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**Marketing Organic Milk in the United States: Findings from the *Agricultural
Resource Management Survey of 2005***

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Marketing Organic Milk

The dairy industry is an important agribusiness sector in the United States, with \$27.4 billion in total sales of dairy products at farm level in 2004 (Miller and Blayney, 2006). Dairy also represents the largest and fastest-growing segment of the organic sector (Dimitri and Greene, 2002). Organics is also of growing importance within U.S. dairy economy. In 2005, sales of organic milk and cream were approximately \$1 billion, equivalent to 6% of retail milk sales in the U.S., and 25% higher than in 2004 (Dimitri and Venezia, 2007). Demand for organic dairy has been fueled by a general growing interest in organic products due to a complex mix of consumer concerns of food safety, nutrition, the environment, and other factors.

Expectations of higher returns in organic dairy relative to conventional dairy farming, as well as increased social and environmental concerns, have contributed to growth of organic milk production (Blank and Thompson, 2004). The standardization of rules for the production, processing and distribution of organic products as implemented by USDA's National Organic Program in 2002, has also facilitated the growth of organic production in the U.S. In 2005, approximately 1% of the dairy cows in the U.S. were certified organic (USDA, ERS, 2006).

Little is known about the production and marketing practices of the organic dairy sector, not in small part because the industry is so new. In particular, little work to date has systematically addressed the decisions made by dairy farmers to produce organic milk, how the organic sector may differ in its marketing practices, or premiums paid to farmers for organic milk. This paper seeks to fill this void in the literature by analyzing the 2005 Agricultural Resource Management Survey Dairy Costs and Returns Report.

The 2005 survey includes a representative sample of U.S. dairy farms, including a targeted oversample of organic dairy farms. Thus, these data provide the first comprehensive view of organic dairy farms in the United States.

We present summary statistics that provide, for the first time, a snapshot of organic dairy farms in the United States, with comparisons to the conventional dairy sector. In addition, we also present preliminary results from analyses of organic marketing practices, including assessment of currently held beliefs about marketing organic or niche products in general, such as 1) organic dairies are more likely to sell milk direct to consumers, and 2) organic dairies are more likely to market their milk via contracts. To our knowledge this is the first econometric analysis of choice of market channel in U.S. dairy markets, conventional or organic. Also, we use a hedonic model of farm prices for milk to estimate premiums for organic and other milk attributes.

Farm Level Marketing of Organic Products

Most of the research on the marketing of organic food products has focused on consumer demand analysis and the marketing of fruits and vegetables (Oberholtzer, Dimitri, and Greene 2005; Thompson 1998). The marketing studies on organic dairy have also focused on retail consumer demand, retail consumer demographics and the information content of organic labels. (Kiesel and Villas-Boas 2007; Dhar and Foltz 2005; Dimitri and Venezia, 2007). Dimitri and Venezia (2007) find that the retailing of organic milk has evolved from being sold mostly in specialty shops in the early 1990s to being available in a wide range of venues including grocery stores and supercenters. This is the first paper to examine farmgate marketing decisions by organic dairies.

The choice of marketing outlet by organic produce farmers has been studied by utilizing a bargaining framework (Park and Lohr, 2006) and a transaction costs framework (MacInnis, 2003). In general these papers have shown that organic farmers face considerable barriers to entry imposed by the market structure, lack of marketing infrastructure. MacInnis (2003) found that organic farmers that have transitioned from conventional farming face lower transaction costs in marketing their products than farmers who have always been organic. It is also shown that organic farmers who utilize a diverse portfolio for marketing their produce tend to have higher incomes.

Organic milk is a highly differentiated product with a government-sponsored certification label that guarantees no usage of antibiotics and hormones in livestock production, and the use of organically grown feed and pasture. For differentiated farm products such as organic milk, the theory of contracts posits that producers can benefit from using contracts since these can reduce income risks caused by price and production variability, ensure market access, and provide higher returns. For buyers, contracting is a way to ensure the proper flow of products, to assure the supply of differentiated products, to ensure traceability for health concerns, and to guarantee certain methods of production as in organic milk farming. The use of contracts facilitates vertical coordination and provides incentives for products geared to new consumer demands, such as organic products (MacDonald et. al., 2004).

Data and Descriptive Statistics

This research analyzes data from the 2005 Agricultural Resource Management Survey (ARMS) Dairy Costs and Returns Report. These data were collected through a

survey that was jointly implemented by the National Agricultural Statistics Service and the Economic Research Service of the USDA. The survey was conducted in 24 major dairy states. The sample is a multi-frame, probability based survey in which farms are randomly selected from groups of dairy farms stratified by farm size. Each sampled farm represents a number of farms that are similar; this number representing the survey expansion factor or weight. Data is collected on farm and operator characteristics, the revenue and costs of production, marketing practices, production technology, and management practices. The total dairy sample had 2,987 farms, including 737 samples targeted organic farms. After accounting for non-response and missing data, there were a total of 1,814 farms, including 352 organic farms. For this study, only data pertaining to farms that milked 10 cows or more in 2005, and that operated for 12 months of the year were utilized, which resulted in 348 organic and 1,411 conventional dairy farms with completed questionnaires. We first present summary statistics in order to provide some detail on the production and marketing practices of organic dairy, and as a way of comparing the organic and conventional dairies in terms of a range of production and marketing practices. The means and the standard errors of the comparison variables are presented. For this analysis, the weighting scheme of the ARMS dataset and the jackknife procedure to estimate standard errors is employed. Weighting of the data is necessary if the purpose is to describe the characteristics of the population. In some cases, only the behavior of the sample is of interest and thus the weighing scheme may distort the estimates (Dubman, 2000). However, the ARMS dataset uses a stratified sample, and using unweighted statistics would not provide generalizable results.

We also use the data to evaluate relationships between the use of contracts (written and forward) and the principal channels by which milk is sold: to a cooperative of which the farmer is a member, to cooperative of which the farmer is not a member, to other processors/haulers/brokers, and direct to consumers. This analysis is done for both organic and conventional farms and presents the weighted results.

Summary statistics reported in Table 1 reveal that conventional and organic dairy farms differ in several important aspects. On average, organic dairy farms are smaller in terms of herd size. In 2005, average farm size was 86 cows on organic farms and 142 cows on conventional farms. Given the difference in farm size, it is not surprising to find that annual milk production on organic farms was also less than that on conventional farms. Average milk per cow was also less on organic farms than on conventional farms, although it is yet to be determined how much of this difference is due to organic production practices *per se* as opposed to, for example, efficiencies associated with herd size.

In terms of total acreage, while organic farms also tended to be smaller, they utilized more acres of land per cow than conventional farms, which is expected due to the pasture requirements for a certified organic farm. For organic farms, approximately one half of total operated acres are certified organic for the production of feed items and pasture. Conventional dairy farms are more likely than organic farms to generate revenue by selling other non-dairy products, primarily corn, soybeans, and forages in addition to milk.

In terms of history, farms under conventional and organic production seem to have been in the dairy industry for about the same time. Yet, on average, organic farms

have been certified organic as such for approximately 4 years. Most organic farms surveyed have converted from conventional production practices, while approximately 11% of organic dairy farms appear to be new entrants into dairy farming.

In terms of operator characteristics, organic dairies are quite similar to conventional dairies. The age of the main operator is approximately 50 years, on average, for each type of farm. Human capital as measured by attainment of a college degree is also similar across types of farms.

There are differences in terms of how farms market their milk. A smaller percentage of organic farms appear to be members of a cooperative. Organic dairies are more likely to make use of written contracts with milk buyers and are more likely to use a forward contract when offered by a buyer than conventional dairies. One reason organic farmers may be more likely to use written contracts and establish prices with forward contracts is that they are seeking assurance of a marketing outlet for their differentiated product.

We also calculated the frequency of use of a written contract for farmers selling to three types of buyers: cooperative of which the farmer is a member, cooperative of which the farmer is not a member and non-cooperative buyers which could be a milk processor or milk haulers/brokers (Table 2). Organic dairy producers are significantly more likely than conventional producers to have a written contract with their milk buyer. Since the organic dairy market is still a small market with only a few buyers, it makes sense that organic milk producers and buyers would have a more formal marketing relationship than the conventional market where there are many more producers and buyers. Regardless of the type of buyer, over 70% of organic milk producers had a written contract with their

buyer. In the conventional milk market, there was more variation in the use of written contracts between the types of buyers. Conventional milk producers who sell to a cooperative of which they are a member are significantly more likely to report they have a written contract with their buyer than producers who sell to cooperatives of which they are not a member or to non-cooperative buyers.

Similar to written contracts, organic dairy farmers are more likely to accept forward contracts when these are offered by their buyers (Table 3). Regardless of type of buyer, 50% or more of the organic farmers that are offered forward contracts accept them to market their milk. On the other hand, at most 14% of conventional farmers accept a forward contract when offered by a non-cooperative buyer. There appears to also be more variability in the acceptance of forward contracts depending on the type of buyer by conventional farmers. Conventional farmers that sell to a non-cooperative buyer are more likely to use forward contracts than farmers who sell to cooperatives.

Evaluating Choice of Marketing Channel by U.S. Dairy Farms

The choice of market channel is modeled as a function of farm characteristics and operator characteristics through a multinomial logit model. Thus the probability of farm i choosing to sell its milk to buyer type j is modeled as a function of farm characteristics as follows:

$$\Pr(Y_i = j | x_i) = \frac{e^{\beta_j x_i}}{1 + \sum_{k=1}^J e^{\beta_k x_i}}$$

where j indexes type of milk buyer (j = cooperative of which the farmer is member, cooperative of which the farmer is not a member, other processors/brokers/haulers, and

direct to consumers), and x_i is a vector of farm and operator characteristics, and β_j is a vector of parameters to be estimated. Dummy variables are used to identify organic dairy farms, farms in transition from conventional to organic production, and farms whose operators have earned a college degree and beyond, whether the farm is diversified (i.e. also receives revenue from crop sales), and whether the farm is located in the western region (AZ, CA, NM, OR, WA), eastern region (ME, NY, PA, VT,VA) Midwestern region (ID, IL, IN, IA, KY, MI, MN, MO, OH, WI), or Southeastern region (FL, GA, TN, TX).

The estimated multinomial logit model for the choice of market channel is presented in Table 4. All parameter estimates are expressed relative to the choice of marketing through a cooperative of which the farmer is a member. This benchmark was utilized since more than 50% of all organic and conventional farmers sell their milk to the cooperatives of which they are members. Age of the farm, whether or not a dairy farm is transitioning from conventional to organic, and education of the main operator have no significant effect on the choice of marketing outlet. On the other hand, herd size appears to affect choice of marketing outlet. Farms with larger herds are more likely to sell directly to consumers. In contrast, farms with larger herds are less likely to sell to cooperatives of which they are not members and to private (i.e., non-cooperative) handlers. Organic farms are also more likely to sell direct to consumer than to cooperatives of which they are a member. No significant differences were found between the other two marketing outlets and the benchmark for organic dairies. Dairy farms that are diversified into crop sales are less likely to sell their milk to non-cooperative milk processors/brokers/haulers than to cooperatives of which they are members. In terms of

location, it was found that farms in the southeast are less likely to sell their milk to non-cooperative milk handlers than to cooperatives of which they are members compared to farms in the West.¹

A Hedonic Model of Farm Prices for Milk

Finally, we specify and estimate a hedonic model in order to evaluate the determinants of farm prices of milk. Factors that are expected to affect the price of milk include organic classification, quantity of milk sold, quality attributes of milk, use of a written contract, and geographic location of the farm. Dummy variables are used to indicate milk classified as organic, use of a written contract between the milk producer and the buyer, and region. The quality variables for milk included in this analysis include percent butterfat content, percent protein content, percent other solids content, and somatic cell count. Interactions between organic milk and regions are also included to estimate premiums paid for organic milk by geographic region.

Results from the hedonic milk price regression are presented in Table 5. The model was statistically significant with an R-squared value of 0.70, capturing a significant portion of the variability of milk prices in the U.S. Under the particular combination of dummy variables used, the intercept can be interpreted as the average price of conventional milk in the western states. It was found that conventional farmers in the West obtain on average \$13.88 per cwt of milk that they sell. This compares to an annual average All Milk Price of \$13.90 reported for California in 2005 (Gould 2007). Conventional farmers in the Southeast, East and Midwest receive prices that are, on

¹ While there are different types of dairy cooperatives such bargaining, processing, etc., we cannot distinguish between these types of cooperatives because the survey only asked if the dairy farmer sold to a cooperative but did not ask about the type of cooperative.

average, higher than prices in the West by \$1.44, \$1.49 and \$0.69 per cwt., respectively. These location premiums are due at least in part to regional biases enforced by Milk Marketing Order regulation (e.g., Cox and Chavas), and may also reflect regional differences in cooperative negotiating power.

In the West, the organic premium is \$6.26 per cwt., a 45 percent mark-up over the conventional milk price. However the organic premium differs by region. The organic premium in the eastern states is on average \$7.57 per cwt., or \$1.31 more than in the western states. In the Midwest, the premium for organic milk is \$5.41 per cwt, or \$0.85 less than in the western states. (The data set does not include any organic dairy farms in the Southeast).

The effect of several quality milk factors was significant, and all had the expected sign. Farmers obtain premiums for butterfat and protein content. For every percent increase in butterfat content, farmers receive a premium of \$0.20 in the West, but this effect was not statistically significant at the 5% level. The other solids content and somatic cell count, as expected, have a significant negative effect on the price of milk. For every increase one percent increase in other solids, the price of milk decreases by \$0.05. For every one thousandth increase in somatic cell count, the price of milk per cwt decreases by \$0.0006 (in the western region).

Whether or not the farmers use a written contract with their buyer, did not have a statistically significant effect on the price of milk.

Conclusion

The increase in demand for organic milk products at retail level has offered dairy farmers a new market for a differentiated milk product. Certified organic milk is produced under stringent production practices, which guarantee the prohibition of antibiotic and hormone usage in milk production, and assures the use of organically grown feed and pasture. Organic dairy farmers have either transitioned from conventional production or are entrants to this relatively new industry, with the expectations of higher prices and higher returns. Yet little is known about this new sector. This study uses the 2005 ARMS data set to provide for the first time a systematic characterization of some of the production and marketing practices of organic dairy farms.

Summary statistics reveal interesting and important differences between organic and conventional dairy farms. As expected, organic dairy farms are, on average, smaller in both herd size and land area devoted to the operation. Yet dairy farms allocate a higher amount of land per head of cow, which coincides with the pasture and feeding requirements specified in the organic standards. Of course, most of the organic farms are relatively young, and most have transitioned from conventional production. This last fact, combined with the size characteristics of organic farms, suggests that organics may be providing a profitable business model for small, conventional farms.

Preliminary results from a multinomial logit model of marketing outlets suggest significant differences in marketing practices between organic and conventional dairies. Congruent with contract theory, it was found that organic dairies are more likely to use written contracts and forward contracts across the different types of buyers, i.e. cooperatives of which farmers are members, cooperatives of which farmers are not members, and non-cooperative handlers. Contracts assure farmers who have invested in

certification fees and incurred the costs of implementing a new production technology, a secure outlet for their differentiated milk product. It was also found that organic dairies are more likely to sell their milk direct to consumers compared to selling to cooperatives of which they are members. This is indicative of the diversity in the choice of marketing outlets for organic milk.

This preliminary analysis does not address the selectivity bias that occurs in the choice of marketing channel. However, as highlighted by Park and Lohr (2006), selectivity bias may be present in observing an organic producer's choice of marketing outlet because the producer will choose the most profitable outlets through which to market her product. Ongoing work addresses this potential selectivity bias in the choice of marketing channel, as well as the marginal effects.

A hedonic pricing model was used to estimate contributions of various quality attributes to the farm price of milk. Preliminary results estimate that the farm-gate premium for organic milk is \$6.26 in the Western region, \$7.47 in the Eastern region, and \$5.41 in the Midwestern region, after controlling for other milk quality characteristics. We found no premium associated with the use of contracts. Ongoing analysis evaluates the role of such premiums, as well as costs of production, in the context of the overall profitability of organic farms.

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Table 1. Descriptive Statistics of Conventional and Organic Dairy Farms in the United States, 2006

	Conventional		Organic	
	Estimate	Std. Error	Estimate	Std. Error
<u>Farm Characteristics</u>				
Acres Operated	407.2	9.7	312.1	62.0
Acres Under Organic Production	1.3	1.1	152.5	26.6
Number of Dairy Cows	142.1	5.8	85.8	23.1
Annual Milk Production (cwt)	29,598	1,446	13,935	5,056
Years Operation Has Produced Milk	23.3	0.7	21.4	1.4
Years Operation Has Produced & Sold Organic Milk	n.a.	n.a.	3.8	0.6
<u>Operator Characteristics</u>				
Operator's Age	51.2	0.8	49.1	1.0
Education – College Graduate and Beyond	0.15	0.02	0.16	0.05
<u>Marketing Characteristics</u>				
Price Received for Milk (\$ per cwt)	15.27	0.08	20.82	1.1
Member of a Cooperative ^a	0.73	0.02	0.64	0.08
Use of Written Contract with Milk Buyer ^a	0.38	0.02	0.62	0.09
Forward Contract is Offered by Milk Buyer ^a	0.43	0.03	0.17	0.09
Forward Contract is Accepted by Farmer ^a	0.03	0.01	0.09	0.06
Sell Other Crops ^a	0.38	0.02	0.19	0.09

a/ 1 = "Yes".

Table 2 . Percentage of Producers Who Have a Written Contract with Their Milk Buyer

Buyer	Organic	Conventional
Cooperative with membership	74.8%	44.6%
Cooperative but not a member	86.0%	18.0%
Non-cooperative buyer	75.5%	20.5%
χ^2 Statistic	1.9	2087.8
(<i>p-value</i>)	(0.38)	(<0.0001)

Table 3. Percentage of Producers Who Were Offered Forward Contracts and Used Them

Buyer	Organic	Conventional
Cooperative with membership	49.5%	5.1%
Cooperative but not a member	82.3%	0%
Non-cooperative buyer	62.7%	14.4%
χ^2 Statistic	4.8	332.2
(<i>p-value</i>)	(0.09)	(<0.0001)

Table 4. Multinomial Logit Model for Marketing Outlet

	Direct to Consumer	Non-Member Cooperative	Processors/Brokers
Intercept	-6.5939 *** (1.1562)	-2.5139*** (0.6262)	-0.8797*** (0.2401)
Decades Under Operation	0.2262 (0.1967)	-0.0631 (0.0881)	-0.0475 (0.0476)
Hundreds of Cows	0.0666*** (0.0225)	-0.2133*** (0.0783)	-0.0569*** (0.0188)
Organic Production	1.9483** (0.8336)	-0.3707 (0.3385)	-0.2822 (0.1755)
Crop and Livestock In Transition	-1.0742 (1.0885) 0.44 (1.1624)	-0.0061 (0.2595) 0.1269 (0.7689)	-0.2908** (0.1451) 0.1673 (0.3965)
Operator Education	0.075 (0.8363)	-0.4983 (0.3499)	-0.1297 (0.1625)
Midwest	-0.2643 (1.1445)	0.3438 (0.5757)	-0.0798 (0.2144)
East	0.4409 (1.065)	0.2921 (0.5879)	-0.1675 (0.2242)
Southeast	0.1033 (1.323)	0.767 (0.5912)	-0.5991** (0.2628)
<i>Likelihood Ratio</i>	4605 (30 df)	<i>P-Value: <0.0001</i>	

Note: Estimates are relative to marketing milk to cooperatives of which the farmer is a member. Standard errors are presented in parentheses. Asterisks denote statistical significance at the 10 percent level (*), 5 percent level (**), and 1 percent level (***).

Table 5. Hedonic Pricing Analysis for Milk

	Estimate	Standard Error
Intercept	13.88***	0.34
Organic Milk	6.26***	0.37
Quantity of Milk (1,000 cwt)	0.00013	0.0004
Butterfat Content (%)	0.20***	0.07
Protein Content (%)	0.09	0.06
Other Solids (%)	-0.05**	0.02
Somatic Cell Count (1000)	-0.0006**	0.0003
Southeastern Region	1.44***	0.21
Eastern Region	1.49***	0.19
Midwestern Region	0.69***	0.18
Organic * Eastern Region	1.31***	0.41
Organic * Midwestern Region	-0.85**	0.41
Use of a Written Contract	-0.02	0.11
R-Squared Value	0.70	
F- Value	272.34	

Asterisks denote statistical significance at the 10 percent level (*), 5 percent level (**), and 1 percent level (***).