AN ANALYSIS OF THE STRUCTURE AND PERFORMANCE OF ORGANIC DAIRY FARMS IN THE NORTHEAST, U.S.A.

by

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A thesis submitted to the

Graduate School-New Brunswick

Rutgers, The State University of New Jersey

in partial fulfillment of the requirements

for the degree of

Master of Science

Graduate Program in Agricultural Economics

written under the direction of

Dr. Sanjib Bhuyan

and approved by

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New Brunswick, New Jersey

May, 2008

ABSTRACT OF THE THESIS

An Analysis Of The Structure And Performance Of Organic Dairy Farms In The Northeast, U.S.A.

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Due to the restructuring and trend toward consolidation that has been taking place in the dairy industry for the past several decades; the number of dairy farms in the U.S. has been steadily declining. Smaller dairy farms have been disappearing at a disproportionate rate. At the same time, demand for organic milk has been consistently rising. There is some evidence to suggest that organic dairy may be a viable economic alternative for dairy farmers, but there is little empirical evidence to verify such claims. This study analyzed the financial performance of U.S. organic dairy farms in comparison to conventional dairy farms in the Northeast, highlighted significant structural differences between profitable and unprofitable organic dairy farms, and examined the factors affecting dairy farm profitability in the Northeast. This study shows that organic dairy farms in the Northeast were profitable and that small organic dairy farms were more economically viable than small conventional dairy farms. It was found that farm size, organic milk price, production efficiency, extra income in addition to milk sales, operator's age and expectations regarding the future of the dairy enterprise, and production efficiency had a positive correlation with organic dairy farm profitability.

Factors that had a negative influence on organic dairy farm profitability were variable costs per cow, the debt-to-asset ratio of the farm, the average age of the milking herd, family farm status, the hours per day the milking system was in operation, and the choice to dry off milk cows seasonally. The results suggest that transitioning to certified organic status is an economically viable alternative for small conventional dairy farms in the Northeast.

ACKNOWLEDGEMENTS

I would like to take the opportunity to thank everyone that contributed to this effort in one way or another. I would like to thank Dr. Sanjib Bhuyan, my advisor, for his countless hours of consultation and inexhaustible patience. Without his guidance and consistent support, this work would not have been possible. I would like to thank Dr. Barbara O'Neill and Dr. Andy Toole for their thoughtful guidance along the way and their willingness to listen. I would like to thank all of the professors in the Department of Agricultural, Food, and Resource Economics who provided me with the necessary tools and encouragement to take on this challenge. My thanks go out to Dr. Edmund Tavernier, Dr. Michael Camasso, Dr. Eliza Mojduska, and Dr. Carl Pray for the skills and knowledge they imparted upon me but, more importantly, for their encouragement. I am much appreciative of Marshalene Houston's frequent help in all matters related to my completion of the M.S. program in Food and Business Economics.

I would like to thank everyone at NASS and ERS for their help in this project and for granting me access to a very valuable dataset. First, I must thank Steve Peterson, Troy Joshua, Francine Houston, and Chan at the NASS field office in Trenton for their patience with me and their gracious hospitality. My appreciation extends to Bob Dubman and William McBride with the ERS, as well, for managing my onslaught of questions with great patience.

I would like to thank all of my loved ones, my family and friends, for their consistent support and encouragement throughout this effort. Without my parents' unwavering support and encouragement, this project never would have been possible. Finally, I am most grateful for the abundant support and patience of one in particular,

Stephanie Fields, whose love and confidence provided the strength necessary to complete this project.

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CHAPTER 1

INTRODUCTION

1.1 Organic Food Demand and Industry Growth

Organic agriculture has become a global phenomenon over the course of a few decades, and the U.S. is dutifully leading the way in consumption of its products (Datamonitor 2005). According to the International Federation of Organic Agriculture Movements (IFOAM), 100 countries and 59 million acres are under organic management worldwide (Willer and Yussefi 2004). In 2002, the global market for organic products reached $23 billion, and the U.S. outpaced Europe in its consumption of organic products (Willer and Yussefi 2004). The U.S. now consumes more organic products than any other nation. Meanwhile, the U.S. ranks fourth in terms of certified organic acreage on a global scale (Table 1), suggesting the degree to which organics have been absorbed by the processes of globalization.

Table 1: Top Four Countries according to Certified Organic Acreage, 2004

Rank	**Country**	**Certified Organic Land**
		Million Hectares
1	Australia	118
2	Argentina	3.1
3	China	2.3
4	U.S.	1.6

Source: Willer and Yussefi (2004)

Sales of organic foods have outpaced the overall food sales growth over the past decade, attracting significant attention in an industry otherwise characterized by slow growth. The U.S. organic food industry experienced a 20 percent average annual growth rate between 1990 and 2000, with sales increasing from $1 billion in 1990 to $7.8 billion in 2000 (Dimitri and Greene 2002). According to Datamonitor (2005), the U.S. organic food market has experienced a compound annual growth rate (CAGR) of 18.9 percent over the period 2001 to 2005 with sales of $16.9 billion in 2005, an 18.3 percent increase over 2004. Currently, the largest share of the world's organic food, 46.6 percent in 2005, is consumed in the U.S (Datamonitor 2005). Datamonitor (2005) projects a CAGR of 15.8 percent over the period 2005 to 2010 for the U.S. organic market and expects it to reach $35.1 billion by 2010. This compares to their 8.6 percent projection for the European market. The performance of the U.S. organic market over the past several decades has been nothing short of exceptional, and by most accounts, it is expected to continue at a similar pace in the years to come.

Success in the organic market has been spread more or less evenly across food categories, but dairy has consistently performed well. According to the Organic Trade Association's (OTA) 2006 Manufacturer Survey, dairy ranked second in terms of sales and third in terms of sales growth relative to other organic food categories. Dairy has consistently been a top-performing category in terms of sales growth. Between 1994 and 1999, organic dairy outpaced other organic food sectors with a five hundred percent increase in revenues (Dimitri and Greene 2002). Sales of organic milk and cream comprised an estimated 6 percent of total organic food sales in 2005 and grew 25 percent over 2004 levels (Dimitri and Venezia 2007). This compares to organics' estimated 2.5 percent share of overall food sales and an average 18 percent annual growth rate. According to Caragh McLaughlin, senior brand manager of Horizon Organics, "Within organic, dairy is one of the largest and fastest growing segments, growing at roughly a 25 percent compound annual growth rate. And within organic dairy, milk is the largest segment. [Using IRI data as a proxy for the industry], organic milk sales will have doubled in less than 3 years" (McLaughlin 2006). The U.S. organic market and organic dairy, in particular, have certainly stood out in the food industry and such market performance has not gone unnoticed.

Unprecedented growth in the organic sector has attracted significant attention within the food industry. With large food industry players, such as Wal-Mart, General Mills, and Kellogg carrying organic products, organic has claimed notice as a mainstream food sector (Brady 2006; Warner 2006). When natural food retail chains, such as Whole Foods and Wild Oats, are included in the large-food-retailer category, it was found that the overwhelming majority of organic foods are sold through large retail outlets and grocery stores (Dimitri and Venezia 2007). This is especially true for organic milk with a mere 7 percent being sold through alternative distribution chains, such as Farmers' Markets (Dimitri and Venezia 2007). The organic movement has clearly achieved mainstream status over the past several decades offering new and arguably much needed opportunities within the agricultural sector.

There is a concern that the more recent direction that the organic movement has taken may not be in accord with its original values (Guthman 2004). In 2002, for example, the U.S. imported $1.5 billion in organic products (Dimitri and Oberholtzer 2006). Such levels of international trade depict a scene that harshly conflicts with the principles of self-sufficiency and sustainability, two hallmarks of the organic ideal (Conford 2001; Guthman 2004; Lampkin 1990; Myers 2005; Oelhaf 1978; among others), and do not necessarily encourage the "rural renaissance" the movement originally intended (Guthman 2004). There has been a trend in the agricultural sector, especially dairy, toward increasing consolidation where more output is being produced on fewer farms. It has been argued that the organic movement intended to slow or reverse this trend, thus, encouraging a "rural renaissance" (Guthman 2004). However, within the organic dairy industry in the Northeast, the rate of conversion to certified organic status might have stagnated, while sales of organic milk outpaced the already extraordinary growth of the organic sector (Organic Trade Association 2006).

Considering the strong growth in demand for organic dairy in the U.S., the apparent lack of supply of organic milk alluded to in the popular press (Brady 2006) has been somewhat of an enigma. Most accounts highlight the obstacles to market entry created by strict rules governing transition to certified organic status as the culprit (Dimitri and Venezia 2007). In this light, supply and demand should match if more transitioning dairies come on line.

1.2 Supply: Rural America and the Restructuring of the Dairy Industry

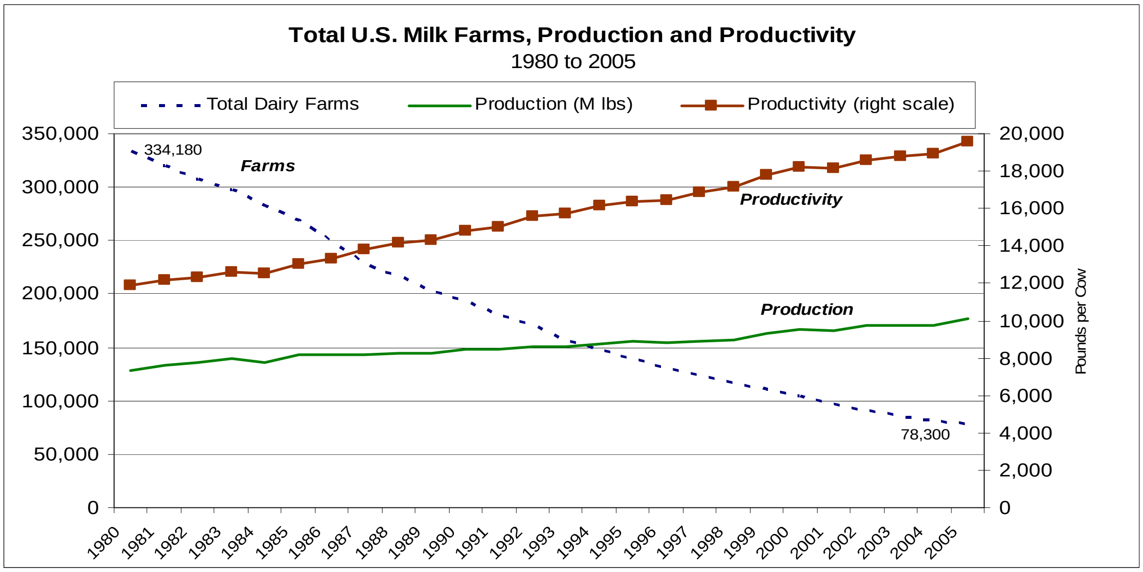
The organic movement first gained institutional legitimacy when Congress passed the Organic Foods Production Act (OFPA) of 1990 (U.S. Department of Agriculture 2007b). It was not until 2002, however, that national organic standards were implemented under the National Organic Program (NOP) of the U.S. Department of Agriculture (USDA 2007b). According to the NOP, the rules governing organic agriculture do not allow the use of genetic engineering, ionizing radiation, most synthetic pesticides, artificial fertilizers, sewage sludge, antibiotics, and growth hormones. There is a list of allowable substances for both organic crop and animal production that the NOP makes available online (U.S. Department of Agriculture 2007b).

The trend in the agricultural industry over the past several decades has been toward increasing consolidation, and the dairy industry is no exception. The total number of dairy farms has steadily declined in the U.S., while the average herd size, productivity, and production have steadily increased (Miller and Blayney 2006). That is, as Figure 1 shows, a greater proportion of milk production has been concentrated on fewer farms.

The loss of dairy farms has been particularly significant in the Northeast. Milk production in traditional dairy states, such as New York and Pennsylvania, has been displaced by the Southwest and West, such as New Mexico and California (Miller and Blayney 2006). The number of dairy farms in the Northeast has declined from 77,560 in 1970 to 19,660 in 2004, a 75% reduction (USDA 2005). In Pennsylvania, the number of dairy farms declined from 30,000 in 1970 to 9,100 in 2004, a 70% drop (USDA 2005). Over the same period, the number of New York dairy farms declined from 28,000 to 6,900 or 75.4% (USDA 2005). This downward trend reflects the overall stress being experienced by America's rural communities. Furthermore, dairy farming has long been the backbone of many agricultural communities throughout human history (Schmid 2003). With the decline in the number of dairy farms, a significant portion of the region's agricultural heritage is probably disappearing.

The evidence suggests that the scale of production plays an important part in the economic success of a dairy enterprise, and small dairy farms are disproportionately afflicted by the consolidation and restructuring of the dairy industry (MacDonald et al. 2007). According to MacDonald et al. (2007), the smallest dairy farms with fewer than 30 cows are "disappearing rapidly" (p. 2), and "the next three [smallest] size classes [30-200 cows] are also in "sharp decline" (p.2). Advice flowing from the agricultural extension agencies toward the troubled dairy industry generally takes one of the following three forms: (1) gain economies of scale and scope by expanding and integrating the latest in technology and management practices, (2) find a niche market,

Figure 1: The Number of U.S. Dairy Farms, Milk Production, and Productivity, 1980 to 2005

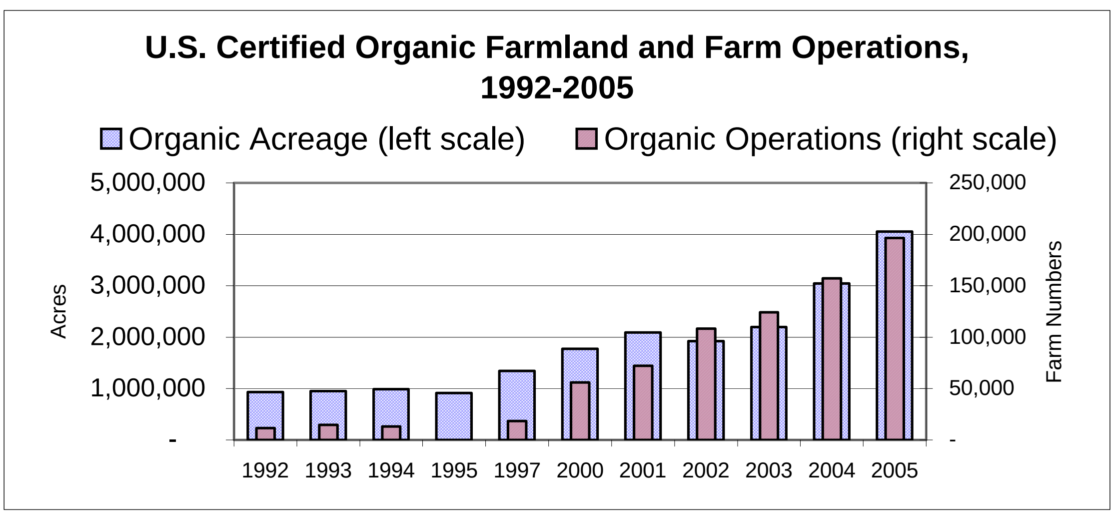


Source: USDA (2006)

such as specialty cheese or organic products, or (3) both (Mulhollem 2006). The second strategy, catering to a niche market, such as the organic food market, may be an increasingly more viable option (MacDonald, McBride, and O'Donoghue 2007).

As Figure 2 shows, certified organic acreage in the United States, as well as the number of certified organic operations, has been growing rapidly. Since national

Figure 2: Total U.S. Certified Organic Farmland and Operations, 1992-2005



Source: USDA (2007c)

organic standards were established in 2002, total certified organic acreage increased 111 percent, and the number of certified organic operations increased 16 percent (Table 2). Over the same period in the U.S., the number of total organic livestock, not including poultry, increased 81 percent (USDA 2007c). The creation of national organic standards certainly bolstered the presence of organic agriculture throughout the United States, but some regions may have witnessed better representation than others.

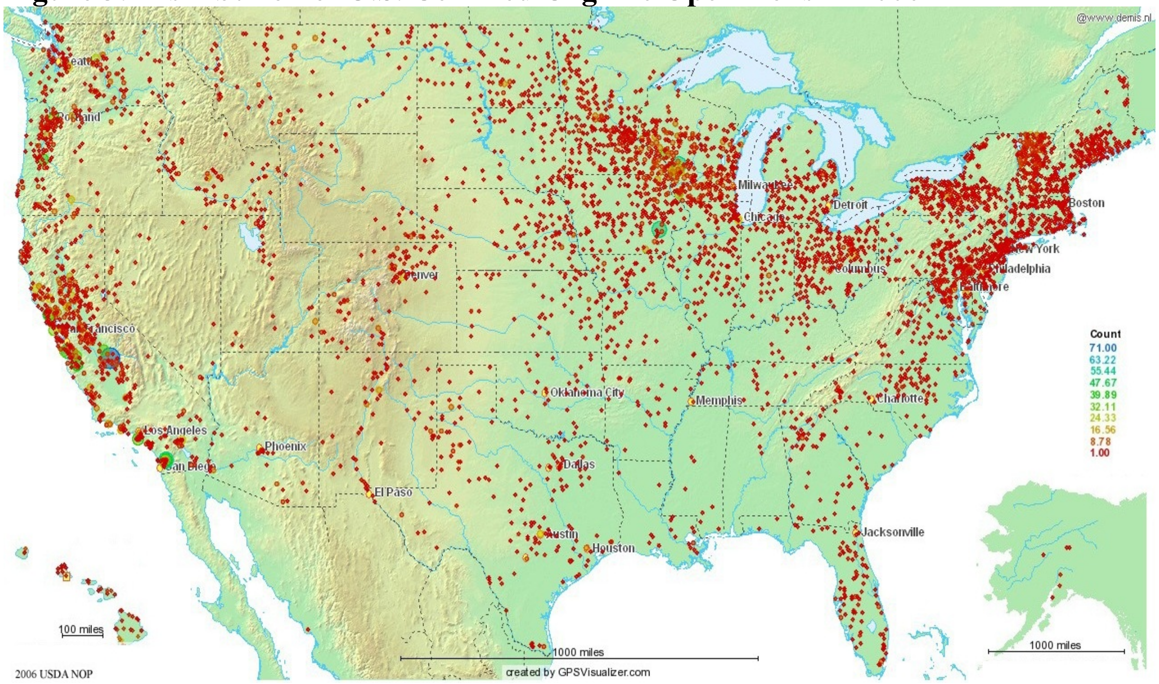
Table 2: Percent Growth in U.S. Certified Organic Farmland, Livestock, and Operations, 1992 to 2005

Item	1992-1997	1997-2002	2002-2005	1992-2005
	Percentage Change			
U.S. certified farmland:				
Total	45	43	111	333
Pasture/rangeland	(7)	26	272	338
Cropland	111	53	33	327
U.S. certified livestock:				
Beef cows	(35)	428	54	431
Milk cows	469	421	30	3745
Other cows	--	--	482	
Hogs & pigs	(65)	471	264	634
Sheep and lambs	(42)	597	(9)	266
Total Livestock	59	485	81	1587
Total certified operations	40	46	16	137

Source: USDA (2007c)

In the Northeast region of the U.S., the organic movement has seen significant concentration and strength (Figure 3). In this region, the number of organic milk cows increased 204 percent from 1997 to 2002 (Table 3). Concerning organic dairy farms, cows must have access to pasture in addition to the rules previously listed (USDA 2007b). According to the NOP, during transition cows must be fed 100 percent organic feed unless transitioning an entire distinct dairy herd at once (USDA 2007b). In such a case the rules allow up to 20 percent conventional feed for the first nine months of transition and 100 percent organic feed thereafter. However, it generally takes three years

Figure 3: Distribution of U.S. Certified Organic Operations in 2006

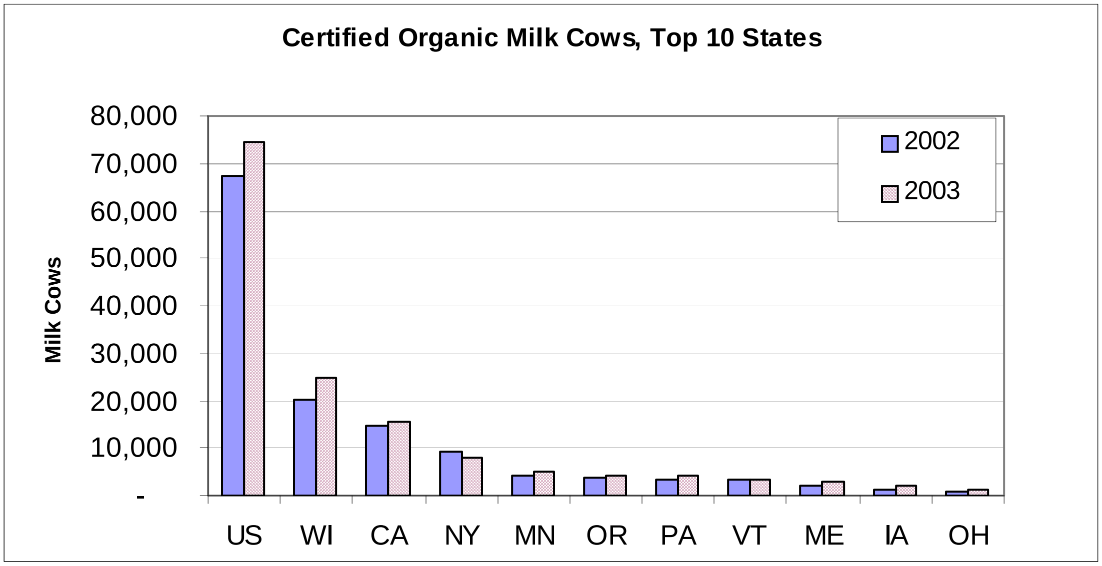


Source: Organic Farming Research Foundation (2006)

to transition the land to certified organic status. Since antibiotics are not allowed, preventative health care management practices, such as vaccines, must be employed. After national organic standards were established in 2002, however, the number of organic milk cows in the Northeast declined 22 percent from 2002 to 2005 (Table 3).

While gaps in the data make drawing conclusions difficult, a glance at Table 3 makes one conclusion clear: the Northeast's share of total U.S. organic milk production has been declining. As Figure 4 shows, in 2002 and 2003, New York, Pennsylvania, Maine and Vermont rank within the top ten states according to their number of organic milk cows. Over the period 2002 to 2005, however, New York, one of the largest dairy states in the nation, has witnessed a 50 percent drop in its number of organic milk cows, and Maryland, a 75 percent reduction (Table 3). Meanwhile, the popular press is speculating on a shortage in the supply of organic milk, as one popular national brand imports dehydrated organic milk powder from New Zealand to manufacture organic yogurt in the U.S. (Brady 2006).

Figure 4: The Top Ten States with the Most Certified Organic Milk Cows, 2002 to 2003



Source: USDA (2007c)

1.3 Purpose of the Study and Research Objectives

Dairy farms in the Northeast have been losing their share of national milk production over the past several decades (Miller and Blayney 2006), and it seems that they are also losing their share of the nation's organic milk product (Table 3). MacDonald et al. (2007) show that small dairy farms are less likely to be as profitable as larger farms; thus, small dairy farms are disappearing more rapidly. They attribute this trend to the significant scale economies enjoyed by larger operations, suggesting the 500-cow mark as an important cutoff point for achieving positive economic returns. MacDonald et al. (2007), however, admit that "a substantial share of smaller dairy farms seem to earn enough from operations to keep operating, and in some cases to be quite

Table 3: Number of Certified Organic Milk Cows in the U.S. and Northeast, 1997 to 2005

U.S. Certified Organic Milk Cows: Northeast vs. US, 1997 to 2005									
	1997	2000	2001	2002	2003	2004	2005	97-02	02-05
				Milk Cows				*Percent Change*	
Connecticut		250	250	-	-	117	117	NA	NA
Delaware				-	-	-	42	NA	NA
Maine	1,020	2,250	1,950	1,950	2,842	3,743	3,743	91	92
Maryland	504	560	750	970	920	987	247	92	-75
Massachusetts		60	60	-	-	32	37	NA	NA
New Hampshire	-	-	-	-	-	122	177	NA	NA
New Jersey	2	-	4	3	3	5	4	50	33
New York	3,386	6,215	6,704	9,071	7,809	4,335	4,580	168	-50
Pennsylvania	1,256	4,398	5,456	3,504	4,083	5,057	5,705	179	63
Rhode Island				-	-	-	-	NA	NA
Vermont		3,025	3,025	3,245	3,456	-	-	NA	NA
Total Northeast	**6,168**	**16,758**	**18,199**	**18,743**	**19,113**	**14,398**	**14,652**	**204**	**-22**
Total U.S.	**12,891**	**38,196**	**48,677**	**67,207**	**74,435**	**74,840**	**87,082**	**421**	**30**
Northeast as % of US	**48%**	**44%**	**37%**	**28%**	**26%**	**19%**	**17%**		

Source: USDA (2007c)

profitable" (p. 11), and "many structural changes will play out over an extended period of time" (p. 11) because of that fact.

Economic theory is typically employed to explain the variation in small dairy farm profitability. The profitability of small dairy farms is typically attributed to how efficiently they operate (Bailey 2002; Mulhollem 2006). The economic opportunities that niche markets may offer are often speculatively discussed (Janzen 2005; Mulhollem 2003), or mentioned in passing (MacDonald, McBride, O'Donoghue 2007; Mulhollem 2006). There is some evidence to suggest that organic dairy may be a viable economic alternative for dairy farmers (Butler 2002; Kriegl 2006; McBride and Greene 2007). However, there is little empirical evidence to verify such claims. In addition, there is a lack of examination and discussion of the factors that influence organic dairy farm profitability.

The aim of this study is, at the minimum, to address the gap in the literature as well as provide empirical evidence of the performance of organic dairy farms in the Northeast U.S.A., a major milk supply region in the country. Thus, this study focuses on organic dairy farms in the Northeast, the overwhelming majority of which are relatively small (<100 cows). Considering the historical momentum of various movements supporting the organic movement, demand for organic foods is likely to persist and probably expand. Considering the disproportionate loss of small farms within the dairy sector that has been occurring, there may be an opportunity for small dairy farms in the Northeast to capitalize on this growth. Therefore, this study will examine this potential by determining whether or not small organic dairy farms were more profitable than small conventional dairy farms in the Northeast as well as examine factors that influence organic dairy farm profitability.

This study analyzes the financial performance of U.S. organic dairy farms in comparison to conventional dairy farms in the Northeast, highlights significant structural differences between profitable and unprofitable organic dairy farms, and examines the factors affecting dairy farm profitability in the Northeast. While there have been several economic studies of organic dairy production within the past two decades (Butler 2002; Dalton et al. 2005; McBride and Greene 2007; McCrory 2001), few have examined in detail the factors driving the economic performance of organic dairy farms in the Northeast. Furthermore, many studies produce conflicting results, suggesting a need for further research. Focusing on the Northeast dairy industry in general and the Northeast organic dairy industry in particular, this study will contribute to the literature and the policy discussions through the following objectives:

1. To analyze the financial performance of organic dairy farms in comparison to conventional dairy farms in the Northeast U.S.A.
2. To compare and analyze the financial performance of organic dairy farms that have been certified organic for at least five years in comparison to those with less than five years experience as certified organic.
3. To analyze the characteristics of organic dairy farms that were profitable in 2005 in comparison to organic dairy farms that were not profitable in 2005.
4. To examine the factors influencing financial performance of organic dairy farms.

1.4 Organization of the Remaining Chapters

Chapter 2 reviews the literature regarding the background of the organic movement and discusses the previous economic studies pertaining to organic agricultural production and dairy farming in general. Chapter 3 discusses and defines the financial performance measures used in this study to determine profitability, and presents the economic model used in the regression analysis. Chapter 4 presents and discusses the results, and Chapter 5 summarizes the results and discusses the implications of the findings of this study.

CHAPTER II

LITERATURE REVIEW

2.1 Background to the Organic Movement

The organic movement finds its origin in the theoretical underpinnings and subsequent theoretically based research of several different historical social movements. Guthman (2004) in her book, *Agrarian Dreams: The Paradox of Organic Farming in California*, depicts the various movements preceding the organic movement that eventually sparked its inception. She describes the organic ideal as the product of several different critiques of the conventional, industrial model, spawned from four broader social movements: the soil fertility movement, the health food movement, the utopian experiments and back-to-the-land movements, and the environmental movement. She argues that what organic agriculture intended to be and what organic agriculture is today are two grossly different ideals. According to her, what the organic movement intended to be can best be understood via the criticisms, theory, and research supporting the social movements that preceded it.

2.1.1 The Soil Fertility Movement

The soil fertility movement advocated holistic agricultural production strategies that were to be later adopted by the organic movement. Conford (2001) in his book, *The Origins of the Organic Movement*, arguably provides the most thorough account of the organic movement's origins. He claims that the soil fertility movement gained much of its form early in the twentieth century largely due to the work of Sir Albert Howard. In 1905, Howard was appointed Economic Botanist of the Agricultural Research Institute in India where he began conducting his studies of what was to become organic agricultural practices (Howard 1972). He later compiled the results of much of his life's research in his lesser-known work (Howard 1972), *The Soil and Health: A Study of Organic Agriculture*, where he laid down the principles that were to become the foundation of the soil fertility and, subsequently, the organic movement. Howard's life thesis portrayed a holistic worldview where human beings and their fate were intrinsically interconnected with nature, which is ultimately governed by the Law of Return (Howard 1972). In Conford's (2001) words, a "healthy, humus-rich soil would produce healthy, disease-resistant crops, which would in turn ensure the health of the animals and human beings who consumed them; the wastes would be returned to enrich the soil" (pp. 19-20). The Law of Return is a principle that is consistently echoed throughout the literature on soil fertility and organic agriculture.

At the same time that Howard was developing his theories in India, F.H. King was traveling to China, Japan, and Korea to undertake similar studies of ancient agricultural practices devoid of artificial fertilizers and pesticides. King, a Ph.D. of agricultural physics, was the Chief of Soil Management Division of the USDA early in the twentieth century. He recorded his findings from China, Korea, and Japan in his book (King 1911), *Farmers of Forty Centuries or Permanent Agriculture in China, Korea and Japan*. This book was later published under the title (King 2004), *Farmers for Forty Centuries: Organic Agriculture in China, Korea and Japan*. In his observations of Japanese, Chinese, and Korean agricultural practices, King reported the unprecedented efficiency and yields unrivaled by that achieved in the United State at that time. King attributed their success to the practices of crop rotation and the recycling of all waste material back to the soil in the form of compost. He witnessed the production of three to four different crops in one year on the same parcel of land. For advocates of organic agriculture then and now, the fact that these ancient civilizations had been practicing intensive agriculture for thousands of years without any use of contemporary synthetic agricultural inputs and any observable indication of decline in the health of the soil served as proof of the efficacy of their ancient techniques.

At about the same time, Rudolf Steiner was instigating a movement parallel to the organic movement in Germany. Steiner, the father of the biodynamic movement, is best known for developing the spiritual science of anthroposophy (Conford 2001). From the spiritual science of anthroposophy, Steiner induced the principles of the biodynamic movement in the eight lectures given in 1924 in Germany (Koepf 1989). He stressed the importance of managing the farm as a holistic organism, necessarily diverse, which realizes the "importance of having soil, plants, insects, animals, woodland, and birds in the correct proportion to each other" (Conford 2001, p. 17). Conford (2001) notes the interestingly coincidental timing of Steiner's work in Germany and Howard's work in India. They both stressed the connection between soil health and human health, and advocated principles in this vein. These principles became effectively operationalized under their respective movements as the Law of Return (Conford 2001).

Jerome Rodale, one of Howard's many pupils and followers, established his farm in Pennsylvania in 1940 to continue experimenting with Howard's ideas. It still exists to this day as an experiment station and clearinghouse for organic agricultural research under the Rodale Institute (Conford 2001). Steiner enjoyed a similar level of influence within the biodynamic movement. One of his more contemporary followers, Dr. Herbert H. Koepf, farmer and doctor of Agricultural Science, provides innumerable examples and insights into the current biodynamic and organic movement in one of his many works, *The Biodynamic Farm* (1989). However, Howard was arguably more influential to the organic movement in the United States than Steiner (Conford 2001), and some of his followers were as influential as he was to the movement.

Lady Eve Balfour, according to Conford (2001), was one of Howard's most influential disciples. After experimenting with Howard's methods for some years on her own farm, Balfour published her findings in *The Living Soil* in 1943 (Conford 2001). The work inspired the formation of the Soil Association in England shortly after its publication, where Balfour served as the first President of the association (Conford 2001). Balfour's *The Living Soil* further testified to the benefits of Howard's agricultural and, specifically, soil management principles. Moreover, it reinforced the importance of the cyclical connection between soil health, plant health, animal health and human health, that is, the Law of Return (Balfour 1943), which was to become an important foundation for the organic movement (Conford 2001).

Based upon the work of these key figures, as well as many others not mentioned here, organic agriculture intended to be a sustainable, self-sufficient production model aimed to work in accordance with the Law of Return (Conford 2001; Guthman 2004). Thus, organic agriculture, as it intended to be, is promoted as a long term, sustainable method of farming. It is sustainable in that it has the potential to maintain or increase soil life and fertility without harming the environment, which it necessarily depends upon (Myers 2005). The soil fertility movement eventually evolved and gained significant momentum in the face of the soil crisis in the early to mid-twentieth century.

Soil health and soil conservation were two of the earliest issues to eventually become part of the organic ideology that intensified in the face of the soil crisis in the U.S. (Guthman 2004). The U.S. experienced a soil crisis prior to receiving significant government intervention in the 1990s (Derr 2003). Koepf depicts the crisis at that time and writes, “Every year, worldwide erosion, loss of organic matter, desertification, salination, and loss to marshiness take an area about the size of Maine … In the five years between 1977 and 1982, the soil lost in the USA by erosion amounted to about one foot of topsoil on one million acres; thus, the agricultural land available per capita is decreasing” (1989, p. 7). It was the soil crisis associated with increasingly intensive agricultural production practices that encouraged the articulation of traditional, even ancient (King 2004), holistic soil management practices which were ultimately adopted by the organic movement (Guthman 2004).

The Depression Era, 1929 to 1940, marked the beginning of soil conservation policy in the U.S. (Derr 2003). In contrast, organic farming has been practiced for over four thousand years in China, Japan, and Korea with virtually no loss in soil fertility (King 2004). Soil conservation policy and management techniques have evolved since then. For example, Crop Residue Management (CRM) describes a number of conservation tillage techniques commonly used today. “CRM is an umbrella term encompassing several tillage systems including conservation tillage (no-till, ridge-till, and mulch-till), and reduced till” (Sandretto and Payne 2006, p. 102). Critics argue, however, that reduced tillage often leads to increased use of herbicides and, thus, pollution and reliance on external inputs (Gassman et al. 2006; Koepf 1989). Within the organic movement, organic agriculture, with its emphasis on soil health, the recycling of waste and nutrients, crop diversity and rotation, and biodiversity, is viewed as a superior conservation tool and preventive solution to most agricultural problems.

2.1.2 The Environmental Movement

The Environmental Movement is often traced back to the 1960s and 1970s and the publication of one particularly powerful piece of agro-industrial criticism. Rachel Carson's (1990) *Silent Spring* arguably evidenced several of the more prophetic critiques of industrial agriculture from earlier times and created increased awareness of conventional agriculture's impacts on the environment and the ecological balance (Conford 2001). Carson's work documented the impact of DDT, which was used as an agricultural pesticide in the past, on human health and the environment. According to Conford (2001), *Silent Spring* paved the way for organics as an alternative model. Thus, organic agriculture, which abstains from the use of most synthetic pesticides and artificial fertilizers, is defined in contrast to its polluting counterpart. It is promoted as a solution to the pollution problems associated with conventional agricultural production. Contemporary research from various disciplines within the environmental school provides some validity to organic agriculture.

Conventional agricultural systems with their reliance on synthetic chemical inputs have been found to compromise soil fertility and biodiversity (Maeder et al. 2002; Hole et al. 2005), among other issues. For example, conventional livestock operations, especially large confinement operations, have been identified as significant non-point sources of pollution, as large amounts of waste become concentrated in relatively small areas (Mallin 2000; U.S. Environmental Protection Agency 2000) and soil erosion enters waterways (Gassman et al. 2006). Moreover, the consequences of conventional crop production cannot be treated as exogenous to conventional livestock production, as the latter is contemporaneously dependent upon the former.

In contrast to conventional livestock operations, organic livestock operations intended to be more diverse, mixed farming systems than their conventional counterparts (Howard 1972; King 1911; Koepf 1989; Vaarst et al. 2004). Under the organic ideal, a dairy farmer would strive to utilize pasture and homegrown fodder while recycling soil nutrients to maintain and build soil health and fertility (Howard 1972). As certified organic pasture is necessarily free of synthetic pesticides and herbicides, environmental and health risks from agricultural runoff are supposedly minimal (Koepf 1989). It is further argued that organic farms, with their emphasis on building soil fertility, encouraging soil biodiversity, utilizing crop rotations, and creating buffer zones, produce lower nitrate leaching rates than conventional farms (Koepf 1989). As agricultural runoff contaminates waterways and chemical residues enter the food supply, the health risks to human beings have received more attention in recent years, and the potential benefits of organic agriculture received more attention.

2.1.3 The Health Food Movement

The organic school emphasizes the connection between soil health, plant health, animal health, and human health, and it holds the belief that Nature's way of managing this cycle is best. Concerns about environmental exposure to chemical residues associated with agricultural runoff have moved organic agriculture to the forefront of public debate within the past few decades. According to Conford (2001), however, the health food movement gained sway in response to the salmonella food scares of the 1980s, the Bovine Spongiform Encephalopathy (BSE) outbreak, and a general suspicion of genetically modified organisms (GMOs). According to the Food and Drug Administration (FDA) (2007), BSE, or mad cow disease, is a brain wasting disease in cattle. It is thought to be transmittable to humans through beef consumption. The human form is known as Creutzfeldt-Jakob disease and may have caused numerous deaths in Britain where the outbreak was worst felt in the 1990s. The outbreak was thought to have spread because beef cattle were routinely fed animal products (FDA 2007) even though cows were traditionally herbivores. Since organic animal production does not allow this practice, the organic seal quickly became associated with protection from the BSE health threat. In other words, concerns arose regarding how food was being produced and handled, and organic food surfaced as a safer food. Much of the discussion and research, however, is often focused on the risk of pesticide exposure.

Several studies provide enough evidence to warrant the suspicions raised by the organic school. Not surprisingly, a comparison of pesticide residues found on produce grown under three different pest management systems found organic produce had significantly lower levels of pesticide residue than other management systems (Bakery et al. 2002). A comparison of preschool children who were fed organic versus conventional diets showed significantly higher levels of organophosphorus pesticide metabolites in the urine of those children who were raised on conventional diets compared to those who were raised on organic diets (Curl, Fenske, and Elgethun 2003). Moreover, occupational pesticide exposure may have a significant positive impact on the rate of birth defects in newborns (Garry et al. 1996). Occupational pesticide exposure may also increase the risk of developing several cancers for workers and their newborns (Daniels, Olshan, and Savitz 1997). Furthermore, leaching of nitrates and nitrites into waterways threatens overall biodiversity, targeting certain species, amphibian species in particular, more than others (Marco, Quilchano, and Blaustein 1999) disrupting the ecological balance. Again, modern scientific research provides some sustenance to the growing organic movement.

2.1.4 Back to the Land Movement

Finally, the utopian experiments and back-to-the-land movements provided additional material to the construction of the organic ideal (Guthman 2004). Nearing and Nearing (1989) provide clear examples and insights into the movement's origins and contributions (Conford 2001) in one of several books, *The Good Life*. In the wake of the Depression, the Nearings were the archetypal back-to-the-landers fleeing a seemingly moribund urbanity desperate to be liberated from their dependence upon an unreliable economic system. From their country cottage in Vermont, and later in Maine, the Nearings reconstructed their lives in the name of self-sufficiency and sustainability. By recording their experience, they provided a detailed blueprint for their followers.

The Nearings recount their experience in *The Good Life*, which often reads more like a how-to guide, providing detailed instructions on how to build a stone house, for example. At the very least, they became symbols of the desire to reconnect with the land and the source of one's food, which the organic movement effortlessly welcomed. The intrinsic *goodness* portrayed in the idyllic simple life of an almost self-sufficient existence on a few acres is reflective of an expansive, deeply rooted ideology pervasive in the American psyche.

2.1.5 Agrarian Idealism

According to Guthman (2004), the organic movement is unique in its adoption of a more traditional idealism found throughout the history of American agricultural discussion and policy, an idealism which has been dubbed agrarianism, agrarian idealism (Barlett 1993; Rohrer and Douglas 1969; among others), or contemporary agrarian populism (Guthman 2004). Agrarian idealism, with its focus on the small, family farm, generally rejects the corporatization and industrialization of the food system (Guthman 2004) and historically finds its roots in the institutionalization of American agriculture (Barlett 1993; Rohrer and Douglas 1969). Moreover, where agrarian idealism has been institutionalized, its expression often seems to emphasize the small, family farm, where farming is viewed as an intrinsically valuable, even moral, way of life (Barlett 1993; Comstock 1987; Rosenblatt 1990). With such deep roots and historical momentum, it is no shock that agrarian idealism persists into the most modern of food movements.

According to Guthman, once the organic movement incorporated the new agrarianism into its ideology, reversing the dominant trends, saving the small family farm, and instigating a "rural renaissance" became a primary aim of the organic movement's original intentions. Guthman goes on to critically analyze the more recent direction of the organic movement. More specifically, she criticizes the movement for following in the footsteps of that which it intended to oppose, "industrial" agriculture, a frustration that has been more broadly expressed in the popular press (Brady 2006). According to Guthman, the organic movement has severely faltered from its original intentions, noting that the path taken by California’s organic producers looks very similar to that of its industrial predecessor. She notes the symptoms of an organic "industry", namely, intensification and consolidation and details the forces at work that facilitated the organic seal's degradation in California. So, paradoxically, the contemporary criticisms that have emerged are often the same criticisms that preceded and arguably instigated the movement's inception.

The extraordinary expansion of the organic sector has opened new opportunities for farmers nationwide. However, questions inevitably arose about the allocation of the economic benefits associated with the growth of the organic sector, just as questions arose about the dispersion of benefits associated with advancements and new opportunities in agriculture that preceded the organic movement,. The green revolution, for example, preceded the organic movement in American history, and it provides an example of one of the familiar criticisms that tends to accompany structural changes within the agricultural industry.

With the success of the green revolution, concerns over the equitable distribution of productivity and subsequent revenue gains arose. Critics argued that productivity gains from new technologies – chemical fertilizers, pesticides, high-yielding crop varieties, and genetically modified crops – would disproportionately support the larger, wealthier farms at the expense of the small family farm. In fact, the stress experienced in rural America during this revolutionary period of change has been blamed on the revolution itself. Rohrer and Douglas (1969) exemplify this attitude and write, "Farm and rural populations declined proportionally as industrialization and urbanization advanced in America" (p. 7). "The American rural dweller undergoing such transitions was and is caught between conflicting choices: either he perpetuates a hallucination, the good rural life inherited from his father's fathers, or he adopts the disappointingly unglamorous urban and industrial ways that cost his freedom. …" (Rohrer and Douglas 1969, p. 6). The trend toward consolidation within the agricultural industry has helped focus a sympathetic lens on the small family farm, in particular, as their numbers continue to decline. Other researchers, however, criticize such idealism and claim that the reality of a dwindling family farm population has not come to fruition (Ruttan 2004).

Ruttan (2004), for example, differentiates between green revolution technologies and their variable impact on the farm family. He concludes that mechanical technologies, such as tractors, do tend to replace manual labor and support large-scale, specialized agricultural production which requires less management oversight. Alternatively, biological technologies, such as genetically modified crops, inherently require more frequent application of additional management skills, and thus, do not support large-scale agricultural production under less management. Therefore, the small family farm maintains an advantage by utilizing biological technologies. Ruttan (2004) notes, "Even in the USA, where the development of labour-saving technology proceeded most rapidly, family farms continue to account for a high share of agricultural production" (p. 47). While this is true on a percentage-of-total-production basis, it overshadows the fact that the number of farms in the U.S. declined from more than six million in the 1930s (Albrecht and Murdock 1990) to roughly two million today (USDA 2006).

The organic movement culminated from these earlier social movements, integrating key principles from each movement into the overarching organic ideal. Specifically, Howard's (1972) Law of Return conceptualized the connection between soil health, plant health, animal health, and human health. Expressed in this way, the organic movement gained acceptance in the following way: (1) from the back-to-the-landers who were seeking a reconnection with the environment that rural life supposedly offered, (2) from the health food movement since the health connection was essentially its core, (3) from the soil fertility movement since healthy soil provided the base of the health connection, and (4) the environmental movement since truly healthy soil was dependent upon the recycling of nutrients via rich compost, and the avoidance of synthetic inputs that leach into the environment.

Codifying these concepts embodied by the organic ideal and transforming them into rules and regulations proved a formidable task. The organic seal's earlier forms had been criticized of being unnecessarily arduous and subjective (Guthman 2004). Partially in response to these criticisms, the USDA established national organic principles in 2002 and outlawed any unauthorized use of the organic seal. Its current form mostly covers the production process and is largely governed by a list of allowable inputs. However, as previously described, organic animal husbandry requires additional provisions to facilitate the performance of natural behaviors and instincts, such as access to pasture for dairy cows.

2.2 Organic versus Conventional Milk Production Models

The organic dairy farm model can be viewed as a result of the same criticisms, frustrations, and subsequent social movements that produced the overarching organic movement. It is worth restating, however, that what organic milk production intended to be and what it became are two different concepts. The original organic milk production model has been proposed as a method to minimize the negative externalities of the modern conventional dairy operation, and address the general concerns related to conventional animal production. Thus, the ideal is best conveyed in juxtaposition to that which it outwardly criticized, that is, the conventional (industrial) model.

Criticism of conventional (industrial) milk production has taken many forms. For example, conventional production of animal products creates waste disposal problems and relies on high-input, intensive production of crops used for feedstuffs, which further creates environmental hazards. Alternatively, the modern conventional dairy cow competes for productive arable land, which might otherwise be utilized to produce food for direct human consumption (Schiere, Ibrahim, and Keulen 2002). The organic dairy farm, in contrast, intended to be a low-input, mixed farm model which has been shown to be a stable, sustainable provider of nutrient-dense food in appropriate environments (Schiere, Ibrahim, and Keulen 2002). Proponents argue that, traditionally, ruminants grazed grasses and other herbaceous plant species, converting undigestible biomass on marginal land into digestible, nutrient-dense animal products (Schiere, Ibrahim, and Keulen 2002). However, the conventional dairy cow no longer grazes on its traditional diet of grasses and herbaceous plants but instead consumes copious amounts of refined, energy-dense feedstuffs in order to boost productivity and profitability in the short term (Koepf 1989).

Conventional dairy herd management and milk production have led to frustrations with dependence upon external inputs, concerns over the sustainability of such practices, and concerns over herd health, in particular (Koepf 1989). Such frustrations have lead to the adoption of two prominent tenets of the organic ideal: self-sufficiency and sustainability (Guthman 2004; Koepf 1989; Lampkin 1990; Myers 2005; among others). In the case of milk production, these two principles have spawned a growing movement back to grass by a body of management intensive rotational graziers (MIRG's) (Hassanein and Kloppenburg 2004). Rotational grazing, with its reliance on pasture, is supposed to be a profitable dairying strategy due to increased self-reliance and decreased use of external inputs and, thus, reduced variable expenses (Koepf 1989).

2.3 Organic Paradigm in Contrast to Agricultural Productivist Paradigm

The movement "back to grass" (Hassanein and Kloppenburg 2004), along with the organic movement in general, is motivated by an ideology derived from increasing concerns regarding the consequences of a high-input, intensive agricultural production model. The organic ideal stands in stark contrast to that claimed by industrial agriculture. For example, the organic farming community has often expressed a different goal set than conventional farmers, placing ecological concerns before economic concerns (Lien et al. 2005; Maxey 2006). However, agricultural development models, like economic development models, assume productivity growth as a main societal objective, as population growth necessarily equates to increased food demand.

The history of agricultural development throughout the world is understood through various transformations of theoretical models, which retrospectively claim this same objective. For example, Hayami and Ruttan (1985) observe that, through various theoretical frameworks, “sustained rates of growth in agricultural output in the range of 1.0 percent per year were feasible in many preindustrial societies. With the advent of industrialization, potentials for the growth of agricultural output shifted upward to the range of 1.5-2.5 percent per year” (p. 41). Industrialization’s increased productivity better served the increasing food demands of a growing domestic and global population.

However, concerns regarding the environmental and social consequences of industrial agriculture’s progress since World War II have encouraged the reevaluation of the term “progress” (Barlett 1993; Comstock 1987; Rhorer and Douglas 1969; Rosenblatt

1990). The organic movement may be viewed as the manifestation of the following question expounded by Koepf (1989): Is it true that maximum performance is achieved at maximum yield? Acs, Berentsen, and Huirne (2005) state, the definition of organic agriculture “stands as the complete opposite to conventional productivist agriculture, which implies extensive use of artificial inputs such as fertilizers and pesticides designed to increase productivity in food production" (p. 3). Since its inception, the organic movement has been rejecting the industrialization of the food supply from the vantage point of soil health and soil conservation, environmental degradation, and human health concerns (Guthman 2004). Thus, as Guthman articulates, the organic movement never intended to compete with, let alone measure its success by, the industrial, productivist logic. In fact, it literally gained its definition in opposition to this logic. Guthman explains, however, that organics ultimately succumbed to this logic through the dynamic interplay of several dominant processes (Guthman 2004). Perhaps understanding organics can only be done in contrast to what it intended not to be, but the future success of the movement now relies on the political and economic system that codified and institutionalized its principles. Since the USDA took a free market approach to supporting organic agriculture creating a national market for it by standardizing its meaning, the free market ultimately determines the success of the label now symbolizing the movement.

2.4 Economic Efficiency of Organic Systems

2.4.1 Technical Efficiency

Economic efficiency measures are important in identifying opportunities to enhance use of the resource base, increasing profitability, and targeting key characteristics of efficient farms. A number of researchers have compared the economic efficiency of organic versus conventional farming systems. Sipilainen and Lansink (2005) found that organic dairy farms in Finland were not technically efficient compared to the conventional frontier, as well as their own organic frontier. This contradicts Lansink, Pietola, and Backman (2002) findings that organic farms are more technically efficient overall relative to their own frontier but use a less productive technology. Tzouvelekas, Pantzios, and Fotopoulos (2001) found that organic and conventional cotton farms in Greece operated with the same allocative and technical efficiency; organic farms operated with diminishing returns to scale, while conventional farms exhibited constant returns to scale. Karagiannias, Salhofer, and Sinabell (2006) found that organic milk production in Austria was slightly less efficient than conventional milk production, and both systems performed at decreasing returns to scale. Paul, Nehring, and Banker (2004) found small family farms in the U.S. were less efficient than larger industrial enterprises, and small family farms failed to capture comparable economies of scale.

From a purely technical efficiency point of view, it may be difficult for organic farmers to compensate for the lack of synthetic fertilizers and pesticides, especially in the short term. Alternative research perspectives, however, have produced different results. A research team in the U.K. found organic agriculture is significantly more energy efficient, especially in livestock production, after accounting for indirect costs, such as the energy used to produce fertilizers and pesticides, which are used to produce feedstuffs (Ministry of Agriculture, Fisheries, and Food 2000). However, the energy efficiency of organic systems was greatly reduced when distribution energy was included (Ministry of Agriculture, Fisheries, and Food 2000). Maeder et al. (2002) found that soil on organic farms had significantly greater soil fertility and biodiversity during a 21-year comparative study of conventional and organic farms in Central Europe. Though organic farms produced yields 20 percent below conventional farms, they used 34 to 51 percent less nutrient input (N, P, K) and were more energy efficient (Maeder et al. 2002). Pimentel et al. (2005) found that in the long run organic farmers produced the same yields as conventional farmers with 30 percent less energy input. These energy efficiency analyses contribute valuable insight into the benefits of organic farming.

2.4.2 Profitability of Organic Dairy Farms

A number of researchers have evaluated the financial performance of organic versus conventional farms. Dalton et al. (2005) analyzed the profitability of organic dairy production in 2004 in Maine and Vermont. They found the production of organic dairy significantly more costly than their conventional counterparts, citing feed as the most significant higher cost input to organic dairy production relative to conventional dairy farms. Furthermore, fertilizer and veterinary costs were 4percent less on average for organic dairy farms relative to conventional dairy farms in the same region. According to the authors, the average organic dairy farm was not found to be profitable in 2004 in Vermont and Maine.

McCrory (2001) compared the profitability of a small sample of organic and conventional dairy farms in Vermont. She found that Vermont organic dairy farms had 45 percent greater net farm income per cow than conventional farms. Vermont organic dairy farms had higher feed expenses, and lower freight and trucking, labor, herd replacement, veterinary, and medical expenses than their conventional counterparts (McCrory 2001).

Vermont organic dairy farms also had 34 and 37 percent greater return on assets and equity, respectively (McCrory 2001).

Butler (2002), however, analyzed the profitability of a small sample of organic dairy farms in two regions of California in 1999 in comparison to conventional dairy farms in the region with somewhat conflicting results. Feed costs for the average organic dairy farm were only slightly higher on a per-cow and per-cwt basis than for conventional farms but were not statistically significantly different. This was assumed to be due to the substitution of expensive organic feed with homegrown fodder and pasture (Butler 2002). Overall labor costs were also not found to be significantly different between conventional and organic dairy farms (Butler 2002). However, in accord with Dalton et al. (2005), larger organic dairy farms tended to hire outside labor more often and at a higher wage than conventional dairy farms, while small family organic farms avoided the expense by utilizing family labor (Butler 2002). While herd replacement costs were additionally found to be higher for organic dairy farms on a per cow and per cwt basis, overall profitability was greater for organic dairy farms in California relative to their conventional counterparts due to the significant price premium for organic milk (Butler 2002).

Kriegl (2006) provides one of the few economic comparisons of conventional versus organic dairy farms with a focus on grass-based dairying or intensive grazing. According to Kriegl (2006), Wisconsin organic intensive graziers tend to earn lower net farm income than non-organic, intensive graziers, and higher net farm income than confinement operations. Wisconsin organic intensive graziers appreciate lower costs of production for purchased feed, veterinary and medical expenses, herd replacement, and chemicals. Wisconsin organic intensive graziers receive higher costs of production for repairs, energy, purchased seeds, and non-dependent labor (Kriegl 2006).

Short-term productivity is expected to decrease as pasture and homegrown fodder is substituted for conventional energy-dense feedstuffs and new management skills are honed to facilitate the new technology. However, purchased feed, veterinary, medical and herd replacement costs are expected to decrease. Kriegl (2006) and Dalton et al. (2005) highlight the importance the organic milk price premium, which is as volatile as the conventional milk price, plays in determining the profitability of organic dairy farms. Although there is evidence that certain types of organic dairy operations are profitable and competitive with conventional dairy production, there is no consensus among researchers and practitioners. This study will add to the literature and the ongoing discussion on the topic by either supporting or disputing conclusions arrived at by earlier studies.

CHAPTER III

METHODOLOGY

3.1 Profitability Measures to Assess Performance

There may be a misperception regarding the objectivity of measuring the financial performance of agricultural producers, or more precisely whether such objectivity exists. As Mishra and Morehart (2001) admit financial performance is ultimately a subjective measure dependent upon the individual researcher's objectives and assumptions. It comes as no surprise then that researchers have used several different indicators to measure the financial performance of agricultural operations in previous studies.

Mishra and Morehart (2001) describe two distinct types of financial performance measures: economic and accounting measures. Economic measures tend to incorporate opportunity costs, while accounting methods do not. In their study of U.S. dairy farms, they employ an economic measure, Operator's Labor and Management Income (OLMI), which includes an estimated cost for management hours worked on farm. In doing so, they argue, they were able to analyze the structural characteristics that tend to influence the returns to dairy management, while adequately accounting for the resource base used in production.

Alternatively, El-Osta and Johnson (1998) employ two accounting measures in analyzing the financial performance of U.S. commercial dairy farms: net farm income (NFI) and net returns per unit (cwt) of milk sold (NRU). El-Osta and Johnson (1998) define NFI as a measure of revenues minus expenses accrued after adjusting for variation in crop and livestock inventories. NRU is defined as gross value product minus expenses, including capital replacement, per hundredweight of milk sold. Though opportunity costs were not incorporated, NFI and NRU arguably reflect the financial position of agricultural producers. Beyond the two examples provided, any number of variations on accounting and economic measures has been used in previous studies.

For example, McBride, Short, and El-Osta (2004) use farm's operating margin (FOM) per hundredweight and per hour of unpaid labor as a measure of financial performance in measuring the financial impact of bovine somatropin adoption on U.S. dairy farms. FOM was defined as revenues minus variable input costs accrued after adjusting for annual change in accounts receivable and crop/livestock inventories. FOM suited McBride, Short, and El-Osta's objective of isolating the impact of changes in variable costs on financial performance.

To address the apparent subjectivity and variability in financial performance measurement, there have been two efforts to establish standard measures of financial performance. The American Agricultural Economics Association (AAEA) guidelines and the Farm Financial Standards Council's (FFSC) guidelines are the products of those efforts. To simplify, in measuring profitability, which is a type of financial performance measure, the AAEA guidelines tend to isolate the costs and returns of producing individual commodities and include the opportunity costs of commodity production. The FFSC guidelines, in contrast, tend to reflect the revenues earned and expenses incurred to earn those revenues for the whole farm enterprise while adjusting for revenues and expenses that may have accrued, though not yet received/paid, during the time frame under study.

Considering the many variations in measurement of profitability, this study aims to follow the FFSC's guidelines as closely as possible. The FFSC guidelines are best suited for capturing the whole farm picture, whereas the AAEA guidelines are best for isolating individual components of the farm enterprise. Since this study focuses specifically on organic dairy farms, it is necessary to account for the whole farm enterprise in order to adequately account for farm diversity. Managing the whole farm as an organism and supporting farm diversity, in contrast to promoting specialization, is central to the organic ideal. Thus, perceiving and analyzing the whole organic farm, as opposed to a single component of a larger operation, is critical in examining such a farm model.

This study follows the FFSC's example of a farm business income statement, which measures Net Farm Income from Farming Operations on an accrual basis (NFIFO), and Net Farm Income (NFI) after taxes. An additional cost component to the income statement, withdrawals for unpaid management and labor, is added to arrive at a third profitability indicator, Net Income (NI). Considering that no single financial performance indicator is without limitations, additional financial performance measures, financial ratios of liquidity, solvency, and efficiency, as well as additional profitability ratios, are included to contribute further insight.

3.2 Financial Performance Measures Used in this Study

According to the Farm Financial Standards Council (FFSC), NFI is a profitability measure and is a type of financial performance measure. The FFSC describes financial performance as "the results of production and financial decisions, over one or more periods of time. Measures of financial performance include the impact of external forces that are beyond anyone's control (drought, grain embargoes, etc.), and the results of operating and financing decisions made in the ordinary course of business" (FFSC 1997, III-1). The FFSC defines the following categories of financial performance: (1) liquidity, (2) solvency, (3) profitability, (4) repayment capacity, and (5) financial efficiency. According to the FFSC, profitability, as a type of financial performance indicator, measures “the extent to which a business generates a profit from the use of land, labor, management, and capital” (FFSC 1997, III-2). Profitability, as defined by the FFSC, thus, best suits the research objectives of this study.

The FFSC interprets NFI as “the return to the farmer for unpaid labor, management, and owner equity” (FFSC 1997, III-16). NFIFO equals revenues minus expenses to match those revenues on an accrual basis minus depreciation. Accrual-adjusted NFI equals NFIFO minus taxes, and NI further includes the opportunity cost of management hours worked but not expensed. That is,

$$\begin{aligned}\text{NFIFO} = {} & (\text{Farm Operating Revenues - Farm Operating Expenses}) \\ & \pm (\text{Change in Inventories}) - (\text{Depreciation}) - (\text{Interest} \pm \text{Interest Accrued})\end{aligned} \tag{1}$$

$$\text{NFI} = \text{NFIFO} - (\text{Taxes}) \tag{2}$$

$$\text{NI} = \text{NFI} - (\text{Withdrawals for Unpaid Labor and Management}) \tag{3}$$

The FFSC notes several limitations for each financial performance measure defined, evidencing the fact that there is no one perfect indicator. NFI’s main limitation is its lack of comparability across farm businesses. Using NFI can also lead to interpretation problems due to differences in the form of business organization. For example, while NFI does not necessarily include estimates of labor costs for unpaid operator and family labor, a corporation would likely pay all farm operators and record these costs. To address some of these limitations and maximize comparability across farm businesses, NFIFO, NFI, and NI, as well as each component of the income statement, are measured in this study on a per cow, and per hundredweight equivalent[1] (CWT EQ) basis.

Standardizing the income statements on a per-CWT EQ basis is particularly important when examining the whole farm enterprise. As Kriegl (2005) explains, "Dairy farms have numerous sources of income: milk, cull cows, calves, […], etc. making the use of an equivalent unit essential. In addition, most dairy farms do not separate the costs of producing crops sold for cash from the cost of producing the crops fed to the dairy herd" (p17). Examining a whole, diverse farm can lead to interpretation problems. For example, what does it mean to say that $100 per cow was spent to purchase feed on a diverse operation that also produces pork and poultry? Using an equivalent unit for standardization, milk sales equivalent in the case of this study, is a way to overcome these interpretation problems.

The following financial performance measures and their definitions are included in the analysis in addition to the FFSC measures of financial performance:

Liquidity

(a) Current Ratio = Total current farm assets / Total current farm liabilities

(b) Working Capital = Total current farm assets - Total current farm liabilities

Solvency

(c) Debt/Asset Ratio = Total farm liabilities / Total farm assets

(d) Equity/Asset Ratio = Total farm equity / Total farm assets

(e) Debt/Equity Ratio = Total farm liabilities / Total farm equity

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[1] The CWT EQ method of standardization involves dividing the income statement by the USDA national average All Milk Price (Kriegl 2005). Measuring profitability on a per hundredweight equivalent (CWT EQ) basis is *not* the same as measuring profitability on a per hundredweight (CWT) basis. NFIFO/CWT, for example, equals NFIFO divided by the weight of milk sold in hundreds of pounds. NFIFO/CWT EQ, in contrast, equals NFIFO divided by the USDA national average All Milk Price.

Profitability

(f) Rate of Return on Farm Assets = (NFIFO + Interest - Withdrawals for unpaid labor) / Average total farm assets

(g) Rate of Return of Farm Equity = (NFIFO - Withdrawals for unpaid labor) / Total farm equity

(h) Operating Profit Margin Ratio = (NFIFO + Interest - Withdrawals for unpaid labor) / Gross revenues

Financial Efficiency

(i) Asset Turnover Ratio = Gross revenues / Total farm assets

(j) Operational Ratios

(i) Operating Expense Ratio = (Total operating expenses - Depreciation) / Gross revenues

(ii) Net Farm Income from Operations Ratio = NFIFO / Gross revenues

The FFSC guidelines are followed in defining and interpreting each financial performance measure listed above. The current ratio, according to the FFSC, "indicates the extent to which current farm assets, if liquidated, would cover current farm liabilities" (1997, III-7). Working capital should be interpreted as "a theoretical measure of the amount of funds available to purchase inputs and inventory items after the sale of current farm assets and payment of all current farm liabilities" (FFSC 1997, III-8). The debt to asset ratio "is the creditors' claim against the assets of a farm business" (FFSC 1997, III-9). In contrast, the equity to asset ratio "is the owner's claims against the assets of a business" (FFSC 1997, III-10), as opposed to creditors' claims. Similar to the debt to asset ratio, the debt to equity ratio confers that the "higher the value of the ratio, the more total capital has been supplied by the creditors and less by the owners" (FFSC 1997, III-11). Concerning the Rate of Return of Farm Assets and Equity ratios, "the higher the value, the more profitable the farming operation" (FFSC 1997, III-12). The Operating Profit Margin Ratio should be interpreted as the "return per dollar of gross revenue" (FFSC 1997, III-15). The Asset Turnover Ratio measures "how efficiently farm assets are being used to generate revenue" (FFSC 1997, III-20). The NFIFO ratio is similar to the Profit Margin Ratio but includes the interest expense, while excluding the opportunity cost for unpaid labor. Finally, the Operating Expense Ratio measures the proportion of gross revenues allocated to operating expenses.

3.3 Factors Affecting Financial Performance

The final objective of this study is to examine the factors that influence the profitability of organic dairy farms in the Northeast U.S.A. This objective is fulfilled by using a multivariate regression analysis. Previous studies are drawn upon in constructing an economic model to explain factors that influence organic dairy farm profitability. The multivariate regression model in this study is built upon the results from tabular analysis of financial performance, and farm and farm operator characteristics.

3.3.1 Farm Characteristics

Farm and herd size are expected to positively affect profitability. Tzouvelekas, Pantzios, and Fotopoulos (2001) found farm size had significant power in explaining variation in economic efficiency of organic cotton farms in Greece. Paul, Nehring, and Banker (2004) found that farm size has significant impact on the productivity and efficiency of U.S. livestock farms. El-Osta and Johnson (1998) found herd size to be the most significant contributing factor to net farm income among U.S. dairy farms. Mishra and Morehart (2001), Short (2000), and McBride and Greene (2007) also found that farm size had a significant, positive impact on the financial success of U.S. dairy farms. Furthermore, Gardebroek (2002) found that in the Netherlands farm size explains significant variation in the choice to farm organically, highlighting the importance the acreage base plays in organic dairy management.

Neely and Escalante (2006) found that larger U.S. organic farms, vegetable producers in particular, tend to hire more off-farm labor with regional variation. This may be especially true for organic farmers striving to facilitate natural biological cycles. Short (2000) found that U.S. dairy farms with low profitability hired more labor than those with high profitability. Small organic dairy farms are expected to rely more on unpaid family labor than larger organic dairy farms. Thus, small organic dairy farms are expected to receive lower levels of Net Income (NI) because NI equals revenues minus expenses including taxes and the opportunity costs of unpaid labor and management. It is hypothesized that size will positively impact NI as larger farms incur lower levels of opportunity costs for unpaid labor and management.

3.3.2 Extra Income

The ideal organic farm model is one that incorporates all levels of the farm, the soil, the plants, the animals, and the human, in a holistic manner. Therefore, one might expect to find less specialization and more diversification on an organic dairy farm. For example, organic pork, poultry, or crops may be produced in addition to organic milk, and such diversification may contribute supplemental income to the operation. Mishra and Morehart (2001) found that diversification was negatively correlated with dairy farm profitability. The detraction from specialization, they suggest, had a negative impact on conventional U.S. dairy farm profitability. However, since diversity is central to the organic ideal, extra income, after controlling for cost and production efficiency, is hypothesized to have a positive influence on organic dairy farm profitability.

3.3.3 Farm Operator Characteristics

Previous research suggests organic farmers face a steep learning curve, as they learn to manage a new technology. Sipilainen and Lansink (2005) found a significant learning effect in analyzing the efficiency of organic versus conventional dairy farms in Finland, estimating roughly seven years as the inflection point. Kreigl (2006) found that in Wisconsin organic dairy farms tend to be more financially successful than their conventional counterparts. The amount of experience within the sample of Wisconsin organic dairy farmers ranged from at least six to roughly twenty-five years of farming experience. Half the sample had been receiving organic milk prices for eight years and the other half for at least three years (Kreigl 2006). Kriegl (2006) notes, "The Wisconsin organic dairy farms that shared financial data were a fairly experienced group. […] It is likely that a less experienced group would not perform as well as the group that shared data" (p. 1). However, McBride and Greene (2007) found that dairying experience had a positive impact on the costs of organic dairy farms in the U.S. which would be associated with decreased profitability. Nonetheless, it is expected that as managerial expertise evolves, efficiency increases, economies of scope are gained, and a farm enterprise may operate closer to maximum profitability given his/her own production constraint. Experience is, thus, hypothesized to have a positive impact on profitability.

An operator's age may influence the way he/she manages the farm operation. An older operator, for example, may have a different goal set than a younger operator and, thus, make different investments, management decisions, or be less likely to adopt newer technologies. El-Osta and Johnson (1998) found that age was negatively correlated with profitability among U.S. dairy farms. McBride and Greene (2007) found that age was positively correlated with the costs of U.S. dairy farms. Thus, age is hypothesized to have a negative impact on profitability.

Education is a variable that falls underneath the umbrella of managerial expertise. Tzouvelekas, Pantzios, and Fotopoulos (2001) found that farmer's age and education have significant power in explaining variation in economic efficiency of organic cotton farms in Greece. McBride and Greene (2007) found that primary organic dairy farm operators with less than a high school diploma were associated with lower economic costs. Mishra and Morehart (2001) found that farmer's education and use of cooperative extension agents had a significant and positive impact on financial success of U.S. dairy farms. Gardebroek (2002) found that education, as well as farm size, explains significant variation in the choice to farm organically in the Netherlands. Education is hypothesized to have a positive impact on profitability.

3.3.4 Technology

Integrating new technology into a dairy enterprise may offer several advantages. A milking system with automatic takeoffs, for example, may facilitate increased milk production without requiring additional labor, or it may simply free labor for other tasks. A milking system with udder washers may ensure cleaner milk and, thus, better milk prices. In addition, the milking system in general may vary in its level of technological advancement according to an operator's individual or regional requirements. Short (2000) found that those farms utilizing milking systems with automatic takeoffs and udder washers tended to be more profitable than others. El-Osta and Johnson (1998) found that more advanced milking parlors were positively correlated with U.S. dairy farm profitability. Therefore, technology measures are hypothesized to have a positive impact on profitability.

3.3.5 Efficiency Measures

In light of the restructuring and the trend toward consolidation that has been taking place within the dairy industry for the past several decades, experts believe that those dairy farms that are able to produce more efficiently will be more likely to survive than others (Bailey 2002; Mulhollem 2006). El-Osta and Johnson (1989) found that lower levels of purchased feed per cow had a positive impact on profitability among U.S. conventional dairy farms. Short (2000) found that more profitable U.S. dairy farms produced more milk per cow than less profitable dairy farms, required less feed per unit of milk sold, used less labor hours per cow, and had lower variable costs. Thus, production per cow is expected to be positively correlated with profitability, and variable costs and labor hours per cow are hypothesized to have a negative correlation with profitability.

3.3.6 Risk Management

Agricultural production is an inherently risky business, and managing risk is an important task for farm operators. Flaten and Lien (2005), however, found that risk aversion among Norwegian organic dairy farmers failed to explain variability in management of the resource base. Lien et al. (2003) found that Dutch organic dairy farmers tended to be less risk averse than conventional dairy farmers and expressed a different goal set. For example, organic dairy farmers were most concerned with forage yield uncertainty and valued sustainability and environment first and maximizing profitability last among their collective goal set (Lien et al. 2005). These studies highlight the impact of uncertainty, an important factor in an inherently risky industry, on financial performance. These studies suggest organic farmers tend to be less risk averse. Intuitively, it might be expected that adopters of a non-conventional technology are less risk averse than their conventional counterparts.

Nonetheless, risk management strategies can still be effective tools for stabilizing revenues and expenses and maximizing income. For example, farm operators may manage risk by employing different production and/or marketing strategies (Short 2000). Mishra and Morehart (2001) found that forward contracting of inputs has a significant, positive impact on financial success of U.S. dairy farms. Paul, Nehring, and Banker (2004) found that contracting inputs and/or outputs has a modest, but significant, impact on the productivity and efficiency of U.S. livestock farms. Furthermore, Short (2000) found that successful U.S. dairy farms tend to employ marketing strategies, such as spreading sales over the course of the year, contracting, and participating in cooperatives. The use of marketing and/or production strategies is expected to positively affect profitability.

3.3.7 Financial Efficiency

Investing in the dairy farm enterprise, such as new technology, for example, often requires large amounts of borrowed capital which must be repaid with interest as the asset depreciates over the lifespan of the debt instrument. Bailey (2002) warns that not all investments are right for all farms, and that each individual farm must thoughtfully manage its investments according to the individual objective and debt carrying capacity of the enterprise. El-Osta and Johnson (1998) and Short (2000) found that the debt-to-asset ratio of the farm had a negative impact on U.S. dairy farm profitability. Thus, it is hypothesized that the debt-to-asset ratio will have a negative correlation with organic dairy farm profitability in the Northeast.

A summary of the econometric studies that analyzed the profitability and factors influencing profitability of U.S. dairy farms is presented in Table 4 below. With the exception of McBride and Greene (2007), the farms examined in these studies were conventional dairy farms. McBride and Greene (2007) examined the costs of organic dairy farms.

3.4 Hypotheses to Fulfill Research Objectives

The first objective of this study is to test for a statistical difference between the financial performance of organic and conventional dairy farmers in the Northeast on a per-farm, per-cow, and per-cwt equivalent level. The sample of dairy farmer financial data is separated into two sub-samples: conventional and organic dairy farmers. The samples are treated as independent samples that are approximately normally distributed.

An un-pooled, two-tailed t-test is used to analyze the difference in means of each variable comprising the income statement from a per-farm, per-cow, and per-hundredweight-equivalent (CWT EQ) perspective. For example, the null and alternative hypotheses to be tested in comparing the mean NFIFO of Northeast organic and conventional dairy farmers are as follows:

H_0: $\mu_1 = \mu_2$,

H_a: $\mu_1 \neq \mu_2$,

Table 4: Previous Econometric Studies of Dairy Farm Profitability

Author (Date)	**Focus of Study**	**Financial Measures**	**Independent Variables**	**Data (Date)**	**Key Findings**
McBride and Greene (2007)	Determine the factors that influence the costs of organic dairy production in the U.S.	Operating Costs (OC), Capital Ownership Costs (OCC), Total Economic Costs (TC)	age, education, occupation, experience, size, specialization, state, pasture-based, DHIA participation, milking frequency or intensity, rbST, artificial insemination, embryo transplants, vet services, nutritionist, cow records, forward purchased inputs, negotiate input price discounts, organic	cross-sectional data, 2005	-age (+) correlation with OC, OCC -less than HS diploma (-) corr. with OCC -occupation not farming (+) corr. with OC, OCC -dairy farming experience (+) corr. with OC, OCC -size (-) corr. with OCC -embryo transplants (+) corr. with OC, OCC -Vet services (-) corr. with OC, OCC -Nutritionist (-) corr. with OCC -Organic (+) corr. with OC, OCC
Mishra and Morehart (2001)	Determine the factors that influence the profitability of organic dairy farms in the U.S., focusing specifically on risk management decisions	Operator's Labor and Management Income (OLMI)	education, use of extension services, off-farm income, debt/asset, value of agricultural output, value of machinery & equipment/value of production, cash operating expenses/value of production, entropy measure of farm diversification, type of business organization, participation in production/marketing contracts, crop/livestock insurance, forward pricing of inputs contracts, government payments, cow production	cross-sectional data, 1994	-college grad (+) corr. with OLMI -use extension (+) corr. with OLMI -off-farm work (-) corr. with OLMI -value product (+) corr. with OLMI -operating expenses/value of production (-) corr. OLMI -diversification (-) corr. with OLMI -family farm (-) OLMI -forward contracting inputs (+) OLMI

			records, adoption of technology		
Short (2000)	Determine the factors that influence the profitability of organic dairy farms in the U.S., focusing specifically on production and cost efficiency	Net Farm Income (NFI), Economic Profit per cwt of Milk Sold (EPM), Economic Profit per Cow (EPC)	age, education, hours per day in operation, automatic takeoffs, udder washers, total variable costs, capital replacement and machinery cost, cwt feed, milk cows, output/cow, debt/asset, labor hrs/cow	Cross-sectional data, 1993	-cwt feed (-) corr. with NFI, EPM, EPC -milk cows (+) corr. with NFI -output/cow (+) corr. with NFI, EPC -debt/asset (-) with NFI -labor hrs (-) NFI, EPM, EPC -value milk sold/total farm product (-) corr. with NFI, EPM, EPC -value of land, buildings, equip. (-) EPM, EPC
El-Osta and Johnson (1998)	Determine the factors that influence the profitability of organic dairy farms in the U.S., focusing specifically on regional variations of production and cost efficiency	Net Farm Income (NFI), Net Returns per Unit (NRU)	rented acres per total operated acres, size of largest tractor on farm, debt/asset, milk cows, cwt purchased feed per cow, cost of land, buildings, and equipment per cow, type of business organization, advanced milking parlor, production record keeping system	Cross-sectional data, 1993	-farm size (+) NFI, NRU -cwt milk sold per cow (+) NRU -advanced milking parlors and record keeping (+) NFI -adv. Milk. parlors (-) NRU -debt/asset (-) NFI -rented acres/total acres (-) NFI -forage expense/cow (-) NRU -hired labor/cow (-) NRU -purchased feed/cow (-) NFI, NRU -land, buildings, equip. (-) NFI, NRU -age (-) NFI

where μ_1 is the mean NFIFO of Northeast organic dairy farmers, and μ_2 are the mean NFIFO of Northeast conventional dairy farmers. This procedure is repeated for the following comparisons, thereby fulfilling objectives 2 through 3:

(1) Farm and farm operator characteristics of organic versus conventional dairy farms,

(2) The financial performance of organic dairy farms with more than five years of experience producing and selling organic milk compared to organic dairy farms with five years or less experience,

(3) Farm and farm operator characteristics of profitable versus unprofitable organic dairy farms.

The fourth and final objective is to try to explain the factors that determine profitability across organic dairy farms in the Northeast. Profitability, measured by three types of measurements, NFIFO, NFI and NI, is modeled as a function of input/output prices and a production constraint, which is dependent upon farm and farm operator characteristics. The conceptual model borrows heavily from McBride and Greene (2007), Mishra and Morehart (2001), El-Osta and Johnson (1998), and Short (2000).

Assume that the following profit function represents a profit-maximizing, price-taking firm.

$$\pi(P_1, P_m, \kappa, \delta) = \sum P_1 Q_1(P_1, \kappa, \delta) - \sum TC_m(P_m, Q_m, \eta, \gamma), \tag{4}$$

where $\mathbf{P_l}$ is a vector of output prices, $\mathbf{Q_l}$ is a vector of quantities of various outputs produced, $\boldsymbol{\kappa}$ is a vector of farm operator characteristics, $\boldsymbol{\delta}$ is a vector of farm characteristics, $\mathbf{TC_m}$ is a vector of costs, $\mathbf{P_m}$ is a vector of input prices, $\mathbf{Q_m}$ is a vector of inputs, $\boldsymbol{\eta}$is a vector of farm operator characteristics**,** $\boldsymbol{\gamma}$ is a vector of farm characteristics.

Transformation of the economic model in Equation (4) yields an econometric model as follows:

$$\pi = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_4 + \alpha_5 X_5 + \alpha_6 X_6 + \alpha_7 X_7 + \varepsilon, \qquad (5)$$

where X_1 is a vector of farm characteristics, X_2 is a vector of extra income variables, X_3 is a vector of farm operator characteristics, X_4 is a vector of technology indicators, X_5 is a vector of efficiency measures, X_6 is a vector of risk management measures, and X_7 is a financial efficiency measure. In the regression model, NFIFO, NFI, and NI are substituted for π. Thus, organic dairy farm profitability is hypothesized to be a function of output/input prices, farm characteristics, extra income, farm operator characteristics, technology, efficiency measures, risk management decisions, and financial efficiency. Assuming a competitive market for input and output, all organic dairy farms are assumed to be price takers. In addition, it is assumed that all dairy farms face the same input market conditions. Table 5 lists the explanatory variables of the model, their definitions, and their expected signs. Chapter 4 presents the results and discussion.

Table 5: List of Regressors, Their Definitions and Their Expected Signs

Independent Variables, Their Definitions and Expected Signs		
Variable	**Definition**	**Expected Sign**
Farm Characteristics:		
AVEPRICE	Average milk price received	+
MILKCOWS	Number of milk cows	+
ACGFEED	Acres of grazing pasture	+
MIRG	Management intensive rotational grazing	+
COWAGE	Average age of the milking herd	-
LEGSTAT	Family farm / Sole proprietorship	+
HRSMLKON	Hours per day milking system in operation	+
SILOCAP	Capacity of milk tanks and silos	+
DRYOFF	Choice to dry off cows seasonally	-
NUTMNPLN	Use of a nutrition management plan	+
VETSERVIC	Use of regularly scheduled veterinary Services	+

Extra Income:		
LPSXMLKS	Livestock and poultry sales (excludes milk sales)	+
CSCCC	Crops sales net CCC loans	+
GOVTYES	Receive government payments	+
Farm Operator Characteristics:		
OPEAGE	Operator's age	-
OPEEDU	Operator's highest level of education	+
MILKEXP	Years dairy farm has been in operation	+
MIRGEXP	Years practicing rotational grazing	+
FUTURE	Years operator expects to continue operation	+
Technology:		
PARLOR	Milking parlor used on operation	+
AUTTAKOF	Milking system with automatic takeoffs	+
Efficiency Measures:		
MLKPRDCW	Milk production per cow	+
PFEEDCOW	Purchased feed per cow	-
HFEEDCOW	Homegrown feed per cow	+
LABCOW	Labor costs per cow	-
LABHRCOW	Labor hours per cow (paid and unpaid)	+
CULLRATE	Cow loss rate	-
Risk Management:		
PDISCOUNT	Negotiate input price discounts	+
WRITTCON	Have a written contract for marketing milk	+
ONSITPRO	Processed milk on site	-
Financial Efficiency:		
DEBT2ASST	Debt/Asset ratio	-

3.5 Data

Data used in this analysis come from the 2005 Agricultural Resource Management Survey (ARMS) of U.S. dairy farms conducted by the Economic Research Service (ERS) and the National Agricultural Statistics Service (NASS) of the United States Department of Agriculture (USDA). The ARMS survey is a multiframe, probability-based survey, and it is designed to collect detailed financial data about farm financial performance (USDA 2007a). The financial data can be used to construct various measures of financial performance, such as profitability, liquidity, and solvency. The survey also collects data on farm operator and farm characteristics, as well as various production management decisions.

The ARMS data used here represent a targeted sample of U.S. milk producers from 24 states, which comprise over 90 percent of total U.S. milk production, as well as a sub-sample of certified organic milk producers from 19 states nationwide (McBride and Greene 2007). The data are weighted according to their probability of occurring, which is based on certain farm characteristics and a known number of farms with those similar characteristics (Short 2000). The stratified sample and the subsequent probability-weighted data allow each farm to represent several similar farms and adjust for the over-sampled, organic population. The USDA provides further details online (USDA 2007a).

This study is focused on the Northeast region of the U.S. which is represented by Pennsylvania, New York, Vermont, and Maine. There were 278 conventional dairy farms and 152 organic dairy farms from this Northeast dairy region. Mixed farms with both organic and conventional operations, as well as those dairy farms transitioning to organic status in 2005 were excluded from the analysis. After removing statistical outliers from the data set, there were 272 conventional and 151 organic dairy farms used for analysis. In the latter group, there were 43 observations from Pennsylvania, 49 observations from New York, 38 observations from Vermont, and 21 observations from Maine.

CHAPTER IV

RESULTS AND DISCUSSIONS

4.1 Profitability of Organic versus Conventional Dairy Farms in the Northeast

Organic and conventional dairy farms tend to operate on significantly different size scales. As Table 6 shows, a typical organic dairy farm in the Northeast was operating on 318 acres in 2005, while a typical conventional dairy farm was operating on 864 acres. The average organic dairy farm sold 6,111 cwt of milk, compared to 57,332 cwt for conventional farms. Furthermore, the mean herd size for organic farms was 54 cows compared to 285 for conventional dairy farms. Thus, a typical organic cow produced 119 cwt of milk, while a typical conventional cow produced 185 cwt of milk in 2005, a 55 percent difference over organic milk production. However, the average milk price received by organic farms was $24/cwt relative to $16/cwt for conventional milk; thus the organic milk price premium was roughly $8/cwt in 2005, or 50 percent higher than the conventional price. This suggests that, while size determines much of the difference in milk production, there may be other factors, such as the milk price, that may be contributing to the relative difference in profitability between these two groups.

It might be expected that organic milk cows would spend more time on pasture and receive more homegrown feed than conventional cows; thus upholding the organic school's tenets of self-sufficiency and sustainability. As Table 6 shows, a typical organic dairy farm used 1.23 cwt of homegrown feed per cwt of milk produced in 2005 compared to 1.62 cwt of homegrown feed on conventional farms, or 24 percent less. The typical organic farm also used less purchased feed per cwt of milk produced; however, this difference was not statistically significant. Overall, a typical organic cow consumed slightly less total feed than a typical conventional cow (Table 6). Organic farms used less feed per cow and per cwt of milk produced and, thus, were slightly more efficient in that respect. On a percentage-of-total-feed basis, however, organic and conventional dairy farms used approximately equivalent proportions of homegrown feed at roughly 14 and 15 percent, respectively. Thus, it can not be concluded that either groups was more or less self-sufficient than the other in this respect. Organic farms were, however, less efficient with labor employed per cow, and labor employed per cwt of milk sold compared to the conventional farms.

More in line with expectations, organic dairy farms had 1.35 acres of pasture per cow and their cows spent 7 months per year out on pasture relative to 0.37 acres and 4 months per year, respectively, for conventional dairy farms. Furthermore, organic dairy herds saw a cull rate of 3.7 percent compared to 5.0 percent for the conventional group, and the average age of the organic herd was 5.1 years relative to 4.6 years among conventional farms. That is, cows on organic farms in the Northeast were producing for a greater number of years than cows on conventional farms, possibly reducing the cost of cow herd replacement.

Table 6: Farm Characteristics of Organic and Conventional Northeast Dairy Farms

Farm Characteristic	**Organic** *n=151*	**Conventional** *n=272*
Average milk price ($/cwt)	24***	16***
Total acres	318***	864***
Total milk sold (cwt)	6,111***	57,332***
Number of milk cows	53***	254***
Milk sold (cwt) per cow	119***	185***
Feed (cwt) per milk sold (cwt)	8.9***	10.5***
Purchased feed (cwt) per cow	842	808
Homegrown feed (cwt) per cow	130***	281***
Purchased feed (cwt) per milk produced (cwt)	6.21	8.13
Homegrown feed (cwt) per milk produced (cwt)	1.23***	1.62***

Total farm labor hours worked per week per cow	10.5***	5.6***
Total farm labor hours worked per week per cwt	0.1***	0.04***
Average age of the milking herd	5.1***	4.6***
Milk cow loss per cow (%)	3.7***	5.0***
Acres of pasture per cow	1.35***	0.37***
Months/Year on pasture	7***	4***

Note: Statistically significantly different means are as follows: *** $p \leq .01$, ** $p \leq .05$, * $p \leq .10$

Table 7 summarizes the results of the two-tailed, un-pooled t-test comparing the average Northeast organic and conventional dairy farm in 2005. In contrast to Dalton et al. (2005) findings, this study shows that the average organic dairy farm was profitable in 2005 (Table 7), earning a NFIFO of $47,356 and a NFI of $42,853 after taxes. However, mean NI was negative at $-3,761, that is, after withdrawals for unpaid labor and management were included. This means that organic dairy farms perhaps did not realize positive returns to unpaid family labor and management in the Northeast in 2005.

The average conventional dairy farm earned a significantly greater NFIFO of $143,024, a NFI of $129,068 after taxes, and a NI of $54,849. As Table 6 shows, the mean differences with respect to NFIFO, NFI, and NI between organic and conventional dairy farms were statistically significantly different. Conventional dairy farms tend to earn significantly more revenue from every component of the operation at the farm level except non-money farm income and the net change in accounts receivable. The average Northeast conventional dairy farm operates on a much larger scale than its organic counterpart (Table 7). At the farm level, conventional dairy farms earned 5.7 times greater milk revenues than organic farms, crop revenues 9.6 times higher than organic farms, and government payments 7.8 times higher than those received by organic farms. However, organic dairy farms tend to incur significantly lower expenses on every cost

Table 7: Income Statement of Organic and Conventional Dairy Farms in the Northeast U.S., 2005

Attributes	**Per Farm**		**Per Cow**		**Per CWT EQ**	
	organic *n=151*	**conventional** *n=272*	**organic** *n=151*	**conventional** *n=272*	**Organic** *n=151*	**conventional** *n=272*
REVENUES						
Milk Sales	146,316***	835,613***	2,762	2,871	8,814***	50,338***
Livestock & Poultry Sales	9,978***	48,595***	205	192	601***	2,927***
Net Change in Value of Livestock & Poultry	-64**	1,367**	-4	5	-4**	82**
Livestock Breeding Stock Cash Sales	2,150**	4,899**	49	34	130**	295**
Gain/Loss Livestock Breeding Stock	129	352	3	3	8	21
Crop Sales Net CCC Loans	1,914***	18,296***	42*	101*	115***	1,102***
Net Change in Value of Crops	-332	251	-8	2	-20	15
Government Payments	4,406***	34,507***	81**	132**	265***	2,079***
Income from Custom Work	344***	1,234***	7	7	21***	74***
Other Farm Related Income	8,819***	28,671***	145	121	531***	1,727***
Income from Livestock Related Operations	273	332	7	3	16	20
Non-Money Farm Income	9,841	9,701	212***	89***	593	584
Net Change in Accounts Receivable	-4,810*	305*	-65*	-10*	-290*	18*
Gross Revenues from Farming Operations, Accrual Adjusted	***178,964****	***984,123****	***3,435***	***3,552***	***10,781****	***59,285****
EXPENSES						
Purchased Feed	41,150***	228,522***	792	779	2,479***	13,766***
Purchased Livestock	467***	1,755***	10	13	28	106
Other Livestock Related Expenses	4,021***	60,924***	78***	172***	242***	3,670***
Labor	11,049***	136,868***	178***	374***	666***	8,245***
Fertilizer & Chemicals	2,615***	34,788***	59***	127***	158***	2,096***
Seeds & Plants	1,453***	15,438***	26***	54***	88***	930***
Fuel & Oil	6,213***	35,123***	117**	135**	374***	2,116***
Equipment & Vehicle Maintenance	7,474***	42,272***	134***	168***	450***	2,547***
Infrastructure Maintenance	3,945***	19,449***	84	73	238***	1,172***
Other Variable Expenses	9,973***	42,447***	191**	162**	601***	2,557***

Custom Work	3,378***	38,657***	63***	154***	204***	2,329***
Utilities	4,558***	22,508***	85**	99**	275***	1,356***
Insurance	2,856***	14,854***	53**	63**	172***	895***
Rent Leasing Land	2,651***	18,356***	48*	65*	160***	1,106***
Net Change in Value of Supplies	355**	2,569**	5	7	21**	155**
Depreciation on Farm Assets	18,449***	81,133***	338	309	1,111***	4,888***
Total Interest	8,228***	34,015***	151	125	496***	2,049***
Interest, Accrual Adjusted	3,482***	16,559***	69*	56*	210***	998***
Total Operating Expenses, Accrual Adjusted	***131,608****	***841,100****	***2,469****	***2,921****	***7,928****	***50,669****
Net Farm Income from Farming Operations, Accrual Adjusted (NFIFO)	**47,356***	**143,024***	**967***	**631***	**2,853***	**8,616***
Real Estate & Property Taxes	4,503***	13,955***	91***	70***	271***	840***
Net Farm Income (NFI)	**42,853***	**129,068***	**876***	**561***	**2,582***	**7,775***
Withdrawals for Unpaid Labor & Management	46,613***	74,220***	987***	534***	2,808***	4,471***
Net Income (NI)	**-3,761***	**54,849***	**-111**	**27**	**-227***	**3,304***

Note: Statistically significant means are as follows: *** p ≤ .01, ** p ≤ .05, * p ≤ .10

component of the operation (Table 7). The average Northeast organic dairy farm had statistically significantly lower operating costs for all cost components from a per-farm perspective. For instance, conventional dairy farms faced purchased feed costs 5.6 times higher than organic farms, other livestock related expenses, such as veterinary and medical expenses, were 15 times higher than organic farms, labor expenses 12.4 times higher than organic farms, and fertilizer and chemicals costs 13 times more than on organic farms.

It would be difficult to attribute such levels of difference at the farm level to anything other than the difference in scale of production between the two ideologically opposed production models. That is, larger scale operations have more cows that produce higher total quantities of milk and, thus, higher levels of milk revenues. Similarly, a greater number of cows require greater levels of inputs and, thus, higher levels of expenses.

Despite the supposed differences in ideology between organic and conventional dairy farms, the two models face similar relative cost structures, albeit on different scales. As Table 7 shows, purchased feed, labor, and depreciation were significant cost components for both groups. However, the three most significant cost components comprising 50 percent of total operating expenses for conventional farms were as follows: purchased feed, labor, and depreciation on farm assets (Table 7). In contrast, the following three most significant expenses for organic farms comprised 54 percent of total operating expenses: purchased feed, depreciation on farm assets, and other variable expenses. It is noteworthy that labor costs for organic farms, which are often associated with increased labor-intensiveness, especially concerning milk production, comprise a smaller percent of total operating expenses (6 percent) than for conventional farms (12 percent).

The two groups also face similar revenue structures. Milk sales, livestock and poultry sales, and government payments were the three most important income components for conventional farms. As Table 7 shows, conventional milk sales, livestock and poultry sales, and government payments comprised 91 percent of an average conventional farm's revenues. The three most important income components for the organic group were milk sales, livestock and poultry sales, and non-money farm income[2], which make up 96 percent of a typical organic farm's revenues.

Analysis at the per-cow level (Table 7, Column 4, 5) becomes more ambiguous than that at the farm level (Table 7, Column 2, 3). In contrast to Dalton et al. (2005) but in accord with Butler (2002) and Kriegl (2006), this study shows that organic dairy farms were more profitable than their conventional counterparts on a per-cow level. On average, organic farms earned a NFIFO/cow of $967 and a NFI/cow of $876, relative to $631 per cow and $561 per cow for conventional dairy farms. The differences were statistically significant. Organic dairy farms do, however, tend to incur higher opportunity costs for labor per cow, and NI was negative at $-111 per cow for organic dairy farms compared to $27 per cow for conventional dairy farms (Table 7, Column 4, 5). However, the difference was not statistically significant. The median NFIFO/cow and NFI/cow for northeast organic dairy farms were also greater than conventional dairy farms, as Table 8 shows, further supporting the Table 7 comparison.

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[2] The USDA provides the following example of non-money farm income: "Nonmoney income, such as the imputed rental value of a farm-owned dwelling, represents a business contribution to the household income because it frees up household cash that would otherwise be spent on housing" (USDA, 1995, p. 64).

While conventional dairy farms earned a higher level of gross revenues from farming operations per cow than organic dairy farms, the difference was not statistically significant (Table 7, Column 4, 5). The average conventional dairy farm, however, received a significantly greater amount of government payments of $132 per cow compared to $81 per cow for organic farmers. The median government payment per conventional cow, furthermore, was $99 compared to $7 per organic cow (Table 8). Conventional farms also earned a significantly greater level of crop sales ($101/cow) relative to the average organic dairy farmer ($42/cow). The median value of crop sales for both groups, however, was zero. In terms of the mean total operating expenses, organic and conventional dairy farms differed significantly.

In contrast to Butler (2002), organic dairy farms still incurred statistically significantly lower total operating expenses than conventional farms on a per-cow basis but not for all cost components (Table 7, Column 4, 5). The mean total operating expenses was $2,469 per cow for the organic group relative to $2,921 per cow for the conventional group. The difference in median values of $2,400 per organic cow and $2,871 per conventional cow (Table 8) was greater than the difference in means; thus further supporting the statistically significant difference. The following expense variables were *not* statistically significantly different between the two groups: purchased feed per cow, purchased livestock per cow, maintenance per cow, depreciation per cow, and interest payments per cow. The lack of a statistically significant difference of purchased feed costs per cow between organic and conventional farms stands in contrast to Dalton et al. (2004). However, in accord with Kriegl (2006) and Butler (2002), this suggests organic dairies tend to compensate for higher priced feed and concentrate by

Table 8: Income Statement of Northeast Organic and Conventional Dairy Farms, Median Estimates Shown, 2005

Attributes	Per Cow		Per CWT EQ	
	organic *n=152*	**conventional** *n=278*	**organic** *n=152*	**conventional** *n=278*
REVENUES				
Milk Sales	2,868	2,987	8,563	26,442
Livestock & Poultry Sales	138	155	422	1,435
Net Change in Value of Livestock & Poultry	0	0	0	0
Livestock Breeding Stock Cash Sales	0	0	0	0
Gain/Loss Livestock Breeding Stock	0	0	0	0
Crop Sales Net CCC Loans	0	0	0	0
Net Change in Value of Crops	0	0	0	0
Gov't Payments	7	99	20	1,025
Income from Custom Work	0	0	0	0
Other Farm Related Income	32	45	121	368
Income Livestock Related Operations	0	0	0	0
Non-Money Farm Income	178	54	500	509
Net Change in Accounts Receivable	0	0	0	0
Gross Revenues from Farming Operations, Accrual Adjusted	***3,408***	***3,577***	***10,639***	***32,279***
EXPENSES				
Purchased Feed	753	786	2,148	6,778
Purchased Livestock	0	0	0	0
Other Livestock Related Expenses	59	130	162	1,238
Labor	37	344	94	3,464
Fertilizer & Chemicals	10	100	29	1,084
Seeds & Plants	10	42	30	391
Fuel & Oil	106	121	307	1,143
Equipment & Vehicle Maintenance	119	146	374	1,143
Infrastructure Maintenance	33	39	102	357
Other Variable Expenses	172	142	486	1,269

Custom Work	30	127	79	1,174
Utilities	84	87	270	776
Insurance	50	52	137	509
Rent Leasing Land	12	33	30	332
Net Change in Value of Supplies	0	0	0	0
Depreciation on Farm Assets	293	305	904	2,209
Total Interest	92	99	251	831
Interest, Accrual Adjusted	49	44	132	394
Total Operating Expenses, Accrual Adjusted	***2,400***	***2,871***	***6,601***	***26,718***
Net Farm Income from Farming Operations, Accrual Adjusted (NFIFO)	**945**	**598**	**2,809**	**4,804**
Real Estate & Property Taxes	88	54	267	528
Net Farm Income (NFI)	**824**	**540**	**2,571**	**4,076**
Withdrawals for Unpaid Labor & Management	923	420	2,899	3,913
Net Income (NI)	**-11**	**56**	**-28**	**563**

Note: Statistical significant tests were not performed on the Median estimates in this Table using homegrown and pasture-based feed systems.

The conventional group incurred statistically significantly greater costs per cow for other livestock related expenses, such as veterinary and medicine costs (Table 7). This might be expected considering the regulatory limitations governing organic husbandry practices coupled with the evidence that organically managed cows tend to suffer lower rates of certain ailments than conventional cows (Hamilton et al. 2006). Conventional operations faced higher costs for fertilizer and chemicals since these materials are not allowed in organic agriculture. Conventional dairy farms required greater labor costs per cow than organic dairy farms, but organic dairy farms required significantly greater opportunity costs for labor per cow than conventional dairy farms. This suggests the degree to which organic farms draw upon family labor, which was presumably unpaid, underpaid, or both. Conventional operations paid almost twice as much for fuel and oil per cow than organic farms. This should not, however, be interpreted as support to the organic school's claim to greater sustainability. Pimentel et al. (2005) have shown that such a static measure of energy use can produce misleading interpretations and stress the importance of accounting for energy used throughout the entire supply chain in an analysis of energy use.

Comparisons at the per-cow level, while intuitively appealing, have certain limitations. Considering the diversity of farm-related, revenue-generating activities that a farm enterprise may be involved in, spreading financial variables over the number of cows may yield ambiguous or misleading interpretations. What does it mean to say that a farm spent $1,000 per cow on purchased feed when some of the feed may have been used to raise livestock, poultry, and breeding stock? For example, the average Northeast conventional dairy farm earned milk sales equal to 82 percent of gross revenues from farming operations (GRFO). This still leaves a significant proportion of revenues coming from farm-related activities other than milk sales, such as livestock and poultry sales (5 percent of GRFO) and other farm-related income (3 percent of GRFO). It is for this reason that Kriegl (2005) advises standardizing profitability on a per CWT EQ basis. However, per CWT EQ measures produce their own limitations due to their non-normal distribution among the conventional group. To address the issue, statistical outliers were removed from the data set and median values, which are less sensitive to outliers, are also discussed.

From a per-CWT EQ perspective (Table 7, Column 6, 7), the average northeast conventional dairy farm earned a statistically significantly greater amount of farm revenue than the average organic farm, but the average organic farm had a statistically significantly lower level of expenses relative to their conventional counterpart. On average, conventional dairy farms earned \$59,285 per CWT EQ in gross revenues compared to \$10,781 per CWT EQ by organic dairy farms. The difference in the median gross revenues between conventional dairy farms at \$32,279 and organic dairy farms at \$10,639 was also significant (Table 8). Total operating expenses of the average conventional dairy farm of \$50,669/CWT EQ was statistically significantly greater than the \$7,928/CWT EQ for organics. The median value of total operating expenses for the conventional group was \$26,718/CWT EQ compared to \$6,601/CWT EQ for the organic group. Thus, considering the average organic milk price premium of \$8.30/CWT, the oft stated question emerges: is the organic price premium, coupled with a lower level of expenses, enough to outweigh the lower levels of productivity and revenues associated with the relative smallness of the organic ideal? This study found that, at the farm-level, the average organic dairy farm was profitable in the Northeast region, but did not necessarily earn positive returns to unpaid labor and management.

The mean NFIFO/CWT EQ, NFI/CWT EQ, and NI/CWT EQ of organic and conventional dairy farms were statistically significantly different (Table 7). Specifically, NFIFO/CWT EQ, NFI/CWT EQ, and NI/CWT EQ of northeast conventional dairy farms were statistically significantly greater than organic farms in 2005. The average northeast organic dairy farm, however, was profitable in 2005 earning a NFIFO/CWT EQ of $2,853 and a NFI/CWT EQ of $2,582 after taxes. This finding is in contrast to Dalton et al. (2005) but in accord with Butler (2002) and Kriegl (2006). However, NI/CWT EQ becomes negative at $-227, that is, after withdrawals for unpaid labor and management are included. This compares to a mean NFIFO/CWT EQ of $8,616, NFI/CWT EQ of $7,775, and NI of $3,304 per hundredweight equivalent on conventional dairy farms. In contrast to organic dairy farms, conventional farms earned positive returns to unpaid labor and management, and in this sense, were more economically viable at the farm level.

The difference in median estimates, however, was less than the difference in means (Table 8). The median organic NFIFO/CWT EQ was $2,809, compared to a conventional NFIFO of $4,804 per hundredweight equivalent. The median organic NFI/CWT EQ was $2,571, relative to a median conventional NFI of $4,076 per hundredweight equivalent. The median NI/CWT EQ was $-28 relative to a median conventional NI of $563 per hundredweight equivalent. The per-CWT-EQ-level perspective was similar to that at the farm-level, and it appears to also be influenced by the difference in scale of production between the two models.

4.2 Profitability and Farm Size

A farm-level analysis clearly has its limitations due to the different scales of production between the two ideologically opposed production models. A per-cow-level analysis, furthermore, is not without its limitations. Standardizing the variables of the income statement on a per-hundredweight-equivalent basis provided a solution to many of these problems, but still may suffer limitations due to the different scales of production. Tables 9 addresses these issues and summarizes the financial performance of organic and conventional dairy farms on a per hundredweight equivalent (CWT EQ) bases according to farm size category. The data were separated into the following three size classes generally used by the USDA (e.g., MacDonald et al. 2007) for comparison: (1) farms with 50 cows or less, (2) farms with 51 to 100 cows, and (3) farms with more than 100 cows. The largest size class (> 100 cows), however, contains only 5 observations among the organic group.

Table 9 summarizes the differences in profitability at the per hundredweight equivalent (CWT EQ) level between small (≤50 cows), medium (51 to 100 cows), and large (>100 cows) Northeast organic and conventional dairy farms. In stark contrast to Tables 7 and 8, Table 9 shows no statistically significant difference in gross revenues, total operating expenses, NFIFO and NFI between small organic and conventional dairy farms. Net Income, however, was statistically significantly different. In contrast to Table 7, small organic farms earned a positive NI, while small conventional farms earned a negative Net Income.

While previous research suggests that small dairy farms are not typically economically viable (MacDonald et al. 2007), this study shows that, while that may be true for conventional dairy farms, small organic dairy farms in the Northeast are typically viable economic enterprises. The majority of organic dairy farms, who are all relatively small (<200 cows), earned a positive NFIFO and NFI in 2005 in the Northeast (Table 9, Column 2). Table 9, moreover, shows that small organic dairy farms also typically earned positive economic returns to unpaid labor in 2005. Thus, transitioning to certified organic status could be a viable economic alternative for small conventional dairy farms in the Northeast, who typically did not earn positive economic returns to unpaid labor in 2005.

Among the small organic and conventional farms, the organic group faced statistically significantly larger costs for purchased feed, infrastructure maintenance, custom work, and utilities (Table 9, Columns 2, 3). The larger purchased feed cost among the organic group was likely due to the greater prices for organic feed and concentrates, and was in accord with Dalton et al. (2005) but in contrast to Butler (2002) and Kriegl (2006). Moreover, in stark contrast to previous findings and intuition, there was no statistically significant difference in expenses for fertilizer and chemicals, seeds and plants, fuel and oil, labor, and other livestock related expenses, such as veterinary and medicine. In this light, small conventional farms do not seem to differ from small organic farms as ideology might predict.

There was no statistically significant difference in GRFO, TOE, NFIFO, and NFI between medium-sized organic and conventional dairy farms (Table 9, Columns 4, 5). In contrast to Table 7 and Table 8, NI was negative for both groups, and there was no statistically significant difference. Conventional farms earned greater revenues

Table 9: Income Statement of Organic and Conventional Dairy Farms in the Northeast, 2005

Attributes	# cows ≤ 50 Per CWT EQ		50 < # cows ≤ 100 Per CWT EQ		# cows > 100 Per CWT EQ	
	Organic *n=83*	**Conventional** *n=36*	**Organic** *n=63*	**Conventional** *n=69*	**Organic** *n=5*	**Conventional** *n=167*
REVENUES						
Milk Sales	6,594**	5,285**	11,281	11,532	14,577	76,084
Livestock & Poultry Sales	539	616	682	734	619	4,332
Net Change in Value of Livestock & Poultry	-32*	7*	33	2	1	132
Livestock Breeding Stock Cash Sales	135	54	121	194	155	389
Gain/Loss Livestock Breeding Stock	11	0	5	15	0	28
Crop Sales Net CCC Loans	160	113	47*	338*	235	1,631
Net Change in Value of Crops	-6	51	-78	1	467	13
Government Payments	131	230	427	443	460	3,153
Income from Custom Work	16	9	29	54	5	97
Other Farm Related Income	281	396	629	499	3,460	2,522
Income from Livestock Related Operations	30	28	0	1	0	26
Non-Money Farm Income	602	484	581	582	602	607
Net Change in Accounts Receivable	-110	-30	-323	-182	-2,859	112
Gross Revenues from Farming Operations, Accrual Adjusted	***8,351***	***7,242***	***13,432***	***14,212***	***17,722***	***89,126***
EXPENSES						
Purchased Feed	1,959**	1,522**	3,184	3,017	2,216	20,847
Purchased Livestock	36	12	20	13	0	164
Other Livestock Related Expenses	187	181	326	529	108	5,720
Labor	255	319	1,100	1,098	2,016	12,907
Fertilizer & Chemicals	193	184	95***	514***	366	3,161
Seeds & Plants	52	72	118***	215***	304	1,410
Fuel & Oil	253	308	501	543	788	3,155
Equipment & Vehicle Maintenance	264	331	654	723	974	3,778
Infrastructure Maintenance	205*	107*	284	379	190	1,729

Other Variable Expenses	407	334	842*	657*	777	3,821
Custom Work	138***	274***	265***	700***	514	3,445
Utilities	179**	261**	376***	488***	579	1,951
Insurance	108	150	239	295	393	1,303
Rent Leasing Land	88	98	241	206	317	1,695
Net Change in Value of Supplies	7	-4	42	7	-4	250
Depreciation on Farm Assets	766	639	1,419	1,161	2,970	7,343
Total Interest	315	247	673	550	1,261	3,057
Interest, Accrual Adjusted	156	108	250	228	597	1,507
Total Operating Expenses, Accrual Adjusted	***5,554***	***5,152***	***10,544***	***11,308***	***14,371***	***76,743***
Net Farm Income from Farming Operations, Accrual Adjusted (NFIFO)	**2,796**	**2,090**	**2,888**	**2,904**	**3,351**	**12,383**
Real Estate & Property Taxes	232	196	311**	387**	425	1,167
Net Farm Income (NFI)	**2,564**	**1,894**	**2,577**	**2,517**	**2,927**	**11,216**
Withdrawals for Unpaid Labor & Management	2,531	2,668	3,092	3,183	3,832	5,392
Net Income (NI)	**33***	**-774***	**-515**	**-666**	**-905**	**5,824**

Note: Statistically significant means are as follows: *** $p \leq .01$, ** $p \leq .05$, * $p \leq .10$

from crop sales, suggesting the importance of non-dairy activities, as conventional farms grow larger in size. As crop production increases, medium-sized conventional farms faced larger costs for fertilizer and chemicals and seeds and plants but not for other livestock related expenses, which include veterinary and medicine.

There were only 5 large organic farms compared to 167 large conventional farms in the region. Moreover, the largest organic farms were a fraction of the size of the largest conventional farms. That is, while the largest organic farms were within the 100 to 200-cow range, the largest conventional farms had thousands of cows. Due to the extremely low number of organic farms in this category, the differences cannot be examined statistically. As expected, large conventional dairy farms earned greater levels of GRFO, TOE, NFIFO, NFI, and NI (Table 9, Columns 6, 7). Large conventional farms also faced much larger expenses for all cost components except for purchased livestock. The differences among large organic and conventional farms cannot be attributed to anything more than the significant differences in scale of production.

Table 10 summarizes the financial performance of Northeast organic and conventional dairy farms according to size class using financial ratios indicating liquidity, solvency, profitability, and financial efficiency. Among the large organic category, a statistical outlier was removed; thus that category contains only four farms. There were no statistically significant differences in any financial ratios between organic and conventional farms among all size classes. Though some differences in means among the largest size class appear significant, they lack statistical significance due to the small sample size.

As Table 10 shows, organic and conventional dairy farms from all size classes, with the exception of medium-sized conventional operations, would not have enough current assets to cover current liabilities if they were forced to liquidate. These findings stand in contrast to Short's (2000) findings, where Northeast dairy farms were found to have the highest current ratios among the nation in 1993 and 1996. The political and economic environment of the dairy industry has changed considerably since the early 1990's with considerable impact on the northeast (Miller and Blayney 2006). However, considering the overwhelming majority of Northeast dairy farms were profitable in 2005, the probability of being faced with forced liquidation can be considered marginal. Small organic farms, however, had less working capital than conventional farms of similar size, but this difference was not statistically significant. There was no statistically significant difference in liquidity between the two groups among any size class.

Northeast organic and conventional dairy farms tended to have relatively low risk exposure, as their respective debt-to-asset ratios show. Based on their debt-to-asset ratio, small organic farms had twice the risk exposure of conventional farms; though this difference was not statistically significant. The debt-to-asset ratios of conventional farms reflect similar findings by Short (2000) for the Northeast conventional dairy farms in 1996. Similarly, the debt-to-equity ratio further suggests the relatively low risk exposure of Northeast dairy farms. There was no statistically significant difference in solvency between organic and conventional farms within any size class. The relatively high equity-to-asset ratios among all groups support the relatively low risk exposure reflected in the debt-to-asset and debt-to-equity ratios. The equity-to-asset ratio measures the owner's claim against farm assets, as opposed to a creditor’s claim to farm assets.

Table 10: Financial Ratios of Northeast Organic and Conventional Dairy Farms by Size Class, 2005

Financial Ratio	# cows ≤ 50		50 < # cows ≤ 100		# cows > 100	
	Organic *n=83*	**Conv.** *n=36*	**Organic** *n=63*	**Conv.** *n=69*	**Organic** *n=4*	**Conv.** *n=167*
Liquidity						
Current Ratio	0.91	0.86	0.99	1.02	0.56	0.78
Working Capital	29,117	52,376	74,246	74,017	343,098	215,720
Solvency						
Debt/Asset	0.40	0.20	0.20	0.17	0.01	0.19
Equity/Asset	0.86	0.91	0.83	0.88	0.80	0.77
Debt/Equity	0.28	0.13	0.27	0.16	0.30	0.41
Profitability						
Rate of Return on Farm Assets	0.00	-0.01	-0.01	-0.01	0.02	0.02
Rate of Return on Farm Equity	-0.02	-0.02	-0.01	-0.01	0.02	0.03
Operating Profit Margin Ratio	-0.01	-0.10	-0.03	-0.05	0.13	0.09
Financial Efficiency						
Asset Turnover Ratio	0.24	0.25	0.27	0.27	0.25	0.40
Operational Ratios						
Operating Expense Ratio	0.61	0.64	0.73	0.75	0.57	0.78
Net Farm Income from Farm Operations Ratio	0.29	0.28	0.15	0.17	0.28	0.13

Note: Statistically significant means are as follows: *** $p \leq .01$, ** $p \leq .05$, * $p \leq .10$

The profitability ratios in Table 10 show that small and medium-sized organic and conventional farms tend to be unprofitable. The rate of return on farm assets, equity and the operating profit margin ratio were negative or zero. According to these financial ratios, the average farm earned no return to assets or equity and operated at a loss. These findings stand in contrast to that depicted by profitability indicators, NFIFO and NFI, reported in earlier tables. NFIFO and NFI do not account for opportunity costs for unpaid labor and management, while the rate of return on farm assets, the rate of return on farm equity, and the operating profit margin ratio include opportunity costs for unpaid labor and management. The opportunity cost for unpaid labor tends to be greater among smaller farms, as they draw upon family labor to operate the dairy enterprise. In contrast, the operating-expense ratio shows that farms earned greater levels of revenue than expenses in 2005, but expenses consumed a relatively large percentage of revenues as reflected in the NFIFO ratio. There was no statistically significant difference in operational ratios between organic and conventional farms. Finally, the asset-turnover ratio measures the efficiency with which a farm generates revenues from the asset base (FFSC 1997). As expected, large conventional farms stand out in Table 10 in their level of financial efficiency.

4.3 Farm and Farm Operator Characteristics of Northeast Organic and Conventional Dairy Farms

Table 11 summarizes the results of the means test (where applicable) comparing farm and farm operator characteristics between organic and conventional dairy farms in the Northeast. In terms of dairy farming experience, conventional dairy farm operators were significantly more experienced than organic dairy farm operators. On average conventional dairy farms had been producing milk for 25 years, while organic operations had been producing milk, not necessarily organic, for 20 years. Though this specific measure refers to the farm operation and not necessarily the farm operator, it is used as a proxy for farm operator's level of dairy farming experience later in regression analysis. The typical organic dairy farm had been producing organic milk for roughly 5 years but milk in general for 20 years. That is, dairy farms typically had 15 years of conventional dairying experience and 5 years of organic dairying experience. This highlights the degree to which conventional dairy farms in the Northeast transitioned to certified organic status as opposed to new startups.

Table 11: Farm and Farm Operator Characteristics of Northeast Organic and Conventional Dairy Farms, 2005

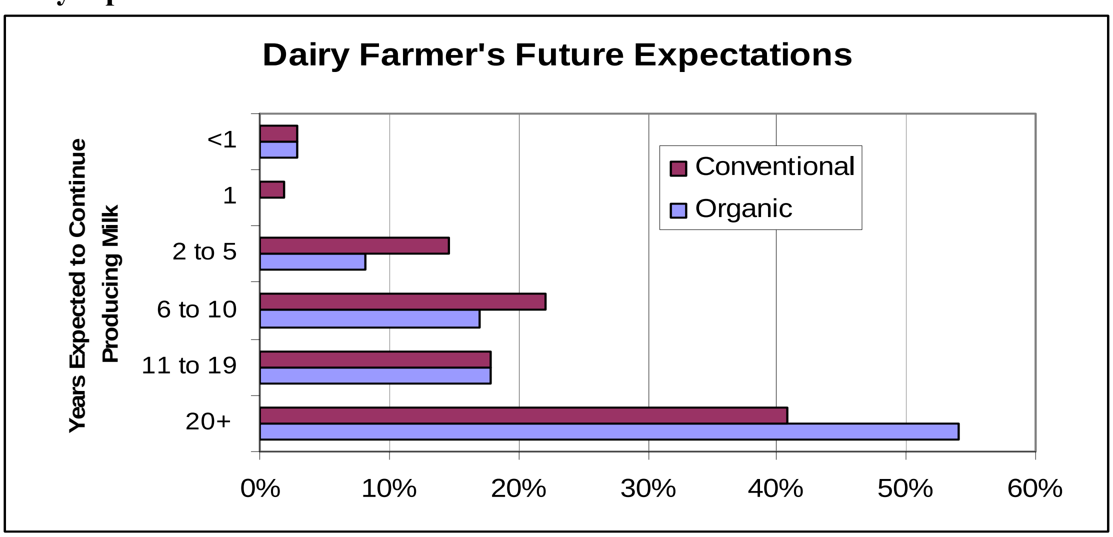
Farm Operator Characteristic	Conventional *N=213*	Organic *N=135*
Does the primary operator have a spouse?	Yes@	Yes@
Primary operator's years of farming experience	26***	21***
Secondary operator's years of farming experience	14**	11**
Years operation has been producing milk	25***	20***
Years operations has been producing organic milk	NA	5
Primary operator's age	53***	48***
Secondary operator's age	34***	27***
Is the primary operator retired?	No@	No@
Did farmer use a nutrition plan to manage herd?	Yes@	No@
Did operation receive EQUIP payments?	No@	No@
Milking Technology Used	Herringbone Parlor@	Barn with Barn Pipeline@
Marketing Channel Used	Member of Cooperative@	Member of Cooperative@

Note: Statistically significant means are as follows: *** $p \leq .01$, ** $p \leq .05$, * $p \leq .10$, and @ denotes use of mode; NA = not applicable.

The overwhelming majority of primary conventional and organic dairy farmers were educated males. Specifically, 99.6 percent of primary conventional dairy farm operators were males, while 94 percent of primary organic dairy farm operators were males (Table 11). Of the primary conventional dairy farm operators, 59.2 percent earned either a high school degree or a high school degree and some college, while 22.5 percent held a college degree. The remaining 18.3 percent did not graduate high school. Of the primary organic dairy farm operators, 43 percent earned either a high school degree or a high school degree and some college, while 18.5 percent held a college degree. The remaining 38.5 percent did not graduate high school. In contrast to previous studies (Lampkin 1990), organic farmers were not more educated than their conventional counterparts.

Northeast organic dairy farmers were slightly more optimistic about the future of their operations than conventional dairy farmers. As Figure 5 shows, 54.1 percent of organic dairy farmers expected to continue producing milk on the current operation for

Figure 5: Organic and Conventional Dairy Farmer's Future Expectations about the Dairy Operation

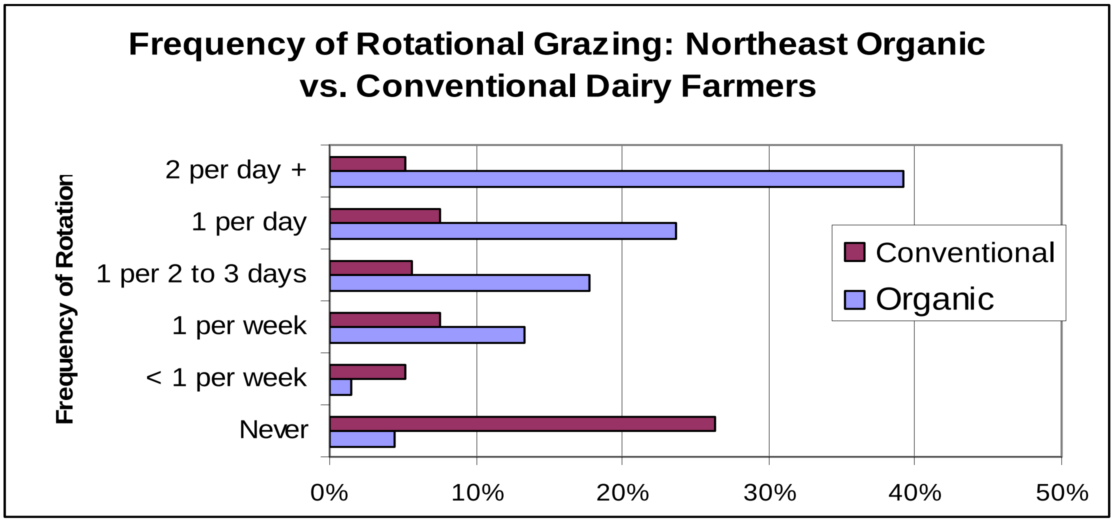


20 or more years relative to 40.8 percent of conventional dairy farmers. Only about 3 percent of both organic and conventional dairy farmers did not expect to produce milk again in 2006, and only 4 conventional farmers (1.9 percent) planned on producing milk for only one more year. Considering that organic dairy farmers were slightly younger than conventional dairy farmers (Table 11), this suggests that organic dairy farmers may be more optimistic because they tend to be younger.

Organic dairy farmers managed the milking herd much differently than conventional dairy farmers, probably due to their ideological differences. A main component of the organic ideal, as it pertains to animal husbandry within the dairy industry, has been to provide milk cows with adequate levels of feed from green growing grass or pasture. Not surprisingly, a significantly larger percentage of Northeast organic dairy farmers were practicing intensive rotational grazing to some degree (Figure 6). Forty percent of organic farms were rotating pasture at least twice a day and another 23.7 percent were rotating pasture at least once a day compared to just 5.2 and 7.5 percent, respectively, for conventional dairy farms. Moreover, 26.3 percent of conventional dairy farms were not rotating the milking herd on pasture at all.

Figure 7 depicts another form of structural difference between the two groups. Organic dairy farmers tend to use different milking facilities than conventional dairy farmers. Organic dairy farmers were much more likely to use pail units or bucket milkers (25.2 percent) than their conventional counterparts (4.7 percent). In contrast, conventional dairy farmers were more likely to use herringbone parlors (37.6 percent), a presumably more advanced facility that can support large scale operation, than their organic counterparts (11.1 percent).

Figure 6: Frequency of Pasture Rotation during Grazing Months: Northeast Organic and Conventional Dairy Farms



Most dairy farmers, as Figure 8 shows, belonged to marketing cooperatives and sold their milk to these co-ops in 2005. However, conventional dairy farmers used such cooperatives at a greater rate. In contrast, organic dairy farmers used non-cooperative processors, cooperatives of which they were not members, non-cooperative broker/haulers, or marketed directly to consumers more often than conventional farms.

Figure 7: The Milking Facilities Used by Northeast Organic and Conventional Dairy Farms

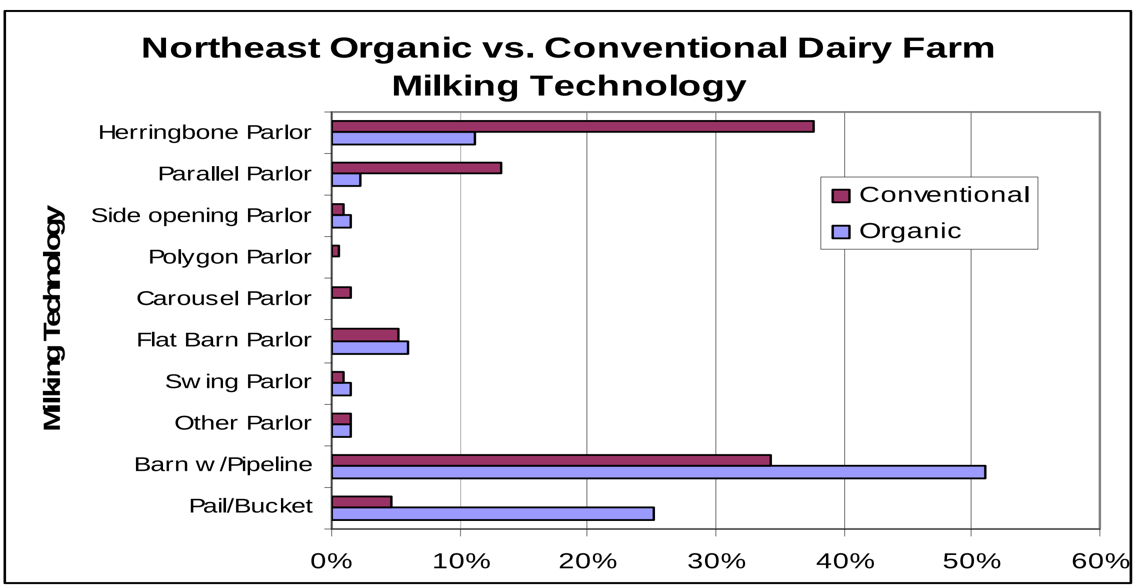
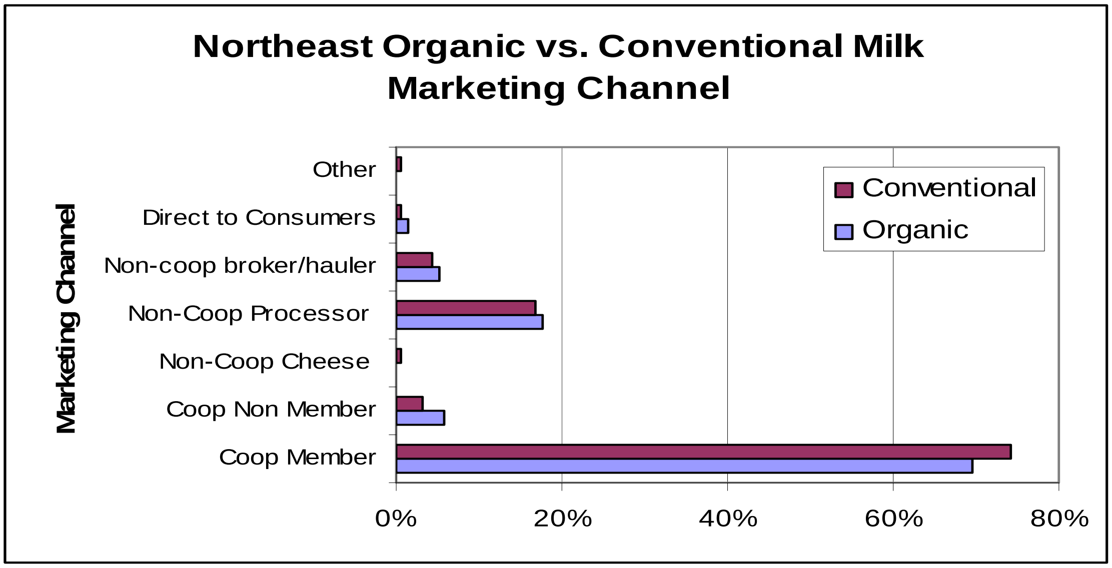


Figure 8: Northeast Organic and Conventional Dairy Farm Milk Marketing Channel, 2005



4.4 Experienced versus Inexperienced Organic Dairy Farmers

The sample of Northeast organic dairy farms consisted of 77 organic dairy farmers with more than five years of experience producing organic milk and 75 organic dairy farmers with five years or less experience producing organic milk. The first group was considered 'experienced' while the second group was considered 'inexperienced'. This decision was based on the fact that the average level of organic dairying experience was 5 years. Therefore, 5 years was used as a cutoff for differentiating experience and inexperienced organic dairy farms. Moreover, a dairy herd can take up to 1 year to transition to organic status, while pasture can take up to three years to transition to certified organic status. Thus, a dairy farm could be selling certified organic milk on uncertified land. Measuring organic dairying experience as 5 years or more ensures that the operation has successfully made it through all of the transition phase.

The average experienced organic dairy farmer had 7.5 years of experience compared to 2.5 years of experience among the inexperienced group. Furthermore, the average experienced Northeast dairy farmer had 23 years of experience producing milk (not just organic milk) versus 18 years of experience among the inexperienced group. The difference in mean years of experience producing milk (not just organic milk) was statistically significant. However, there was no statistically significant difference in overall years of farming experience between the experienced and inexperienced organic dairy farmers.

The average experienced Northeast organic dairy farm did not earn a statistically significantly different NFIFO, NFI or NI than the average inexperienced organic dairy farm (Table 12). This result did *not* change at the per-cow or per-CWT EQ level[3]. These findings suggest that the learning curve, with a hypothesized inflection point of roughly five years, was insignificant in explaining profitability among northeast organic dairy farms. This may be due to the fact that many organic farms were formerly conventional farms and, thus, had several years of dairying experience before their organic experience. Considering the similar operational structure between small organic and conventional farms alluded to in Table 9, much of this dairying experience might be transferable to organic dairying.

4.5 Profitable versus Unprofitable Northeast Organic Dairy Farms

Table 13 summarizes the differences in revenues and expenses between profitable and unprofitable organic dairy farms in the Northeast. Profitable organic dairy farms earned $1,089 more per cow in gross revenues than unprofitable farms. Profitable farms earned $801 more per cow from milk sales, $56 more per cow from livestock breeding

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[3] This result did *not* change after redefining experience as 5, 4, or 3 years or more of experience producing organic milk.

Table 12: Income Statement of Experienced and Inexperienced Organic Dairy Farms in the Northeast, 2005

Attributes	Per Farm		Per Cow		Per CWT EQ	
	>5yrs Exp *n=64*	≤ 5yrs Exp *n=88*	>5yrs Exp *n=64*	≤ 5yrs Exp *n=88*	>5yrs Exp *n=64*	≤5yrs Exp *n=88*
REVENUES						
Milk Sales	140,879	151,244	2,726	2,801	8,487	9,111
Livestock & Poultry Sales	9,853	10,031	206	203	594	604
Net Change in Value of Livestock & Poultry	-496	251	-12	3	-30	15
Livestock Breeding Stock, Cash Sales	2,563	1,826	55	44	154	110
Gain/Loss Livestock Breeding Stock	277	20	6	0	17	1
Crop Sales Net CCC Loans	3,242	927	69	21	195	56
Net Change in Value of Crops	162	-745	-4	-12	10	-45
Government Payments	3,437	5,078	71	88	207	306
Income from Custom Work	60*	547*	1*	11*	4*	33*
Other Farm Related Income	5,798	11,021	114	168	349	664
Income from Livestock Related Operations	100	395	3	9	6	24
Non-Money Farm Income	9,667	10,006	215	211	582	603
Net Change in Accounts Receivable	-2,281	-6,594	-46	-78	-137	-397
Gross Revenues from Farming Operations, Accrual Adjusted	***173,261***	***184,007***	***3,403***	***3,468***	***10,437***	***11,085***
EXPENSES						
Purchased Feed	40,536	41,978	795	794	2,442	2,529
Purchased Livestock	620*	351*	13*	8*	37*	21*
Other Livestock Related Expenses	3,684	7,634	70	140	222	460
Labor	10,301	12,024	182	182	621	724
Fertilizer & Chemicals	2,490	2,676	54	62	150	161

Seeds & Plants	1,412	1,467	26	26	85	88
Fuel & Oil	6,023	6,433	120	115	363	388
Equipment & Vehicle Maintenance	7,698	9,501	137	168	464	572
Infrastructure Maintenance	4,263	3,715	95	77	257	224
Other Variable Expenses	9,805	10,108	196	186	591	609
Custom Work	3,939	2,941	73	55	237	177
Utilities	4,510	4,623	84	87	272	279
Insurance	2,792	2,890	52	53	168	174
Rent Leasing Land	3,260	2,273	59	40	196	137
Net Change in Value of Supplies	306	386	3	6	18	23
Depreciation on Farm Assets	17,853	18,850	346	332	1,075	1,136
Total Interest	9,524	7,266	165	140	574	438
Interest, Accrual Adj.	3,081	3,779	56	77	186	228
Total Operating Expenses, Accrual Adjusted	***131,486***	***138,124***	***2,519***	***2,535***	***7,921***	***8,321***
Net Farm Income from Farming Operations, Accrual Adjusted (NFIFO)	**41,775**	**45,883**	**884**	**933**	**2,517**	**2,764**
Real Estate & Property Taxes	4,432	4,560	90	92	267	275
Net Farm Income (NFI)	**37,343**	**41,323**	**794**	**841**	**2,250**	**2,489**
Withdrawals for Unpaid Labor & Management	45,112	47,884	965	1,004	2,718	2,885
Net Income (NI)	**-7,769**	**-6,562**	**-170**	**-163**	**-468**	**-395**

Note: Statistically significantly different means are as follows: *** $p \leq .01$, ** $p \leq .05$, * $p \leq .10$

stock cash sales and $41 more per cow from non-money farm income. Profitable farms also had lower losses ($148/cow) for accrual adjustments in crop values, a measure of withdrawals from the asset base that generally must be restored the following year. In addition to receiving greater levels of gross revenues, profitable farms incurred lower total operating expenses at $688 per cow. Profitable farms incurred lower expenses for fuel and oil ($39/cow), depreciation on farm assets ($310/cow), total interest ($129/cow), and accrual adjustments to interest ($62/cow), a measure of interest that accrued but was not paid during the year.

As Table 14 shows, the greatest difference influencing financial performance between profitable and unprofitable organic dairy farms in the Northeast could be attributed to both higher milk production and sales per cow as well as lower costs per cow. That is, profitable organic dairy farms were more efficient in both production and managing costs. The most important cost components were depreciation on farm assets and interest payments on the debt that was most likely owed to pay for those assets. In other words, the debt structure of organic dairy farms likely has a significant impact on profitability.

Table 14 summarizes the differences in farm characteristics, farm operator characteristics, and management decisions between profitable and unprofitable organic dairy farms in the Northeast. Differences between the two groups can be largely attributed to differences in milk production per cow, that is, animal performance, and factors contributing to this difference. Profitable farms produced 27 cwt more milk per cow than unprofitable farms. This may be due to the fact that profitable farms purchased

Table 13: Income Statement of Profitable and Unprofitable Organic Dairy Farms in the Northeast, 2005

Attributes	Per Cow		Per CWT EQ	
	Profitable *n=130*	**Unprofitable** *n=21*	**Profitable** *n=130*	**Unprofitable** *n=21*
REVENUES				
Milk Sales	2,873***	2,072***	9,035	7,444
Livestock & Poultry Sales	202	224	599	614
Net Change in Value of Livestock & Poultry	-4	1	-2	-16
Livestock Breeding Stock Cash Sales	57***	1***	150***	2***
Gain/Loss Livestock Breeding Stock	3	1	9	2
Crop Sales Net CCC Loans	42	38	122	75
Net Change in Value of Crops	12*	-136*	59*	-507*
Government Payments	88	41	281	168
Income from Custom Work	7	6	20	27
Other Farm Related Income	128	253	441	1,093
Income Livestock Related Operations	8	0	19	0
Non-Money Farm Income	218	177	613*	469*
Net Change in Accounts Receivable	-47	-179	-198	-856
Gross Revenues from Farming Operations, Accrual Adjusted	***3,587****	***2,498****	***11,147***	***8,514***
EXPENSES				
Purchased Feed	810	676	2,513	2,268
Purchased Livestock	6	36	16	104
Other Livestock Related Expenses	77	82	238	272
Labor	170	226	639	831

Fertilizer & Chemicals	47	133	130	328
Seeds & Plants	27	20	92*	58*
Fuel & Oil	111**	150**	353*	504*
Equipment & Vehicle Maintenance	129	166	431	570
Infrastructure Maintenance	79	118	218	362
Other Variable Expenses	184	233	563	835
Custom Work	58	93	189	296
Utilities	84	95	267	324
Insurance	51	65	164	220
Rent Leasing Land	46	58	153	200
Net Change in Value of Supplies	6	0	25	2
Depreciation on Farm Assets	310*	513*	996**	1,826**
Total Interest	129**	287**	401**	1,083**
Interest, Accrual Adjusted	62*	110*	189**	340**
Total Operating Expenses, Accrual Adjusted	***2,373******	***3,061******	7,526**	***10,420****
Net Farm Income from Farming Operations, Accrual Adjusted	**1,214*** **	**-563*** **	**3,621*** **	**-1,905*** **
Real Estate & Property Taxes	90	99	269	283
Net Farm Income	**1,124*** **	**-663*** **	**3,352*** **	**-2,189*** **
Withdrawals for Unpaid Labor & Management	985	1,001	2,787	2,937
Net Income	**140*** **	**-1,664*** **	**565*** **	**-5,126*** **

Note: Statistically significantly different means are as follows: *** p ≤ .01, ** p ≤ .05, * p ≤ .10

719 cwt more organic feed per cow than unprofitable farms. Counter intuitively, profitable farms were less efficient than unprofitable farms in terms of total feed use. Profitable farms used more total feed (8.21 cwt) to produce a cwt of milk than unprofitable farms (2.68 cwt). Profitable farms used 7.06 cwt of purchased feed per cwt of milk produced relative to 0.94 cwt on unprofitable farms. Profitable farms were slightly more efficient in terms of homegrown feed per cwt of milk produced (1.15) than unprofitable farms (1.74). Profitable farms were slightly more efficient in terms of farm labor hours worked per cwt of milk produced (0.09) than unprofitable farms (0.17). However, the difference was not statistically significant, and there was no significant difference in labor costs between the two groups (Table 13).

Profitable farms chose to dry off milk cows seasonally less frequently (10% of the time) than unprofitable farms (29% of the time) (Table 14). Moreover, profitable farms also had greater capacity of milk tanks and silos than unprofitable farms that facilitated the ability to produce more milk. These factors may suggest why profitable farms were able to produce more milk per cow and earn more milk revenues than unprofitable farms.

Table 14: Farm and Farm Operator Characteristics of Profitable and Unprofitable Organic Dairy Farms in the Northeast, 2005

Attribute	**Profitable** *n=130*	**Unprofitable** *n=21*
<u>Farm Characteristic:</u>		
Average number of milk cows	53	57
Total acres	310	367
Number of operators	2	2
Sole proprietorship	Yes@	Yes@
Acres of pasture for grazing	97	106
Months/Year on pasture	7*	6*
Total loss per milk cow (%)	4	5
Average age of milking	5	6

herd		
Hours per day milk system in operation	4	4
Percent of feed from pasture during grazing months	75-100%@	75-100%@
Amount paid to 3rd party certification	$939**	$733**
Frequency of pasture rotation during grazing months	2/day or more@	2/day or more@
Capacity of milk tanks/silos	966***	717***
Dry off cows seasonally	10%	29%
Use veterinary services regularly	No@	No@
Use a nutritionist	No@	No@
Min. price needed to continue operations reported	$22/cwt	$22/cwt
Livestock and poultry sales	$9,944	$10,186
Crop sales, net CCC loans	$2,021	$1,252
Government Payments	$4,668	$2,782
Farm Operator Characteristics:		
Primary operator's years of farming experience	21	23
Years operation has been producing milk	20	24
Years operations has been producing organic milk	5	5
Primary operator's age	48	50
Primary operator's highest level of education	High school and some college@	High school and some college@
Is the primary operator retired	No@	No@
Technology		
Milking units with automatic takeoffs	No@	No@
Use holding pen with udder washer	No@	No@
Milking system computerized data gathering	No@	No@
Milking Facility Used	Barn with Pipeline@	Barn with Pipeline@

Efficiency Measures		
Milk production (cwt) per cow	122***	95***
Purchased feed (cwt) per cow	804**	85**
Homegrown feed (cwt) per cow	131	148
Purchased feed (cwt) per milk produced (cwt)	7.06**	0.94**
Homegrown feed (cwt) per milk produced (cwt)	1.15*	1.74*
Acres of pasture for grazing per cow	1.9	1.8
Farm labor hours worked per cow	10.4	11.5
Farm labor hours worked per milk sold (cwt)	0.09	0.17
Risk Management Decisions:		
Keep individual cow production records	Yes@	Yes
Lock in input prices	No@	No@
Negotiate input price discounts	No@	No@
Receive volume premiums	No@	No@
Written contract for milk handling payments	Yes@	Yes@
Use forward contracts to sell milk	No@	No@
Process milk on site	No@	No@
Did farmer use a nutrition plan to manage herd?	No@	Yes@
Marketing Channel Used	Member of cooperative@	Member of cooperative@

Note: Statistically significant means are as follows: *** $p \leq .01$, ** $p \leq .05$, * $p \leq .10$, @ denotes use of mode.

Primary operators were asked about the most difficult aspect of organic dairy farming. The difference between unprofitable and profitable organic dairy farms in this regard was subtle. Among the profitable organic dairy farms, “certification paperwork and compliance costs” was the most frequent response regarding the most difficult aspect of organic dairy farming followed by “high cost of production” (Table 15). Among the unprofitable group, however, "high cost of production" was the most frequent response followed by the "certification paperwork and compliance costs". The third most frequent response among both groups was "finding organic grains and forage"[4].

Table 15: Most Difficult Aspect of Organic Dairy Farming for Profitable and Unprofitable Organic Dairy Farms in the Northeast, n=141

Difficulty Type	Profitable	Unprofitable	Total
Certification Paperwork and Compliance Costs	42 (34.71%)	7 (35.00%)	49
High Cost of Production	32 (26.45%)	9 (45.00%)	41
Finding Grains and Forage	21 (17.36%)	2 (10.00%)	23
Maintain Animal Health	13 (10.74%)	2 (10.00%)	15
Finding Feed Supplements	2 (1.65%)	0 (0.00%)	2
Finding Replacement Heifers	2 (1.65%)	0 (0.00%)	2
Other	9 (7.44%)	0 (0.00%)	9
Total	121	20	141

Note: Column percentages in parentheses

A farmer's expectations about the future of the dairy enterprise may have a significant impact on how the operation was managed in 2005. An examination of primary operators' age and expectations about the operation show that a greater proportion of the oldest organic dairy farmers (55+ years) were planning to exit the industry within five years relative to younger farmers (<55 years) (Table 16). Among those organic dairy operators ages 55 and older, roughly 31 percent were planning to exit within the next 5 years. Among those organic dairy farm operators ages 54 and younger, roughly 6 percent were planning to exit within the next 5 years. Younger, more optimistic organic dairy operators may be more apt to make the necessary changes and investments

[4] The results were identical when farm size and difficulty, as opposed to profitability and difficulty, were examined.

in the dairy enterprise than older, less optimistic operators. These management choices may have an impact on the economic viability of the dairy operation.

Table 16: The Number of Years that the Primary Operator Expected to Continue the Dairy Operation, n=141

Age	**< 1 Year**	**1 Year**	**2-5 Years**	**6-10 Years**	**11-19 Years**	**20+ Years**	**Total**
25-34	1 (25.00%)	0 (0.00%)	0 (0.00%)	1 (4.17%)	1 (4.00%)	14 (18.67%)	17
35-44	0 (0.00%)	0 (0.00%)	2 (15.38%)	1 (12.50%)	1 (28.00%)	14 (30.67%)	17
45-54	2 (1.42%)	0 (0.00%)	1 (7.69%)	12 (50.00%)	14 (56.00%)	25 (17.73%)	54
55-64	0 (0.00%)	0 (0.00%)	9 (69.23%)	5 (20.83%)	2 (8.00%)	9 (12.00%)	25
65+	1 (25.00%)	0 (0.00%)	1 (7.69)	3 (12.50%)	1 (4.00%)	4 (5.33%)	10
Total	4	0	13	24	25	75	141

Note: Column percentages in parentheses

4.6 Profit, Farm Characteristics, and Size of Organic Dairy Farms

Table 17 summarizes the income statement of the average small (# cows ≤ 50), medium (50 < # cows ≤ 100), and large (# cows < 100) organic dairy farm in the Northeast. The differences in mean estimates were tested statistically between the small and medium-sized groups. Differences between these two groups and the largest size class were not tested statistically due to the small number of large organic dairy farms.

Both the level of gross farm revenues and the level of total operating expenses increased along with size class. That is, large organic dairy farms typically earned more revenues than medium-sized organic dairy farms, and medium-sized organic dairy farms typically earned statistically significantly more revenues than small organic dairy farms. At the same time, large farms incurred greater total operating expenses than medium-sized farms, and medium-sized farms incurred statistically significantly more expenses than small farms. Thus, the difference in NFIFO and NFI between the three groups was marginal, and there was no statistically significant difference in NFIFO, NFI, or NI between small and medium-sized organic dairy farms.

The difference in NI between small and medium-sized organic dairy farms was important, however, and it was related to the significant difference in the opportunity cost of unpaid labor and management between the two groups. Small organic dairy farms incurred a statistically significantly lower opportunity cost for unpaid labor and management than medium-sized farms and, thus, earned a greater NI than medium-sized farms. Moreover, as noted previously in section 4.2, small organic dairy farms in the Northeast typically earned positive returns to unpaid labor and management. Intuitively, it might be expected that smaller farms would require less labor to operate. In addition to incurring a lower opportunity cost for unpaid labor and management, small farms incurred a statistically significantly lower level of paid labor expenses than medium-sized farms. This suggests that small farms required less total labor hours to operate the farm enterprise.

Table 18 presents the farm characteristics of the average small, medium-sized, and large organic dairy farm in the Northeast. Because the organic rules stipulate that organic cows have adequate access to pasture, acreage and pasture acreage typically

Table 17: Income Statement of Organic Dairy Farms in the Northeast, 2005

Attributes	Per CWT EQ		
	# cows ≤ 50 *n=83*	**50 < # cows ≤ 100** *n=63*	**# cows > 100** *n=5*
REVENUES			
Milk Sales	6,594***	11,281***	14,577
Livestock & Poultry Sales	539	682	619
Net Change in Value of Livestock & Poultry	-32**	33**	1
Livestock Breeding Stock Cash Sales	135	121	155
Gain/Loss Livestock Breeding Stock	11	5	0
Crop Sales Net CCC Loans	160	47	235
Net Change in Value of Crops	-6	-78	467
Government Payments	131*	427*	460
Income from Custom Work	16	29	5
Other Farm Related Income	281	629	3,460
Income from Livestock Related Operations	30	0	0
Non-Money Farm Income	602	581	602
Net Change in Accounts Receivable	-110	-323	-2,859
Gross Revenues from Farming Operations, Accrual Adjusted	***8,351****	***13,432****	***17,722***
EXPENSES			
Purchased Feed	1,959***	3,184***	2,216
Purchased Livestock	36	20	0
Other Livestock Related Expenses	187***	326***	108
Labor	255***	1,100***	2,016
Fertilizer & Chemicals	193*	95*	366
Seeds & Plants	52***	118***	304
Fuel & Oil	253***	501***	788
Equipment & Vehicle Maintenance	264***	654***	974
Infrastructure Maintenance	205	284	190
Other Variable Expenses	407***	842***	777

Custom Work	138***	265***	514
Utilities	179***	376***	579
Insurance	108***	239***	393
Rent Leasing Land	88***	241***	317
Net Change in Value of Supplies	7	42	-4
Depreciation on Farm Assets	766***	1,419***	2,970
Total Interest	315***	673***	1,261
Interest, Accrual Adjusted	156**	250**	597
Total Operating Expenses, Accrual Adjusted	***5,554****	***10,544****	***14,371***
Net Farm Income from Farming Operations, Accrual Adjusted (NFIFO)	**2,796**	**2,888**	**3,351**
Real Estate & Property Taxes	232***	311***	425
Net Farm Income (NFI)	**2,564**	**2,577**	**2,927**
Withdrawals for Unpaid Labor & Management	2,531***	3,092***	3,832
Net Income (NI)	**33**	**-515**	**-905**

Note: Statistically significant means are as follows: *** $p \leq .01$, ** $p \leq .05$, * $p \leq .10$. Statistical significant tests were not performed for the large (# cows > 100) in this Table due to small sample size.

increased as farm size, measured by the number of milk cows, increased (Table 18). In addition, the quantity of milk produced and the number of milk cows also increased along with size class, roughly doubling from small to medium-sized farms and roughly doubling again from medium-sized to large organic dairy farms. There was no statistically significant difference in animal productivity or feed efficiency between the different size classes (Table 18), which provides some insight into understanding the lack of significant difference in profitability between the groups (Table 17). However, labor efficiency increased as size increased. Specifically, medium-sized organic dairy farms used statistically significantly less labor to produce a unit of milk than small organic dairy farms.

Table 18: Farm Characteristics of Northeast Organic Dairy Farms by Size Class

Farm Characteristic	**# cows ≤ 50**	**50<# cows≤100**	**# cows > 100**
	n=83	*n=63*	*n=5*
Total Acres	221***	418***	670
Acres for Grazing	67***	135***	137
Milk Sold (cwt)	4,522***	7,872***	9,556
Milk Produced (cwt)	4,640***	8,177***	9,724
Number of Milk Cows	39***	67***	131
Milk Produced (cwt) per Cow	118.69	120.77	77.69
Total Feed (cwt) per Milk Produced (cwt)	8.27	6.75	2.36
Purchased Feed (cwt) per Milk Produced (cwt)	7.13	5.46	0.27
Homegrown Feed (cwt) per Milk Produced (cwt)	1.14	1.29	2.09
Total Feed (cwt) per Cow	915.53	786.67	173.72
Purchased Feed (cwt) per Cow	789.33	646.14	19.73
Homegrown Feed (cwt) per cow	126.20	140.52	154.00
Labor Hours Worked per Milk Produced (cwt)	0.12***	0.08***	0.06
Labor Hours Worked per Cow	12.36***	8.58***	4.66

Note: Statistically significantly different means are as follows: *** $p \leq .01$, ** $p \leq .05$, * $p \leq .10$

4.7 Profit, Farm Characteristics and Legal Status of Organic Dairy Farms

Table 19 depicts the profitability of the following two groups of organic dairy farms in the Northeast: (1) sole proprietorships or family farms[5], and (2) all other business classifications, such as partnerships and corporations. The overwhelming majority of organic dairy farms in the Northeast were sole proprietorships; thus the remaining classifications were lumped together to enable a comparison. However, due to the small number of non-family farms, the differences between the two groups were not tested statistically.

From a per-farm, per-cow, and per-cwt eq perspective, family farms earned a lower NFIFO, NFI, and NI than other organic dairy farms. Family farms did not typically earn positive returns to unpaid labor and management, while other farms did earn positive returns. This was due to the fact that, though family farms typically incurred lower paid labor expenses, they incurred greater opportunity costs for unpaid labor and management. That is, family farms probably relied more heavily on unpaid labor in order to maintain profitability.

Table 20 depicts the typical family and non-family organic dairy farm in the Northeast. Family farms tended to have fewer cows that required less acreage for grazing. In addition, milking herds on family farms were typically less productive, and family farms were less efficient in terms of feed and labor use. More specifically, family farms used roughly 20 times more purchased feed per cow and per unit of milk produced than non-family farms (Table 20). Table 20 provides valuable insight for better understanding the differences in profitability depicted in Table 19.

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[5] In this study, sole proprietorships are considered to be family farms, and the two terms, 'sole proprietorship' and 'family farm' are used interchangeably throughout.

Table 19: Income Statement of Organic and Conventional Dairy Farms in the Northeast U.S., 2005

Attributes	Per Farm		Per Cow		Per CWT EQ	
	Other *n=10*	**Family** *n=141*	**Other** *n=10*	**Family** *n=141*	**Other** *n=10*	**Family** *n=141*
REVENUES						
Milk Sales	188,605	143,317	2,897	2,753	11,362	8,634
Livestock & Poultry Sales	11,222	9,890	182	206	676	596
Net Change in Value of Livestock & Poultry	2,360	-236	32	-6	142	-14
Livestock Breeding Stock Cash Sales	1,480	2,198	25	51	89	132
Gain/Loss Livestock Breeding Stock	70	133	2	3	4	8
Crop Sales Net CCC Loans	317*	2,027*	4	44	19	122
Net Change in Value of Crops	-1,268	-266	-13	-8	-76	-16
Government Payments	5,759	4,310	87	81	347	260
Income from Custom Work	0	369	0	7	0	22
Other Farm Related Income	6,104	9,011	85	149	368	543
Income from Livestock Related Operations	0	292	0	7	0	18
Non-Money Farm Income	9,158	9,889	155	216	552	596
Net Change in Accounts Receivable	-1,500	-5,045	-19	-68	-90	-304
Gross Revenues from Farming Operations, Accrual Adjusted	***222,306***	***175,889***	***3,437***	***3,435***	***13,392***	***10,596***
EXPENSES						
Purchased Feed	45,861	40,816	735	796	2,763	2,459
Purchased Livestock	8	500	0	11	0	30
Other Livestock Related Expenses	4,207	4,008	69	79	253	241
Labor	32,918	9,498	450	159	1,983	572
Fertilizer & Chemicals	658	2,754	8	62	40	166
Seeds & Plants	850	1,496	10	27	51	90
Fuel & Oil	8,518	6,050	117	116	513	364
Equipment & Vehicle Maintenance	6,703	7,529	98	136	404	454

Infrastructure Maintenance	5,529	3,833	123	82	333	231
Other Variable Expenses	12,604	9,786	180	191	759	590
Custom Work	1,357	3,521	21	66	82	212
Utilities	6,611	4,412	99	84	398	266
Insurance	5,000	2,704	71	51	301	163
Rent Leasing Land	4,430	2,524	59	47	267	152
Net Change in Value of Supplies	573	339	6	5	35	20
Depreciation on Farm Assets	20,135	18,329	307	341	1,213	1,104
Total Interest	5,173	8,445	76	156	312	509
Interest, Accrual Adjusted	3,653	3,470	52	70	220	209
Total Operating Expenses, Accrual Adjusted	***163,640***	***129,336***	***2,469***	***2,468***	***9,858***	***7,791***
Net Farm Income from Farming Operations, Accrual Adjusted (NFIFO)	**58,666**	**46,554**	**968**	**967**	**3,534**	**2,804**
Real Estate & Property Taxes	5,765	4,414	85	91	347	266
Net Farm Income (NFI)	**52,901**	**42,140**	**883**	**875**	**3,187**	**2,539**
Withdrawals for Unpaid Labor & Management	45,130	46,718	759	1,003	2,719	2,814
Net Income (NI)	**7,771**	**-4,579**	**124**	**-128**	**468**	**-276**

Note: Statistical significant tests were not performed for this Table due to small sample size among ‘Other’ category.

Table 20: Farm Characteristics of Northeast Organic Dairy Farms by Legal Status

Farm Characteristic	Other	Family
	n=10	*n=141*
Total Acres	439	309
Acres for Grazing	108	97
Milk Sold (cwt)	7,719	5,971
Milk Produced (cwt)	7,881	6,170
Number of Milk Cows	68	53
Milk Produced (cwt) per Cow	122	118
Total Feed (cwt) per Milk Produced (cwt)	1.11	7.89
Purchased Feed (cwt) per Milk Produced (cwt)	0.31	6.62
Homegrown Feed (cwt) per Milk Produced (cwt)	0.81	1.26
Total Feed (cwt) per Cow	129	887
Purchased Feed (cwt) per Cow	40	751
Homegrown Feed (cwt) per cow	89	136
Labor Hours Worked per Milk Produced (cwt)	0.08	0.11
Labor Hours Worked per Cow	8.87	10.65

Note: Statistically significantly different means are as follows: *** $p \leq .01$, ** $p \leq .05$, * $p \leq .10$

4.8 Factors Determining Organic Dairy Farm Profitability

This section presents the factors that impact the profitability of organic dairy farms in the Northeast. A multiple regression analysis was carried out using a weighted least squares regression procedure. Table 17 provides the summary statistics of the independent variables comprising the regression model and Table 18 presents the regression results. Three models of profitability are presented using the three dependent variables, NFIFO (Model 1), NFI (Model 2), and NI (Model 3). The variable definitions were presented in Chapter 3, Section 3.2, and are not repeated here. The overall model's significance was 12.66 for Model 1, 12.22 for Model 2, and 12.91 for Model 3 (Table 18). In terms of explanation of variability, 73.17 percent of variability in Model 1 was explained by the regressors, 72.41 percent in Model 2, and 73.60 percent in Model 3 (Table 18).

Table 21: Summary Statistics of Explanatory Variables, n=141

Variable	Unit	Mean	Std. Dev.	Min.	Max.
Farm Characteristics:					
AVEPRICE	$/cwt	24.00	2.19	15.84	31.58
MILKCOWS	Number	53.07	22.89	16.00	190.00
ACGFEED	Acres	95.51	78.66	6.00	400.00
MIRG	Yes/No	Yes*	0.39	0.00	1.00
COWAGE	Years	5.15	1.25	2.00	10.00
LEGSTAT	Yes/No	Yes*	0.24	0.00	1.00
HRSMLKON	Hours	3.64	1.53	1.00	12.00
SILOCAP	Gallons	928.41	801.57	200.00	8,000.00
DRYOFF	Yes/No	No*	0.33	0.00	1.00
NUTMNPLN	Yes/No	No*	0.48	0.00	1.00
VETSERVIC	Yes/No	No*	0.48	0.00	1.00
Extra Income:					
LPSXMLKS	$	10,130.06	11,297.45	0.00	74,484.00
CSCCC	$	1,976.30	12,066.39	-6,068.00	139,749.00
GOVTYES	Yes/No	Yes*	0.49	0.00	1.00
Farm Operator Characteristics:					
OPEAGE	Years	48.05	11.38	25.00	82.00
OPEEDU	Scale	2*	0.39	0.00	1.00
MILKEXP	Years	20.57	13.63	2.00	75.00
FUTURE	Scale	6*	1.24	1.00	6.00
Technology:					
PARLOR	Yes/No	No	0.43	0.00	1.00
AUTTAKOF	Yes/No	No	0.34	0.00	1.00
UDDRWASH	Yes/No	No	0.14	0.00	1.00
Efficiency Measures:					
MLKPRDCW	CWT	119.14	38.32	40.00	195.33
HFEEDCOW	CWT	131.08	106.65	0.00	1.00
LABHRCOW	Hours	10.44	5.59	2.20	48.75
CULLRATE	Ratio	0.04	0.03	0.00	0.15
TVCCOW	$	1,978	1,148	313.70	11,186
Risk Management:					
PDISCOUNT	Yes/No	No	0.47	0.00	1.00
WRITTCON	Yes/No	Yes	0.38	0.00	1.00
ONSITPRO	Yes/No	No	0.18	0.00	1.00
Financial Efficiency:					
DEBT2ASST	$	0.16	0.19	0.00	1.02

Note: * denotes use of mode.

Economic theory dictates two possible ways of increasing profitability in the short run holding the price of inputs, output and other variables constant: (1) reduce variable costs of production, that is, produce more efficiently, or (2) increase the volume of production (FFSC 1997). This study finds that, while variable expenses and scale of production explain much of the variation in profitability, there are additional characteristics that influence organic dairy farm profitability in the Northeast.

4.8.1 Farm Characteristics

One of the economic assumptions about the organic dairy farms was that all organic dairy farms were price takers, and all organic dairy farms received the same organic milk price. The organic milk price received, however, varied considerably within a range of $15.85/cwt to $31.58/cwt (Table 17). Receiving a higher organic milk price, ceteris paribus, was expected to increase profitability. The results show that the average organic milk price (AVEPRICE) received had a significantly positive impact on NFIFO (Table 18).

Farm size has consistently been shown to positively impact financial performance (MacDonald et al. 2007; Mishra and Morehart 2001; Short 2000). This study found that the number of milk cows (MILKCOWS) had a positive impact on NFIFO (Table 18). An additional organic milk cow typically added 119cwt of milk to annual production (Table 16). Thus, at an average organic milk price received of $24/cwt (Table 17), an additional cow added roughly $2,856 in milk revenues to the typical organic dairy farm in the Northeast in 2005.

The average age of the milking herd (COWAGE) was hypothesized to have a negative impact on profitability. The results show that cow age had a negative impact on

NFIFO, NFI, and NI. As cows age, their productivity may decline. Replacing less productive cows with more productive cows may have facilitated higher levels of production.

Family farms were expected to have lower levels of NI than other types of farms (partnerships and corporations) since NI accounts for the opportunity costs of unpaid labor. This study found that in terms of legal status (LEGSTAT) of organic dairy farms in the Northeast, sole proprietorship (family farm) was negatively correlated with NFIFO, NFI, and NI. Similar findings were made by Mishra and Morehart (2001). Though family farms may enjoy the benefit of unpaid family labor, family members may not always be available to work on the farm. Spouses, for example, often work off-farm to provide supplemental income to the household[6]. With fewer family members available to work on the farm, there may be less of an opportunity for the specialization of expertise and the economic benefits associated with achieving economies of scope.

Longer hours of operating the milking system was expected to contribute to increased milk production. Short (2000) found that longer hours of operation was associated with greater NFI. Thus, it was hypothesized to have a positive impact on profitability. The hours per day that the milk enterprise was in operation (HRSMLKON), however, had a statistically significant and negative impact on NI (Table 18), but it was insignificant in explaining the variations in NFIFO and NFI (Table 18). Operating the milking system for longer hours likely requires more labor. Considering the majority of the organic dairy farms in the Northeast are family farms, much of the labor is probably unpaid. While NFIFO and NFI do not account for the opportunity cost

[6] It should be noted that off-farm income was not included in the calculation of NFIFO, NFI, and NI.

Table 22: Factors Determining Organic Dairy Farm Profitability in the Northeast U.S., 2005 (n=141)

Variable	Expected Sign	Model 1 NFIFO		Model 2 NFI		Model 3 NI	
		Coefficient	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*
Farm Characteristics:							
AVEPRICE	+	6,123.66***	(<0.001)	6,131.13***	(<0.001)	6,191,06***	(<0.001)
MILKCOWS	+	1,233.45***	(<0.001)	1,179.08***	(<0.001)	959.80***	(<0.001)
ACGFEED	-	32.51	(0.447)	33.20	(0.442)	27.80	(0.520)
MIRG	+	8,574.49	(0.352)	8,116.50	(0.383)	5,719.08	(0.538)
COWAGE	-	-7,956.27***	(0.006)	-8,148.28***	(0.005)	-11,411.00***	(<0.001)
LEGSTAT	-	-29,964**	(0.022)	-29,982**	(0.023)	-37,083***	(0.005)
HRSMLKON	+	-2,567.24	(0.278)	-2,152.37	(0.367)	-4,425.19*	(0.065)
SILOCAP	+	6.99	(0.119)	6.83	(0.131)	6.53	(0.149)
DRYOFF	-	-29,749**	(0.013)	-29,722**	(0.014)	-26,466.00**	(0.028)
NUTMNPLN	+	-872.98	(0.913)	-776.35	(0.923)	-4,314.626	(0.592)
VETSERVIC	+	2,297.43	(0.767)	2,786.69	(0.722)	3,651.27	(0.642)
Extra Income:							
LPSXMLKS	+	1.38***	(<0.001)	1.39***	(<0.001)	1.23***	(0.001)
CSCCC	+	1.58***	(<0.001)	1.59***	(<0.001)	1.56***	(<0.001)
GOVTYES	+	-14,518	(0.149)	-13,745	(0.18)	-12,637.00	(0.213)

Farm Operator Characteristics:							
OPEAGE	-	674.09	(0.119)	651.12	(0.137)	841.66*	(0.055)
OPEEDU	+	-1,633.48	(0.779)	-1,305.46	(0.825)	-3,236.16	(0.584)
MILKEXP	+	-260.21	(0.363)	-264.11	(0.361)	-231.51	(0.423)
FUTURE	+	7,305.08**	(0.031)	7,592.00**	(0.026)	7,614.57**	(0.026)
Technology:							
PARLOR	+	5,171.24	(0.625)	6,637.63	(0.535)	7,674.27	(0.474)
AUTTAKOF	+	-16,545.00	(0.121)	-15,250.00	(0.157)	-22,084.00**	(0.042)
UDDRWASH	+	-22,825.00	(0.256)	-23,792.00	(0.241)	-13,100.00	(0.518)
Efficiency Measures:							
MLKPRDCW	+	1,013.21***	(<0.001)	998.632***	(<0.001)	917.45***	(<0.001)
HFEEDCOW	+	-32.49	(0.315)	-31.80	(0.330)	-48.65	(0.137)
LABHRCOW	+	-317.52	(0.703)	-296.801	(0.724)	-1,067.20	(0.206)
CULLRATE	-	53,620.00	(0.655)	37,758.00	(0.755)	118,790.00	(0.328)
TVCCOW	-	-0.78***	(<0.001)	-0.785***	(<0.001)	-0.807***	(<0.001)
Risk Management:							
PINPUTLCK	+	3,511.71	(0.816)	2,196.83	(0.886)	3,981.94	(0.794)
PDISCOUNT	+	-6,727.52	(0.464)	-7,313.08	(0.430)	-3,941.77	(0.671)
VOLPREM	+	5,426.72	(0.574)	5,927.64	(0.544)	15,509.00	(0.1143)

WRITTCON	+	14,202	(0.133)	14,371	(0.132)	11,811.00	(0.215)
FWARDCON	+	2,818.33	(0.771)	2,721.51	(0.781)	-1,045.82	(0.915)
ONSITPRO	+	-10,485	(0.697)	-11,482	(0.674)	-27,170	(0.320)
Financial Efficiency:							
DEBT2ASST	-	-90,626***	(<0.001)	-86,947***	(<0.001)	-77,511.00***	(0.003)
Intercept		-207,425***	(<0.001)	-209,805***	(0.002)	-198,807***	(0.003)
F-stat		12.66***	(<0.001)	12.22***	(<0.001)	12.91***	(<0.001)
Adj. R^2		0.73		0.72		0.74	

Note: Values displayed are parameter estimates and corresponding p-values are in parentheses. Statistically significant means are as follows: *** $p \leq .01$, ** $p \leq .05$, * $p \leq .10$

of this unpaid labor, NI does account for this opportunity cost. Thus, longer operating hours likely increased the opportunity cost for unpaid labor and decreased NI.

On the other hand, taking milk cows out of production on a seasonal basis was likely to decrease milk production. As previously discussed in the context of Table 15, unprofitable organic dairy farms were more likely to dry off milk cows seasonally than profitable farms. The choice to dry off cows seasonally was expected to negatively impact NFIFO. This study found that the choice to dry off milk cows seasonally (DRYOFF) negatively influenced NFIFO (Table 18). These findings coupled with the previous findings suggest the importance of finding an optimal level of production intensity.

Management Intensive Rotational Grazing (MIRG) requires more than simply allowing cows to roam freely on pasture. Managing pasture and rotations requires skill, time, energy and inputs, but rotational grazing is supposed to rely less on external inputs (Shiere et al. 2002), therefore, possibly reducing variable costs. Thus, MIRG was hypothesized to have a positive affect on NFIFO. However, rotational grazing was found to be insignificant in explaining the variation in profitability.

4.8.2 Extra Income

Organic dairy farms in this sample primarily produced milk. However, there were other sources of revenue that contributed to NFIFO, NFI, and to a lesser degree, NI. It was expected that revenues from non-milk sales would contribute to profitability in a positive way. The additional revenues generated, however, may not be enough to offset the costs, and there may be implicit costs associated with reducing the specialization of the dairy enterprise. Nonetheless, livestock and poultry sales, crop sales and the receipt of government payments were expected to have a positive impact on profitability. The results show that livestock and poultry sales (LPSXMLKS) and crop sales (CSCCC) both had a positive influence on NFIFO, NFI, and NI (Table 18). Receiving government payments (GOVTYES), however, was negatively correlated with profitability (Table 18).

4.8.3 Farm Operator Characteristics

Farm operators bring different skill sets to each individual enterprise that may be captured by various operator characteristics. As a farm operator's age increases, knowledge and expertise is likely to increase. However, as a farm operator's age increases, his/her management decisions may change based on the future expectations of the dairy operation. The age of the primary operator has been found to be associated with higher operating costs (McBride and Greene 2007), and lower NFI (El Osta and Johnson 1998). After controlling for experience, farm operator's age was hypothesized to negatively impact profitability. The results show, however, that age (OPEAGE) had a significant and positive impact on NI, and it was insignificant in explaining NFIFO and NFI.

Higher education of dairy operators has been found to be correlated with higher levels of profitability (Mishra and Morehart 2001). Mishra and Morehart (2001) suggest that education may measure one's ability to process new and complex information, a presumably important characteristic for organic dairy farmers learning to manage a new technology within a new set of rules and regulations. Primary operator's education (OPEDU) was expected to have a positive impact on profitability. The results show, however, that education was not significant in explaining the variation in NFIFO (Table

18). These findings are in line with those by Short (2000) and El-Osta and Johnson (1998) focusing on U.S. dairy farmers in general.

Experiential knowledge in contrast to or in addition to education can facilitate the development of managerial expertise that perhaps can only be acquired on the farm. Dairy farming experience, therefore, was expected to have a positive impact on NFIFO. However, this study found that dairy farming experience (MLKEXP) did not have any impact of organic dairy farm profitability. Short (2000) also found that dairy farming experience was insignificant in explaining profitability among U.S. dairy farms.

It was hypothesized that the longer an organic dairy farmer expected to continue the current operation (FUTURE), the greater the level of NFIFO, NFI, and NI would be. This is because a primary operator's expectations about the future of the dairy enterprise may affect certain management decisions that subsequently may have a positive impact on performance. It was found that future expectations (FUTURE) were statistically significant with a positive coefficient in all three models.

4.8.4 Technology

Integrating new technology into the organic dairy production model was hypothesized to have a significant and positive impact on profitability. New technologies may lead to increased efficiencies. Technological tools may free labor for other tasks; thus increasing specialization. Moreover, technology adoption has been found to have a positive impact on dairy farm financial performance (El Osta and Johnson 1998; Short 2000).

The majority of milking facilities (technology) used on organic dairy farms in the Northeast were some variation of a parlor, usually barns with pipelines. However, there were farms utilizing pail and bucket units as well. The variable PARLOR captured those farms primarily utilizing some type of parlor and the pail and bucket units represented the rest. The variables, AUTTAKOF and UDDRWASH, captured those farms that had milking systems with automatic takeoffs and udder washers, respectively. El-Osta and Johnson (1989) found that more advanced milking facilities were positively correlated with profitability and economic performance. Short (2000) found that dairy farms with higher profitability were more likely to have milking equipment with automatic takeoffs and udder washers; thus these three variables were used as measures of technology adoption.

All three technology measures, PARLOR, AUTTAKOF, and PARLOR were hypothesized to have a positive impact on profitability. The results show that AUTTAKOF was the only variable of significance. However, it had a statistically significant and negative impact on NI and no significant impact on NFIFO and NFI. This finding is in contrast to Short (2000) findings and could be explained as follows: it is possible that acquiring new technological equipment can be costly and increase financial stress. Greater debt loads would lead to increased interest payments and depreciation expenses and decreased profitability, which may have been the case in this sample.

4.8.5 Efficiency Measures

Both production and cost efficiency measures were used to capture the variation in profit due to production and cost efficiencies. Milk production per cow (MLKPRDCW) was used as a measure of production efficiency and total variable costs per cow (TVCCOW) was used as a measure of cost efficiency. Short (2000) found that higher NFI farms typically had greater levels of milk production per cow and lower levels of total variable expenses. El-Osta and Johnson (1989) found that greater milk sold per cow was correlated with dairy farm economic performance. Greater levels of milk production per cow were expected to positively impact profitability, while greater total variable costs per cow were expected to have a significant and negative impact on profitability. In line with expectations, the results show that milk production per cow (MLKPRDCW) was significant and had a positive coefficient in all three models, and TVCCOW was significant and had a negative impact on NFIFO, NFI, and NI.

4.8.6 Risk Management

Farm operators used different mechanisms to manage the risk associated with fluctuations in the prices of inputs and output, and the risk involved with ensuring a market for their product. Various risk management strategies have been found to increase profitability (Mishra and Morehart 2001). Negotiating input price discounts (PDISCOUNT), or locking in low input prices via forward contracts (PINPUTLCK), and locking in favorable milk prices via forward contracts (FWARDCON) were expected to have a positive impact on profitability (Table 18). These risk management tools, however, were insignificant in explaining the variation in profitability among organic dairy farms in the Northeast.

4.8.7 Financial Efficiency

Agriculture is an inherently risky business. Managing that risk to minimize its impact on the farm business was expected to be important in determining profitability. The debt-to-asset ratio measures the proportion of farm assets owned by creditors, or the risk exposure of a farm business (FFSC 1997, Sec. 3, p. 9). Greater levels of risk exposure were expected to have a negative impact on profitability. The results show that the debt-to-asset ratio (DEBT2ASST) had a significantly negative impact on profitability in all three models (Table 18). This finding is in accord with Short (2000) and El-Osta and Johnson (1989), who found that higher debt-to-asset ratios were negatively correlated with profitability.

4.9 Factors Affecting the Profitability of Profitable Organic Dairy Farms

Finally, the factors determining the profitability of only those organic dairy farms in the Northeast that were profitable in 2005 (n=121) were examined. The aim here is to determine whether or not the factors that impacted the profitability of profitable organic dairy farms are the same as those affecting the profitability of organic dairy farms in general. The same weighted least squares regression procedure was performed, using the same three models (NFIFO, NFI, and NI) presented in Table 18. The results are presented in Table 19. Since the models examined were identical and only the sample was restricted, the results presented in Table 19 are very similar to those in Table 18. Therefore, only the differences from Table 18 are discussed here.

Among the farm characteristics, the farm legal status, family farm (LEGSTAT) had a negative correlation with NI but no correlation with NFIFO and NI. These results are intuitive because NI accounts for the opportunity cost of unpaid labor, which was presumably higher among family farms. The hours per day that the milking system was in operation (HRSMLKON) was found to be significant and negatively correlated with NFIFO, NFI, and NI. While this was not expected, it could be explained as follows: longer operating hours may have required greater levels of expenses resulting in the negative and significant relationship. The use of a nutrition management plan (NUTMNPLN) was found to be significant and negatively correlated with NI but not with NFIFO and NFI. The use of such a plan may be associated with higher levels of unpaid management labor among profitable organic dairy farms in the Northeast.

Among the farm operator characteristics, the operator's age (OPEAGE) was found to be statistically significant and positively correlated with NFIFO, NFI, and NI. However, dairy farming experience (MILKEXP) was found to have a significantly negative impact on NFIFI, NFI, and NI. Considering these findings together, there may be something unique about general farming expertise acquired over time that is transferable to organic dairy farming. Perhaps experience with crop production was more important than dairy farming experience among profitable organic dairy farmers in the Northeast, as organic dairy farms tend to substitute homegrown feed in place of costly purchased feed.

In terms of technology, adoption of milking systems with udder washers (UDDRWASH) was found to have a negative correlation with NFIFO, NFI, and NI. This may be attributed to the higher debt loads and interest payments, and asset depreciation that accompany technology adoption. The efficiency measure, labor hours per cow (LABHRCOW), was found to have a negative correlation with NI but not NFIFO and NFI. After controlling for variable costs per cow (VCCOW), which includes labor costs per cow, greater labor hours likely reflects the opportunity costs for unpaid labor that NI captures. Receiving volume premiums was found to be significant and positively correlated with NI but not with NFIFO and NFI. This finding suggests that the opportunity cost of unpaid labor and management reflected in NI but not in NFIFO and NFI was associated with volume premiums. Processing milk on site was found to be significantly negatively correlated with NI but not NFIFO and NFI, suggesting the correlation between the cost of processing on site and the level of unpaid labor and management.

The factors determining the profitability of profitable organic dairy farms were similar to those impacting all organic dairy farms. Production and cost efficiency had a positive correlation with profitability and the debt exposure had a negative impact on profitability for both groups. Additionally, extra income, farm size, and the organic milk price received explained a significant amount of variation in organic dairy farm profitability for both groups. The most important changes that occurred between the overall group of organic dairy farms and the profitable group of organic dairy farms were that risk management decisions had a significant impact on the profitability of profitable organic dairy farms but not among the overall group. The receipt of volume premiums, the use of written contracts in general, and the use of forward contracts for milk marketing were positively correlated with profitability, while processing milk on site had a negative impact on profitability among the profitable group of organic dairy farms in the Northeast. Similar findings were made by Mishra and Morehart (2001) concerning conventional U.S. dairy farms. This suggests the similarity in risk factors and risk management strategies between organic and conventional milk producers.

Table 23: Factors Determining Organic Dairy Farm Profitability in the Northeast U.S., 2005, Profitable Organic Dairy Farms Only (n=121)

Variable	Model 1 NFIFO		Model 2 NFI		Model 3 NI	
	Coefficient	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*
Farm Characteristics:						
AVEPRICE	2,453.88*	(0.056)	2,340.68*	(0.068)	2,220.42*	(0.076)
MILKCOWS	614.854***	(<0.001)	551.84***	(<0.001)	390.22***	(0.001)
ACGFEED	-2.97	(0.915)	-4.97	(0.859)	-0.84	(0.976)
MIRG	-1,250.20	(0.843)	-2,713.48	(0.667)	-2,948.10	(0.633)
COWAGE	-319.67	(0.886)	-604.94	(0.786)	-3,237.38	(0.139)
LEGSTAT	-6,958.06	(0.370)	-5,879.64	(0.448)	-13,572.00*	(0.076)
HRSMLKON	-5,013.30***	(0.002)	-4,456.18***	(0.006)	-7,153.02***	(<0.001)
SILOCAP	0.78	(0.775)	0.41	(0.879)	-0.23	(0.933)
DRYOFF	-12,705.00	(0.128)	-12,511.00	(0.114)	-6,528.20	(0.422)
NUTMNPLN	-3,779.60	(0.474)	-3,423.84	(0.516)	-8,958.77*	(0.085)
VETSERVIC	-4,433.09	(0.389)	-3,954.89	(0.441)	-1,373.16	(0.784)
Extra Income:						
LPSXMLKS	1.04***	(<0.001)	1.06***	(<0.001)	0.84***	(<0.001)
CSCCC	1.11***	(<0.001)	1.11***	(<0.001)	1.06***	(<0.001)
GOVTYES	-9,558.93	(0.165)	-8,244.73	(0.230)	-8,691.10	(0.196)
Farm Operator Characteristics:						
OPEAGE	623.17**	(0.023)	621.16**	(0.023)	658.89**	(0.014)
OPEEDU	916.88	(0.809)	1,421.12	(0.708)	-559.86	(0.880)
MILKEXP	-397.10**	(0.040)	-395.47**	(0.040)	-371.49**	(0.049)
FUTURE	4,041.29*	(0.085)	4,311.80*	(0.066)	4,834.35**	(0.036)
Technology:						
PARLOR	-5,274.65	(0.336)	-5,380.94	(0.326)	-1,509.58	(0.778)

AUTTAKOF	5,596.27	(0.447)	7,951.95.00	(0.280)	-675.37	(0.925)
UDDRWASH	-49,354.00**	(0.020)	-50,490.00**	(0.017)	-38,227.00*	(0.063)
Efficiency Measures:						
MLKPRDCW	934.48***	(<0.001)	923.26***	(<0.001)	838.87***	(<0.001)
HFEEDCOW	-9.89	(0.631)	-10.30	(0.616)	-17.78	(0.378)
LABHRCOW	-405.07	(0.480)	-392.94	(0.492)	-1,007.13*	(0.074)
CULLRATE	42,828.00	(0.585)	25,030.00	(0.749)	118,090.00	(0.125)
TVCCOW	-32.08***	(<0.001)	-32.50***	(<0.001)	-30.89***	(<0.001)
Risk Management:						
PINPUTLCK	-10,699.00	(0.286)	-11,409.00	(0.255)	-12,254.00	(0.212)
PDISCOUNT	4,672.06	(0.456)	4,009.11	(0.522)	7,246.02	(0.238)
VOLPREM	654.76	(0.921)	1,543.50	(0.815)	10,716.00*	(0.099)
WRITTCON	11,747.00*	(0.058)	12,517.00**	(0.043)	7,315.97	(0.224)
FWARDCON	11,265.00*	(0.097)	10,898.00	(0.108)	9,772.69	(0.140)
ONSITPRO	-10,485.00	(0.697)	-17,263.00	(0.439)	-46,208.00**	(0.032)
Financial Efficiency:						
DEBT2ASST	-64,379.00***	(<0.001)	-59,929.00***	(<0.001)	-46,261.00***	(0.005)
Intercept	-111,046.00**	(0.011)	-111,604.00	(0.010)	-103,470.00**	(0.015)
F-stat	9.71***	(<0.001)	9.31***	(<0.001)	8.67***	(<0.001)
Adj. R^2	0.70		0.69		0.68	

Note: Values displayed are parameter estimates and corresponding p-values are in parentheses. Statistically significant means are as follows: *** $p \leq .01$, ** $p \leq .05$, * $p \leq .10$

CHAPTER V

CONCLUSIONS

The purpose of this study was to analyze the structure and performance of organic dairy farms in the Northeast in comparison to conventional dairy farms in the region. This study utilizes a unique data set of farm financials, farm characteristics, and farm operator characteristics from the USDA's 2005 dairy farm ARMS survey. The data set is unique in that the USDA collected data from organic dairy farms for the first time in 2005.

The first objective of this study was to analyze the financial performance of organic and conventional dairy farms in the Northeast. The typical organic farm was profitable in 2005, earning a positive NFIFO and NFI. However, NI was typically negative, meaning that organic dairy farms typically did not earn positive returns to unpaid management and labor. The relative importance of each profitability measure used in this study, NFIFO, NFI, and NI, ultimately depends upon the subjective interpretation of the primary stakeholder, the dairy farmer.

On a per-cow level, organic dairy farms had greater NFIFO and NFI than conventional dairy farms, and there was no statistically significant difference in NI. Diversification was important for both conventional and organic dairy farms. Dairy farms in the Northeast received significant revenues from livestock and poultry sales, and crop sales. Conventional dairy farms also received significant income from government payments, but organic dairy farms relied more on non-money farm income.

Organic farms incurred lower levels of total operating expenses than conventional farms at the per-cow level. Conventional dairy farms incurred greater costs per cow for fertilizer and chemicals, veterinary and medicine, labor, fuel and oil. It was interesting to find that there was no statistically significant difference in purchased feed costs per cow between the two groups. Expensive organic feed is often targeted as a significant impediment to profitability, and primary operators reported the high cost of organic feed as one of the most difficult aspects of organic dairy farming. In accord with Butler (2002), organic dairy farms in the Northeast typically substituted homegrown feed and pasture for expensive feed and concentrates.

On a per CWT EQ level, there was no statistically significant difference in NFIFO and NFI between small (≤50 cows) organic and conventional dairy farms. Small organic dairy farms earned a positive and statistically significantly greater NI per CWT EQ than small conventional dairy farms. This finding is important because it shows that small organic dairy farms were economically viable in the Northeast in 2005, more so than their conventional counterparts. This finding has important implications because most previous studies have shown that small dairy farms are typically less economically viable throughout the U.S., and as a result, they are disappearing at a faster rate than larger dairy farms (MacDonald et al. 2007; Miller and Blayney 2002). McBride and Greene (2007) found that smaller dairy farms were more likely to choose the organic approach than larger dairy farms. According to them, larger farms typically had greater investments in infrastructure that enclose milk cows in confinement, and such investments would not be transferable to the organic model. This study shows that small conventional dairy farms that have transitioned to organic status in an attempt to survive and be profitable were successful in doing so.

On a per CWT EQ level, there was no statistically significant difference in costs for veterinary and medicine, labor, fertilizer and chemicals, seeds and plants, and fuel and oil between small (≤50 cows) organic and conventional dairy farms in the Northeast in contrast to what ideology might predict. According to the results, it does not appear that small conventional dairy farms are operating much differently than small organic dairy farms. As Dalton et al. (2005) noted, however, the relative success of organic dairy farms is dependent upon the organic milk price premium, which is as volatile as the conventional milk price. The organic milk price premium was roughly $8/cwt in 2005 in the Northeast. It is a significant premium, and it cannot necessarily be expected to remain stable over time. Therefore, those organic dairy farms relying on a significant organic milk price premium in order to be profitable may be in for a shock as the volatility of the milk price premium plays out in the future.

From a per CWT EQ perspective, there was no statistically significant difference in NFIFO, NFI, and NI between medium-sized (51-100 cows) organic and conventional dairy farms in the Northeast. Both groups incurred negative returns to unpaid labor and management. Large conventional dairy farms (>100 cows) were significantly larger than large organic dairy farms. Therefore, large conventional dairy farms were significantly more profitable than the few large organic dairy farms in the sample.

The second objective of this study was to analyze the financial performance of organic dairy farms that had at least 5 years of experience producing organic milk compared to organic dairy farms with less than 5 years of experience. There was no statistically significant difference in profitability between these two groups. This suggests that there are other factors that are more important in explaining the variation in profitability among organic dairy farms. This led to the third objective of this study: to analyze the structure and performance of profitable and unprofitable organic dairy farms in the Northeast. Organic dairy cows on profitable farms were slightly more productive than cows on unprofitable farms. This difference may be attributed to the greater frequency with which unprofitable farms chose to dry off milk cows seasonally; thus taking them out of production. Profitable farms used homegrown feed and labor more efficiently, but they were significantly less efficient with purchased feed.

The fourth objective of this study was to examine the factors influencing financial performance of organic dairy farms in the region. Regression results showed that the average milk price received, the number of milk cows, and extra income from livestock, poultry, and crop sales had a significantly positive impact on the profitability of organic dairy farms in the Northeast. In addition, the number of years the dairy enterprise was expected to continue operating had a significant and positive impact on profitability. An operator's positive expectations regarding the future of the dairy operation may have had an impact on how the enterprise was managed in 2005.

Not surprisingly, farms that were operating more efficiently were more profitable. Managing total variable costs and increasing production per cow was significant in explaining variability in profitability. In addition, farms that managed their level of debt exposure were more likely to be profitable than others. The debt-to-asset ratio measures the proportion of assets owned by creditors, and it had a significant and negative impact on profitability. It was found that unprofitable organic dairy farms had higher levels of depreciation on farm assets and interest payments which might be associated with debt levels.

The hours per day that the milking system was in operation was found to have a negative correlation with NI, however, it did not impact NFIFO or NFI. This finding contradicts expectations. The negative impact on NI might be expected because NI accounts for the opportunity costs of unpaid labor and management. As the majority of organic dairy farms in the Northeast are family farms, longer labor hours required to run a milking system for a longer time were probably draw from unpaid family labor.

The use of automatic takeoffs had a negative impact on NI, but it was not significant in explaining variability in NFIFO or NFI. Automatic takeoffs probably represented an expensive investment that led to increased depreciation and interest expenses. Furthermore, milking technology designed to increase the productivity or efficiency of the milking operation may be less suitable to the organic model.

This study analyzes the impact that farm and farm operator characteristics had on the profitability of organic dairy farms in the Northeast. In terms of NFIFO and NFI, it was found that larger organic dairy farms that were able to produce more efficiently and keep debt levels down were more likely to be profitable. Additionally, in terms of NI, the level of dependence upon unpaid family labor and management was significant in determining the returns to unpaid management and labor among organic dairy farms in the Northeast. This study found that transitioning to certified organic status was a profitable decision among most organic dairy farms in the Northeast in 2005, especially for small (<50 cows) operations.

This study's findings have important and useful implications for various stakeholders within the organic dairy sector. This information is useful to small conventional dairy farms in the Northeast that are struggling to survive and may by contemplating transitioning to organic status. On the same thread, this study is valuable to the extension agents in the region, who may be advising those small dairy farms previously mentioned, as well as other organizations that support organic agriculture in the region, such as the Northeast Organic Farming Association (NOFA).

This study's findings have public policy implications. Organic dairy farm primary operators reported that certification paperwork and compliance costs were the most difficult aspect of organic dairy farming. Considering that small organic dairy farms were more economically viable than small conventional dairy farms in the Northeast region, it can be concluded that the organic status provided a solution to a problem faced by many small conventional dairy farms in the region. Therefore, policy makers should strive to minimize the hardship of maintaining the organic certification and address the burden that paperwork and compliance costs place on organic dairy farms.

In terms of the shortcomings of this study, it is limited in that in utilizes cross-sectional data that represent only one year of dairy farming performance. Political and environmental factors and the organic milk price premium may vary over time and, thus, could alter the findings of such a study in the near future. Furthermore, this study focused solely on the FFSC's guidelines for calculating profitability, and does not address the AAEA's alternative guidelines for measuring profitability. Additionally, profitability is only one measure of financial performance. Future studies of this kind may want to address measures of liquidity, solvency, or operational ratios, for example, in more depth. Finally, this study does not address the cost of transitioning to organic status, which can be a significant barrier to entry. Additionally, this study does not account for those mixed farming operations that produce both organic and conventional agricultural products within the same operation. These types of dairy farms would add information and nuances to a study of this kind.

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