, such optimizing behavior continued even after Shaker faithfulness to their spiritual heritage caused a substantial change in their consumption patterns. We find that, within their own internally determined set of constraints, both religious and budget related, the Shakers possessed a subtle understanding of allocation problems. Their skillfully balancing of religious and economic concerns may surprise those who expected such a group to have emphasized moral- rather than market-economic practices in the building of their communities.

Dairying among the Shakers and their contemporaries

Until the late 1860s, when the refrigerated railroad car was introduced, the tendency of milk to spoil limited the extent of markets for milk to just a few miles from a given dairy. For example, the Boston milkshed extended to no more than 10 to 30 miles from town in the early 1840s, with most production concentrated in the 12 to 14 mile radius (Gates 1960, Bidwell and Falconer 1925). One way to delay spoilage was to convert milk into butter or cheese, which could then travel farther to market. Country dairies were generally known to be cleaner than city dairies, and their products were easier to sell than the “swill” milk from city dairies, in part because the latter relied on cattle that were often diseased and kept in miserable conditions (Brunger 1955). City dairies often were located next to distilleries in order to use leftover mash from the whiskey

making process to feed their cows, and the crowding of the cattle tended to spread diseases such as bovine tuberculosis. Several of the Shaker communities lay within milksheds of major cities (Boston, Albany, Dayton, and Cleveland) and thus provide illuminating comparisons to dairies operated by nearby farmers.

One way to improve output was through selective breeding. One of the notable early events in this field was the "Importation of 1817," which saw the introduction of Durham Shorthorns to Kentucky (Pirtle 1926; Ham 1962). The Shorthorn is a dual purpose breed (beef and milk) that was “the most important of all” imported breeds and is still quite popular today (Bidwell and Falconer, p. 223). The Shakers at South Union, Kentucky, purchased a bull out of these “seventeens” and thus began a long relationship between the Society and blooded Durhams. In the 1850s Ohio Shakers were importing Scottish Shorthorns for breeding purposes. Stock of the South Union Shakers was so famous it attracted no less a figure than Henry Clay, who was always interested in improving his herds (Keith 1977). By the late 1860s, the Shakers at Union Village, Ohio, and Pleasant Hill, Kentucky, were the owners of the two greatest herds of registered purebred Shorthorns in the nation. Breeding stock was sent to the Eastern Shakers so that they could share in the bounty that their Western brethren were creating. Although some New York Shakers reported raising Holsteins later in the century (Anderson 1950), a certain uniformity thus developed among Shaker cattle herds.

The success of Shaker breeding can be seen in a comparison of weights of cattle at slaughter. Bidwell and Falconer (1925, p. 224) reported that around 1840, at the Brighton market serving Boston, the average weight of cows was about 450 pounds, of steers about 600 pounds, and of oxen about 875 pounds. By contrast, two New York Shaker oxen slaughtered in late 1838 weighed well over 1100 pounds, a cow from the same slaughter weighed 772 pounds, and the 1847 slaughter reported on three cattle that weighed an average of 1450 pounds.[1] Clearly the Shakers, at least in the East, were raising larger cattle than the typical animals sent to market.

[1]Western Reserve Historical Society Shaker Collection items V:B-104, 27 November 1838; V:B-70, 31 December 1847;

While Western Shakers concentrated on developing herds of purebred shorthorns, Eastern Shakers became well known for the buildings in which they housed their herds. The Harvard, Massachusetts, Shakers constructed a huge multi-story barn for their cattle that towered over the other buildings there. The cow barn at the Alfred, Maine, community measured 45 feet by 145 feet, while the Canterbury, New Hampshire, Shakers built a 200 foot long barn for their cows (Emlen 1987). Possibly the best known of the Shaker structures for their dairy cattle were the Great Barn at New Lebanon and the Round Stone Barn at Hancock, Massachusetts. The New Lebanon barn measured 50 by 196 feet and was 5 stories high, with walls 32 inches thick. It contained stalls for some 70 cows; Anderson's (1950) source, writing in 1885, describes them as Holsteins. The Hancock round barn (diameter: 90 feet) may be the best known of all Shaker buildings. It could hold 52 cows within its 36 inch walls. A central haymow allowed a small number of Shakers to feed their herd (Burns 1993).

Strong similarities existed between the Shakers and Worldly dairies regarding the sexual division of labor. In both, women did most of the milking, although during the middle nineteenth century this may have been becoming less common (Bidwell and Falconer 1925, 424). Among the Harvard Shakers in the 1860s, adult women were responsible for the milking of three cows each, morning and evening, and also made the butter and cheese. At the Enfield, Connecticut, Shaker community sisters made 1500 pounds of cheese in 1860, but later in the century at Enfield, cheesemaking became a brethren's industry (Burns 1993). This shift to cheesemaking by men seems to have occurred in New York State as well, where it was associated with the rise of cheese factories (McMurry 1995). While the dairying season in the World extended from March to November in the northeast (Atack and Bateman, 162), the Shaker season may have been considerably shorter, perhaps only from May to late October (Anderson 1950). During the warm weather, Shaker sisters did the milking, while Shaker brothers milked the cows in cold or stormy weather (Nordhoff 1875).

While selective breeding may have led to larger animals in the Shaker herds, the value of blooded stock is seen most clearly in measurements of milk output per cow, and comparisons with

similar measures in herds kept by Worldly farmers. Comparing like-to-like, however, requires estimating production from figures that may not be immediately comparable. Impressionistic numbers that are of limited use can be found in both the Shaker literature and in agricultural histories. For example, the great Shaker builder Micajah Burnett reported that at Pleasant Hill in the 1850s, several of the 150 milch cows there daily gave thirty to sixty pounds of milk "unsurpassed in quality and richness" (quoted in Ham 1962, p. 233). Based on a seven month milking season (April through October), this implies an annual output of nearly 10,000 pounds of milk, a huge amount in an era when 3,000 to 4,000 pounds were thought to be the minimum output necessary to make dairying profitable (Bidwell and Falconer 1925, pp. 229, 431; Jones 1983, p. 188). By another comparison, dairies in western Massachusetts, which were producing butter and cheese for sale in New York City, also showed much smaller outputs in 1838: 913 cows near Cheshire produced an average of 3866 pounds of milk annually, and 812 cows near Pittsfield produced an average of 1893 pounds of milk. But the Shaker records remain credible, if unenlightening, since clearly Burnett was talking about the prize milkers in his herd and not the average output of all 150 cows. While Shaker manuscript sources reveal a great deal of information concerning dairy production, it is difficult to obtain comparable data on nearby dairy farmers. It is possible to estimate comparable output figures for Shaker and Worldly dairies, however, using a different source: the federal census of agriculture.

The U.S. Census of Agriculture, as conducted in 1850, 1860, and 1870, asked several questions related to dairy production. None of those questions, however, was the weight of milk produced per cow, which would allow for comparisons immediately. Each asked for the number of milch cows and pounds of cheese and butter produced at the farm. In 1870, a question was added on the quantity of milk sold, in gallons. The census is not a perfect source of information, and its shortcomings have been chronicled elsewhere (Atack and Bateman 1987). We do have a check on some of the Shaker responses to the Census marshal, namely the *Register of Stock* that they were required by law to submit annually to the state of New York (Murray 1996). The matches are not perfect: the census asked for stock and output for the previous year, while the

Register was intended to enumerate Shaker material wealth as of 1 January of each year, and only coincidentally was information given on flow variables like the quantity of butter and cheese produced in the last year. Nonetheless, the rare opportunity to compare census responses with any other source of information leads us to consider Tables 1 and 2, which list Census and *Register* responses for cattle and dairy products (Steckel 1991).

The two sets of records show reasonably good, but far from perfect, agreement. For both 1850 and 1860, quantities of cattle and dairy production are quite close for the Church family, the largest and most important sub-unit within the community. In general, the quantities of cattle match up quite well; in Canaan in 1860, for example, the numbers of both milch cows and other cattle are the same in each record. Small differences typical of the other entries may be the result of accurate recording done at different times, as could have been the case had the *Register* figures been tallied after a winter slaughter, or the Census figures after an unhealthy spring. Some figures are not very close at all, especially in dairy production, where the East family's butter production for 1859 was 1500 pounds according to the *Register* or nearly double that according to the Census. There seem to have been no systematic differences between the two sets of numbers. It would have been reasonable to suspect underreporting to the State, since the *Register* was a direct result of fears of neighbors that the Shakers were becoming too rich (Murray 1996). Hence, we use the Census manuscript data to analyze further Shaker and neighboring dairy productivities.

Differential productivity in communal and family dairying

We compare dairy productivity in the standard terms of pounds of milk per cow. A dairy cow's milk production was consumed in three different ways. During the milking season, some milk was consumed right away in fluid form. Since fluid milk would not keep long, the alternative was to turn it into butter or cheese. Census and Shaker manuscript records show the amounts of cheese and butter produced in pounds. We translate these values into pounds of milk equivalents

according to Atack and Bateman (1987)'s formula of 1 pound of cheese = 10 pounds of milk and 1 pound of butter = 22 pounds of milk.

We estimate fluid milk consumption using standard techniques from historical dietary studies. Atack and Bateman (1987) refer to the Bennett and Pierce (1961) paper as among the most reliable of estimates of milk consumption, so we rely on it here. Bennett and Pierce estimate that on average in 1879 each American consumed 260 pounds of whole milk, 107 pounds of non fat fluid milk, and 10.7 pounds of cream, for a total of 377.7 pounds of milk (and cream) consumed, or roughly one pound per day. Since a gallon of milk weighs just over 8 pounds, this estimate reduces to about a pint a day. Now farm families were supposed to have consumed more than this amount, which makes sense given the transport restrictions of the era. Balancing this concern for the Shakers, however, were strands within the various communities of belief in vegetarianism that limited dairy consumption, some of which was a residual from earlier experiments with Grahamism (Youngs 1856, pp 291-298; see also Nordhoff 1874, p. 141). Therefore, in calculating milk production among the Shakers, we allow for consumption of the same one pound (or one pint) per day as estimated for the country as a whole at a somewhat later date. We add this amount when feasible to the pounds of milk that were converted into butter and cheese to derive estimates of the entire fluid milk output of a cow.

We compare Shaker yields of milk per cow to similarly calculated averages from Bateman (1968), which are presented in Tables 3 and 4 for 1850 and 1860 respectively. Except for the Enfield, Connecticut, Shakers in 1850 New York and New England the Society enjoyed greater dairy productivity than their neighbors in the World. While the Shaker superiority in New England (outside of Connecticut) was on the order of 5 to 10 percent, the difference in New York was small. But then the Empire State was the leading dairy producer in the nation, so in rough terms the Shakers were as productive as the biggest dairy producers in the country. Atack and Bateman (1987) note the disparities in Eastern and Western dairy practices, which are expressed here though even larger differentials in the West favoring the Shakers. Since we lacked 1850 Population Census returns for the Kentucky Shaker communities, we were not able to adjust the

estimates for South Union for milk consumption. Thus the two-to-one ratio of Shaker to Worldly milk yields actually underestimated the Shaker productivity advantage. There is thus no reason to believe that as of mid-century, the communal dairying operations of the Shakers were any less productive than those of typical family farms.

By 1860, the Shaker advantage had disappeared (Table 4). In the four states for which comparison data were available, the Shakers produced less milk per cow than did the average farmer in that state. The Shaker disadvantage remained in Connecticut, but was a new development in New Hampshire, New York, and Ohio. In fact, New York Shaker output dropped precipitously, by about 20 percent, over the decade. Ohio Shaker output fell by more than half, while in both these cases statewide average milk production grew slightly. The loss of Shaker productivity advantages around this time has been noted elsewhere (Co gel and Murray 19??). Here we consider differences between the Shakers and their more immediate neighbors, that is those farms included in a sample of 5 (or as many as were available) from each township in which a Shaker community was located. Table 5 shows mean values and standard deviations for variables describing both the Shakers and these neighboring farmers.

The data in Table 5 are consistent with those in Tables 3 and 4 but provide a finer degree of detail. Since we would have estimated milk consumption to have been a pint per person for both Shakers and their neighbors, the estimates of milk production per cow as given in Tables 5 and 6 were derived from butter and cheese production only, and have not been adjusted for fluid milk consumption. The 1870 figures do include milk sold from the farms. The decline in the Shaker production superiority is evident over the 1850 to 1870 period. Neighboring farmers did not increase their output, while Shaker output dropped sharply. The census did not report acres of pasture, so the cows/acre variable gives the total number of cows at that farm divided by the total number of improved acres. While no distinct trend was clear among the Shakers, their neighbors were gradually increasing the number of cows they kept on their land. It is very clear that the Shakers had much larger farms than their neighbors, and much larger herds of milch cows that were becoming even larger over time as well. The amount of hay available for each cow

slightly favored the neighboring farms, a difference that grew over time. Without knowledge of the sizes of their respective pastures, it is difficult to determine the importance of this variable, but it serves as a rough proxy for food supply for the cattle. The dummy variable "urban" was set equal to 1 for farms in counties with a large city, somewhat arbitrarily defined as those farms near Boston, Albany, Cleveland, and Dayton.

The effect of each variable on the quantity of milk provided per cow can be seen in Table 6. The dependent variable in these ordinary least squares regressions was the logarithm of pounds of milk per cow. Population density of all cows (cows per acre) on a farm only mattered in 1850, when greater density led to a decline in milk output. In the later two decades, greater output of hay per cow was associated with more milk output. These two findings may indicate a shift of importance in the milch cows' nutritional source, from pasturing to barn feeding of hay.

To understand the effects of specifically communal dairying and of location near a large city, four dummy variables were created for each observed farm: Shaker and rural; Shaker and urban; non-Shaker and rural; and non-Shaker and urban. The third of these was omitted from the regressions. Controlling for availability of land and food for the cattle, and the number of cattle, the Shaker dairies nearest large cities were the most productive of these four types of dairies. However, F-tests comparing the urban Shaker and urban non-Shaker coefficients showed a distinct decline in Shaker production superiority just within the counties containing large cities. While the hypothesis of equality could be rejected at a confidence level of .002 in 1850, and at a confidence level of .01 in 1860, it could not be rejected in 1870 (p-value = .29). The Shirley, Massachusetts, Shakers were almost certainly selling their milk in Boston. The North family there sold its entire production of milk (4600 gallons from 12 cows) in 1870 and made no butter or cheese. Probably they shipped it into town on the Fitchburg Railroad, which had been a major carrier of milk into Boston since 1847, and ran alongside the North family's property (Gates 1960, p. 239; Horgan 1987, p. 109). In other counties, Shaker dairies were significantly more productive in 1850, but not in later decades. Thus in the regions closest to markets for dairy products, Shaker decline was most evident, but the decline could also be seen in rural counties.

Integration of market and spiritual forces

Although we have spoken of the Shaker decline from 1850, it is not clear from what heights were Shaker dairy productivities declining. We cannot extract earlier information from the federal census of agriculture, which dates from 1850 in its most useful form. There is, however, a vast trove of information in the manuscript record created by the Shakers themselves. While lacking the breadth that makes the census so valuable, the detail in the New Lebanon Shaker manuscript record allows for a close examination of the factors affecting Shaker dairy productivity on an annual basis. We stress that religious and market forces were both important influences on Shaker dairy production.

We turn to the manuscript record left by the New Lebanon Shakers, and in particular, the Church family there. It is important not to generalize too extensively from the New Lebanon Church Family. Although Andrews (1933, p. 13) emphasized the conformity of the other communities to the model provided by New Lebanon, Stein (1992, p. 149) provides a counterbalance to this notion, citing regional, geographical, and leadership differences from commune to commune. On the other hand, of the body of Shaker manuscripts easily available to the scholarly public on microfilm, that pertaining to New Lebanon is huge and of generally high quality. The importance of New Lebanon to the larger society was substantial as well. It was the site of the Lead Ministry (i.e., headquarters); it was one of the largest communities; it was geographically central; and like many Shaker societies, it was in a rural area near a large city, in this case, Albany.

For nearly four decades, the scribes of the First Order of the Church family (Isaac N. Youngs and John Brown) recorded various statistics at the end of each year. These included cheese and butter production, quantities of each that were sold, number of milch cows belonging to the First Order, and the number of Believers in the Church family.[2] At rates of 22:1 for butter

[2]The manuscript volumes containing these records are New York State Library Shaker collection item 13500 and WRHS Shaker collection items V:B-70 and V:B-71. In the years with missing data we were able to fill in the gaps

and 10:1 for cheese, and a pound a day of milk for each Shaker, we were able to estimate annual production of milk per cow in pounds. Figure 1 shows the trends in milk production per cow over the period 1835 to 1871. A sharp increase in milk production during the late 1840s is evident, followed by a gradual decline through the middle 1860s. We consider two questions inspired by this graph. First, what caused milk output to vary from year to year, and second, what caused the spike upward in the 1840s. In a nutshell, the answer to the first is the market, and the answer to the second was the Shakers' spiritualism. We consider the latter issue first.

While the later 1830s are well known as a time of fantastic spiritual happenings within the Society, the years just before saw a somewhat related phenomenon that more directly changed the Shaker diet: the rise of Grahamism. Sylvester Graham (1794-1851) developed a diet that virtually eliminated consumption of meat, dairy (especially butter) and other rich foods in favor of "natural" brown bread made from a special refined flour. Graham promoted this diet as an aid to sexual continence, which was bound to appeal to Shaker leaders. Discussion of Graham's diet and the first mention of Believers following it date from 1835 at New Lebanon. Prior to this time the Shaker diet was rich, especially in foods that were fried in lard, typical of American diets at that time (Rorabaugh 1979). She goes on to speculate that many Shakers may have returned to their diet of fried doughnuts, buttered pancakes, and meats soon after the novelty of the Graham diet wore off (Brewer 1986, pp. 107-110). Figures 1 and 2 both reflect the known trends and support Brewer's speculation. From 1835 on, milk production fell steadily, presumably due to the decline in demand caused by adoption of the Graham diet. Figure 2 shows how the milk that was not immediately drunk was processed. The decline in milk that was turned into butter after 1835 was thus paralleled by an increase in cheese production. After 1837, however, production of milk and the share of it that was converted into butter recovered, and remained stable through the mid-1840s.

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with Youngs's volume "Names and Ages," Andrews Collection item 1078, and the *Register of Stock* that was reported to the New York state government, WRHS item II:B-38.

From the beginnings of the Society direct contact between Shakers and residents of the spirit world, whether through visions, violent dancing (hence the nickname of the Society's members), shouting, or other means, was generally accepted. In August 1837, however, began the most intense period of spiritual activity in Shaker history. The Era of Manifestations, as it was known to the Shakers, was a revival of spiritual activity that encompassed the entire Society (Stein 1992, pp. 165ff). "Gifts" were bestowed by spirits upon Shaker "visionists," who reported the presence of the Society's foundress, Ann Lee, all leading up to the visitation in 1841 of Holy Mother Wisdom, the female side of the divinity. By 1844 or 1845, the Era was winding down. Its effects, however, continued to be felt in the Society for decades to come, for example the repercussions of a spiritual directive received in 1841: a command to cease consuming pork (Murray and Co gel 1998).

Although the ban was unpopular and unevenly followed, the ban on pork and subsequent ending of Shaker hog slaughtering in the East seem to have affected Shaker dairy production indirectly. Table 1 shows a sharp increase in milk output per cow starting in 1845, and Table 2 shows that the proportion of milk that was converted into butter jumped around the same time, from about 35 percent to about 60 percent. We suspect that the connection between the ban on pork and increased butter production lies in the need for oil or grease for cooking purposes. With their source of lard gone, the Shakers may well have turned to butter for cooking purposes. At the New Lebanon Church Family, a compromise was reached among the adherents of Grahamism, vegetarianism, and all others that led to a diet with less meat and grease than previously, in an attempt to lessen the burden that several diets placed on the cooks (Youngs 1856, p. 300). There is little evidence of greater direct butter consumption, as on bread, so that cooking would seem to have been the logical outlet for the increase in butter production.

Figure 2 also shows the proportion of milk that was converted to cheese for their own consumption and for sale in markets. After about 1848, the proportion made into cheese was constant at 35 to 40 percent. Through the 1850s, there was a slight tendency to increase to sell more of their cheese and consume somewhat less. We consider reasons for the New Lebanon

Shakers to vary the share of milk that became cheese and the share of cheese that was sold (there is no evidence that they ever sold their butter). The price of cheese would be a natural consideration for the latter. Even though Figure 2 shows that at most the Shakers sold less than a tenth of their milk production, we believe prices entered into the decision of how to divide milk production into butter and cheese as well. By implication, then, the influence of the market in the second and third quarters of the nineteenth century may have extended well beyond its participants to have included people who sought to escape its influence by forming communes that eschewed prices in their internal allocation schemes.

To examine the effect of changes in prices on quantities of dairy products, we consider a series of simple regressions, first of division of milk production on prices. We use dairy output data from the First Order of the Church family at New Lebanon, and price data from New York City (Cole 1938, Ronk 1936) for the period 1835-1871. Since dairies as far away as Herkimer County (northeast of Utica), New York, and Berkshire County, Massachusetts, had already been integrated into the market for dairy products in New York by this time (Atack and Bateman, 1987; Bidwell and Falconer 1925) it is reasonable to conclude that if the New Lebanon Shakers responded to any prices, they would attend to New York City prices. Once the cows were milked, and presumably after consuming the day's allotment of fluid milk, the Shakers had to decide how much milk to convert to cheese and how much into butter. We believe that, before the ban on pork took effect by the late 1840s, the relative prices of cheese and butter were important determinants of such decisions.

We divided the sample into two subsections at 1850, to see if there had been a change in responsiveness to prices after the ban on pork consumption had spread through the Order. In the following regressions,

dependent variable = ln (pounds of cheese/pounds of butter), and

price = ln (price of cheese in pennies per pound/price of butter in pennies per pound).

We estimate the following equations for the years with available data (all but 1867):

dependent variables	1835-1850 parameters	1851-1871 parameters
intercept	3.12**	-0.96*
price	3.42**	-0.51
R squared	.50	.06
Durbin Watson	1.49 (no serial correlation)	1.273 (indeterminate)

(** = significance at .01 level; *= significance at .10 level)

We interpret this as showing a very strong Shaker supply response in dairy production, up to the time of the ban on pork. The coefficient of the price variable at this time was significantly different from zero at the .002 level. As we have shown, after the ban a large share of milk production was given over to making butter, which was needed to replace the now-banned lard in cooking. And at that time, cheese and butter production did not respond to changes in relative prices, as suggested by the insignificant coefficient of the relative price variable for the remaining years. These results are reasonably robust to the cutoff year, taking into account the small sample size in the pre-ban years.

We next consider the question of share of cheese that was sold. For the years 1841-1869 we know the quantity of cheese that was sold (and credited in the manuscripts to "Sisters' work"). We estimate a regression equation using the following variables:

dependent variable = log (pounds of cheese sold/pounds of cheese made),

price = log (price of cheese in pennies per pound/Warren Pearson price index for foods),

demand = log (amount of cheese made/First Order population).

	parameter estimate	p-value
intercept	1.59	.42
price	1.64	.01
demand	0.30	.52
R squared	.26	

Durbin Watson	1.78 (no serial correlation)	

The share of Shaker cheese production that was sold on the market was unrelated to the amount of cheese per Shaker that was available to be sold. That is, it was not the case that the Shakers automatically sold more cheese in years of high production, relative to the number of people who had to be fed. On the other hand, in years when the price of cheese was high relative to the price of other foods, the Shakers did sell more of the cheese they had made. On average, a 10 percent increase in the real price of cheese resulted in the sale of 16 percent more cheese. Again, we see the Shakers making production decisions in response to price changes. Given the relatively small proportion of their cheese that they sold, less than 10 percent, this is a remarkable finding. It suggests that Shaker dairy production decisions, even for goods that they overwhelmingly consumed themselves, were influenced by price changes. The influence of the market extended well beyond its active participants.

Conclusions

The economics of communal dairying in the past leads into many fields. One question about the nature of firms organized non-hierarchically is whether they can produce as efficiently as conventionally organized firms. We have shown that at the middle of the nineteenth century, Shaker dairies produced more milk per cow than did ordinary family run dairies, even in the most important dairying states. But this productivity advantage declined sharply into the second half of the century, suggesting that the ultimate Shaker decline in numbers was matched by a decline in their agricultural output. Regression analysis indicated that the source of the decline was not a decline in inputs such as land or fodder availability. It may have been that the loss of Shaker members included those most skilled in operating large farms.

The Shakers formed their communal enterprises to enable them to conduct their primary mission: to live holy lives. This religious aspect of their decision making increased the demand for

their own butter, as a substitute for lard in cooking which was abandoned by spiritual directive. Prior to this time the Shakers produced dairy products in accordance with price signals, whereas even after most of their milk was dedicated to buttermaking, their sales of cheese varied following price changes. We suspect, although we cannot prove, that one reason for the longevity of the Society was its ability to interpret and respond carefully to such price signals.

Overall, the results presented here are consistent with newer syntheses about the extent of the market in early America. The romanticized moral economy hypothesis imagines an American that consisted of small Jeffersonian farmers who were essentially self-sufficient, and who interacted with each other through the bestowal of gifts rather than the sale of commodities. The equally romanticized Shakers have been misrepresented as people whose interests were strictly otherworldly, except for the design and manufacture of their furniture. More recent studies of the rural Northeast in the nineteenth century have found farmers who responded to price signals in ways not at all dissimilar from present day farmers (Rothenberg 1992), and dairy operations in New York that responded to price signals while maximizing a less well defined utility rather than the stereotypical profits (McMurry 1995). We see the Shakers as responding to price signals. But they were clearly not a profit maximizing firm in the usual sense of that phrase. Their religious beliefs, and the practices that flowed from them, constrained them in their consumption, and hence in their production. Within those constraints, it is clear, the Shakers used market information to their best advantage. In addition to otherworldly ecstasies, not in opposition to them, the Shakers possessed considerable market savvy.

Table 1

Responses to U.S. Census of Agriculture vs. Register of Stock reported to State of New York, 1850

Family	Milch cows	Other cattle	Cheese	Butter
Census				
Church	62	48	5680	8515
Second	42	45	3000	3900
East	20	36	2150	2858
Canaan	29	21	5000	3000
Report to New York				
Church	62	53	5772	8446
Second	39	50	3000	3900
East	17	21	1800	1500
Canaan	32	28	na	na

Table 2

Responses to U.S. Census of Agriculture vs. Register of Stock reported to State of New York, 1860

Family	Milch cows	Other cattle	Cheese	Butter
Census				
Church	63	87	4000	6000
North	25	26	1200	1760
East & 2nd	45	58	1400	4375
Canaan	35	29	650	1160
Report to New York				
Church	68	73	3869	6640
North	22	30	na	na
East & 2nd	41	46	na	na
Canaan	35	29	na	na

Table 3

Productivity in dairies of Shakers and others, 1850

Average yields of milk per cow, in pounds

State	Shakers	Statewide
Connecticut	3362	4203
Kentucky	3675*	1746
Maine	3345	3274
Massachusetts	3849	3512
New Hampshire	3823	3719
New York	4519	4511
Ohio	5426	3315

*Kentucky Shaker milk production not adjusted for fluid milk consumption, so this is an underestimate of actual production.

Sources: Shakers, Census of Agriculture schedules. Statewide, Bateman, "Improvement in Dairy Farming," p. 258.

Table 4

Productivity in dairies of Shakers and others, 1860

Average yields of milk per cow, in pounds

State	Shakers	Statewide
Connecticut	3564	4501
New Hampshire	3197	3340
New York	3427	4617
Ohio	2333	3755

Sources: Shakers: Census of agriculture enumeration schedules. Statewide: Atack and Bateman, *To Their Own Soil*, p. 150, divided by number of milch cows in Kennedy, *Agriculture in the United States in 1860*.

Table 5

Means and standard deviations of variables in milk production regressions

	1850		1860			
	Shakers	neighbors	Shakers	neighbors	Shakers	neighbors
milk/cow (lbs.)	3137 (2036)	2325 (1861)	2468 (962)	1992 (1205)	2096 (1583)	2063 (1658)
cows/acre	0.09 (0.06)	0.08 (0.06)	0.07 (0.03)	0.09 (0.06)	0.12 (0.05)	0.11 (0.07)
improved acres	428 (289)	103 (122)	553 (334)	87.5 (77.5)	741 (841)	86.2 (86.4)
milch cows	22.7 (15.2)	4.6 (5.6)	23.4 (12.2)	5.3 (5.8)	34.2 (51.3)	4.0 (3.8)
hay/cow (tons)	5.1 (4.0)	5.2 (5.0)	4.1 (1.9)	4.6 (3.6)	2.7 (2.9)	4.7 (6.2)
urban	0.22	0.20	0.19	0.29	0.23	0.22
N	41	75	32	70	30	67

Notes: milk/cow not adjusted for fluid milk consumption. Cows per acre is the sum of milch cows, working cows, and working oxen divided by improved acres. Tons of hay per cow is the farm's hay production divided by the sum of milch cows, working cows, and working oxen. Urban refers to location in a county with a city of more than 100,000 people.

Table 6

Regression of log of average output of pounds of milk per cow.

	1850		1860		1870	
	-hat	Std. error	-hat	Std. error	-hat	Std. error
constant	7.95***	0.17	7.30***	0.16	7.21***	0.18
cows/acre	-3.65***	1.30	0.36	1.16	1.42	1.08
improved acres	-0.0006	0.0005	-0.0001	0.0004	-0.0002	0.0002
milch cows	-0.002	0.009	0.0005	0.009	0.00006	0.003
hay/cow (tons)	0.005	0.01	0.06***	0.02	0.03**	0.01
Shaker, urban	0.71***	0.25	0.31	0.24	0.53*	0.27
neighbor, urban	-0.23	0.20	-0.38***	0.14	0.19	0.20
Shaker, rural	0.58***	0.19	0.17	0.18	0.04	0.18
R^2	.21		.22		.14	
N	114		98		93	

Notes: Dependent variable in logs, so only observations with nonzero amounts of milk produced were used. Milk/cow not adjusted for fluid milk consumption. Census of 1870 was first to ask for amount of milk sold. Cows per acre is the sum of milch cows, working cows, and working oxen divided by improved acres. Tons of hay per cow is the farm's hay production divided by the sum of milch cows, working cows, and working oxen. Urban refers to location in a county with a city of more than 100,000 people.