Orderly Marketing in Agriculture Revisited

Howard Leathers

This paper presents a model of economic behavior that explicates the phenomenon known as "orderly marketing," which was a main objective of the Marketing Orders agricultural program introduced early in the New Deal. Recent analyses of marketing orders start with an implicit assumption that there is no market failure—thus, that price regulation can cause only deviations from the first-best market solution. However, historical evidence suggests that disorderly marketing might refer to a kind of market imperfection. In the model presented here, a monopsonist processor sets a price to be paid, and an aggregate quantity to be purchased. In some states of the world, some farmers are excluded from the market. In other words, non-price rationing can occur, and changes in consumer expenditure for the final product are absorbed by the processor rather than passed along to the farmer. The classified price and pooling provisions of federal orders can lead to a Pareto improvement in welfare.

Key Words: disorderly marketing, market orders

Agricultural programs can either be "predatory"—aimed at transferring income into the farm sector—or "productive"—aimed at correcting a market failure (Rausser 1992). As economists have gained better insight into what kinds of market failures may exist—particularly market failures associated with imperfect information—it is useful to revisit old debates and arguments in favor of agricultural programs to see whether assertions that programs are "in the public interest" are legitimate assertions, or whether they are simply propaganda for predatory programs.

During the early decades of the twentieth century, "orderly marketing" was a rallying cry of those concerned about the plight of the American farmer and the disparity of income between farmers and their city brethren. Writing in 1937, Samuel Herman called for government action to rectify certain "evils that have arisen in the past connected with the distribution of the economic return for farm products …[:] glutted and undersupplied markets, unfair trade practices, and unfair methods of competition" (Herman 1937, p. 400). The perceived "evils" referred to by Herman include non-price rationing—a situation in which farmers who are willing to sell at the prevailing price are unable to make sales—and an inequitable distribution of consumer dollars between the farm sector and the processor. In the 1930s, these concerns were addressed by the establishment of the Federal Market Order Program. The stated objectives of the law authorizing marketing orders were to "establish … parity prices [to farmers]" and to "establish and maintain such orderly marketing conditions … as will provide, in the interests of producers and consumers, an orderly flow of the supply thereof to market throughout its normal marketing season to avoid unreasonable fluctuations in supplies and prices."[1]

This paper looks at the Federal Milk Marketing Order program to see if an argument can be made that the programs were Pareto-improving. Although marketing orders have been studied extensively, they are typically analyzed as being a method used to increase farm prices. The studies implicitly assume that there is no inherent market failure that might justify marketing orders. Then the studies (i) estimate what prices and quantities

Howard Leathers is Associate Professor in the Department of Agricultural and Resource Economics at the University of Maryland, College Park, Maryland. This research was sponsored by the Maryland Agricultural Experiment Station. Thanks to anonymous reviewers for helpful comments and suggestions. Any remaining errors are the author's.

[1] From the Agricultural Marketing Agreement Act of 1937, available online at the Legal Institute's website, http://www4.law.cornell.edu/uscode/7/602.html.

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would prevail in the absence of marketing orders, (ii) estimate welfare measures with and without marketing orders, and (iii) use the difference as an estimate of the welfare costs of marketing orders. For example, Gardner (2002, pp. 204–205) describes milk marketing orders as mechanisms for strengthening the bargaining power of cooperatives and increasing revenues to dairy farmers. But he notes that the higher revenues come at the expense of consumers and create significant deadweight losses. For other examples of this approach, see Dardis and Bedore (1990), Dobson and Salathe (1979), Masson and Eisenstat (1980), and Helmberger and Chen (1994).

By implicitly assuming that there is no underlying market failure, this approach effectively ignores the second objective of the legislation listed above—to maintain orderly marketing conditions. The conditions that could cause an unregulated market to exhibit "disorderly marketing" (or at least the widely held perception of disorderly marketing) have not been analyzed. This paper presents a more explicit formulation of those conditions in order to improve our understanding of the impacts of marketing orders.

The contemporaneous literature reviewed in the next section makes it clear that "disorderly marketing" is not an exact synonym for "low farm prices." Following this review is a section that presents an analytical model in which "disorderly marketing" as described in the contemporaneous literature can rationally occur. The model has the following characteristics: a monopsonist processor enters into a contract (possibly an implicit contract) with farmers; the contract sets a price to be paid for the commodity, but also permits the processor to exclude some farmers from the market; and in the optimal contract, non-price rationing can occur, and changes in consumer expenditure for the final product are absorbed by the processor rather than being passed along to the farmer. The section also presents a numerical example of a market with "disorderly marketing conditions." The section after that discusses why alternative contracts or patterns of ownership may not emerge to eliminate the disorderly marketing conditions. That section also points out how the classified price and pooling provisions of federal orders can lead to a Pareto improvement in welfare. The historical failure of cooperative marketing to solve disorderly marketing conditions is discussed in the context of the model.

What Is Disorderly Marketing?

In the early decades of the twentieth century, the term "orderly marketing" became associated with a farm movement led by Aaron Sapiro that encouraged formation of marketing cooperatives to bargain for higher farm prices (see Hamilton 1991, Chapter 1, for a description). But the terms "orderly" and "disorderly" are descriptors of markets, and are not perfect synonyms for "high" and "low" farm prices. For example, in 1934, John Black made a distinction between "orderly marketing" and increasing farm incomes:

> The Agricultural Adjustment Act clearly combines two distinct though not unrelated purposes. The first is to readjust and reorganize the agriculture of the nation in such a manner as to free it from the evils of…disorderly marketing that have affected it in the past….[T]he second objective of the program…[is] to provide immediate relief from the acute distress…by the prolonged depression [Black 1934, p. 56].

If the terms "orderly" and "disorderly" marketing are not equivalent to "high" and "low" farm prices, what do these terms mean? Waugh, Burtis, and Wolfe (1936) cited descriptions of disorderly marketing ["With perishable products, there may be a glut in one market while another market is undersupplied" (citing Converse 1935, p. 538)] and orderly marketing ["This is what is commonly called 'orderly marketing'.... The aim ... is to put on the market each day, week, or month, just the amount which the market will absorb"[2] (citing Clark and Weld 1932, p. 561)].

Clearly, the perception of disorderly marketing grew out of unpredictability of demand and supply. For perishable products, price swings cannot be reduced through storage. In addition to the price swings, disorderly marketing also entailed a form of non-price rationing. In periods of relatively abundant supply, some farmers were able to sell their output to the processor, while other farmers, willing to sell at the price paid by the processor, were excluded from the market, and were forced to sell on a secondary market. The existence of non-price rationing is demonstrated

[2] Of course, unless market demand is perfectly inelastic, there is no single "amount which the market will absorb."

in this description of milk marketing:[3] "[Farmers] are often surprised, if not indignant, at having milk returned...while their neighbors meet with no such misadventure. Return of milk...occurs through efforts of dealers to relieve themselves of a surplus" [U.S. Department of Agriculture (1873), excerpted in Rasmussen (1975, p. 1446)].

The existence (or perception) of non-price rationing is linked to the existence (or perception) of monopsony power on the part of processors. The political climate of the late nineteenth and early twentieth centuries was one in which considerable attention was paid to economic power of large companies or trusts. In this political climate, non-price rationing no doubt made farmers feel that they were helpless to compete with the monopsony processors. Since there are farmers willing to sell at the price established by the processor, farmers who do sell perceive that they have no bargaining power. It is this element that is referred to variously as "cut-throat competition" (Garver and Trelogan 1936), "unfair trade practices" (Herman 1937), "unfair methods of competition" (Herman 1937), and "unfair and discriminatory trade practices" (U.S. General Accounting Office 1985).

Clearly, a motivation for Sapiro's cooperative movement (where the term "disorderly marketing" originated—see above) was to give some countervailing market power to farmers. The reasons why cooperative marketing may fail as a solution to monopsony power are explained later in the paper. However, it is clear that the years leading up to the enactment of Federal Marketing Order legislation were a period of widespread concern about market power among processors of agricultural commodities. The growth in concentration of monopsony power in the dairy industry was described by Brown (1928): "Since 1923, a significant number of...dealers have either discontinued their business or have merged with others." Brown then warned against "abuses which monopoly makes possible" [Brown (1928, pp. 271–272), cited in Taylor and Taylor (1952, p. 739)].[4] The sense of inequitable treatment by the market was no doubt exacerbated by the fact that during periods of tight supply, the resulting higher consumer prices were not fully passed along to the farmers.

The Model

This section presents a model which is consistent with the above descriptions of disorderly marketing. First we present "stylized facts" that describe the conditions in an unregulated market. Then we incorporate those stylized facts into a mathematical model of optimizing buyers and sellers. We use the model to show that optimizing behavior can lead to market outcomes that resemble the descriptions of disorderly marketing. This lays the groundwork for exploring how price regulation—and in particular the classified pricing and pooling type of regulation found in federal market orders—can lead to Pareto improvements compared to the non-regulated market.

The stylized facts of a pre-regulatory milk market[5] are these:

- Farmers can produce a product in a high quality form (Grade A), or they can produce the product in a lower quality form (Grade B). The difference between Grade A and Grade B is that Grade A milk meets higher sanitary standards. The cost of producing Grade A is higher than the cost of producing Grade B.
- Grade B is suitable only for processing into a storable good (cheese, for example). Grade A can be sold in a non-storable form (fluid milk),

[3] During the late 1800s and early 1900s, milk marketing associations developed in an attempt to provide more order to milk markets. It was the failure of these associations that led most directly to agricultural marketing orders. However, to find a description of the market that is undisturbed by either regulation or marketing associations, it is necessary to go back to the late 1800s.

[4] Arguably, disorderly marketing conditions are even more likely in non-monopsony markets, since a monopsony internalizes what might otherwise be the externality of carrying surplus milk production in surplus months. Consider the situation described by Kriger (1998) for the New York City market in the 1930s. There, three large bottlers operated effectively as a cartel. "Because these firms dominated the New York metropolitan market, they had to carry excess fluid milk capacity, called surplus milk, in order to satisfy demand during the fall and winter when farmers produced less milk. The dilemma for the 'Big Three,' as they were known, was to keep retail milk prices high enough to pay for this excess fluid capacity. Smaller dealers, in contrast, carried no surplus and thus could afford to cut prices below that of the large dealers. While retail price cutting often offered the small milk handlers a competitive advantage, the practice of cutting prices locked them into an ongoing price war with the Big Three" (Kriger 1998).

[5] This paper focuses on disorderly marketing in markets for milk. Similar conditions hold for many fruits and vegetables which can be sold in a non-storable "fresh" form or a storable processed form (such as jam). See Calomiris and White (1994).

or can be processed along with the Grade B commodity into a storable good.

- A single monopsonistic processor of fluid milk buys from farmers and sells facing a downward-sloping demand curve. Cheese processors exist in a competitive market.
- Farm-level output has a random element, so it is impossible to hit precisely a targeted level of farm output.[6] (In reality, the difficulties in matching quantity supplied to quantity demanded result from fluctuations and uncertainties in both supply and demand; for mathematical simplicity, the model incorporates all of the uncertainty on the supply side.)
- Farmers are risk-averse, but processors are risk-neutral. (Again, for mathematical simplicity, we assume processors are risk-neutral rather than a more general assumption that processors are better able than farmers to undertake risk.)

These five aspects are incorporated into the model as follows:

Farmers. Farmers can produce Grade B milk. Farmers who choose to produce Grade B milk have output of $1 + u_i$, where u_i is a random variable with expected value zero, and $u_i > -1$. Producers of Grade B milk earn expected utility of $\overline{U}$. Alternatively, farmers can incur a cost of c (higher than the cost of producing Grade B milk) and produce Grade A milk. Here too the output is $1 + u_i$. For simplicity of exposition, we assume that u_i is the same for all farmers. We number the states $1 \ldots I$ so that $u_1 < u_2 < \ldots < u_I$, and denote the probability of u_i as ρ_i. Farmers are assumed to be risk-averse.

Processors. Farmers who produce Grade A milk hope to sell it to a fluid milk processor, or bottler. That processor is a monopolist-monopsonist who faces a demand curve $P = D(Q)$ and who has processing costs (exclusive of the cost of the raw milk from farmers) of $C(Q)$. The processor is risk-neutral.

Contractual provisions. The processor establishes the terms of the market by setting N (the number of Grade A farmers offered contracts), p_i (the price to be paid in state i), and α_i (the percentage of Grade A milk produced in state i that is processed as fluid milk in state i).[7]

The terms of the optimal contract are determined by solving the processor's problem to maximize expected profit:

$$\underset{N,\ p_i\ \alpha_i}{\text{Max}} \ \sum_i \rho_i [D(Q_i) \cdot Q_i - p_i Q_i - C(Q_i)],$$

subject to

$$\sum_i \begin{matrix} \rho_i \{\alpha_i U\ [p_i(1+u_i) - c] \\ +\ (1-\alpha_i)\ U(1+u_i - c)\} \geq \overline{U}, \end{matrix}$$

where $\alpha_i \leq 1$ and $p_i \geq 1$. The first constraint states that farmers must willingly choose to produce the Grade A product: they can earn at least as much expected utility under the Grade A contract as they can producing Grade B. The second constraint is that total milk processed by the bottler cannot exceed the total amount of Grade A milk produced. The third constraint states that the price paid by the bottler must be at least as high as the price (arbitrarily set at 1) paid by cheese processors to Grade B producers.

We derive in the appendix the characteristics of the equilibrium in which at least some Grade A product is produced. Characteristics 1, 2, and 5 from the appendix describe the general form of the optimal contract, which is illustrated in Figure 1. When Grade A supplies are extremely tight (farm output is $1 + u_{k^{**}}$ or less), Grade A price is higher than the Grade B price (the price ratio is greater than 1), and all Grade A farmers receive the higher price (each farmer has a probability of 1). When Grade A supplies are extremely plentiful (farm output is $1 + u_{k^*}$ or higher), Grade A farmers receive the same price as Grade B farmers (the price ratio equals 1). But when output is between these two extremes, Grade A milk receives a higher price than Grade B milk, but only some Grade A farmers receive this higher price. It is this last case (states between k^{**} and k^* in the

[6] In reality, milk markets are characterized not only by unpredictability of supply and demand, but also by strong patterns of seasonality in supply and demand.

[7] Here we assume that there are a large number of producers and that the processor purchases α percent of the milk produced by buying the entire output of α percent of the producers. The reason for this assumption will be discussed in the next section.

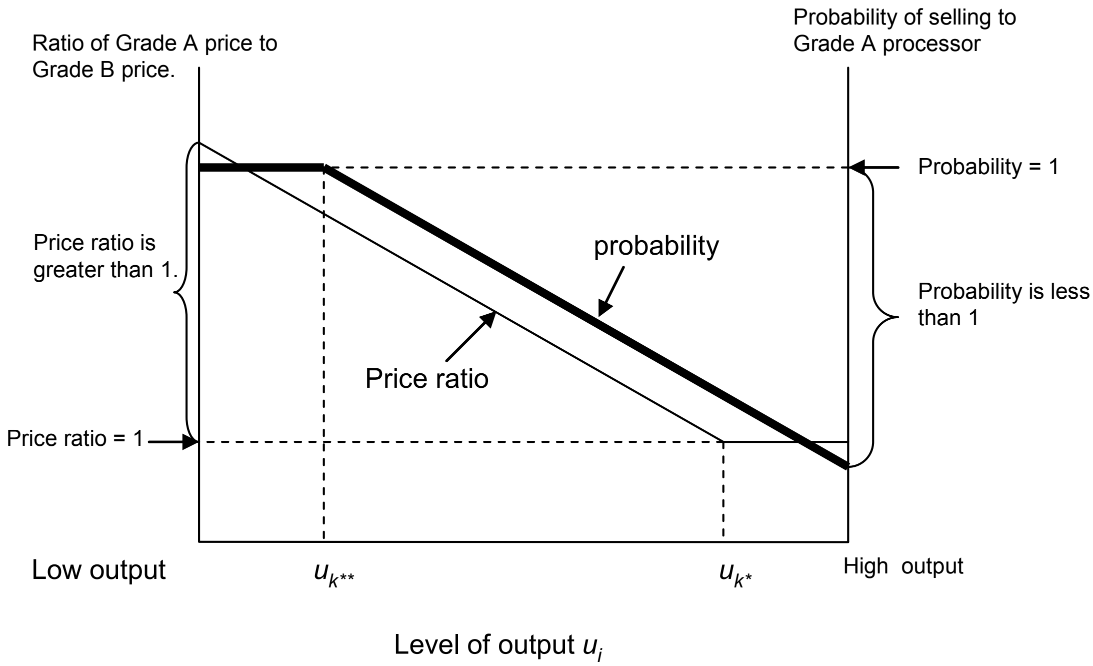

Figure 1. Disorderly Marketing in an Optimal Contract

figure) in which conditions prevail that are consistent with those ascribed to "disorderly marketing." There is a price premium for the Grade A product, but not all producers of the Grade A product are able to sell on the high price market.[8] [Again, quoting the U.S. Department of Agriculture (1873): "[Farmers] are often surprised, if not indignant, at having milk returned…while their neighbors meet with no such misadventure."]

Although the model here has been presented as an explicit contract between the bottler and the N Grade A producers, the equilibrium can be attained without explicit contracting if the bottler announces state-contingent prices and aggregate quantities prior to the farm production decision. If fewer than the optimal N farmers choose Grade A production, the expected utility of Grade A producers will be higher than that of Grade B producers, and farmers will enter Grade A production. As we will see below, the fact that this can be implemented without transaction costs may explain why this kind of contract design dominates other possible contracts.

The details of a market with disorderly marketing can be seen in a simple numerical example. The purposes of the numerical example are (i) to illustrate the meaning of the stylized facts, and (ii) to show the characteristics of the optimal unregulated equilibrium.

The stylized facts are incorporated as follows. In this example, Grade B milk costs 0.5 to produce, and can be sold for 1. Milk output per farm is shown in Table 1. It is more expensive to produce Grade A: Grade A milk costs 0.75 to produce. All farmers are risk-averse: a typical farmer's utility function is $U(y) = -2.2 + 5y - y^2$. The expected utility of producing Grade B milk (this is

Table 1. Output in Different States

State	Output $(1 + u)$	Probability
1	0.5	0.1
2	1.0	0.8
3	1.5	0.1

[8] In this respect, the marketing conditions described here are similar to those observed in labor markets in which labor unemployment occurs without downward adjustments in wages. See Fehr and Falk (1999) for a paper in this literature.

$\overline{U}$ in the above model) is 0. The demand curve facing the bottler-processor is $P_C = 1010 - 10Q$ and processing costs (exclusive of purchases of the raw milk) are $10Q$.

Under these assumptions, the characteristics of the unregulated equilibrium are as follows. The optimal number of Grade A farmers is 95.34, and the purchases and prices in each state are shown in Table 2. The characteristics of the optimal contract in each state from the bottler's point of view are shown in Table 3.

Several points are worthy of note in this example. First, non-price rationing is optimal. In state 2, the price paid by the bottler exceeds the price paid by cheese manufacturers.[9] However, not all farmers who produce Grade A milk are able to sell to the bottler at the higher price. It is not rational for the bottler to lower the farm price because the higher price is necessary to induce farmers to produce the better quality milk needed for bottling. In the example, as supplies become more plentiful at the farm level, farm prices drop. That is not the case for consumer prices, which increase as farm level supplies increase from state 2 to state 3. The reason is the following: in state 2, the bottler accepts more milk than the quantity that would maximize profits; the higher quantity increases the chance that farmers will participate in the higher priced market, and therefore the price paid by the bottler drops; in state 3, however, the price cannot drop any further since the bottler must at least meet the competition of cheese plants.

Second, farm-level prices are a lot more volatile than are consumer prices. On the other hand, farm incomes of *producers who ship to the bottler* are quite stable. Grade A farmers do suffer when they are excluded from the market for bottled milk: whenever they ship to cheese plants they have lower utility than that of Grade B farmers because the costs of producing Grade A are higher. The example illustrates why a farmer might perceive these conditions as unfair: in some circumstances when producer prices fall considerably, consumer prices are nearly unchanged (from state 2 to state 3). In other circumstances, price increases at the consumer level (the \$5.55 increase when moving from state 2 to state 1) are not fully reflected in producer prices (a \$1.63 increase). And in 90 percent of the cases (states 2 and 3), the farmer who is selling to the bottler feels powerless to negotiate a higher price because there are many other farmers with Grade A milk to sell who are being excluded from the fluid market. Finally, in this model, consumer markets always clear and consumers consume the quantity corresponding to the market price on the aggregate demand curve; nevertheless, we can see how consumers may perceive a "milk shortage" in state 1 (the shortest supply state), since consumer prices spike, relative to prices in states 2 or 3.

Market and Regulatory Responses to Disorderly Marketing

The previous section shows how an unregulated market can result in nonprice rationing consistent with the contemporaneous descriptions of "disorderly marketing." Those contemporaneous descriptions were not simply observations; they served as an impetus for policy action in the form of Federal Market Orders. In this section, we use the above model as a basis for exploring two related questions. First, does the above model entail a market failure that government action (such as those included in Federal Market Order regulations) can correct? Second, do alternative market-oriented institutional arrangements exist that would improve on the contract presented above without requiring any government action?

The contract described above illuminates the nature of the market imperfection that might exist in an unregulated spot market. The processor announces prices that will prevail in every state of production; farmers know that in some states, processors will not purchase all available supplies; therefore, farmers, as they make their decisions about whether to produce Grade A or Grade B milk, take into account the probability of being excluded from the high price fluid market. The processor optimally transfers some of the risk associated with output levels back to farmers, even though the processor is risk-neutral and the farmers are risk-averse. This is the essence of the market failure, creating a situation in which marketing orders can increase welfare.

In particular, the regulatory framework used in Federal Milk Orders directly addresses the market

[9] In this example, price = 1 in state 3. However, it is easy to construct examples (by raising the cost of producing Grade A milk, for example) in which the bottler's price exceeds the cheese manufacturer's price in every state. It is also easy to show, as well as intuitively obvious, that $\alpha = 1$ in at least one state.

Table 2. Optimal Contract Provisions in Each State

State	α	P	Income if Sold to Bottler	Income if Sold for Cheese	Utility if Sold to Bottler	Utility if Sold for Cheese	Utility of Grade B Producers
1	1	2.76	.63	not relevant	0.553	not relevant	-0.22
2	0.5237	1.38	.63	.25	0.553	-1.012	0.04
3	0.3493	1	1.5	.75	0.725	0.988	0.18

Table 3. Prices, Quantities, and Profits in Each State

State	Quantity Processed	Producer Price	Consumer Price	Profits Plus Fixed Costs
1	47.67	2.76	523.45	24,337.45
2	49.93	1.38	500.69	24,431.74
3	49.95	1	500.5	24,450.53

failure identified in the last paragraph. A system of "classified pricing and pooling" has been used by Federal Milk Orders since their inception in the 1930s. Under this system milk processors do not pay farmers directly, but pay into a pool administered by the Order administrator. The price paid by the processor depends on how the processor uses the milk. A bottler pays a high ("Class I") price; a cheese manufacturer pays a low ("Class III") price.[10] The pool distributes this money by paying all Grade A farmers a common ("blend") price.[11]

This system of classified pricing and pooling has the potential for a Pareto improvement over the market solution presented above. The pooling provisions eliminate an individual farmer's risk of being excluded from the Grade A market. Holding all prices and quantities constant for the bottler, the expected utility of Grade A farmers can be increased by the pooling of proceeds in each state, because farmers are risk-averse (U is concave) and, by Jensen's inequality,

$$U\left(\alpha[p(1+u)-c] + (1-\alpha)\,[(1+u)-c]\right) >$$
$$\alpha U\left([p(1+u)-c] + (1-\alpha)\; U\;[(1+u)-c]\right).$$

The surplus (difference between left-hand side and right-hand side) created by the pooling could be distributed among the farmers, consumers, and the processor; but the existence of a surplus lends credibility to the claim that the Federal Order Program is (or can be) beneficial to consumers.

The contract described in the previous section—in which the processor optimally chooses to accept delivery of output from some qualifying farmers and to reject delivery from others—is consistent with the descriptions of disorderly marketing conditions. But we need to explore further the possibility that other contract designs might evolve to eliminate disorderly marketing. In particular, contracts in which the processor bears all of the risk would be a preferred alternative to the "spot market" equilibrium described above. It is easy to find theoretical contractual solutions to the disorderly marketing problem. However, each of these "orderly marketing contracts"

[10] In a number of respects, the model presented here is a substantial simplification of reality. For example: an intermediate Class II price is paid by processors of yogurt, ice cream, fluid cream, etc.: butter and non-fat dry milk producers pay a Class IV price slightly different from the Class III price; payments to individual farmers are adjusted to reflect the butterfat and protein content of the milk.

[11] Obviously, administering this classified pricing and pooling system is costly, and these costs are financed by a levy on each hundredweight of milk regulated (not by general tax revenues). For there to be a true welfare gain from the program, these costs must be less than the gain shown in the inequality below. It is a fair question to ask why the costs associated with the quasi-governmental order program are less than the monitoring costs that would allow a bottler to institute alternative contract B described in the above section. It may be that firms are more open with "government" inspectors (auditors) than with those from other private firms; it may be that centralizing the monitoring operation in a single regulatory body avoids wasteful duplication of monitoring by various private agents. In a more complex and realistic model, outputs of each farmer might not be directly observable and might require monitoring of shipments to several different processors, making monitoring by one processor difficult. This is beyond the scope of the present paper.

requires some transaction costs—costs associated with verification of contract performance. If these costs are high enough, the orderly marketing contracts will be inferior (from the standpoint of the processor) to the disorderly marketing contracts. For the purposes of this paper, it is sufficient to show that disorderly marketing of the type described here *can* exist under some (arguably realistic) circumstances. For the purposes of public policy, and the debate about whether Marketing Orders can be economically justified, a much more careful evaluation must be made of the transaction costs and the economic feasibility of alternative *orderly* marketing contracts.

Two alternative contracts are obvious. In the first alternative (call it contract X), the processor sets α as above, but takes that proportion from every producer, rather than taking the entire production of α percent of the producers and none of the production of the remaining producers. In the second alternative (call it contract Y), the processor pays farmers a flat fee and takes delivery from as many farmers as needed to set output at a profit-maximizing level.

Contract X could be implemented in two ways. Grade A farmers could ship all of their milk to the bottler, and the bottler could then re-ship the excess milk to a cheese manufacturer. It is easy to see how high transportation costs could make this alternative impractical. Or, the bottler could contact all Grade A farmers and inform each farmer how much milk to ship to the bottler. This too involves costly record-keeping and communication. A modified approach[12] would have farmers ship to the bottler or the cheese plant, as directed by the bottler, and would have payment made from the cheese plant to the *bottler*.

Contract Y requires monitoring of quality of output for farmers who do not ship to the bottler. In the example of the last section, in states 2 and 3 there are many farmers who produce Grade A who do not ship to the bottler. Contract Y would have the bottler pay a fixed payment to all N farmers, regardless of whether their milk was shipped to the bottler or not. Without monitoring, Grade B farmers could falsely claim that they were non-shipping Grade A farmers, and could request payment from the bottler. If the cost of this monitoring is sufficiently high, the Contract Y alternative will also be impractical. Neither of these contract forms have been observed in the real world, and there are two likely reasons: since the 1930s the Federal Order program has made private contracts such as these unnecessary; prior to the 1930s it seems likely that transaction costs made these infeasible. However, as this discussion of alternative contracts and transaction costs makes clear, the model above does not prove that disorderly marketing is an inevitable condition. As the structure of transaction costs changes, these alternative contracts may serve as a free-market (or non-governmental) solution to disorderly marketing. For example, a reliable publicly funded system of certifying Grade A farmers would substantially reduce transaction costs associated with contracts like Contract Y.

A final non-regulatory solution to disorderly marketing might be the development of a classified pricing and pooling system operated by a marketing cooperative without government assistance. Cooperative marketing was the first solution proposed to the disorderly marketing problem. A cooperative of all Grade A producers in an area could be formed to undertake the pooling function, with all members of the cooperative receiving the same price regardless of how any individual's milk was sold.

The above model gives insight into the reason why cooperative bargaining alone cannot achieve the same welfare gains as the Marketing Order program. Such an arrangement is inherently unstable. Any one member of the cooperative has an incentive to break with the cooperative and bargain separately with the bottler. The bottler is able to offer that farmer a contract with a price well below the price the bottler pays to the cooperative, but with an assurance that that farmer will always ship to the bottler ($\alpha = 1$ in all states). The farmer will accept the offer as long as the price is above the pooled price paid by the cooperative to its members.

In fact, this describes the historical experience of marketing cooperatives before the advent of Marketing Orders. As described by Mortensen (1940), "In the early 1920's producers selling

[12] A system like this is used in some fresh produce markets where a single collector gathers farm produce from multiple farmers and then makes multiple sales to different users. Here too, the fact that such an arrangement did not emerge in milk markets is attributable to the size of transaction costs. The existence of a three-way contract between the bottler, cheese plant, and dairy farmer, complicates enforcement by creating incentives for any two of these to collude against the third.

fluid milk to cities had organized … effective producers' associations whose primary function was to bargain with city milk distributors [bottlers] for the farm price to be paid for milk sold for fluid consumption. In 1931 and 1932 ... the situation became more difficult to control. The dairy farmer who had been selling his product to creameries [butter manufacturers], cheese factories, or condenseries for manufacturing purposes … [began] distributing it directly to consumers in fluid form or … selling it through a milk distributor" (Mortensen 1940, pp. 5–6). A contemporaneous account describes the breakdown of cooperatives as follows: "By 1933, the well organized fluid milk markets were confronted with serious problems as a result of surplus milk seeping into the cities to undercut prices set by the organized interests controlling the regular markets" (Garver and Trelogan 1936, p. 610). Kriger (1998) describes the failure of cooperatives to solve the disorderly marketing problem in the New York City area, which ultimately led to "milk strikes"—with farmers dumping their own (and other farmers') milk.

Conclusions

The stated purpose of the Federal Market Order program was not simply to raise farm prices; it also was intended to reduce or eliminate "disorderly marketing conditions." Modern economic analyses of marketing orders have by and large ignored the possibility that an inherent market failure (these "disorderly marketing conditions") may exist and may be an economic justification for the existence of marketing orders. This paper explores that possibility by developing a model with the following characteristics: (i) the commodity is produced by risk-averse farmers in different qualities, with higher quality being more costly to produce; (ii) the commodity is not storable in its high quality form; (iii) the processor of the high quality form has monopoly-monopsony power; and (iv) farm output is stochastic so that it is impossible to match actual farm output with a target quantity for processing.

Under these conditions, the optimal choices of the processor (expressed as an explicit contract offered to farmers or as implicit understanding of the equilibrium conditions by farmers, which leads to a "spot market" equilibrium) have characteristics that may be perceived as disorderly marketing conditions: non-price rationing occurs in the sense that some farmers who are willing to sell to the higher price market are excluded from that market; this fact makes it more difficult for farmers to act collectively; resulting farm prices are more voluble than are consumer prices. This model also helps explain why marketing orders use classified pricing and pooling as a regulatory mechanism and why voluntary cooperative arrangements by farmers may be inherently unstable in the absence of a regulatory framework.

The modern literature on imperfect information gives us insight into the perceived problem of "disorderly marketing" that led to the adoption of the Federal Milk Market Order program. The classified pricing and pooling provisions create a regulatory solution that is superior to the "free market" outcome. Although superior "free market" or unregulated contracting solutions exist in principle, whether or not the market would support these alternative solutions in the absence of marketing orders depends on transaction costs associated with alternative contracts. Economic studies of marketing orders should recognize the possibility of inherent market failure and should be more cautious about assuming that the unregulated equilibrium is a first-best alternative.

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APPENDIX

Mathematical Derivation of Characteristics of an Optimal Contract

Recall from the text that u_i is the random component of production in state i, ρ_i is the probability of state i, N is the total number of farmers offered the contract, Q_i is aggregate output in state i, p_i is the price paid under the contract in state i, α_i is the percentage of the aggregate commodity that is bought by the processor (or, described differently, α_i is the probability that an individual farmer will participate in the higher priced Grade A market), c is the farmer's additional cost of producing Grade A output, C is the processing cost function, D is consumer demand for the processed good, and $\overline{U}$ is the reservation level of utility that is earned by a farmer who produces Grade B output.

Since $Q_i=\alpha_i N(1+u_i)$, the maximization problem is

$$\underset{N,\ p_i\ \alpha_i}{\text{Max}}\ L=\sum_i \rho_i \begin{bmatrix} D\left(N\alpha_i(1+u_i)\right)\cdot\left(N\alpha_i(1+u_i)\right) \\ -p_i\left(N\alpha_i(1+u_i)\right) \\ -C\left(N\alpha_i(1+u_i)\right) \end{bmatrix}$$

$$+\ \lambda\left[\sum_i \rho_i \begin{Bmatrix} \alpha_i U[p_i(1+u_i)-c] \\ +(1-\alpha_i)U(1+u_i-c) \end{Bmatrix} -\overline{U}\right]$$

$$+\ \sum_i \mu_i\left[1-\alpha_i\right]+\sum_i \nu_i\left[p_i-1\right],$$

where λ, μ_i, and ν_i are Lagrangian multipliers associated with the constraints.

The first-order conditions associated with the above are

$$\text{(A1)}\quad \frac{\partial L}{\partial N}=\sum_i \rho_i\psi_i\alpha_i(1+u_i)\le 0,\quad \frac{\partial L}{\partial N}N=0,$$

$$\text{(A2)}\quad \frac{\partial L}{\partial \alpha_i}=\rho_i\psi_i N(1+u_i)$$
$$+\ \lambda\rho_i\begin{bmatrix} U\left(p_i(1+u_i)-c\right) \\ -U(1+u_i-c) \end{bmatrix}$$
$$-\ \mu_i\le 0,\quad \frac{\partial L}{\partial \alpha_i}\alpha_i=0,$$

$$\text{(A3)}\quad \frac{\partial L}{\partial p_i}=-\rho_i\alpha_i N(1+u_i)$$
$$+\ \lambda\rho_i\alpha_i(1+u_i)U'\left(p_i(1+u_i)-c\right)$$
$$+\ \nu_i\le 0,\quad \frac{\partial L}{\partial p_i}p_i=0,$$

where

$$\psi_i = \frac{d\Pi_i}{dQ_i}$$

for

$$\Pi_i = [D(Q_i)\cdot Q_i - p_i Q_i - C(Q_i)],$$

and by assumption

$$\frac{d\psi_i}{dQ_i} = \frac{d^2\Pi_i}{dQ_i^2} < 0\,.$$

In addition, the constraints require

$$\text{(A4)}\qquad \frac{\partial L}{\partial \lambda} = \sum_i \rho_i \alpha_i \begin{Bmatrix} U\left(p_i(1+u_i)-c\right) \\ -\,U(1+u_i-c) \end{Bmatrix} - \overline{U} + \sum_i \rho_i U(1+u_i-c) = 0,$$

$$\frac{\partial L}{\partial \mu_i} = 1-\alpha_i \geq 0, \qquad \frac{\partial L}{\partial \mu_i}\mu_i = 0,$$

$$\frac{\partial L}{\partial \nu_i} = p_i - 1 \geq 0, \qquad \frac{\partial L}{\partial \nu_i}\nu_i = 0.$$

The participation constraint (A4) must be binding. If not, the processor could increase expected profits by reducing payments to farmers in some states. Also, from (A4) and from the fact that c is greater than the cost of producing Grade B, it is obvious that $p_i > 1$ in at least one state.

The characteristics of the equilibrium in which at least some Grade A product is produced can be derived from the complementary slackness conditions listed above.

Characteristic 1. Let k be a state in which $p_k = 1$. For all states $j > k$, $p_j = 1$.

PROOF. $p_k = 1$ and $\nu_k \geq 0$ implies

$$U'\,[p_k(1+u_k)-c] \leq \frac{N}{\lambda}\,.$$

For $j > k$, since $p_j \geq p_k = 1$,

$$p_j(1+u_j) - c > p_k(1+u_k) - c,$$

and so under risk aversion,

$$U'\,[p_j(1+u_j)-c] < U'[p_k(1+u_k)-c] \leq \frac{N}{\lambda},$$

requiring $\nu_j > 0$.

Characteristic 2. Define k^* as the largest state in which price is greater than 1 (so $p_1 \ldots p_{k^*}$ are greater than 1 and $p_{k^*+1}, \ldots, p_I = 1$). Farm income for farmers shipping to the processor is the same in all states 1 … k^*.

PROOF. From (A3), in all states where $\nu_j = 0$,

$$U'\,[p_j(1+u_j)-c] = \frac{N}{\lambda}\,.$$

Therefore, farm income $[p_j(1+u_j)-c] \equiv y^*$ is the same in all of these states.

Characteristic 3. Define k^* as in Characteristic 2. For $j > k^*$, either processor profits are maximized in that state, or $\psi_j > 0$ and $\alpha_j = 1$.

PROOF. For $j > k^*$, $p_j = 1$, and (A2) becomes

$$\rho_j \psi_j N\ (1+u_j) \leq \mu_i\,.$$

For this to hold, either $\psi_j = \mu_i = 0$, which means

$$\frac{d\Pi_j}{dQ_j} = 0$$

(i.e., profits are maximized in the state), or $\psi_j \geq 0$ and $\mu_i > 0$, which means $\alpha_j = 1$. (Since ψ is decreasing in Q, when $\psi > 0$, setting $\alpha = 1$ moves the firm as close as possible to profit-maximization within the state.)

Characteristic 4. In states $i \leq k^*$, either $\alpha_i = 1$ or ψ_i (evaluated at $\alpha_i = 1$) < 0.

PROOF. From (A2),

$$\lambda\rho_i\left[U\left(p_i(1+u_i)-c\right) - U(1+u_i-c)\right] \leq -\rho_i\psi_i N(1+u_i) + \mu_i.$$

The left-hand side is positive, since $p_i > 1$. Therefore, $\psi_i < 0$ or $\mu_i > 0$.

Characteristic 5. Suppose that for some state j, $\alpha_j < 1$. Then $\alpha_i < 1$ for all states $i > j$.

PROOF A. If $j > k^*$ (as defined above), then from $\alpha_j < 1$ and (A2), we know that $\psi_j(u_j, \alpha_j < 1) \leq 0$, so $\psi_j(\alpha_j = 1) < 0$, and $\psi_i(\alpha_i = 1) < 0$ for any state $i > j$. Therefore, as described in Characteristic 3, $\alpha_i = 1$ cannot be optimal.

PROOF B. If $j = k^*$, then $\alpha_j < 1$ implies $\psi_j(\alpha_j = 1) \leq 0$ from Characteristic 4; therefore, $\psi_i(\alpha_i = 1) < 0$ for $i > j$ and Characteristic 3 implies $\alpha_i < 1$.

PROOF C. If $j < k^*$, then $\alpha_i < 1$ for all $j \leq i \leq k^*$. To show this, $\alpha_j < 1$ implies $\mu_j = 0$, and (A2) is

$$\text{(A5)} \quad \psi_j N(1+u_j) + \lambda \begin{bmatrix} U\left(p_j(1+u_j) - c\right) \\ -U(1+u_j - c) \end{bmatrix} \leq 0 .$$

Suppose there is some i in the range defined so that $\alpha_i = 1$. For this i, (A2) is

$$\text{(A6)} \quad \psi_i N(1+u_i) + \lambda \begin{bmatrix} U\left(p_i(1+u_i) - c\right) \\ -U(1+u_i - c) \end{bmatrix} = \frac{\mu_i}{\rho_i} > 0 .$$

Since $i > j$ and $\alpha_i > \alpha_j$, then $\psi_i < \psi_j < 0$, and $\psi_i(1 + u_i) < \psi_j(1 + u_j) < 0$. Since both i and j are less than or equal to k^*, $p_i(1 + u_i) - c = p_j(1 + u_j) - c$ by Characteristic 2.

Subtracting (A5) from (A6) yields

$$[\psi_i N(1+u_i) - \psi_j N(1+u_j)]$$
$$+\lambda\ [U(1+u_j - c) - U(1+u_i - c)] \geq \frac{\mu_i}{\rho_i}.$$

Both terms on the left-hand side are negative, but the right-hand side is positive, creating a contradiction, therefore $\alpha_i < 1$.

PROOF D. Combining proof parts (B) and (A) with the result in (C) completes the proof.