BENCHMARKING FARM FINANCIAL PERFORMANCE: STABILITY AND MANAGEMENT IMPLICATIONS

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ABSTRACT

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The primary research question of this study was, "how many years are of data are needed to be reasonably sure that farms are ranked correctly?" The data were obtained from the Michigan Dairy and Crop Farm Business Summaries. First, the stability across farms was examined to determine if farms consistently rank in the top or bottom third. Asset driven measures (ATO, DTA, CR) were less variable than income and profitability measures (NFI, ROA, OPMR). Then, farms were ranked according to their five-year average for each financial measure to test if there was a significant difference between the top and bottom third. The results revealed that there was a significant difference between the top and bottom thirds for every financial measure for both the dairy and crop farms. The farms were then organized into thirds using their five-year average ROA and the differences between the most profitable and least profitable farms were examined. Farms in the top third tended to have a significantly higher ATO, OPMR, and NFI than the farms in the bottom third for ROA. Next, the number of years of data needed to rank farms into thirds with a high degree of accuracy was estimated. This was accomplished by estimating the farm's true, long-run performance and calculating how many years it took to be reasonably confident that the farm was ranked in the correct third. The number of years that were ideal to use depended on which variable the farmer is looking at and the level of accuracy they desire.

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Chapter 1-Introduction

Benchmarking is a tool used by farm managers to compare the performance of their farm to the performance of others or an industry standard. Performance may vary across farms due to external factors such as weather. However, differences between farms due to internal factors, such as managerial ability, can make benchmarking a useful tool. The individual producer is responsible for controlling many factors that influence profitability. These include input costs, and efficiently converting capital, feed, and labor into milk (El-Osta & Johnson, 1998). It is useful for farm managers to know the characteristics that cause farms to outperform others over time (Langemeier, 2010).

Through the use of external benchmarking, farmers can identify areas where they are weak compared to similar farms and work to improve these areas. They can also use benchmarking to identify their strengths. Knowing their strengths and weaknesses and using this information to strategize, can allow farms to outperform the competition in the future (Barney & Clark, 2007).

One convention is to compare farm financial performance over the course of the past year to the performance of other similar farms over the past year. The volatility in the dairy industry may affect farm performance. In order to draw conclusions from benchmarking, it is necessary to understand the effect on performance that is firm specific versus industry wide. Before making managerial decisions based on benchmarking, a farmer should know not just how their performance over the past year compared to other farms, but how their long-run performance compared to the rest of the industry in the long run. Rougoor et al. (1998) argued that the goal is to achieve long-term financial success, thus it is imperative to analyze the relationship between farm management and financial performance over time.

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For this analysis, several financial ratios were used. The current ratio was included as a measure of a farm's liquidity, or its ability to pay its short-term financial obligations using current assets. The debt-to-asset ratio is a measure of farm solvency and shows what percent of the farm's assets were financed by debt. The asset turnover rate represents the farm's efficiency at generating sales using assets. The rate of return on assets shows the firm's efficiency at using its assets to generate profits. And, a farm's operating profit margin ratio measures the proportion of every dollar of sales that is kept by the farm as profit. Several cost and income measures were also analyzed (net farm income, value of homegrown feed, purchased feed cost, and labor cost). *1.1 Objectives*

The motivation behind this thesis was to take a closer look at benchmarking. Is it enough for a farm to use one year of data? Or do they need data over a longer period, in order to be confident that their ranking is a reflection of their true performance? Data from Michigan State University Farm Business Analysis on both crop and dairy farms was used to assess variation in farm financial performance. If the variation were due solely to industry effects and therefore common across all farms, one year of data would be sufficient to use when benchmarking. However, if the variation about the true, but unknown performance over the long-term is at least partially firm specific, the question becomes, "how many years are of data are needed to be reasonably sure that farms are ranked correctly?"

In order to answer this question, four research objectives were addressed. The first objective was to summarize Michigan farm performance using profitability, solvency and liquidity measures. The second objective was to examine the stability of rankings across farms. The third objective was to ascertain the number of years of data needed to estimate a farm's relative long-run performance. This was accomplished by comparing a farm's ranking using one-

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year, two-year average, three-year average, etc. to their ranking using an estimated long-run true value. Then the percent of farms placed in to the correct third was calculated. The fourth objective was to examine how large the common year effects were compared to firm effects through regression analysis. The results of this analysis were used to estimate the parameters that will be used in the future in Monte Carlo simulations.

The thesis proceeds as follows: in chapter two the data for both the dairy and crop farms are analyzed through the use of summary statistics and plot graphs. The methods and results for each model are presented in chapter three. Chapter four summarizes and concludes.

Chapter 2-Data

2.1 Dairy Farm Data

The data used for this study were obtained from the Michigan Dairy Farm Business Summary. The farms included in the dataset were any farm that had provided financial records to Michigan State Farm Business Analysis for at least one year between 2001 and 2012. A dairy farm was defined as any farm that received more than 50% of its revenue from dairy sales. There was data available for 299 dairy farms between 2001 and 2012. There were 139 dairy farms that had data for five or more years during the period, 100 that had data for seven or more years, and 62 that had data for ten or more years. These farms were larger and better managed than the average dairy. This was not a random sample and it was biased, however it is valid data to use in a study on benchmarking because you want to benchmark against better farms.

The dataset was used to form five groups of data that were used throughout the analysis. The first group consisted of all 299 dairy farms with records in one or more years during the period 2001-2012. The second group consisted of only the 139 dairy farms with five or more years of records between 2001 and 2012. The third group consisted of a panel of 41 farms with ten years of continuous data between 2002 and 2011. The fourth group consisted of 61 farms with continuous data between 2001 and 2007. The final group had 51 farms with continuous data between 2006 and 2012.

2.1.1 All Dairy Farms

The herd size for all dairy farms ranged from ten to more than 4,000 milk cows. The majority of farms in the sample had less than 1,000 cows as seen in figures 2.1 and 2.2. The average herd size of the farms in the sample increased throughout the period.

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			Standard			Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(cows)		
2001	196	140	318	3,704	28	124
2002	206	145	237	2,200	25	151
2003	195	145	175	1,543	18	160
2004	199	149	179	1,544	14	133
2005	194	150	172	1,613	20	133
2006	211	161	189	1,638	21	149
2007	226	171	208	1,611	10	156
2008	230	167	211	1,564	18	180
2009	243	192	220	1,558	18	187
2010	267	186	247	1,581	20	211
2011	303	185	482	4,467	40	232
2012	291	195	352	2,700	40	202

Table 2.1: Summary Statistics for Herd Size, All Dairy Farms, 2001-2012

Figure 2.1: Annual Distribution of Herd Size for All Dairy Farms, 2001-2012



Figure 2.2: Annual Distribution of Herd Size for All Dairy Farms with <1200 cows, 2001-2012



Herd Size (cows)

Throughout the period, the average milk price received varied from year to year. Figure 2.3 shows the distribution in milk price received by farm by year. It reveals the difference in the milk price received during boom and bust years. Also evident are the higher milk prices since 2007. Milk prices trended upwards throughout the period, which coincided with an increase in feed costs. Although, the margin between milk price and feed cost decreased.

		.	Standard	, <u>,</u>	,	Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(\$/cwt)		
2001	15.19	15.18	0.75	18.86	13.02	0.73
2002	12.49	12.44	0.66	15.86	11.11	0.61
2003	12.57	12.52	0.76	15.36	10.13	0.79
2004	16.38	16.29	0.89	20.11	14.15	0.81
2005	15.63	15.50	0.74	18.70	14.39	0.83
2006	13.31	13.25	0.66	17.08	11.65	0.61
2007	19.11	19.12	1.28	22.65	12.89	0.94
2008	19.33	19.25	1.08	22.55	16.34	0.97
2009	13.17	13.04	0.90	16.36	11.28	0.99
2010	16.78	16.68	0.95	20.56	14.37	0.99
2011	20.55	20.40	1.05	24.44	17.36	1.03
2012	18.54	18.50	1.03	22.23	13.90	0.83

 Table 2.2: Summary Statistics for Milk Price, All Dairy Farms, 2001-2012



Figure 2.3: Annual Distribution of Milk Price for All Dairy Farms, 2001-2012

Milk Price (\$/cwt)

Both the average owned and rented crop acres increased slightly throughout the period (table 2.3 and 2.4). Aside from 2002, the farms in the sample owned on average more crop acres than they rented. This coincided with an increase in the average total crop acres per farm. The average owned crop acres per farm and average rented crop acres per farm both increased by about 100 acres throughout the period, while the total crop acres per farm increased by about 200 acres.

			Standard			Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(acres)		
2001	355	240	432	2,440	0	459
2002	352	300	309	2,440	0	331
2003	403	295	474	3,250	0	350
2004	402	293	469	3,250	0	335
2005	422	294	465	2,440	0	345
2006	468	318	523	2,500	0	378
2007	489	334	524	2,841	0	382
2008	482	340	497	2,841	0	430
2009	470	347	504	2,841	0	473
2010	494	328	482	2,402	0	434
2011	477	300	567	3,600	0	479
2012	486	352	529	3,181	0	501

 Table 2.3: Summary Statistics for Total Owned Crop Acres, All Dairy Farms, 2001-2012

Figure 2.4: Annual Distribution of Total Owned Crop Acres for All Dairy Farms, 2001-2012



 Table 2.4:
 Summary Statistics for Total Rented Acres, All Dairy Farms, 2001-2012

			Standard			Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(acres)		
2001	278	160	398	2,467	0	158,687
2002	404	260	404	2,562	0	163,560
2003	336	230	356	2,057	0	126,643
2004	349	208	413	2,803	0	170,567
2005	377	225	472	3,517	0	223,153
2006	304	141	429	3,143	0	183,880
2007	322	170	427	2,523	0	181,936
2008	347	177	455	2,633	0	207,457
2009	377	230	474	2,660	0	224,437
2010	311	197	382	1,990	0	145,615
2011	281	155	336	1,608	0	112,828
2012	390	225	509	2,220	0	258,740

Figure 2.5: Annual Distribution of Total Rented Crop Acres for All Dairy Farms, 2001-2012



The current ratio (CR) is a measure of a farm's liquidity, or its ability to pay its shortterm financial obligations using current assets. Assets were valued at market value.

$$CR_i = \frac{Current Assets_i}{Current Liabilities_i}$$
, where $i = an$ individual farm

A CR>1 suggests that the farm will be able to cover expected liabilities to come due during the current year using its current assets. If the CR<1, the farm will not be able to meet its financial obligations by liquidating its current assets and may have to use long term assets or an operating loan. This can present an issue for the farm in the future, as it needs these long-term assets to continue production. Also, long-term assets are often illiquid and therefore not easily converted to cash, often resulting in them being sold for less than their value.

The mean CR for the farms in the sample was greater than one for all years in the period, which is positive (table 2.5). However, the minimum was less than one in every year, which means that there were farms in the sample that were illiquid.

			Standard			Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(ratio)		
2001	4.23	1.81	8.18	58.62	0.16	2.28
2002	6.22	1.55	15.45	134.15	0.07	2.95
2003	3.33	1.58	7.09	56.78	0.02	1.97
2004	4.68	1.85	10.35	90.26	0.02	3.01
2005	8.42	1.94	22.99	184.16	0.13	3.30
2006	7.49	2.34	21.31	184.42	0.17	3.44
2007	8.37	3.26	23.64	211.59	0.30	4.77
2008	6.71	2.81	16.51	130.43	0.39	3.12
2009	5.36	2.34	11.30	77.90	0.19	2.82
2010	5.37	2.78	11.01	85.27	0.24	3.86
2011	7.36	3.05	16.54	111.73	0.20	4.01
2012	10.18	3.43	24.65	158.26	0.47	4.55

Table 2.5: Summary Statistics for CR, All Dairy Farms, 2001-2012

Figure 2.6: Annual Distribution of CR for All Dairy Farms, 2001-2012



Figure 2.7: Annual Distribution of CR for All Dairy Farms with a CR of 0-5, 2001-2012



The debt to asset ratio (DTA) is a measure of farm solvency. A high DTA ratio implies that a farm is financing its assets with debt rather than equity, thus increasing the riskiness of the investment. A DTA>50% means that the farm has more liabilities than equity. This can present a problem when milk prices are down, such as in 2009, because it will be difficult to pay operating expenses let alone repaying debt. Also, as a farm continues to increase its debt load, creditors will begin to charge a higher interest rate. Once a farm takes out too much debt, creditors will no longer lend to them. The level of debt that would be considered "too much" would depend on the farm and the creditor. For dairy farms, the standard benchmark is to have a DTA<60%.

$$DTA_{i} = \frac{\left[\frac{End\ Total\ Assets_{i} + Beginning\ Total\ Assets_{i}}{2}\right]}{\left[\frac{End\ Total\ Liabilities_{i} + Beginning\ Total\ Liabilities_{i}}{2}\right]}$$

While the mean DTA for all dairy farms in the sample was less than 50% (table 2.6), there were 236 observations throughout the period that had a DTA greater than 50%. 156 of these observations occurred from 2001 to 2006. The farms with a DTA greater than 50% are financing over half of their assets using debt as opposed to equity. There were 5.85% of farms in the dataset that had a DTA>60%.

			Standard			Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(%)		
2001	31.88	28.77	19.70	94.82	(0.02)	27.46
2002	30.27	27.82	20.13	97.71	0.00	32.75
2003	31.68	29.48	19.71	86.70	0.00	32.21
2004	31.24	30.22	19.17	79.46	0.00	32.64
2005	28.38	25.86	18.95	103.82	0.00	25.22
2006	28.70	26.48	18.28	76.65	0.00	25.47
2007	25.83	25.02	16.81	75.95	0.00	25.22
2008	27.26	25.30	17.95	74.93	0.00	28.47
2009	31.31	29.45	19.88	89.90	0.00	27.42
2010	29.91	27.24	20.10	92.42	0.00	25.60
2011	26.67	24.62	17.52	87.03	0.00	23.21
2012	27.71	25.51	18.00	83.95	(0.01)	22.80

Table 2.6: Summary Statistics for DTA, All Dairy Farms, 2001-2012

Figure 2.8: Annual Distribution of DTA for All Dairy Farms, 2001-2012



Asset turnover rate (ATO) represents the farm's efficiency at generating sales using its

assets.

$$ATO_{i} = \frac{Sales_{i}}{\left[\frac{End\ Total\ Assets_{i}\ +\ Beginning\ Total\ Assets_{i}}{2}\right]}$$

As seen in the plot graph (figure 2.9), there is a wide range of ATO between the dairy farms in the sample. The farms with a low ATO have unproductive assets that are not generating sales. The average ATO between 2001 and 2012 was 30.29, so it would be preferable to be above this.

			Standard			Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(%)		
2001	32.88	30.27	14.18	85.04	8.99	19.80
2002	28.94	26.04	12.73	66.93	4.23	17.80
2003	30.22	27.52	14.46	93.80	5.13	18.45
2004	33.94	32.54	15.07	93.48	9.54	19.70
2005	31.34	29.41	12.27	72.43	8.42	15.22
2006	27.78	26.50	10.23	60.64	5.73	12.97
2007	34.05	32.16	12.90	70.98	7.38	15.87
2008	29.66	29.49	12.36	68.17	1.19	14.58
2009	21.98	20.92	9.38	51.04	(0.60)	10.33
2010	29.41	28.57	11.20	64.68	6.88	14.57
2011	32.77	30.96	11.19	71.96	10.16	15.22
2012	29.84	29.13	10.32	69.05	10.06	12.28

Table 2.7: Summary Statistics for ATO, All Dairy Farms, 2001-2012

Figure 2.9: Annual Distribution of ATO for All Dairy Farms, 2001-2012



Return on assets (ROA) shows the efficiency at using assets to generate profits. When calculating the ROA, unpaid labor was adjusted for. The average ROA throughout the period was 5.63%, so in the long run it would be ideal for a farm to have a higher ROA than that.

$$ROA_{i} = \frac{NFI_{i} - Interest_{i} - Value of Unpaid Labor and Management_{i}}{\left[\frac{End Total Assets_{i} + Beginning Total Assets_{i}}{2}\right]}$$
$$= \frac{Operating Profit_{i}}{Average Asset Value_{i}}$$

The industry effect for ROA is evident in figure 2.10. The majority of farms did well in 2011 and 2012 and poor in 2009. The range in ROA between farms is also clear. In 2009, one farm had an ROA of -20% while another had an ROA around 15%. Table 2.8 and figure 2.10 show that there were two years that were high for ROA and one year that had on average an extremely low ROA. In 2007 and 2011, the average ROA was above 10%. In 2009, the average and median ROA were negative. Looking at the plot graph, every farm except one had an ROA less than 10% in 2009. This conveys the variability and riskiness associated with farming.

			Standard			Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(%)		
2001	5.82	4.47	7.56	34.82	(15.41)	9.05
2002	2.79	1.83	7.26	33.09	(16.69)	8.35
2003	3.47	3.27	6.26	31.86	(14.48)	6.37
2004	6.91	6.80	6.65	29.20	(20.82)	7.71
2005	5.78	5.57	6.51	31.84	(11.39)	6.62
2006	5.02	4.26	5.85	23.51	(10.90)	6.34
2007	10.39	9.63	7.87	34.39	(8.55)	9.17
2008	5.52	4.90	7.94	35.44	(16.55)	7.70
2009	(1.11)	(0.65)	6.02	13.00	(20.12)	7.27
2010	5.88	5.44	5.33	27.01	(6.01)	6.31
2011	10.54	9.23	8.31	36.45	(17.98)	8.07
2012	7.32	6.62	7.41	29.96	(9.26)	8.26

 Table 2.8: Summary Statistics for ROA, All Dairy Farms, 2001-2012

Figure 2.10: Annual Distribution of ROA for All Dairy Farms, 2001-2012



ROA (%)

A farm's operating profit margin ratio (OPMR) measures the proportion of every dollar of sales that is kept by the farm as profit. As a guideline, a farm should make sure it's OPMR in the long run was greater than the average OPMR throughout the period, which was 16.99%.

$$OPMR_i = \frac{NFI_i - Interest_i - Value of Unpaid Labor and Management_i}{Sales_i}$$

$$=\frac{Operating \ Profit_i}{Sales_i}$$

OPMR was very volatile throughout the period. Not only has the average OPMR for each year varied, within each year there was a large variance and standard deviation between farms. In 2009 both the average and median OPMR were negative (table 2.9). This was due in large part to the margin between feed cost and milk price received being extremely low.

		e e e e e e e e e e e e e e e e e e e	Standard	· · · ·	,	Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(%)		
2001	19.08	15.52	31.22	165.86	(71.89)	27.73
2002	6.66	6.25	31.16	100.94	(153.02)	23.19
2003	11.24	11.77	27.06	184.70	(82.23)	19.67
2004	18.51	18.58	17.36	105.36	(38.17)	18.96
2005	17.55	17.97	26.56	137.24	(106.88)	21.43
2006	17.73	15.67	24.16	145.87	(70.28)	20.55
2007	29.49	28.05	25.18	106.42	(71.55)	22.69
2008	17.67	17.51	25.41	87.04	(104.24)	25.19
2009	(6.47)	(2.53)	33.55	57.83	(144.55)	33.18
2010	19.60	20.16	20.75	132.75	(49.29)	18.94
2011	31.35	26.70	27.40	129.16	(79.18)	20.68
2012	23.42	21.96	24.28	77.33	(40.78)	28.23

 Table 2.9:
 Summary Statistics for OPMR, All Dairy Farms, 2001-2012



Figure 2.11: Annual Distribution of OPMR for All Dairy Farms, 2001-2012

Figure 2.12: Annual Distribution of OPMR for All Dairy Farms with OPMR -20 to 50, 2001-2012



OPMR (%)

NFI/cwt represents the after tax dollars that a farm has available per hundredweight to reinvest in the farm or withdraw. A farm should strive for its long run average NFI/cwt to be greater than the average throughout the period of \$4.40.

NFI/cwt_i

$$=\frac{Sales_i - COGS_i - Operating \ Expenses_i - Depreciation_i - Interest_i - Taxes_i}{[Pounds \ of \ Milk \ Sold_i/100]}$$

As seen in figure 2.13, the average NFI/cwt varied greatly throughout the period, ranging from -\$0.21 in 2009 to \$8.71 in 2011.

			Standard			Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(\$/cwt)		
2001	4.53	3.52	5.94	45.89	(9.46)	4.42
2002	3.71	2.08	8.59	69.06	(6.41)	3.99
2003	3.29	2.80	4.96	36.79	(7.99)	3.06
2004	5.10	4.10	5.76	47.65	(2.41)	3.26
2005	4.48	4.11	4.66	26.60	(8.57)	3.99
2006	3.79	3.34	4.16	30.92	(7.16)	3.06
2007	7.11	6.04	7.37	44.53	(9.97)	4.99
2008	4.15	3.65	6.62	43.29	(13.98)	5.26
2009	(0.21)	(0.29)	5.11	23.53	(14.43)	4.00
2010	3.78	3.68	4.13	17.54	(8.26)	4.24
2011	8.71	5.88	9.09	50.14	(2.77)	5.03
2012	5.54	5.04	4.97	21.46	(6.20)	5.31

Table 2.10: Summary Statistics for NFI, All Dairy Farms, 2001-2012

Figure 2.13: Annual Distribution of NFI for All Dairy Farms, 2001-2012



Figure 2.14: Annual Distribution of NFI for All Dairy Farms with NFI -5 to 10, 2001-2012



NFI (\$/cwt)

Value of Crops $Grown_i = Acres Grown x$ Yield x Average Price for Michigan

Value of Crops Grown -Crops Sold -(Ending Inventory Crops & Feed – Beginning Inventory Crops & Feed) Value of Homegrown Feed

Value of Homegrown Feed/cwt_i =
$$\frac{Value \text{ of Homegrown Feed}_i}{[Pounds \text{ of Milk Sold}_i/100]}$$

Figure 2.18 shows the corn price between 2001 and 2012. As seen in figure 2.18, the corn

price increased throughout the period with a spike in 2008. The average value of homegrown

feed per farm followed a similar trend, as seen in table 2.11.

Table 2.11: Summary Statistics for Value of Homegrown Feed, All Dairy Farms,2001-2012

			Standard			Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(\$/cwt)		
2001	4.78	3.81	5.06	29.27	0.00	6.49
2002	3.16	2.78	3.48	16.22	0.00	5.03
2003	4.54	3.51	5.77	50.01	0.00	6.01
2004	7.22	5.60	7.11	70.41	0.00	4.77
2005	5.65	4.55	4.12	26.89	0.00	4.28
2006	5.75	4.57	5.15	28.35	0.00	4.13
2007	8.75	5.74	8.35	51.41	0.00	7.41
2008	12.33	9.66	10.95	74.74	1.41	9.23
2009	9.33	6.87	9.46	62.77	0.00	5.41
2010	8.25	5.47	9.61	75.56	0.00	6.05
2011	14.54	9.37	14.09	74.46	0.00	14.39
2012	12.05	9.32	10.25	78.93	0.14	8.06

Figure 2.15: Annual Distribution of Value of Homegrown Feed for All Dairy Farms, 2001-2012



Value of Homegrown Feed (\$/cwt)

Figure 2.16: Annual Distribution of Value of Homegrown Feed for All Dairy Farms with Value of Homegrown Feed<25, 2001-2012



Value of Homegrown Feed (\$/cwt)

Each farm in the study provided their purchased feed cost for the year.

$$Purchased Feed Cost/cwt_i = \frac{Purchased Feed Cost_i}{[Pounds of Milk Sold_i/100]}$$

The average purchased feed cost increased throughout the period as the price of feed increased. Comparing table 2.11 to table 2.12, on average the farms in the study grew more crops than they purchased. In earlier years, purchasing grain was optimal, but higher feed prices encouraged growing them on farm. This accounts for the faster and larger growth in mean value of homegrown feed (table 2.11) compared to the growth of purchased feed cost (table 2.12).

			Standard			Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(\$/cwt)		
2001	3.69	3.59	1.37	10.83	0.48	1.44
2002	3.35	3.23	1.25	10.73	0.00	1.44
2003	3.51	3.47	1.22	7.29	0.00	1.41
2004	4.36	4.23	1.35	9.30	1.31	1.65
2005	4.06	3.99	1.35	9.15	0.92	1.67
2006	3.74	3.73	1.29	11.04	0.66	1.36
2007	4.99	4.71	1.77	11.31	0.77	1.89
2008	5.56	5.43	1.82	9.95	1.28	2.62
2009	4.56	4.29	1.74	10.97	0.87	1.54
2010	4.72	4.53	1.74	8.89	0.55	2.14
2011	6.01	6.17	1.92	10.78	1.81	2.52
2012	6.14	6.08	2.09	12.11	1.26	2.63

Table 2.12: Summary Statistics for Purchased Feed Cost, All Dairy Farms, 2001-2012

Figure 2.17: Annual Distribution of Purchased Feed Cost for All Dairy Farms, 2001-2012



Purchased Feed Cost (\$/cwt)

Figure 2.18: Corn Price, 2001-2012



The labor cost used accounted for both paid and unpaid labor and management.

 $Labor \ Cost/cwt_i = \frac{Value \ of \ Unpaid \ Labor \ and \ Management_i + Hired \ Labor \ Expense_i}{[Pounds \ of \ Milk \ Sold_i/100]}$

The labor cost/cwt decreased slightly throughout the period. One explanation for this may be increased efficiency in labor use. If a farm is producing more pounds of milk using the same amount of labor, the labor cost per hundredweight will decrease.

			Standard			Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
_				(\$/cwt)		
2001	4.60	4.37	1.58	10.93	1.66	1.87
2002	4.76	4.38	1.60	11.47	2.29	1.92
2003	4.34	3.96	1.65	11.59	1.76	1.71
2004	4.42	4.04	1.66	12.98	1.53	1.39
2005	4.51	4.17	1.68	12.37	1.99	1.90
2006	4.21	3.93	1.70	12.73	1.63	1.76
2007	4.33	4.05	1.84	12.07	1.39	1.77
2008	4.20	3.84	1.86	12.57	1.18	2.28
2009	4.66	4.32	1.78	10.97	1.21	1.63
2010	3.65	3.54	1.22	7.56	1.50	1.57
2011	4.30	3.91	1.86	13.33	1.52	1.87
2012	3.91	3.55	1.96	13.05	1.41	1.66

Table 2.13: Summary Statistics for Labor Cost, All Dairy Farms, 2001-2012

Figure 2.19: Annual Distribution of Labor Cost for All Dairy Farms, 2001-2012



The plot graphs convey the movement of the mean and range of the data points for each variable throughout the twelve-year period. As seen in the graphs along with the tables of summary statistics for each variable, it would not be recommended to benchmark using only one year of data, as the variability for each performance measure is large and can change dramatically from year to year.
		Standard					
		Mean	Median	Deviation	Maximum	Minimum	
Herd Size	(cows)	224	160	257	4,467	10	
Milk Price	(\$/cwt)	15.83	15.57	2.80	24.44	10.13	
Total Owned	(aaraa)	121	200	490	2 600	0	
Crop Acres	(acres)	434	300	480	3,000	0	
Total Rented	(aaraa)	240	202	472	2 5 1 7	0	
Crop Acres	(acres)	340	203	423	5,517	0	
CR	(ratio)	6.36	2.21	16.77	211.59	0.02	
DTA	(%)	29.37	26.84	18.96	103.82	0.00	
ATO	(%)	30.29	28.73	12.51	73.98	(0.60)	
ROA	(%)	5.63	5.12	7.51	36.45	(20.82)	
OPMR	(%)	16.99	16.92	28.05	184.70	(153.02)	
NFI	(\$/cwt)	4.40	3.60	5.99	50.14	(14.43)	
Value of						~ /	
Homegrown	(\$/cwt)	7.49	5.29	8.47	78.93	0.00	
Feed							
Purchased	(¢ / +)	4 40	4 17	1 70	12 11	0.00	
Feed Cost	(\$/CWI)	4.42	4.1/	1./8	12.11	0.00	
Labor Cost	(\$/cwt)	4.36	4.04	1.72	13.33	1.39	

 Table 2.14:
 Summary Statistics for All Dairy Farms, 2001-2012

2.1.2 Dairy Farms with Five or more Years of Data

The herd size of the farms with five or more years of data ranged from less than 50 (with one farm only having 10 cows in 2007), to more than 1,500 (table 2.15). The average herd size increased from 189 cows in 2002 to 274 cows in 2012.

		v		/ /	•	,
			Standard			Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(cows)		
2001	189	150	173	1,544	41	133
2002	196	151	176	1,557	45	139
2003	202	150	184	1,543	45	156
2004	203	153	184	1,544	24	128
2005	211	166	187	1,613	24	144
2006	221	172	202	1,638	21	179
2007	233	177	217	1,611	10	172
2008	229	167	216	1,564	18	164
2009	243	185	229	1,558	18	172
2010	269	187	252	1,581	20	215
2011	263	185	239	1,550	40	228
2012	274	195	261	1596	40	196

 Table 2.15:
 Summary Statistics for Herd Size, Dairy Farms with 5+ years, 2001-2012

Figure 2.20: Annual Distribution of Herd Size for Dairy Farms with 5+ years, 2001-2012



The milk price received was extremely volatile throughout the period. In 2011 farms received on average \$20.72/cwt (table 2.16). Milk prices were lowest in 2002, 2003, and 2009.

		v	Standard	· · ·	· · · · · · · · · · · · · · · · · · ·	Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(\$/cwt)		
2001	15.21	15.24	0.72	17.66	13.12	0.84
2002	12.50	12.46	0.63	15.57	11.11	0.64
2003	12.63	12.57	0.71	15.01	10.88	0.72
2004	16.38	16.30	0.80	19.15	14.15	0.83
2005	15.62	15.50	0.72	18.67	14.39	0.84
2006	13.36	13.26	0.66	17.08	12.00	0.61
2007	19.15	19.17	1.29	22.65	12.89	1.02
2008	19.33	19.24	1.12	22.55	16.34	1.07
2009	13.13	13.06	0.81	16.90	11.28	0.95
2010	16.80	16.68	0.96	20.56	14.37	1.01
2011	20.60	20.42	0.97	24.44	17.36	0.94
2012	18.60	18.50	0.96	22.23	15.30	0.83

 Table 2.16:
 Summary Statistics for Milk Price, Dairy Farms with 5+ years, 2001-2012





Comparing table 2.17 to table 2.18, besides 2002, dairy farms with five or more years of data owned on average more crop acres than they rented.

			Standard			Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
_				(acres)		
2001	407	288	439	2,440	0	456
2002	371	300	340	2,440	0	304
2003	447	305	522	3,250	0	345
2004	442	313	501	3,250	0	332
2005	475	318	503	2,440	0	413
2006	490	361	487	2,402	0	396
2007	495	346	512	2,841	0	450
2008	507	340	524	2,841	0	475
2009	487	360	528	2,841	0	470
2010	514	355	487	2,402	0	452
2011	487	322	496	2,596	0	468
2012	510	390	524	3,181	0	477

Table 2.17: Summary Statistics for Total Owned Crop Acres, Dairy Farms with 5+years, 2001-2012

Figure 2.22: Annual Distribution of Total Owned Crop Acres for Dairy Farms with 5+ years, 2001-2012



Total Owned Crop Acres

			Standard			Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(acres)		
2001	260	141	377	2,467	0	359
2002	414	315	405	2,562	0	466
2003	314	228	329	1,745	0	361
2004	348	214	421	2,803	0	396
2005	405	250	503	3,517	0	474
2006	330	151	447	3,143	0	427
2007	340	194	430	2,523	0	458
2008	361	230	455	2,633	0	479
2009	398	309	497	2,660	0	588
2010	318	190	391	1,990	0	481
2011	299	184	345	1,608	0	492
2012	401	230	502	2,220	0	450

Table 2.18: Summary Statistics for Total Rented Crop Acres, Dairy Farms with 5+years, 2001-2012

Figure 2.23: Annual Distribution of Total Rented Acres for Dairy Farms with 5+ years, 2001-2012





The average CR throughout the period was greater than21 (table 2.19). On average, the farms in the sample were liquid; they had sufficient current assets to cover their current liabilities. The median was not always greater than 2, which is the standard for dairy farms. Median is a better measure of CR, as farms with a small value of liabilities will have a large CR. Every year from 2002 to 2012 there were farms with a CR less than 1. These farms were illiquid.

		v	Standard	v	U /	Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(ratio)		
2001	4.28	1.86	7.30	47.84	0.19	2.74
2002	5.66	1.64	12.20	68.75	0.23	2.93
2003	3.36	1.65	7.20	56.78	0.20	2.05
2004	5.20	1.90	11.29	90.26	0.31	2.88
2005	8.13	2.11	19.52	146.76	0.26	3.33
2006	8.25	2.16	23.28	184.42	0.36	3.67
2007	8.88	3.25	25.22	211.59	0.30	4.96
2008	7.43	2.86	17.60	130.43	0.39	3.64
2009	5.92	2.53	12.16	77.90	0.19	2.82
2010	5.59	2.91	11.31	85.27	0.24	4.01
2011	7.96	3.06	17.88	111.73	0.20	3.93
2012	10.58	3.24	26.86	158.26	0.47	3.94

 Table 2.19:
 Summary Statistics for CR, Dairy Farms with 5+ years, 2001-2012

Figure 2.24: Annual Distribution of CR for Dairy Farms with 5+ years, 2001-2012



DTA was constant throughout the period (figure 2.25), with the farms financing on

average 25 to 30% of their assets with debt (table 2.20).

		·	Standard	, v	v	Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(%)		
2001	31.18	28.11	19.35	80.44	0.00	23.37
2002	30.77	29.61	19.06	87.31	0.00	28.93
2003	31.20	29.48	18.84	77.22	0.00	31.97
2004	30.78	29.90	18.76	76.99	0.00	32.92
2005	27.74	26.64	18.08	77.56	0.00	25.95
2006	28.71	27.72	18.50	76.65	0.00	25.69
2007	25.93	25.10	17.12	75.95	0.00	26.10
2008	26.32	24.90	18.08	74.93	0.00	28.69
2009	30.06	27.26	19.26	81.81	0.00	27.63
2010	28.37	26.84	18.30	82.16	0.00	25.75
2011	26.46	24.62	16.96	64.19	0.00	23.54
2012	26.05	25.25	16.02	60.25	0.00	22.41

Table 2.20: Summary Statistics for DTA, Dairy Farms with 5+ years, 2001-2012





DTA (%)

		*	Standard	· •	•	Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(%)		
2001	32.95	30.93	12.97	73.98	10.97	18.17
2002	29.05	26.83	11.66	66.93	7.71	13.44
2003	29.67	28.09	12.48	65.67	10.46	17.44
2004	33.21	32.09	13.54	72.25	9.83	19.10
2005	31.91	30.56	12.48	72.43	8.42	14.93
2006	28.26	26.44	10.46	60.64	5.73	13.34
2007	34.52	32.82	12.49	70.98	7.41	14.67
2008	29.10	29.35	12.32	68.17	1.19	14.75
2009	21.20	20.92	8.34	39.73	(0.60)	9.47
2010	29.15	28.36	11.11	64.68	6.88	14.57
2011	32.69	30.97	11.22	71.96	10.16	14.59
2012	29.17	28.94	9.80	60.71	10.06	12.57

 Table 2.21: Summary Statistics for ATO, Dairy Farms with 5+ years, 2001-2012

Figure 2.26: Annual Distribution of ATO for Dairy Farms with 5+ years, 2001-2012



The average ROA for the farm with five or more years of data varied throughout the period. In 2007 the average ROA was 10.30, whereas in 2009 the average ROA was -0.84. The movement in ROA from year to year can be seen in figure 2.27. It shows the significant difference in ROA in good years and bad years for the dairy industry in Michigan.

		•	Standard	· •	• •	Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(%)		
2001	6.21	6.17	7.03	34.82	(15.41)	8.09
2002	3.35	1.83	7.43	33.09	(14.80)	7.91
2003	4.28	4.06	6.33	31.86	(13.77)	6.19
2004	7.19	6.84	6.22	29.20	(5.14)	7.75
2005	5.91	5.70	6.42	31.84	(11.39)	6.76
2006	4.75	4.16	5.49	23.13	(10.90)	6.09
2007	10.30	9.63	7.43	34.39	(8.55)	8.17
2008	5.01	4.59	7.88	35.44	(16.55)	7.46
2009	(0.84)	(0.60)	5.98	13.00	(20.12)	7.27
2010	5.65	5.32	4.78	15.77	(6.01)	6.22
2011	9.57	8.28	8.00	36.45	(17.98)	8.00
2012	6.51	6.62	6.58	29.84	(9.26)	8.10

Table 2.22: Summary Statistics for ROA, Dairy Farms with 5+ years, 2001-2012





Table 2.23 shows that in 2009, the farms in the sample had a negative average OPMR.

Looking at the figure 2.28, no farms had an OPMR above 50 in 2009.

		v	Standard	· · · ·	U /	Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
_				(%)		
2001	19.85	16.83	29.77	165.86	(71.89)	24.04
2002	9.78	7.71	26.25	100.94	(102.74)	23.14
2003	13.92	14.61	28.94	184.70	(82.23)	18.79
2004	19.54	20.00	16.74	105.36	(26.48)	18.91
2005	17.82	17.65	24.45	137.24	(70.21)	20.40
2006	16.41	14.95	23.90	145.87	(70.28)	20.69
2007	29.14	28.34	20.89	93.66	(40.44)	21.19
2008	16.43	17.18	25.79	87.04	104.24	25.19
2009	(4.36)	(2.05)	31.74	57.83	(144.55)	33.25
2010	18.52	20.08	16.93	62.41	(49.29)	18.94
2011	29.08	25.64	26.25	129.16	(79.18)	19.75
2012	21.98	21.47	24.60	74.58	(40.78)	27.14

 Table 2.23:
 Summary Statistics for OPMR, Dairy Farms with 5+ years, 2001-2012

OPMR (%)

		v	Standard	v	•	Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
_				(\$/cwt)		
2001	4.62	3.55	6.14	45.89	(9.46)	4.43
2002	2.99	2.21	3.84	15.95	(4.92)	3.81
2003	3.31	2.82	4.35	31.11	(7.99)	2.84
2004	5.25	4.25	6.18	47.65	(2.41)	3.23
2005	4.53	4.08	4.22	18.31	(5.75)	4.10
2006	3.72	3.35	4.28	30.92	(7.16)	2.89
2007	7.24	6.12	6.82	44.53	(9.86)	4.16
2008	3.85	3.53	6.36	43.29	(13.98)	4.73
2009	(0.72)	(0.29)	6.43	19.41	(14.43)	4.22
2010	3.87	3.79	3.88	17.24	(6.53)	4.07
2011	7.67	5.86	7.13	38.99	(2.77)	3.85
2012	5.48	5.02	5.19	21.46	(6.20)	5.44

 Table 2.24:
 Summary Statistics for NFI, Dairy Farms with 5+ years, 2001-2012

Figure 2.29: Annual Distribution of NFI for Dairy Farms with 5+ years, 2001-2012

Comparing table 2.25 to table 2.26, dairy farms with more than five years of data grew on average more feed than the purchased in every year in the dataset except for 2002. However, as seen in table 2.25 and 2.26 along with figure 2.30 and 2.31, the feed grown by each farm increased faster and higher than the purchased feed cost.

			Standard			Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(\$/cwt)		
2001	4.66	3.79	4.80	26.75	0.00	5.39
2002	2.85	2.72	3.10	12.79	0.00	4.68
2003	4.26	3.67	3.80	16.29	0.00	4.26
2004	7.63	5.68	7.49	70.41	0.00	5.42
2005	5.99	5.26	4.14	26.89	0.00	4.45
2006	5.90	4.78	4.75	28.35	0.00	3.70
2007	8.76	5.55	8.54	51.41	0.00	7.51
2008	13.02	10.76	11.50	74.74	1.41	8.72
2009	9.46	7.25	9.50	62.77	0.40	5.65
2010	8.54	5.59	9.81	75.56	0.00	6.06
2011	16.01	10.75	14.77	74.46	0.00	15.96
2012	12.37	9.48	10.43	78.93	2.25	8.53

Table 2.25: Summary Statistics for Value of Homegrown Feed, Dairy Farms with 5+years, 2001-2012

Figure 2.30: Annual Distribution of Value of Homegrown Feed for Dairy Farms with 5+ years, 2001-2012

Value of Homegrown Feed (\$/cwt)

			Standard			Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(\$/cwt)		
2001	3.58	3.58	1.01	6.56	1.67	1.17
2002	3.26	3.20	1.04	5.68	0.00	1.36
2003	3.58	3.56	1.18	7.76	0.16	1.27
2004	4.22	4.13	1.20	7.36	1.31	1.55
2005	4.04	4.08	1.27	8.27	0.92	1.70
2006	3.57	3.60	1.05	6.45	0.66	1.35
2007	4.86	4.71	1.54	8.66	0.77	1.86
2008	5.52	5.38	1.82	9.95	1.69	2.61
2009	4.54	4.32	1.59	10.92	0.87	1.65
2010	4.61	4.44	1.71	8.58	0.55	2.15
2011	5.95	6.17	1.77	9.63	1.90	2.49
2012	5.87	5.79	1.92	10.12	1.26	2.54

Table 2.26: Summary Statistics for Purchased Feed Cost, Dairy Farms with 5+ years,2001-2012

Purchased Feed Cost (\$/cwt)

			Standard			Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(\$/cwt)		
2001	4.41	4.09	1.32	10.93	2.37	1.68
2002	4.51	4.38	1.29	10.51	2.29	1.73
2003	4.25	3.97	1.51	11.59	1.76	1.68
2004	4.36	4.04	1.47	9.79	1.53	1.42
2005	4.57	4.17	1.80	12.37	1.99	1.91
2006	4.32	4.00	1.54	10.71	1.63	1.74
2007	4.24	4.08	1.62	9.81	1.39	1.69
2008	4.27	3.93	1.67	9.70	1.53	2.19
2009	4.60	4.32	1.51	10.92	1.70	1.70
2010	3.67	3.62	1.25	7.56	1.50	1.58
2011	4.33	3.91	1.70	10.18	1.52	2.23
2012	4.15	3.77	2.04	13.05	1.41	1.79

 Table 2.27: Summary Statistics for Labor Cost, Dairy Farms with 5+ years, 2001-2012

Figure 2.32: Annual Distribution of Labor Cost for Dairy Farms with 5+ years, 2001-2012

Comparing table 2.28 and table 2.14, the summary statistics for each variable showed a similar trend in both the dataset of all dairy farms and the sample of only those with five or more years of data.

· · · · · ·	•			Standard		
Year		Mean	Median	Deviation	Maximum	Minimum
Herd Size	(cows)	224	166	209	1,638	10
Milk Price	(\$/cwt)	16.00	15.77	2.83	24.44	10.88
Total Owned Crop Acres	(acres)	467	323	488	3,250	0
Total Rented Crop Acres	(acres)	349	214	431	3,517	0
CR	(ratio)	6.66	2.35	17.07	211.59	0.19
DTA	(%)	28.60	26.53	18.23	87.31	0.00
ATO	(%)	30.29	28.94	12.18	73.98	(0.60)
ROA	(%)	5.78	5.51	7.19	36.45	(20.12)
OPMR	(%)	17.65	17.60	26.19	184.70	(144.55)
NFI	(\$/cwt)	4.47	3.74	5.89	50.14	(14.43)
Value of Homegrown Feed	(\$/cwt)	7.94	5.53	8.82	78.93	0.00
Purchased Feed Cost	(\$/cwt)	4.38	4.16	1.66	10.92	0.00
Labor Cost	(\$/cwt)	4.33	4.05	1.63	13.33	1.39

Table 2.28: Summary Statistics for Dairy Farms with 5+ years, 2001-2012

2.1.3 Dairy Farm Summary Statistics

Although the sample size for the panel data was small, the mean and standard deviation for each variable are generally consistent with the dataset consisting of all dairy farms. However, this is not true for the 2001-2007 panel and the 10-year panel for CR. The CR for both panels is much lower on average and has a standard deviation of roughly half that of the dataset with all farms. The standard deviation for ROA is slightly lower for the panels. The mean value of homegrown feed and purchased feed cost were much lower for the 2001-2007 panel and higher for the 2006-2012 panel compared to the mean for both variables for the dataset with all farms. This can be mainly attributed to the increase in feed values from 2001 to 2012.

	J			_	_	
		All		7-year	7-year	
		farms	Farms	panel	panel	
		2001-	with 5+	2001-	2006-	10-year
Year		2012	years	2007	2012	panel
			Me	an		
			(Standard I	Deviation)		
CP	(ratio)	6.36	6.66	3.83*	6.09	4.49*
CK	(18110)	(16.77)	(17.07)	(6.84)	(15.70)	(8.19)
	(0/)	29.37	28.60	28.89	26.98*	27.75*
DIA	(70)	(18.96)	(18.23)	(17.92)	(16.22)	$\begin{array}{c} \text{ar} \\ \text{el} \\ 5- & 10\text{-year} \\ \underline{2} & \text{panel} \\ \hline \\ 2 & \text{panel} \\ \hline \\ 2 & \text{panel} \\ \hline \\ 2 & \text{panel} \\ \hline \\ 3 & \text{c} \\ 3$
4 TO	(0/)	30.29	30.29	32.77*	28.71*	30.59
AIO	(%)	(12.51)	(12.18)	(11.74)	(10.21)	(10.44)
ROA	(%)	5.63	5.78	6.13	5.45	5.58
KUA	(70)	(7.51)	(7.19)	(6.59)	(6.62)	10-year panel 4.49* (8.19) 27.75* (16.29) 30.59 (10.44) 5.58 (6.99) 16.61 (23.34) 3.97 (5.11) 7.31 (8.39) 4.50 (1.62) 4.05* (1.17)
ODMD	(0/)	16.99	17.65	17.47	18.01	16.61
OFWIK	(70)	(28.05)	(26.19)	(22.03)	(24.44)	(23.34)
NEI	(C/ourt)	4.40	4.47	4.25	4.19	3.97
INF1	(ratio) (%) (%) (%) (%) (\$/cwt) (\$/cwt) (\$/cwt) (\$/cwt)	(5.99)	(5.89)	(4.32)	(5.28)	(5.11)
Value of Homogroup Food	(C/ourt)	7.49	7.94	5.35*	10.44*	7.31
value of Homegrown Feed	(\$/CWI)	(8.47)	(8.82)	(5.33)	(9.33)	10-year panel 4.49* (8.19) 27.75* (16.29) 30.59 (10.44) 5.58 (6.99) 16.61 (23.34) 3.97 (5.11) 7.31 (8.39) 4.50 (1.62) 4.05* (1.17)
Durchaged Feed Cest	(C/arret)	4.42	4.38	3.85*	4.98*	4.50
ruicilased reed Cost	(\$/CWL)	(1.78)	(1.66)	(1.27)	(1.80)	(1.62)
Labor Cost	(\$/cwt)	4.36	4.33	4.30	4.06*	4.05*
	-	(1.72)	(1.63)	(1.28)	(1.35)	(1.17)

Table 2.29:	Dairy Farm	Summary	Statistics
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*=Significantly different from the dataset with All Farms at the 5% level

2.2 Crop Farm Data

The data for the crop farms was obtained from Michigan State University Crop Farm Business Analysis. A crop farm was defined as any farm that received more than 50% of its revenue from crop sales. There were records for 242 crop farms between 2002 and 2012. There were 72 farms that had five or more years of data.

Three different groups of the data were used throughout the analysis. The first group consisted of all 242-crop farms with records in one or more years during the period 2002-2012. The second group consisted of only the 72 crop farms with five or more years of records between

2002 and 2012. The third group consisted of a panel of 22 farms with ten years of continuous data between 2008 and 2012.

2.2.1 All Crop Farms

Through 2005, the crop farms in the dataset owned on average significantly less acres than they rented. The average number of acres owned versus acres rented has moved inversely of one another over the period (table 2.30 and table 2.31). The number of crop acres rented has decreased dramatically, while the number of owned acres has increased slightly. Table 2.34 and figure 2.40 show that ATO remained relatively stable over the period, although the variability between crop farms was large. Figure 2.42 and table 2.36 show that OPMR moved around often and had a large standard deviation and variance. The average DTA ratio decreased between 2002 and 2012 (table 2.33) while the CR increased (table 2.32). Thus, many of the crop farms in the dataset improved their solvency and liquidity over the past eleven years.

Table 2.50. Summary Statistics for Total Owned Crop Acres, An Crop Parins, 2002-2012									
			Standard			Interquartile			
Year	Mean	Median	Deviation	Maximum	Minimum	Range			
				(acres)					
2002	354	247	341	1,669	0	295			
2003	308	232	301	1,740	0	340			
2004	375	254	458	2,682	0	355			
2005	442	317	512	2,902	0	326			
2006	512	320	709	4,489	0	401			
2007	413	236	596	3,100	0	359			
2008	413	250	609	3,165	0	469			
2009	460	263	621	3,321	0	442			
2010	478	326	572	3,470	0	424			
2011	477	333	592	3,410	0	412			
2012	424	300	442	2,250	0	378			

Table 2 30: Summary Statistics for Total Owned Cron Acres All Cron Farms 2002-2012

Figure 2.33: Annual Distribution of Total Owned Crop Acres for All Crop Farms, 2002-2012

Figure 2.34: Annual Distribution of Total Owned Crop Acres for All Crop Farms with <1,000 Acres, 2002-2012

Total Owned Crop Acres

			Standard			Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(acres)		
2002	823	456	1,138	6,354	0	826
2003	760	491	1,067	6,354	0	857
2004	747	420	1,020	5,837	0	753
2005	703	342	979	5,389	0	838
2006	512	300	659	3,445	0	664
2007	586	300	709	3,445	0	707
2008	576	430	617	2,474	0	693
2009	442	138	568	2,488	0	699
2010	481	245	570	2,526	0	788
2011	452	190	605	2,995	0	635
2012	524	314	622	2,700	0	837

 Table 2.31:
 Summary Statistics for Total Rented Acres, All Crop Farms, 2002-2012

Figure 2.35: Annual Distribution of Total Rented Crop Acres for All Crop Farms, 2002-2012

Figure 2.36: Annual Distribution of Total Rented Crop Acres for All Crop Farms with <1,500 Acres, 2002-2012

Total Rented Crop Acres

			Standard			Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(ratio)		
2002	2.93	1.59	4.01	20.93	0.02	2.61
2003	2.94	1.27	5.70	39.97	0.00	1.60
2004	3.68	1.41	7.13	48.33	0.00	2.18
2005	5.76	1.96	15.18	105.72	0.15	2.67
2006	5.08	1.77	8.22	49.59	0.04	3.67
2007	5.58	1.99	8.81	56.39	0.04	4.02
2008	5.96	2.62	8.21	39.64	0.19	4.99
2009	8.86	2.28	15.29	99.99	0.01	7.97
2010	7.08	2.68	11.92	82.45	0.02	4.69
2011	10.22	4.12	15.59	96.29	0.05	9.65
2012	10.43	3.99	17.79	110.16	0.11	8.41

 Table 2.32:
 Summary Statistics for CR, All Crop Farms, 2002-2012

Figure 2.37: Annual Distribution of CR for All Crop Farms, 2002-2012

CR

			Standard			Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(%)		
2002	30.65	27.88	22.25	97.87	0.00	32.42
2003	34.14	29.84	26.08	114.84	0.00	37.36
2004	31.04	25.44	24.92	109.38	0.00	34.55
2005	28.26	21.88	24.39	104.85	0.00	36.00
2006	25.95	23.03	20.42	84.57	0.00	31.21
2007	24.49	21.87	20.31	84.98	0.00	29.32
2008	27.80	24.00	23.04	96.32	0.00	33.03
2009	23.32	16.35	22.46	98.16	0.00	31.55
2010	25.03	22.10	20.18	80.72	0.00	30.96
2011	22.68	21.25	17.57	81.55	0.00	25.58
2012	22.50	20.20	17.19	68.83	0.00	25.33

 Table 2.33:
 Summary Statistics for DTA, All Crop Farms, 2002-2012

Table 2.34: Summary Statistics for ATO, All Crop Farms, 2002-2012

			Standard			Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(%)		
2002	29.21	21.49	29.69	193.88	(0.38)	23.05
2003	29.76	20.36	28.61	165.73	0.63	24.98
2004	30.77	23.19	30.60	189.37	0.40	20.65
2005	28.85	25.85	21.40	110.72	2.50	22.41
2006	32.20	24.09	28.81	162.68	4.80	26.31
2007	33.49	25.18	30.89	175.26	2.18	28.08
2008	36.60	28.66	33.18	164.38	0.72	23.68
2009	25.84	19.86	22.05	116.79	(0.34)	23.86
2010	30.29	27.27	23.30	109.22	(0.93)	23.95
2011	30.61	28.06	19.77	105.09	1.93	21.56
2012	29.78	26.99	18.17	103.89	1.56	23.03

Figure 2.40: Annual Distribution of ATO for All Crop Farms, 2002-2012

		•	Standard			Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(%)		
2002	2.49	2.57	9.69	46.06	(23.03)	7.79
2003	2.45	2.24	7.29	30.34	(27.21)	6.00
2004	3.81	2.79	8.05	29.11	(15.96)	8.48
2005	5.05	3.67	5.98	22.78	(7.20)	7.08
2006	7.75	5.42	10.18	42.63	(12.84)	9.27
2007	8.44	6.55	9.64	31.68	(23.24)	11.00
2008	6.57	5.60	8.14	45.14	(10.37)	8.72
2009	3.48	2.60	7.63	38.16	(11.68)	7.73
2010	7.37	7.05	11.40	44.18	(29.45)	10.41
2011	7.91	7.72	8.35	34.90	(22.67)	8.99
2012	8.93	8.07	7.71	37.72	(9.35)	9.53

Table 2.35: Summary Statistics for ROA, All Crop Farms, 2002-2012

ROA (%)

Year	Mean	Median	Standard Deviation	Maximum	Minimum	Interquartile Range
				(%)		
2002	11.90	8.91	48.61	226.03	(102.88)	40.71
2003	11.65	9.55	42.08	197.36	(171.98)	30.39
2004	10.85	10.30	41.20	207.87	(191.43)	34.46
2005	21.84	15.78	38.19	148.22	(103.04)	27.21
2006	25.19	20.61	39.54	144.06	(106.85)	25.70
2007	28.03	25.79	47.79	155.14	(227.95)	30.91
2008	17.76	20.99	39.32	178.98	(120.08)	23.48
2009	9.74	15.06	40.78	102.55	(175.10)	29.66
2010	19.72	25.91	52.68	152.93	(224.57)	24.57
2011	23.43	29.05	33.49	93.53	(208.03)	21.04
2012	31.95	29.34	30.64	151.04	(43.23)	25.54

Table 2.36: Summary Statistics for OPMR, All Crop Farms, 2002-2012

Figure 2.42: Annual Distribution of OPMR for All Crop Farms, 2002-2012

Figure 2.43: Annual Distribution of OPMR for All Crop Farms, with OPMR -22 to 65, 2002-2012

		*	Standard			Interquartile
Year	Mean	Median	Deviation	Maximum	Minimum	Range
				(\$/acre operated	d)	
2002	92.26	52.88	191.08	962.18	(312.42)	141.11
2003	77.59	54.07	146.38	1,021.31	(210.71)	101.07
2004	78.24	69.10	135.13	756.26	(220.00)	123.61
2005	121.35	72.23	149.54	653.59	(172.50)	138.50
2006	168.44	116.97	217.34	1,117.12	(280.91)	160.51
2007	219.89	185.62	222.54	845.91	(425.90)	219.66
2008	138.56	139.65	143.29	424.65	(199.17)	175.54
2009	94.90	89.04	230.49	1,419.34	(421.91)	174.17
2010	192.44	196.76	203.47	719.11	(365.25)	218.69
2011	247.78	236.89	219.86	858.38	(464.75)	240.69
2012	327.09	264.44	285.78	1,284.90	(204.39)	270.78

Table 2.37: Summary Statistics for NFI, All Crop Farms, 2002-2012

NFI (\$/acre operated)

1 abic 2.50. Summaly statistics for All Crup Farms, $2002-2$	Table 2.38:	2.38: Summar	v Statistics	for All	Crop	Farms.	2002-	·201
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				Standard		
Year		Mean	Median	Deviation	Maximum	Minimum
Total						
Owned	(acres)	423	275	533	4,489	0
Crop Acres						
Total						
Rented	(acres)	595	329	805	6,354	0
Crop Acres						
CR	(ratio)	6.31	2.09	11.91	110.16	0.00
DTA	(%)	26.81	22.74	21.99	114.84	0.00
ATO	(%)	30.70	25.05	26.21	193.88	0.38
ROA	(%)	5.86	5.11	8.99	46.06	(29.45)
OPMR	(%)	19.27	19.64	42.20	226.03	(227.95)
NFI	(\$/acre)	161.43	124.10	216.58	1,419.34	(464.75)

2.2.2 Crop Farm Summary Statistics

Table 2.39 shows that some of the variables in the data set of crop farms with five or more years of data and the five-year panel of crop farms from 2008-2012 are significantly different than the data from farms across all years. This is due to the years represented in the samples along with a low number of farms.

Table 2.57. Crop Farm Summary Statistics						
Year		All farms 2002-2012	Farms with 5+ years	5 year panel 2008-2012		
			Mean			
		(6	Ivicali ton dond Dorvicti	(m. 1)		
		(2	standard Deviat	lon)		
Total Owned	(noros)	423	489*	430		
Crop Acres	(acres)	(533)	(599)	(537)		
Total Rented	(a area)	595	554	694		
Crop Acres	(acres)	(805)	(655)	(610)		
CD	(rotio)	6.30	6.82	4.64		
CK	(lallo)	(11.91)	(11.64)	(8.20)		
	(0/)	26.81	23.25*	32.58*		
DIA	(70)	(21.99)	(18.73)	(19.77)		
ATO	(0/)	30.70	28.00*	33.45		
AIO	(%)	(26.21)	(20.04)	(20.48)		
DOA	(0/)	5.86	6.10	7.80*		
KUA	(%)	(8.99)	(8.10)	(6.70)		
ODMD	(0/)	19.27	21.84	22.72		
Urivik	(70)	(42.20)	(40.04)	(20.38)		
NEI	(\$/acre	155.31	172.61	198.49		
ΙΝΓΙ	operated)	(252.83)	(262.06)	(426.58)		

	Table 2.39:	Crop Fari	n Summary	^v Statistics
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*=Significantly different from the dataset with All Farms at the 5% level

Chapter 3-Methods and Results

This chapter explains the relative stability of the financial ratios across farms and over time. The difference in the top and bottom thirds over time is tested to see the importance of a farm's ranking relative to other similar farms. The industry effect for a given year is estimated using regression analysis. The impact of long-term data versus using data for only one year is explored. Also considered is the number of years required to have some assurances that a farm is ranked correctly.

3.1 Model 1: Stability Across Farms

Langemeier (2010) conducted a study on farms in the Kansas Farm Management Association between 2004 and 2008 to determine whether a farm was consistently ranked in the top or bottom quartile for OPMR and ATO. The farms were not split into crop farms and livestock farms. The stated goal was to determine whether performance differences were due to external factors, such as weather, or internal factors, such as managerial ability. The results showed that Kansas farms did not rank in the same quartile for OPMR or ATO consistently throughout the five-year period. However, when a farm's five-year average for each measure was used, there was a significant difference between the characteristics of farms in the top and bottom quartiles. Langemeier concluded that not ranking consistently in the top quartile was due to external factors, but that there was still a need for benchmarking as the difference between the characteristics of farms in the top and bottom quartiles for both OPMR and ATO was significant. Langemeier said this suggested that there was the potential for a farm to have a competitive advantage over time due to internal factors. He also concluded that it is important to use more than one year of data to benchmark farm financial performance. This study first follows the Langemeier (2010) study in order to ascertain whether or not farms tended to consistently be classified in the top or bottom third for a given measure. It was not possible to determine whether performance differences were due to external or internal factors using this method because industry effects were not accounted for. The results of this study reveal the emphasis that a farm should place on their performance relative to other similar operations in the short-term and long-term. If there is a propensity for individual farms to rank consistently in the top or bottom third for a given financial measure, then a farm manager should make decisions based on where they rank relative to other farms. If farms do not rank in the top or bottom third consistently, it is then necessary to understand if over time there is a significant difference in the characteristics of farms in the top and bottom third. If there is, then by using a long-run average when obtaining their relative ranking, a farm will be more able to determine their actual strengths and weaknesses and use these to form a management strategy for the future.

The dairy farm data were split into eight balanced panels, 2001-2005 (n=76), 2002-2006(n=70), 2003-2007(n=73), 2004-2008(n=72), 2005-2009(n=71), 2006-2010(n=62), 2007-2011(n=61), and 2008-2012 (n=55). The crop farm data was split into seven balanced panels, 2002-2006 (n=22), 2003-2007 (n=30), 2004-2008 (n=20), 2005-2009 (n=17), 2006-2010 (n=21), 2007-2011(n=19), and 2008-2012 (n=22). Each panel consisted only of farms that had records for every year during the five-year period.

3.1.1 Step One

For each panel the data were split into individual years. Then, for the dairy farms, thirds were calculated each year for nine financial performance measures: current ratio (CR), debt-to-asset ratio (DTA), asset turnover rate (ATO), rate of return on assets (ROA), operating profit margin ratio (OPMR), NFI (\$/cwt), value of homegrown feed (\$/cwt), purchased feed cost

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(\$/cwt), and labor cost (\$/cwt). For the crop farms, thirds were calculated for six measures: CR, DTA, ATO, ROA, OPMR and NFI (\$/acre operated). The number of years each individual farm was in the top third for each measure was recorded. The number of years they ranked in the bottom third was also counted. Then, the number of farms that had ranked in the top third all five years for a specific measure was counted.

 $T_{f,y}$ = Number of farms ranked in the top third, f=financial measure, y=number of times in the top third (y=0, 1, 2, 3, 4, or 5).

 $B_{f,y}$ = Number of years ranked in the bottom third

This number was divided by the total number of farms in the panel to obtain the percentage of farms that had ranked in the top third for all five years for the financial measure.

- $\frac{T_{f,y}}{N} = \%$ of farms that ranked in the top third y times over the period
- $\frac{B_{f,y}}{N} = \%$ of farms that ranked in the bottom third y times over the period

This process was then repeated to see what percent of farms ranked in the top third zero, one, two, three, four, or five years for each financial measure. The same method was used to analyze the farms in the bottom third.

The percent of farms that ranked in the top or bottom zero, one, two, three, four, or five during the period was recorded and can be seen in tables 3.1 - 3.30.

Dairy Farm Results

Tables 3.1 - 3.16 revealed that farms were able to rank in the same third the most consistently for CR, DTA and ATO. More than 9% of dairy farms were ranked in the top third and more than 11% were ranked in the bottom third for CR, DTA and ATO in every five-year panel. This is likely because DTA and ATO are asset driven and therefore more stable. More

than 42% of the farms were never ranked in the bottom for CR, DTA, and ATO. This indicates that producers can make informed management decisions if they rank in the top bottom third for CR, DTA, or ATO for even one year, as this is a stable ranking. Although, it may be difficult to adjust these measures in the short-term as they are asset driven. Farms ranked in the same third least consistently for ROA, OPMR, and NFI. More than 10% of farms ranked in the top third for only one year and more than 17% in the bottom third for only one year. Less than 40% of the dairy farms were never ranked in the bottom for ROA, OPMR, and NFI. Ranking in the top or bottom third for one year for ROA, OPMR, or NFI was not a clear signal for managerial decision-making.

These findings were similar to Langemeier (2010) in that it was easier to be ranked in the top third consistently for ATO than in the top OPMR quartile. The results indicate that farms often moved thirds from year to year. That is, their relative rankings were unstable.

Table 3.1: Dairy Farms in the Top Third of Each Measure, 2001-2005							
	5 years	4 years	3 years	2 years	1 year	0 years	
			(%)			
CR	14.47	9.21	5.26	11.84	15.79	43.42	
DTA	21.05	6.58	5.26	5.26	6.58	55.26	
ATO	15.79	13.16	6.58	1.32	10.53	52.63	
ROA	1.32	14.47	13.16	15.79	28.95	26.32	
OPMR	0.00	14.47	15.79	19.74	19.74	30.26	
NFI	2.63	13.16	9.21	25.00	21.05	28.95	
Value of							
Homegrown Feed	3.95	3.95	26.32	15.79	18.42	31.58	
Purchased Feed							
Cost	13.16	9.21	5.26	14.47	17.11	40.79	
Labor Cost	14.47	10.53	3.95	10.53	17.11	43.42	

Table 3.2: Dairy Farms in the Bottom Third of Each Measure, 2001-2005								
	5 years	4 years	3 years	2 years	1 year	0 years		
			("	%)				
CR	13.16	5.26	10.53	17.11	11.84	42.11		
DTA	23.68	3.95	3.95	5.26	7.89	55.26		
ATO	18.42	5.26	9.21	7.89	7.89	51.32		
ROA	1.32	7.89	17.11	23.68	27.63	22.37		
OPMR	1.32	11.84	17.11	19.74	19.74	30.26		
NFI	7.89	10.53	6.58	21.05	21.05	32.89		
Value of								
Homegrown Feed	3.95	6.58	11.84	27.63	27.63	22.37		
Purchased Feed								
Cost	13.16	6.58	11.84	7.89	21.05	39.47		
Labor Cost	14.47	7.89	10.53	9.21	10.53	47.37		

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¥	5 years	4 years	3 years	2 years	1 year	0 years
			("	%)		
CR	14.29	12.86	5.71	5.71	12.86	48.57
DTA	20.00	8.57	4.29	5.71	5.71	55.71
ATO	18.57	5.71	7.14	10.00	7.14	51.43
ROA	2.86	7.14	17.14	18.57	32.86	21.43
OPMR	2.86	10.00	20.00	11.43	27.14	28.57
NFI	2.86	10.00	14.29	25.71	15.71	31.43
Value of						
Homegrown Feed	4.29	8.57	18.57	15.71	21.43	31.43
Purchased Feed						
Cost	11.43	12.86	8.57	7.14	15.71	44.29
Labor Cost	20.00	4.29	4.29	10.00	14.29	47.14

	5 vears	Avears	3 vears	2 vears	1 vear	0 vears
	J years	4 years	5 years		i ycai	0 years
			()	%)		
CR	11.43	10.00	10.00	14.29	8.57	45.71
DTA	21.43	5.71	4.29	7.14	7.14	54.29
ATO	12.86	14.29	8.57	4.29	8.57	51.43
ROA	0.00	8.57	20.00	20.00	30.00	21.43
OPMR	2.86	8.57	17.14	18.57	27.14	25.71
NFI	4.29	11.43	10.00	18.57	30.00	25.71
Value of						
Homegrown Feed	5.71	8.57	8.57	20.00	35.71	21.43
Purchased Feed						
Cost	12.86	5.71	11.43	11.43	20.00	38.57
Labor Cost	15.71	7.14	10.00	7.14	12.86	47.14

Table 3.4: Dai	v Farms in	the Bottom	Third of Each	Measure.	2002-2006
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Table 3.5: Dairy Farms in the Top Third of Each Measure, 2003-2007								
	5 years	4 years	3 years	2 years	1 year	0 years		
			(%)				
CR	15.07	12.33	6.85	2.74	13.70	49.32		
DTA	23.29	5.48	2.74	5.48	6.85	56.16		
ATO	15.07	8.22	9.59	9.59	8.22	49.32		
ROA	5.48	9.59	8.22	27.40	19.18	30.14		
OPMR	4.11	10.96	12.33	19.18	24.66	28.77		
NFI	4.11	10.96	13.70	20.55	17.81	32.88		
Value of								
Homegrown Feed	5.48	20.55	5.48	10.96	16.44	41.10		
Purchased Feed								
Cost	15.07	5.48	10.96	8.22	17.81	42.47		
Labor Cost	16.44	10.96	4.11	8.22	9.59	50.68		

Table 3.6: Dairy Farms in the Bottom Third of Each Measure, 2003-2007								
	5 years	4 years	3 years	2 years	1 year	0 years		
			("	%)				
CR	17.81	5.48	8.22	9.59	9.59	49.32		
DTA	20.55	6.85	5.48	4.11	9.59	53.42		
ATO	16.44	9.59	5.48	8.22	10.96	49.32		
ROA	1.37	9.59	17.81	17.81	30.14	23.29		
OPMR	5.48	6.85	13.70	17.81	32.88	23.29		
NFI	4.11	8.22	17.81	13.70	30.14	26.03		
Value of								
Homegrown Feed	5.48	15.07	10.96	5.48	32.88	30.14		
Purchased Feed								
Cost	13.70	6.85	6.85	13.70	20.55	38.36		
Labor Cost	15.07	9.59	5.48	8.22	17.81	43.84		

Table 3.7: Dairy Farms in the Top Third of Each Measure, 2004-2008								
	5 years	4 years	3 years	2 years	1 year	0 years		
			("	%)				
CR	11.11	15.28	6.94	8.33	12.50	45.83		
DTA	25.00	5.56	1.39	4.17	6.94	56.94		
ATO	16.67	5.56	8.33	9.72	16.67	43.06		
ROA	4.17	12.50	6.94	23.61	27.78	25.00		
OPMR	1.39	15.28	12.50	13.89	33.33	23.61		
NFI	2.78	9.72	15.28	27.78	12.50	31.94		
Value of								
Homegrown Feed	18.06	4.17	6.94	12.50	13.89	44.44		
Purchased Feed								
Cost	13.89	6.94	5.56	18.06	16.67	38.89		
Labor Cost	15.28	5.56	8.33	16.67	9.72	44.44		

Table 3.8: Dairy Farms in the Bottom Third of Each Measure, 2004-2008

	5 years	4 years	3 years	2 years	1 year	0 years				
		(%)								
CR	19.44	6.94	2.78	11.11	11.11	48.61				
DTA	25.00	2.78	4.17	5.56	6.94	55.56				
ATO	20.83	6.94	4.17	6.94	8.33	52.78				
ROA	4.17	5.56	13.89	22.22	37.50	16.67				
OPMR	4.17	6.94	16.67	15.28	37.50	19.44				
NFI	6.94	9.72	12.50	12.50	30.56	27.78				
Value of										
Homegrown Feed	12.50	12.50	8.33	5.56	18.06	43.06				
Purchased Feed										
Cost	15.28	6.94	2.78	18.06	18.06	38.89				
Labor Cost	16.67	8.33	4.17	8.33	20.83	41.67				

Table 3.9: Dairy Farms in the Top Third of Each Measure, 2005-2009								
	5 years	4 years	3 years	2 years	1 year	0 years		
			(%)				
CR	9.86	12.68	12.68	9.86	11.27	43.66		
DTA	22.54	7.04	2.82	7.04	5.63	54.93		
ATO	19.72	2.82	7.04	11.27	15.49	43.66		
ROA	4.23	11.27	12.68	16.90	30.99	23.94		
OPMR	1.41	11.27	15.49	23.94	22.54	25.35		
NFI	4.23	7.04	15.49	26.76	19.72	26.76		
Value of								
Homegrown Feed	9.86	12.68	12.68	9.86	11.27	43.66		
Purchased Feed								
Cost	7.04	18.31	4.23	12.68	22.54	35.21		
Labor Cost	7.04	15.49	8.45	11.27	23.94	33.80		

Table 3.10: Dairy Farms in the Bottom Third of Each Measure, 2005-2009

	5 years	4 years	3 years	2 years	1 year	0 years
			("	%)		
CR	15.49	11.27	8.45	4.23	12.68	47.89
DTA	25.35	1.41	4.23	7.04	9.86	52.11
ATO	16.90	11.27	7.04	5.63	7.04	52.11
ROA	4.23	5.63	12.68	26.76	33.80	16.90
OPMR	1.41	14.08	11.27	16.90	38.03	18.31
NFI	2.82	11.27	14.08	19.72	28.17	23.94
Value of						
Homegrown Feed	15.49	11.27	2.82	9.86	18.31	42.25
Purchased Feed						
Cost	12.68	5.63	9.86	15.49	22.54	33.80
Labor Cost	5.63	18.31	8.45	11.27	19.72	36.62

Table 3.11: Dairy Farms in the Top Third of Each Measure, 2006-2010

	5 years	4 years	3 years	2 years	1 year	0 years			
		(%)							
CR	9.21	6.58	11.84	13.16	3.95	55.26			
DTA	18.42	5.26	3.95	2.63	7.89	61.84			
ATO	14.47	2.63	6.58	13.16	9.21	53.95			
ROA	3.95	7.89	7.89	18.42	26.32	35.53			
OPMR	3.95	7.89	14.47	11.84	19.74	42.11			
NFI	2.63	7.89	14.47	15.79	18.42	40.79			
Value of									
Homegrown Feed	9.21	11.84	3.95	11.84	9.21	53.95			
Purchased Feed									
Cost	5.26	15.79	3.95	10.53	15.79	48.68			
Labor Cost	5.26	11.84	5.26	13.16	22.37	42.11			

Table 3.12: Dairy Farms in the Bottom Third of Each Measure, 2006-2010								
	5 years	4 years	3 years	2 years	1 year	0 years		
			(*	%)				
CR	13.16	10.53	2.63	9.21	3.95	60.53		
DTA	18.42	5.26	3.95	2.63	7.89	61.84		
ATO	13.16	6.58	7.89	7.89	6.58	57.89		
ROA	1.32	10.53	9.21	22.37	17.11	39.47		
OPMR	2.63	9.21	9.21	19.74	21.05	38.16		
NFI	0.00	13.16	9.21	19.74	18.42	39.47		
Value of								
Homegrown Feed	9.21	13.16	3.95	5.26	17.11	51.32		
Purchased Feed								
Cost	11.84	6.58	6.58	11.84	9.21	53.95		
Labor Cost	5.26	10.53	11.84	9.21	15.79	47.37		

 Table 3.13: Dairy Farms in the Top Third of Each Measure, 2007-2011

					,	
	5 years	4 years	3 years	2 years	1 year	0 years
			()	%)		
CR	9.84	8.20	13.11	14.75	13.11	40.98
DTA	21.31	3.28	6.56	6.56	11.48	50.82
ATO	13.11	6.56	11.48	11.48	14.75	42.62
ROA	0.00	11.48	11.48	26.23	31.15	19.67
OPMR	0.00	14.75	13.11	19.67	26.23	26.23
NFI	3.28	9.84	18.03	14.75	24.59	29.51
Value of						
Homegrown Feed	9.84	11.48	9.84	14.75	9.84	44.26
Purchased Feed						
Cost	9.84	8.20	9.84	14.75	22.95	34.43
Labor Cost	8.20	11.48	11.48	11.48	19.67	37.70

 Table 3.14: Dairy Farms in the Bottom Third of Each Measure, 2007-2011

Table 5.14. Daily Farms in the Bottom Third of Each Measure, 2007-2011								
	5 years	4 years	3 years	2 years	1 year	0 years		
			(%)				
CR	13.11	11.48	9.84	6.56	9.84	49.18		
DTA	22.95	4.92	4.92	4.92	4.92	57.38		
ATO	13.11	11.48	6.56	13.11	6.56	49.18		
ROA	1.64	9.84	13.11	22.95	31.15	21.31		
OPMR	3.28	8.20	16.39	18.03	29.51	24.59		
NFI	1.64	9.84	16.39	18.03	31.15	22.95		
Value of								
Homegrown Feed	14.75	4.92	8.20	11.48	22.95	37.70		
Purchased Feed								
Cost	14.75	4.92	11.48	9.84	16.39	42.62		
Labor Cost	6.56	11.48	11.48	13.11	24.59	32.79		

Table 3.15: Dairy Farms in the Top Third of Each Measure, 2008-2012										
	5 years	4 years	3 years	2 years	1 year	0 years				
		(%)								
CR	10.91	14.55	5.45	10.91	12.73	45.45				
DTA	20.00	7.27	1.82	9.09	10.91	50.91				
ATO	12.73	9.09	7.27	14.55	12.73	43.64				
ROA	0.00	9.09	18.18	23.64	25.45	23.64				
OPMR	1.82	9.09	12.73	32.73	14.55	29.09				
NFI	1.82	12.73	16.36	21.82	10.91	36.36				
Value of										
Homegrown Feed	9.09	14.55	7.27	12.73	12.73	43.64				
Purchased Feed										
Cost	9.09	7.27	12.73	16.36	18.18	36.36				
Labor Cost	9.09	10.91	12.73	9.09	18.18	40.00				

Table 3.16: Dairy Farms in the Bottom Third of Each Measure, 2008-2012								
	5 years	4 years	3 years	2 years	1 year	0 years		
			("	%)				
CR	10.91	18.18	5.45	1.82	16.36	47.27		
DTA	21.82	7.27	1.82	7.27	5.45	56.36		
ATO	12.73	12.73	7.27	5.45	16.36	45.45		
ROA	3.64	10.91	7.27	23.64	32.73	21.82		
OPMR	3.64	7.27	18.18	18.18	25.45	27.27		
NFI	1.82	7.27	16.36	25.45	25.45	23.64		
Value of								
Homegrown Feed	14.55	5.45	9.09	10.91	20.00	40.00		
Purchased Feed								
Cost	16.36	9.09	5.45	7.27	14.55	47.27		
Labor Cost	5.45	14.55	9.09	14.55	21.82	34.55		

Crop Farm Results

The results for the crop farms were consistent with the results for the dairy farms. DTA, CR, and ATO had the most persistent rankings. More than 13% of farms were ranked in the top third for all five years. More than 9% were also ranked in the bottom third for all five years. For CR, DTA, or ATO, there were more than 42% of farms that were never ranked in the bottom third. This supports the results from the dairy farm data that ranking in the top or bottom third just once for CR, DTA, or ATO is enough for a farm manager to make decisions based on. ROA, OPMR, and NFI were the least consistent in their rankings. As many as 52% of farms only

ranked in the top or bottom third for OPMR, ROA, and NFI once depending on the five-year panel being looked at. Also, there were less than 36% of farms that never ranked in the bottom third for ROA, OPMR, and NFI. The implication is that farm managers should not make huge decisions based on ranking in the bottom third once for ROA, OPMR, and NFI. The results show that these measures are too variable and ranking in the top or bottom once does not provide enough insight into a farm's long-run performance to make management decisions. These results are similar to the dairy farm results and Langemeier's (2009) conclusion that it was difficult for a farm to consistently rank in the top third.

Table 3.17: Crop Farms in the Top Third of Each Measure, 2002-2006								
	5 years	4 years	3 years	2 years	1 year	0 years		
	(%)							
CR	13.64	4.55	9.09	18.18	9.09	45.45		
DTA	13.64	9.09	9.09	13.64	0.00	54.55		
ATO	18.18	4.55	13.64	0.00	9.09	54.55		
ROA	0.00	13.64	9.09	31.82	13.64	31.82		
OPMR	4.55	9.09	9.09	22.73	27.27	27.27		
NFI	4.55	4.55	22.73	18.18	13.64	36.36		

Table 3.18: Crop Farms in the Bottom Third of Each Measure, 2002-2006								
	5 years	4 years	3 years	2 years	1 year	0 years		
		(%)						
CR	18.18	4.55	4.55	9.09	18.18	45.45		
DTA	22.73	4.55	0.00	9.09	9.09	54.55		
ATO	9.09	22.73	0.00	9.09	4.55	54.55		
ROA	4.55	13.64	0.00	22.73	36.36	22.73		
OPMR	0.00	18.18	9.09	18.18	22.73	31.82		
NFI	4.55	4.55	22.73	9.09	31.82	27.27		
Table 3.19: Crop Farms in the Top Third of Each Measure, 2003-2007								
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	5 years	4 years	3 years	2 years	1 year	0 years		
	(%)							
CR	20.00	13.33	0.00	0.00	13.33	53.33		
DTA	20.00	6.67	10.00	3.33	3.33	56.67		
ATO	16.67	10.00	3.33	13.33	6.67	50.00		
ROA	0.00	16.67	6.67	26.67	26.67	23.33		
OPMR	3.33	23.33	0.00	20.00	16.67	36.67		
NFI	3.33	16.67	10.00	10.00	33.33	26.67		
Table 3.20: Crop Fa	arms in th	e Bottom	Third of	Each Mea	sure, 200	3-2007		
	5 years	4 years	3 years	2 years	1 year	0 years		
			(*	%)				
CR	10.00	16.67	6.67	6.67	16.67	43.33		
DTA	16.67	10.00	6.67	10.00	3.33	53.33		
ATO	26.67	0.00	10.00	0.00	3.33	60.00		
ROA	3.33	10.00	16.67	20.00	20.00	30.00		
OPMR	0.00	13.33	23.33	13.33	16.67	33.33		
NFI	6.67	3.33	26.67	13.33	13.33	36.67		

Table 3.21: Crop Farms in the Top Third of Each Measure, 2004-2008							
	5 years	4 years	3 years	2 years	1 year	0 years	
			(%)			
CR	14.29	19.05	4.76	0.00	4.76	57.14	
DTA	19.05	9.52	4.76	9.52	0.00	57.14	
ATO	14.29	9.52	9.52	9.52	9.52	47.62	
ROA	0.00	14.29	19.05	14.29	23.81	28.57	
OPMR	0.00	23.81	9.52	14.29	14.29	38.10	
NFI	0.00	14.29	9.52	33.33	14.29	28.57	

1 able 3.22: Crop Farms in the Bottom 1 hird of Each Measure, 2004-2
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Table 5.22. Crop Farms in the Dottom Find of Each Measure, 2004-2000								
	5 years	4 years	3 years	2 years	1 year	0 years		
			(9	%)				
CR	14.29	14.29	9.52	4.76	0.00	57.14		
DTA	23.81	9.52	0.00	0.00	9.52	57.14		
ATO	23.81	4.76	4.76	4.76	4.76	57.14		
ROA	9.52	9.52	4.76	19.05	28.57	28.57		
OPMR	4.76	9.52	14.29	14.29	33.33	23.81		
NFI	9.52	14.29	0.00	14.29	33.33	28.57		

Table 3.23: Crop Fa	23: Crop Farms in the Top Third of Each Measure, 2005-2009						
	5 years	4 years	3 years	2 years	1 year	0 years	
			("	%)			
CR	17.65	5.88	17.65	5.88	0.00	52.94	
DTA	17.65	11.76	0.00	17.65	5.88	47.06	
ATO	17.65	11.76	5.88	11.76	0.00	52.94	
ROA	5.88	0.00	23.53	23.53	29.41	17.65	
OPMR	0.00	11.76	23.53	23.53	11.76	29.41	
NFI	0.00	5.88	23.53	29.41	23.53	17.65	

Table 3.23: Crop Fari	ns in the	Top Third	l of Each	Measure,	2005-2009
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Table 3.24: Crop Farms in the Bottom Third of Each Measure, 2005-2009							
	5 years	4 years	3 years	2 years	1 year	0 years	
			(1	%)			
CR	29.41	0.00	5.88	0.00	11.76	52.94	
DTA	29.41	5.88	0.00	0.00	5.88	58.82	
ATO	23.53	5.88	5.88	5.88	5.88	52.94	
ROA	0.00	5.88	17.65	35.29	29.41	11.76	
OPMR	5.88	11.76	11.76	17.65	29.41	23.53	
NFI	5.88	11.76	11.76	23.53	17.65	29.41	

Table 3.25: Crop Farms in the Top Third of Each Measure, 2006-2010								
	5 years	4 years	3 years	2 years	1 year	0 years		
	(%)							
CR	23.81	9.52	0.00	4.76	0.00	61.90		
DTA	23.81	0.00	9.52	9.52	0.00	57.14		
ATO	23.81	4.76	0.00	9.52	9.52	52.38		
ROA	9.52	0.00	14.29	19.05	38.10	19.05		
OPMR	9.52	4.76	9.52	19.05	33.33	23.81		
NFI	0.00	14.29	9.52	23.81	33.33	19.05		

Table 3.26: Crop Farms in the Bottom Third of Each Measure, 2006-2010							
	5 years	4 years	3 years	2 years	1 year	0 years	
			()	%)			
CR	19.05	4.76	9.52	4.76	14.29	47.62	
DTA	19.05	4.76	4.76	14.29	9.52	47.62	
ATO	23.81	0.00	0.00	19.05	9.52	47.62	
ROA	4.76	4.76	19.05	19.05	28.57	23.81	
OPMR	4.76	0.00	23.81	19.05	33.33	19.05	
NFI	4.76	4.76	19.05	19.05	28.57	23.81	

Table 3.27: Crop Farms in the Top Third of Each Measure, 2007-2011						
	5 years	4 years	3 years	2 years	1 year	0 years
			()	%)		
CR	21.05	5.26	5.26	5.26	5.26	57.89
DTA	21.05	5.26	5.26	5.26	5.26	57.89
ATO	21.05	5.26	5.26	5.26	5.26	57.89
ROA	0.00	10.53	10.53	31.58	21.05	26.32
OPMR	5.26	10.53	10.53	15.79	26.32	31.58
NFI	0.00	10.53	15.79	15.79	36.84	21.05

Table 3.28: Crop Farms in the Bottom Third of Each Measure, 2007-2011

	5 years	4 years	3 years	2 years	1 year	0 years
			(*	%)		
CR	15.79	15.79	0.00	0.00	15.79	52.63
DTA	15.79	5.26	10.53	5.26	15.79	47.37
ATO	21.05	0.00	5.26	5.26	26.32	42.11
ROA	5.26	5.26	10.53	15.79	47.37	15.79
OPMR	5.26	5.26	10.53	15.79	47.37	15.79
NFI	0.00	15.79	10.53	5.26	52.63	15.79

Table 3.29: Crop Farms in the Top Third of Each Measure, 2008-2012						
	5 years	4 years	3 years	2 years	1 year	0 years
			()	%)		
CR	22.73	0.00	4.55	9.09	13.64	50.00
DTA	13.64	9.09	13.64	4.55	4.55	54.55
ATO	13.64	18.18	0.00	9.09	0.00	59.09
ROA	0.00	4.55	27.27	13.64	31.82	22.73
OPMR	9.09	4.55	4.55	27.27	27.27	27.27
NFI	4.55	4.55	27.27	13.64	9.09	40.91

Table 3.30: Crop Farms in the Bottom Third of Each Measure, 2008-2012

	5 years	4 years	3 years	2 years	1 year	0 years
			()	%)		
CR	27.27	0.00	0.00	4.55	13.64	54.55
DTA	13.64	13.64	4.55	9.09	4.55	54.55
ATO	18.18	4.55	4.55	13.64	9.09	50.00
ROA	4.55	0.00	18.18	27.27	27.27	22.73
OPMR	0.00	9.09	18.18	27.27	13.64	31.82
NFI	0.00	4.55	18.18	27.27	31.82	18.18

3.1.2 Step Two

The five-year average for all nine measures was calculated for each dairy farm for every panel. The five-year average for all six measures was calculated for each crop farm for every panel. $\bar{x}_{i,f}$ = Five-year average for an individual farm, where f is the financial measure Thirds were computed across farms using the five-year average value for each farm.

Organize \hat{x}_i across farms into thirds

A t-test was conducted using Excel to test if there was a statistically significant difference (p<0.10) between the top and bottom third for each measure.

 $\overline{X}_{1,f}$ = Sample mean for the top third

 $\overline{X}_{2,f}$ = Sample mean for the bottom third

 $H_0: \overline{X}_{1,f} = \overline{X}_{2,f}$

 $H_1 \colon \overline{X}_{1,f} \neq \overline{X}_{2,f}$

 $\alpha = 0.10$

$$t = \frac{\overline{X}_{1,f} - \overline{X}_{2,f}}{s_{\overline{X}_{1,f}} - \overline{X}_{2,f}} \text{ where, } s_{\overline{X}_{1,f}} - \overline{X}_{2,f}} = \sqrt{\frac{s_{1,f}^2}{N_{1,f}} + \frac{s_{2,f}^2}{N_{2,f}}}.$$

The results revealed that there was a significant difference between the top and bottom thirds for every financial measure for both the crop and dairy farms. This implies that a relative farm ranking using a long-term average does have value and should be used when making management decisions. Even for financial measures, such as ROA, OPMR, and NFI, which have a lot of variability making it difficult to rank in the same third consistently, there was a significant difference between the farms in the top and bottom thirds when using a five-year average. While ranking in the bottom for just one year did not always provide enough information for a producer to use to make a managerial decision, ranking in the bottom using a five-year average does give them a lot of insight into farm performance.

3.1.3 Step Three

In order to examine the different characteristics of farms that were highly profitable and those that were less profitable, the farms were organized into thirds based on their five-year average ROA. Farms were organized into thirds based on $\hat{x}_{i,ROA}$. The first ROA third represented the farms with the highest ROA. For each third, the average ROA of the farms was recorded. Then, for the top ROA third, the average ATO, OPMR, DTA, CR, labor cost/cwt, purchased feed cost/cwt, value of homegrown feed/cwt and NFI/cwt of the dairy farms was recorded. This was repeated for the middle, and bottom thirds. The same process was repeated for the crop farms, using CR, DTA, ATO, OPMR, and NFI/acre.

 $\overline{Z}_{q,f}$ = Sample mean for each f, where q = 1 (the top ROA third), 2 (the middle ROA third), or 3 (the bottom ROA third).

A t-test was conducted using Excel to see if there was a statistically significant (p<0.10) difference between the financial performance measures of those farms in the top and bottom ROA third.

- $H_0: \overline{Z}_{1,f} = \overline{Z}_{3,f}$
- $\mathrm{H}_1 \colon \overline{Z}_{1,\mathrm{f}} \!\neq \! \overline{Z}_{3,\mathrm{f}}$
- $\alpha = 0.10$

$$t = \frac{\overline{Z}_{1,f} \cdot \overline{Z}_{3,f}}{s_{\overline{Z}_{1,f}} \cdot \overline{Z}_{3,f}} \text{ where, } s_{\overline{Z}_{1,f}} \cdot \overline{Z}_{3,f} = \sqrt{\frac{s_{1,f}^2}{N_{1,f}} + \frac{s_{3,f}^2}{N_{3,f}}}$$

Dairy Farm Results

Based on the results in Tables 3.31-3.38, farms in the top and bottom third for ROA did not have significantly different values for CR and DTA. This goes back to figures 2.6 and 2.8, which show CR and DTA are similar across farms. Having a high CR or a low DTA does not necessarily imply that a farm will be in the top ROA quartile. In the early panels (2001-2005, 2002-2006, 2003-2007), there was not a significant difference between the farms in the top and bottom thirds for purchased feed cost. The difference in purchased feed cost between the top and bottom thirds was significant in the later panels (2004-2008 and later). This shows that in recent years, the least profitable farms have not been successful at controlling their feed costs relative to the more profitable farms. Feed costs have become more important recently, as the margin between milk income and feed price in the U.S. has gotten smaller and more volatile. Farms in the top third tended to have a significantly higher ATO, OPMR, and NFI than the farms in the bottom third for ROA. This conclusion was based on a t-test comparing the top and bottom thirds at a 10% significance level. A farm that is not currently in the top ROA third could look at these results and realize that maybe they need to also improve their OPMR and/or ATO in order to obtain a higher ROA. If a farm was to only look at their relative ranking for one measure, ROA would be a reasonable ratio to use. If the farm sees that they are not performing at a high enough level with regards to ROA, they can then look at their relative ranking for ATO and OPMR. Multiplying ATO and OPMR results in ROA and both were significantly different between the farms in the top and bottom third for ROA. This will allow the farm to see if they have an efficiency problem or a profit margin problem. Looking at their relative ranking for NFI would also provide valuable insight.

The results are consistent with Langemeier's findings that there was a significant

difference in the characteristics of farms in the top and bottom quartiles for ROA.

			ROA 🛛	Third	
		Тор	Middle	Bottom	p-value
ROA	(%)	9.19	5.06	0.93	0.00
CR	(ratio)	5.65	7.24	3.38	0.29
DTA	(%)	32.13	25.23	33.16	0.82
ATO	(%)	33.97	33.03	26.55	0.03
OPMR	(%)	24.17	16.22	1.46	0.00
NFI	(\$/cwt)	4.79	4.19	2.16	0.00
Value of Homegrown Feed	(\$/cwt)	3.41	5.17	6.13	0.01
Purchased Feed Cost	(\$/cwt)	3.55	3.69	3.87	0.26
Labor Cost	(\$/cwt)	3.76	4.54	4.59	0.04

Table 3.31: Summary Statistics of ROA Thirds, Dairy Farms, 2001-2005

*If p<0.10 there is a statistical difference, if p>0.10 the difference is not significant

			ROA	Third	
		Тор	Middle	Bottom	p-value
ROA	(%)	9.72	5.78	3.54	0.00
CR	(ratio)	9.78	4.50	6.55	0.47
DTA	(%)	30.80	29.63	25.08	0.27
ATO	(%)	34.64	32.14	27.90	0.03
OPMR	(%)	22.74	15.74	4.90	0.00
NFI	(\$/cwt)	4.47	3.91	2.48	0.01
Value of Homegrown Feed	(\$/cwt)	3.40	4.72	6.33	0.00
Purchased Feed Cost	(\$/cwt)	3.64	3.71	3.70	0.83
Labor Cost	(\$/cwt)	3.81	4.11	4.67	0.02

Table 3.32: Summary Statistics of ROA Thirds, Dairy Farms, 2002-2006

*If p<0.10 there is a statistical difference, if p>0.10 the difference is not significant

Table 3.33: Summary Statistics of ROA Thirds, Dairy Farms, 2003-2007

			ROA	Third	
		Тор	Middle	Bottom	p-value
ROA	(%)	11.14	6.71	2.61	0.00
CR	(ratio)	4.43	8.68	5.66	0.65
DTA	(%)	32.52	23.72	29.57	0.54
ATO	(%)	38.06	30.31	29.71	0.01
OPMR	(%)	29.96	22.16	8.34	0.00
NFI	(\$/cwt)	6.19	5.36	2.92	0.00
Value of Homegrown Feed	(\$/cwt)	4.78	6.74	7.13	0.04
Purchased Feed Cost	(\$/cwt)	4.05	3.90	4.27	0.52
Labor Cost	(\$/cwt)	3.64	4.00	4.90	0.00

*If p<0.10 there is a statistical difference, if p>0.10 the difference is not significant

			ROA	Third	
		Тор	Middle	Bottom	p-value
ROA	(%)	11.26	6.50	2.44	0.00
CR	(ratio)	10.16	4.00	10.55	0.95
DTA	(%)	30.60	23.86	29.72	0.86
ATO	(%)	39.01	27.97	28.51	0.00
OPMR	(%)	29.82	23.10	8.76	0.00
NFI	(\$/cwt)	6.24	6.25	2.63	0.00
Value of Homegrown Feed	(\$/cwt)	5.23	10.89	8.26	0.00
Purchased Feed Cost	(\$/cwt)	4.22	4.38	4.93	0.03
Labor Cost	(\$/cwt)	3.86	3.98	5.09	0.01

 Table 3.34:
 Summary Statistics of ROA Thirds, Dairy Farms, 2004-2008

Table 3.35: Summary	Statistics	of ROA	Thirds,	Dairy	y Farms.	2005-2009
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			ROA 7	Third	
		Тор	Middle	Bottom	p-value
ROA	(%)	9.66	4.90	1.67	0.00
CR	(ratio)	9.52	5.00	8.64	0.89
DTA	(%)	25.94	30.22	27.27	0.74
ATO	(%)	33.60	27.16	27.67	0.05
OPMR	(%)	28.88	15.78	4.49	0.00
NFI	(\$/cwt)	6.25	4.05	1.83	0.00
Value of Homegrown Feed	(\$/cwt)	6.72	7.64	10.52	0.03
Purchased Feed Cost	(\$/cwt)	4.31	4.16	5.19	0.01
Labor Cost	(\$/cwt)	3.96	3.87	5.15	0.02

*If p<0.10 there is a statistical difference, if p>0.10 the difference is not significant

			ROA 7	Third	
		Тор	Middle	Bottom	p-value
ROA	(%)	8.70	4.63	1.35	0.00
CR		5.61	10.07	3.72	0.27
DTA	(%)	28.51	25.88	27.46	0.82
ATO	(%)	33.88	25.69	24.03	0.00
OPMR	(%)	25.75	16.90	6.92	0.00
NFI	(\$/cwt)	4.99	3.96	2.26	0.01
Value of Homegrown Feed	(\$/cwt)	6.38	8.51	13.71	0.02
Purchased Feed Cost	(\$/cwt)	4.31	4.20	5.29	0.02
Labor Cost	(\$/cwt)	3.62	3.88	4.55	0.00

 Table 3.36:
 Summary Statistics of ROA Thirds, Dairy Farms, 2006-2010

*If p<0.10 there is a statistical difference, if p>0.10 the difference is not significant

			ROA 🗌	Third	
		Тор	Middle	Bottom	p-value
ROA	(%)	9.57	5.95	1.76	0.00
CR	(ratio)	6.84	6.22	4.59	0.32
DTA	(%)	29.08	27.52	24.89	0.40
ATO	(%)	32.74	29.95	25.21	0.01
OPMR	(%)	29.17	19.56	5.27	0.00
NFI	(\$/cwt)	6.51	4.23	2.30	0.00
Value of Homegrown Feed	(\$/cwt)	10.04	10.35	12.07	0.36
Purchased Feed Cost	(\$/cwt)	4.83	4.72	5.56	0.11
Labor Cost	(\$/cwt)	3.76	4.11	4.22	0.16

Table 3.37: Summary Statistics of ROA Thirds, Dairy Farms, 2007-2011

			ROAT	Third	
		Тор	Middle	Bottom	p-value
ROA	(%)	8.20	5.44	0.48	0.00
CR	(ratio)	6.74	5.15	11.75	0.40
DTA	(%)	27.35	26.44	26.80	0.92
ATO	(%)	30.97	27.77	25.53	0.08
OPMR	(%)	28.02	18.59	(0.09)	0.00
NFI	(\$/cwt)	5.84	4.51	1.00	0.00
Value of Homegrown Feed	(\$/cwt)	10.17	10.69	13.93	0.10
Purchased Feed Cost	(\$/cwt)	5.01	4.70	6.06	0.03
Labor Cost	(\$/cwt)	3.81	3.94	4.47	0.11

 Table 3.38:
 Summary Statistics of ROA Thirds, Dairy Farms, 2008-2012

*If p<0.10 there is a statistical difference, if p>0.10 the difference is not significant

Crop Farm Results

Based on the results in Tables 3.39 - 3.45, crop farms in the top and bottom third for ROA did not have significantly different CR and DTA (p>.10). This is consistent with the dairy farm results. In the later panels, tables 3.42 - 3.45, OPMR and NFI were not statistically significant between the top and bottom thirds. The difference between the ATO for the top and bottom thirds was only significant in table 3.39, 3.41, and 3.45. These results did not align with the dairy farm results. The analysis of the crop farms suggests that in recent years there was no real difference between farms in the top and bottom thirds for ROA. However, the small number of farms in each panel (n<30) may have affected these results.

			ROA Thi	ird	
		Тор	Middle	Bottom	p-value
ROA	(%)	9.88	4.78	0.12	0.00
CR	(ratio)	3.94	5.29	8.76	0.30
DTA	(%)	25.45	22.66	16.68	0.31
ATO	(%)	41.89	21.17	14.44	0.07
OPMR	(%)	35.45	32.84	(10.29)	0.01
NFI	(\$/acre operated)	187.37	148.04	35.22	0.01

Table 3.39: Summary Statistics of ROA Thirds, Crop Farms, 2002-2006

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			ROA Tł	nird	
		Тор	Middle	Bottom	p-value
ROA	(%)	11.84	4.92	0.33	0.00
CR	(ratio)	3.78	6.90	9.95	0.20
DTA	(%)	26.07	27.26	21.16	0.60
ATO	(%)	40.49	26.21	24.34	0.15
OPMR	(%)	47.02	23.63	(12.14)	0.00
NFI	(\$/acre operated)	251.76	125.82	39.90	0.00

*If p<0.10 there is a statistical difference, if p>0.10 the difference is not significant

	<i>y</i>		ROA Th	ird	
		Тор	Middle	Bottom	p-value
ROA	(%)	13.46	7.16	2.38	0.00
CR		4.77	4.67	12.24	0.13
DTA	(%)	19.84	31.01	12.58	0.39
ATO	(%)	48.63	25.54	23.55	0.08
OPMR	(%)	45.82	34.00	8.93	0.01
NFI	(\$/acre operated)	242.23	179.58	114.46	0.08

Table 3.41: Summary Statistics of ROA Thirds, Crop Farms, 2004-2008

*If p<0.10 there is a statistical difference, if p>0.10 the difference is not significant

Table 3.42: Summary Statistics of ROA Thirds, Crop Farms, 2005-2009

)	,		
			ROA Th	ird	
		Тор	Middle	Bottom	p-value
ROA	(%)	10.67	6.84	1.82	0.00
CR	(ratio)	6.76	6.22	14.01	0.27
DTA	(%)	15.96	26.50	18.78	0.79
ATO	(%)	38.68	23.89	33.41	0.73
OPMR	(%)	39.47	35.13	22.88	0.22
NFI	(\$/acre operated)	228.55	181.58	133.33	0.19

*If p<0.10 there is a statistical difference, if p>0.10 the difference is not significant

			ROA Th	ird	
		Тор	Middle	Bottom	p-value
ROA	(%)	11.78	6.87	2.83	0.00
CR	(ratio)	4.47	3.45	10.17	0.14
DTA	(%)	24.56	36.49	15.67	0.37
ATO	(%)	40.59	36.11	30.44	0.48
OPMR	(%)	37.94	22.94	11.73	0.11
NFI	(\$/acre operated)	133.86	186.06	117.14	0.78

 Table 3.43:
 Summary Statistics of ROA Thirds, Crop Farms, 2006-2010

	Summar	y blackstep of fice		<i>sp</i> i ai iii <i>s</i> , <i>z</i>		
				ROA Th	ird	
			Top	Middle	Bottom	n-v

Table 3.44:	Summary	Statistics of ROA	A Thirds, Cro	p Farms, 2007-2011
				DOA Thind

			-		
		Тор	Middle	Bottom	p-value
ROA	(%)	11.47	7.83	2.19	0.00
CR	(ratio)	5.94	4.91	11.38	0.30
DTA	(%)	30.00	31.43	17.37	0.25
ATO	(%)	53.96	29.81	27.64	0.10
OPMR	(%)	24.67	27.16	18.07	0.76
NFI	(\$/acre operated)	183.43	249.52	55.60	0.24

*If p<0.10 there is a statistical difference, if p>0.10 the difference is not significant

			ROA T	hird	
		Тор	Middle	Bottom	p-value
ROA	(%)	11.93	7.92	4.13	0.00
CR	(ratio)	10.09	3.43	5.48	0.31
DTA	(%)	25.07	38.42	34.78	0.40
ATO	(%)	48.60	35.28	17.76	0.02
OPMR	(%)	27.41	23.07	23.58	0.63
NFI	(\$/acre operated)	275.63	238.36	62.55	0.09

Table 3.45: Summary Statistics of ROA Thirds, Crop Farms, 2008-2012

*If p<0.10 there is a statistical difference, if p>0.10 the difference is not significant

3.1.4 Management Implications

The results of the Stability Across Farms steps reveal that it was difficult for a farm to consistently rank in the top third for a given performance measure from year to year. However, over a period of time it was possible for a farm to distinguish itself as a top performer. If a farm manager is using their relative ranking to make future plans, it is important that they do not base

their decision on their performance for a single year for measures that are not asset driven, as they are too variable. Using their long-run average, even for asset-driven measures, can provide valuable insight into how the farm has been performing relative to others. Farm managers can use their long-run performance to determine areas where they need to improve their management strategy and areas where they are doing well. This will help the producer plan for the future.

The results of Model 1: Stability Across Farms for steps 1-3 were consistent with the results when the farms were ranked into quartiles, as shown in Appendix A.

3.2 Model 2: Ranking Farms

Tone of the primary questions this thesis set out to answer is, "how many years of data are necessary to accurately classify a farm as performing in the top, middle, or bottom relative to other farms?" By using Model 2: Ranking Farms, industry fluctuations in the milk and feed prices are accounted for because the model is simply determining how farms performed relative to one another in a given year. This model reveals how many years of data a farm should use in order to predict its true performance relative to other farms.

If a farm manager is going to make management decisions based on their ranking relative to other farms for a financial performance measure, they need to know that the value they are using represents their performance over time. As seen in Model 1: Stability Across Farms there was a lot of variation in financial performance measures from year to year making it difficult for producers to form a conclusion on their performance using one-year of data. It is important that the farm manager base their decisions on their long-run performance. Model 1: Stability Across Farms revealed that farms that perform well over a given period have significantly different characteristics than those who perform poorly. Over time, a farm can distinguish itself as a top performer. This means that benchmarking has a purpose and can provide farms with an

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assessment of their strengths and weaknesses so long as the benchmarks and the farm financial performance measure are calculated using a long-term average. As most individual farms do not have data for every year they have been in business, farm managers would want to know how many years of data they need to estimate their long-run performance with a high degree of certainty. This is what Model 2: Ranking Farms reveals. In the future, simulations can be run to estimate the benchmarks for each performance measure that a farm should compare their performance to.

A balanced panel of dairy farms with data for all ten years between 2002 and 2011 was used (n=41) for the analysis. A ten-year average was calculated for each farm for each of the nine benchmarking measures. This was considered to be a farm's true performance for each measure. Then the farms were separated into thirds. Using 2002 as the one-year data, the farms were again organized into thirds. Then, these rankings were compared with the rankings using the ten-year data to determine the percentage of farms that were put into the correct third. This was then continued using 2002 and 2003 as the two-year average data, and so on until 2002 through 2010 was used as the nine-year average data. This was done to determine how many years of data are necessary until the true underlying effects and not random effects are observed. R_t = Number of farms ranked correctly, where t = 1, 2, 3, 4, 5, 6, 7, 8, or 9-year average.

 $\frac{R_t}{N} = \%$ Correct for that year, where N=the number of farms.

This was repeated using a seven-year average as the true distribution in order to compare with the previous method using the ten-year average as the true distribution. First, a balanced panel from 2001-2007 (n=61) was used. Then the process was repeated using a second balanced panel from 2006-2012 (n=51). Comparisons can be made between the two sets as one set is more recent and includes 2009, which was a poor economic year for dairy farms.

The same process was used to analyze the crop farms. Data from a balanced panel (n=22)

of crop farms from 2008-2012 was used. The five-year average 2008-2012 was used as the

farm's true performance for each measure. The measures included in the analysis were CR, DTA,

ROA ATO, OPMR, and NFI (\$/acre operated).

3.2.1 Model 2: Ranking Farms-Results

Dairy Farm Results

Comparing table 3.54 to table 3.55, the impact of 2009 is evident. Farms were ranked correctly less often in terms of ATO, OPMR, and NFI when 2009 was included in the dataset. For both panels, more than 60% of farms were placed into the correct third for each financial performance measure using a four-year average.

 Table 3.46: Dairy Farms Accurately Ranked into Thirds Using a 7-Year Average as an Estimate of the True Distribution (2001-2007)

	1 vear	2 year average	3 year average	4 year average	5 year average	6 year average
-			(%	()		
CR	71.70	69.81	73.58	73.58	81.13	92.45
DTA	72.13	70.49	77.05	86.89	90.16	93.44
ATO	80.33	83.61	86.89	93.44	93.44	96.72
ROA	50.85	54.24	71.19	77.97	71.19	86.44
OPMR	55.74	63.93	73.77	77.05	83.61	93.44
NFI	67.21	70.49	73.77	83.61	83.61	80.33
Value of						
Homegrown	52.46	49.18	49.18	63.93	80.33	86.89
Feed						
Purchased Feed Cost	70.49	77.05	80.33	86.89	86.89	93.44
Labor Cost	60.66	67.21	73.77	83.61	83.61	93.44

	1 yoor	2 year	3 year	4 year	5 year	6 year
-	i year	average	average	average	average	average
			(%	(o)		
CR	82.35	80.39	80.39	88.24	92.16	96.08
DTA	82.35	84.31	84.31	92.16	92.16	92.16
ATO	60.78	72.55	76.47	72.55	88.24	88.24
ROA	52.94	58.82	72.55	80.39	76.47	92.16
OPMR	50.98	58.82	60.78	74.51	84.31	92.16
NFI	43.14	64.71	68.63	66.67	72.55	88.24
Value of						
Homegrown	80.39	84.31	84.31	84.31	88.24	100.00
Feed						
Purchased	64 71	70.50	78 13	84 31	88 24	88 74
Feed Cost	04.71	70.39	/0.45	04.31	00.24	00.24
Labor Cost	74.51	70.59	80.39	72.55	80.39	88.24

 Table 3.47: Dairy Farms Accurately Ranked into Thirds Using a 7-Year Average as an Estimate of the True Distribution (2006-2012)

Using a ten-year average as the true value for a given measure, it was clear that using even two years of data was better than using one year of data. Farms were placed in the correct third over 50% of the time when using a two year average for all measures analyzed except the value of homegrown feed. For DTA and purchased feed cost/cwt the farm was correct over 80% of the time with a two-year average. For ROA the percentage of farms ranked correctly increased by 24% when using two years of data. Using a three year average resulted in an increased probability of a correct benchmark for ROA, ATO, DTA, labor cost/cwt and purchased feed cost/cwt. OPMR and CR both correctly benchmark farms about 15% better when using a four-year average compared to a three-year average. NFI is the least predictable measure to benchmark, as it only reaches a high of 85% of farms being ranked correctly. Langemeier and Yeager (2009) found that farms stabilized more often when benchmarking OPMR compared to ATO. This is in contrast to the results of Model 2: Ranking Farms. Farms were ranked correctly more often using ATO than when using OPMR. It is expected that ATO would be more stable than OPMR because a farm's assets are assumed to remain relatively unchanged from year to

year, whereas profit margin is extremely variable from year to year. Examining table 3.56, if the ten-year average was considered true, using a four-year average for all measures a farm resulted in a farm being placed in the correct third, 58-85% of the time. Compared to the current system of benchmarking using one year of data and only being correct 15-78% of the time depending on the measure, 58-85% accuracy is desirable. Of the 291 dairy farms in the data set, 55% had four or more years of data.

If 75% is the desired level of accuracy when benchmarking, table 3.56 can be used to determine the number of years needed to benchmark each financial performance measure. A four-year average is necessary for CR, DTA only needs one year of data, purchased feed cost needs a two-year average, ATO and labor cost need a three-year average, a five-year average is needed for ROA, a six-year average needed for homegrown fed and a seven-year average is necessary for OPMR and NFI. As seen in tables 3.54-3.56, the number of years that should be used for benchmarking performance depends on the measure being analyzed and how accurate the farm wishes to be.

<u> </u>	1 year	2 year average	3 year average	4 year average	5 year average	6 year average	7 year average	8 year average	9 year average
			U		(%)		0		
CR	65.79	60.53	60.53	76.32	71.05	73.68	84.21	89.47	100.00
DTA	78.05	82.93	85.37	85.37	80.49	85.37	90.24	95.12	100.00
ATO	58.54	65.85	75.61	75.61	80.49	90.24	90.24	95.12	95.12
ROA	36.59	60.98	68.29	70.73	78.05	75.61	80.49	85.37	95.12
OPMR	56.10	56.10	53.66	68.29	68.29	70.73	75.61	90.24	95.12
NFI	56.10	56.10	51.22	58.54	56.10	65.85	80.49	85.37	80.49
Value of Homegrown Feed	15.38	35.90	46.15	58.97	69.23	82.05	89.74	89.74	89.74
Purchased Feed Cost	73.17	80.49	82.93	82.93	82.93	80.49	85.37	90.24	100.00
Labor Cost	65.85	70.73	75.61	75.61	80.49	85.37	85.37	95.12	100.00

 Table 3.48: Dairy Farms Accurately Ranked into Thirds Using a 10-Year Average as an Estimate of the True Distribution (2002-2011)

Crop Farm Results

The crop results show that all measures except ROA and OPMR were accurately ranked more than two-thirds of the time using one year. These results may be skewed due to the small sample size (n=22). The sample may not be an accurate representation of all Michigan crop farms. A five-year average was used as the true distribution, which is likely different than the farms actual long-run average. Although the number of years of data needed to obtain an accurate reflection of a farm's true long-term performance may not be the same as what these results revealed, they did were consistent with the results of the study. The profitability measures needed more years of data than the asset driven measures to be ranked correctly 75% of the time (table 3.57).

	1 year	2 year average	3 year average	4 year average
			(%)	
CR	72.73	68.18	77.27	77.27
DTA	81.82	81.82	81.82	81.82
ATO	81.82	81.82	90.91	90.91
ROA	54.55	54.55	63.64	77.27
OPMR	31.82	54.55	54.55	72.73
NFI	68.18	54.55	63.64	81.82

 Table 3.49: Crop Farms Accurately Ranked into Thirds Using a 5-Year

 Average as an Estimate of the True Distribution (2008-2012)

3.2.2 Implications

These results can be used by farm managers to determine the number of years of data needed to calculate an estimate of their long-run average for each financial performance measure. They can then use these long-run values to compare their performance to other farms. When farms use only one year of data to analyze their relative performance, they are not necessarily obtaining a full understanding of how their management strategies are working long-term. It is important to understand how their farm performed throughout the past year, but also how this relates to their long-term performance.

3.3 Model 3: Estimation of Sources of Variation

In order to determine the number of years of data needed when benchmarking, it is necessary to understand the sources and extent of variation that describe Michigan dairy and crop farm financial performance. One approach is to model variation in observed annual farm financial performance as the result of the underlying, but unknown, mean farm performance, a common annual effect across farms, and annual farm specific idiosyncratic variation. Common sources of variation across farms are called systemic risk and are the result of factors such as a common market price. This static model can be described by:

 $y_{it} = \mu_i + \theta_t + \epsilon_{it}$ for i=1,...,N and t=1,...,T

y_{it}: is observed performance for firm i for a financial measure, y, in year t,

 μ_i : is the mean value of the financial measure for firm i,

- $\theta_t:$ is common, annual, systemic source of variation across firms in year t (normalized to have mean zero), and
- ε_{it} : is idiosyncratic, firm specific variation associated with firm i.

If all variation were common across all farms, then only one year of data would be sufficient to accurately rank farms. However, if some of the variation is firm specific, multiple years of data are needed to accurately rank farm performance. Thus, estimation of the magnitudes of variation helps in understanding the reported results and to support subsequent Monte Carlo simulations to refine classification rules. The results of this future analysis will provide producers, farm management groups and lenders with a complete picture of how to change the benchmarking process. The new benchmarking process will result in an accurate ranking of a farm's true long-run performance independent of any common, systemic variation. The variance parameters were estimated for ROA, OPMR, and ATO using ordinary least squares to estimate the model described:

 μ_i : Average firm effect

 $\sigma_{u,i}$: Distribution of firm effects

 σ_{vear} : Distribution of year effects, systemic source of variation

 $\sigma_{\epsilon_{i,t}}$: Distribution of random events given firm and year, idiosyncratic source of variation

Tables 3.50 – 3.53 describe the parameter estimates for different panels. The variance estimates for the 2001-2007 and 2006-2012 dairy panels are similar for their common measures. But, on a relative basis there were some large differences across panels. While the coefficient of variation (CV) of idiosyncratic variation was 92% to 96% for ROA, the CV of OPMR was 58% in the 2001-2007 and 169% in the 2006-2012 panel. The respective CV's for ATO are 31% and 19%. While average OPMR's and ATO's were very different for each of the panels, their net effect on rate of return resulted in similar performance across panels.

The CV of idiosyncratic variation of ROA for crop farms for the 2008-2012 panel was 74%, lower than the 2006-2012 dairy panel.

Table 3.50: Estimation of Parameters, Dairy Farms, 7-Year Panel, 2001-2007									
у	μ_i	$\sigma_{\mu,i}$	σ_{year}	$\sigma_{\epsilon_{i,t}}$	σ_{total}				
ROA	6.13	3.01	1.04	5.64	6.59				
OPMR	32.77	10.19	3.45	19.06	22.03				
ATO	17.47	2.91	0.99	5.44	11.74				

Table 3.51: Estimation of Parameters, Dairy Farms, 7-Year Panel, 2006-2012									
у	μ_{i}	$\sigma_{\mu,i}$	σ_{year}	$\sigma_{\epsilon_{i,t}}$	σ_{total}				
ROA	5.45	2.78	1.02	5.21	6.62				
OPMR	18.01	10.91	4.00	20.42	24.44				
ATO	28.71	2.66	0.98	4.97	10.21				

Table 3.52: Estimation of Parameters, Dairy Farms, 10-Year Panel, 2002-2011									
у	μ_{i}	$\sigma_{\mu,i}$	σ_{year}	$\sigma_{\epsilon_{i,t}}$	σ_{total}				
ROA	5.58	2.66	1.31	5.94	6.99				
OPMR	16.61	9.17	4.53	20.50	23.34				
ATO	30.59	2.59	1.28	5.79	10.44				

Table 3.53: Estimation of Parameters, Crop Farms, 5-Year Panel, 2008-2012									
у	μ_{i}	$\sigma_{\mu,i}$	σ_{year}	$\sigma_{\epsilon_{i,t}}$	σ_{total}				
ROA	7.80	3.64	1.78	5.75	6.70				
OPMR	22.72	5.94	2.83	9.39	20.38				
ATO	33.45	12.03	6.01	19.02	20.48				

Chapter 4-Conclusions

In conclusion, chapter 2 showed that there is a great deal of variation in financial performance measures from year to year for both dairy and crop farms. This in turn means that in order to use long-term averages to rank farms, year effects should be controlled. When ranking farms, the industry effect is not of interest. Rather, the firm's performance aside from the industry effect is what a producer is interested in using when ranking its performance relative to other farms.

It was difficult for farms to consistently rank in the top third. Asset driven performance measures were less variable then income and profitability measures. The rankings across farms were more stable for DTA, ATO, and CR, so a change in the third a farm is ranked in from one year to the next is a significant event that the producer should assess.

Using a five-year average, the top and bottom thirds were significantly different for each financial measure for both crop and dairy farms. Farms that were highly profitable over a five-year period had different characteristics than farms that were less profitable. Farms in the top third tended to have a significantly higher ATO, OPMR, and NFI than the farms in the bottom third for ROA.

Many farms were placed in the wrong third when only one year of data was used. There was evidence that using multiple years of data over time would provide a better estimation of the farm's performance. The number of years that were ideal to use depended on which variable the farmer is looking at and the level of accuracy they desire. The crop farms showed a similar trend to the dairy farms, with producers needing to use data over a longer period when ranking their performance for profitability measures than for asset driven measures. One limitation of this

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analysis might be the small sample size. In the future it would be beneficial to repeat this study using a larger sample.

Future research is necessary to determine a more accurate estimation of the true underlying distribution for each financial performance measure for the industry and also to estimate the long-run average for each measure for an individual farm. Simulations should be used to estimate the true distribution for each financial performance measure for the industry. The results of Model 3: Estimation of Sources of Variation can be used as the parameters for running a Monte Carlo simulation. This will result in a method for ranking farms independent of industry effects for a given year.

For this study, when ranking farms, thirds were used. However, if the last farm in the top third and the first farm in the second third do not significantly differ, the third they are ranked in does not provide insight. Instead, future research should look at using critical values to place farms into a certain bin. Using this method the farms would not be split evenly amongst the three bins.

Farm management groups and University Extension personnel can use the results of this thesis in combination with the results of the future simulations to provide farm managers with a better method for obtaining their relative ranking. At the moment, farm managers could calculate their five-year average for a given measure provided they have recorded data over the past five years. However, they do not have access to the dataset they need to use to compare their performance. This also means that benchmarking reports should report longer-run performance measures.

Lenders can also use the results of this thesis in order to better evaluate a farm when deciding whether or not to give a producer a loan. The results of this study revealed that using

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only a couple years of past data does not accurately reflect a farm's long-term performance. Creditors often project how a farm will perform in the next few years. This study showed that if an average of the farm's performance over a period of time is used, creditors could obtain an estimate of the farm's true long-run performance. This in combination with forward projections would provide creditors with a more complete picture of a farm's past performance and future outlook. APPENDICES

Appendix A

Model 1: Stability Across Years with Results in Quartiles

Table A.1: Dairy Farms in the Top Quartile of Each Measure, 2001-2005								
	5 years	4 years	3 years	2 years	1 year	0 years		
			(%)				
CR	9.21	5.26	9.21	7.89	14.47	53.95		
DTA	14.47	6.58	2.63	6.58	5.26	64.47		
ATO	11.84	10.53	2.63	5.26	5.26	64.47		
ROA	0.00	5.26	10.53	22.37	27.63	34.21		
OPMR	0.00	6.58	13.16	14.47	30.26	35.53		
NFI	2.63	10.53	5.26	14.47	25.00	42.11		
Value of Homegrown Feed	2.63	2.63	18.42	14.47	17.11	44.74		
Purchased Feed Cost	9.21	9.21	3.95	7.89	14.47	55.26		
Labor Cost	5.26	11.84	5.26	9.21	17.11	51.32		

Step One: Dairy Farm Results

Table A.2: Dairy Farms in the Bottom Quartile of Each Measure, 2001-2005 3 years 2 years 5 years 4 years 1 year 0 years (%) CR 7.89 6.58 5.26 15.79 11.84 52.63 67.11 DTA 17.11 5.26 2.63 2.63 5.26 ATO 10.53 5.26 7.89 9.21 9.21 57.89 ROA 32.89 1.32 3.95 10.53 19.74 31.58 40.79 OPMR 1.32 3.95 13.16 22.37 18.42 NFI 3.95 9.21 3.95 17.11 22.37 43.42 Value of 3.95 5.26 7.89 36.84 17.11 28.95 Homegrown Feed Purchased Feed 10.53 6.58 3.95 7.89 18.42 52.63 Cost 9.21 3.95 5.26 13.16 51.32 Labor Cost 17.11

Table A.3: Dairy Farms in the Top Quartile of Each Measure, 2002-2006								
	5 years	4 years	3 years	2 years	1 year	0 years		
			(%)				
CR	8.57	10.00	5.71	7.14	14.29	54.29		
DTA	15.71	4.29	7.14	2.86	5.71	64.29		
ATO	15.71	4.29	4.29	5.71	8.57	61.43		
ROA	1.43	4.29	14.29	12.86	35.71	31.43		
OPMR	1.43	5.71	11.43	17.14	30.00	34.29		
NFI	2.86	7.14	8.57	18.57	22.86	40.00		
Value of Homegrown Feed	1.43	8.57	17.14	10.00	15.71	47.14		
Purchased Feed Cost	7.14	10.00	8.57	7.14	12.86	54.29		
Labor Cost	12.86	4.29	7.14	5.71	14.29	55.71		

 Table A.4: Dairy Farms in the Bottom Quartile of Each Measure, 2002-2006

	5 years	4 years	3 years	2 years	1 year	0 years			
		(%)							
CR	8.57	7.14	8.57	10.00	11.43	54.29			
DTA	14.29	8.57	2.86	2.86	8.57	62.86			
ATO	10.00	7.14	7.14	10.00	8.57	57.14			
ROA	0.00	4.29	12.86	21.43	30.00	31.43			
OPMR	1.43	4.29	12.86	20.00	25.71	35.71			
NFI	2.86	7.14	7.14	18.57	27.14	37.14			
Value of Homegrown Feed	5.71	2.86	11.43	24.29	22.86	32.86			
Purchased Feed Cost	11.43	4.29	5.71	8.57	20.00	50.00			
Labor Cost	10.00	7.14	8.57	5.71	12.86	55.71			

Table A.5: Dairy Farms in the Top Quartile of Each Measure, 2003-2007								
	5 years	4 years	3 years	2 years	1 year	0 years		
			(%)				
CR	8.22	12.33	4.11	10.96	5.48	58.90		
DTA	17.81	5.48	2.74	2.74	5.48	65.75		
ATO	12.33	5.48	6.85	8.22	9.59	57.53		
ROA	1.37	10.96	6.85	13.70	31.51	35.62		
OPMR	2.74	5.48	9.59	19.18	27.40	35.62		
NFI	2.74	9.59	6.85	16.44	24.66	39.73		
Value of Homegrown Feed	4.11	15.07	5.48	8.22	16.44	50.68		
Purchased Feed Cost	9.59	6.85	8.22	5.48	19.18	50.68		
Labor Cost	13.70	2.74	8.22	8.22	9.59	57.53		

Table A.6: Dairy Farms in the Bottom Quartile of Each Measure, 2003-2007								
	5 years	4 years	3 years	2 years	1 year	0 years		
			(%)				
CR	10.96	8.22	4.11	8.22	13.70	54.79		
DTA	17.81	5.48	2.74	2.74	5.48	65.75		
ATO	10.96	4.11	9.59	10.96	8.22	56.16		
ROA	0.00	6.85	16.44	13.70	26.03	36.99		
OPMR	0.00	6.85	13.70	16.44	28.77	34.25		
NFI	2.74	5.48	12.33	15.07	27.40	36.99		
Value of Homegrown Feed	1.37	13.70	8.22	8.22	28.77	39.73		
Purchased Feed Cost	8.22	6.85	8.22	6.85	23.29	46.58		
Labor Cost	12.33	8.22	1.37	9.59	12.33	56.16		

	5 years	4 years	3 years	2 years	1 year	0 years				
		(%)								
CR	9.72	4.17	11.11	6.94	12.50	55.56				
DTA	16.67	5.56	2.78	4.17	2.78	68.06				
ATO	12.50	5.56	8.33	1.39	12.50	59.72				
ROA	2.78	8.33	5.56	15.28	30.56	37.50				
OPMR	1.39	4.17	12.50	18.06	27.78	36.11				
NFI	2.78	5.56	8.33	19.44	25.00	38.89				
Value of Homegrown Feed	12.50	4.17	8.33	6.94	6.94	61.11				
Purchased Feed Cost	6.94	9.72	2.78	12.50	18.06	50.00				
Labor Cost	11.11	5.56	2.78	11.11	16.67	52.78				

Table A.8: Dairy Farms in the Bottom Quartile of Each Measure, 2004-2008								
	5 years	4 years	3 years	2 years	1 year	0 years		
			("	%)				
CR	12.50	2.78	9.72	4.17	13.89	56.94		
DTA	18.06	1.39	5.56	4.17	4.17	66.67		
ATO	11.11	8.33	2.78	11.11	5.56	61.11		
ROA	2.78	4.17	9.72	16.67	31.94	34.72		
OPMR	2.78	2.78	13.89	9.72	38.89	31.94		
NFI	2.78	5.56	8.33	18.06	27.78	37.50		
Value of Homegrown Feed	5.56	11.11	11.11	2.78	13.89	55.56		
Purchased Feed Cost	8.33	8.33	4.17	9.72	18.06	51.39		
Labor Cost	12.50	2.78	8.33	8.33	9.72	58.33		

Table A.9: Dairy Farms in the Top Quartile of Each Measure, 2005-2009

	5 years	4 years	3 years	2 years	1 year	0 years
			(9	%)		
CR	7.04	8.45	7.04	9.86	16.90	50.70
DTA	15.49	4.23	5.63	4.23	7.04	63.38
ATO	11.27	9.86	2.82	2.82	16.90	56.34
ROA	1.41	8.45	11.27	9.86	32.39	36.62
OPMR	0.00	8.45	5.63	23.94	28.17	33.80
NFI	1.41	5.63	9.86	22.54	22.54	38.03
Value of Homegrown Feed	8.45	11.27	4.23	4.23	18.31	53.52
Purchased Feed Cost	5.63	9.86	8.45	4.23	25.35	46.48
Labor Cost	5.63	9.86	7.04	5.63	26.76	45.07

Table A.10: Dairy Farms in the Bottom Quartile of Each Measure, 2005-2009

	5 years	4 years	3 years	2 years	1 year	0 years
			(*	%)		
CR	7.04	11.27	7.04	7.04	11.27	56.34
DTA	15.49	5.63	4.23	4.23	5.63	64.79
ATO	11.27	5.63	9.86	4.23	9.86	59.15
ROA	0.00	5.63	14.08	16.90	28.17	35.21
OPMR	1.41	2.82	11.27	19.72	35.21	29.58
NFI	0.00	8.45	8.45	16.90	33.80	32.39
Value of Homegrown Feed	7.04	11.27	4.23	8.45	16.90	52.11
Purchased Feed Cost	7.04	4.23	7.04	15.49	22.54	43.66
Labor Cost	4.23	12.68	7.04	5.63	22.54	47.89

Table A.11: Dairy Farms in the Top Quartile of Each Measure, 2006-2010							
	5 years	4 years	3 years	2 years	1 year	0 years	
			("	%)			
CR	6.45	6.45	8.06	16.13	14.52	48.39	
DTA	16.13	3.23	8.06	4.84	1.61	66.13	
ATO	11.29	8.06	4.84	6.45	12.90	56.45	
ROA	3.23	6.45	9.68	17.74	22.58	40.32	
OPMR	4.84	6.45	4.84	20.97	22.58	40.32	
NFI	1.61	6.45	8.06	22.58	25.81	35.48	
Value of Homegrown Feed	8.06	14.52	1.61	3.23	19.35	53.23	
Purchased Feed Cost	4.84	8.06	9.68	12.90	17.74	46.77	
Labor Cost	4.84	11.29	3.23	12.90	24.19	43.55	

 Table A.12: Dairy Farms in the Bottom Quartile of Each Measure, 2006-2010

	5 years	4 years	3 years	2 years	1 year	0 years
			()	%)		
CR	12.90	4.84	4.84	11.29	8.06	58.06
DTA	16.13	3.23	6.45	4.84	6.45	62.90
ATO	12.90	3.23	8.06	9.68	8.06	58.06
ROA	0.00	8.06	6.45	25.81	25.81	33.87
OPMR	0.00	4.84	9.68	24.19	32.26	29.03
NFI	0.00	4.84	8.06	29.03	27.42	30.65
Value of Homegrown Feed	6.45	8.06	11.29	8.06	14.52	51.61
Purchased Feed Cost	8.06	1.61	11.29	16.13	16.13	46.77
Labor Cost	3.23	8.06	9.68	17.74	16.13	45.16

Table A.13: Dairy Farms in the Top Quartile of Each Measure, 2007-2011

	5 years	4 years	3 years	2 years	1 year	0 years
			('	%)		
CR	4.92	8.20	8.20	14.75	19.67	44.26
DTA	18.03	3.28	4.92	4.92	3.28	65.57
ATO	11.48	6.56	4.92	11.48	9.84	55.74
ROA	0.00	6.56	9.84	21.31	32.79	29.51
OPMR	0.00	9.84	9.84	14.75	32.79	32.79
NFI	1.64	8.20	9.84	18.03	24.59	37.70
Value of Homegrown Feed	6.56	9.84	8.20	9.84	14.75	50.82
Purchased Feed Cost	6.56	4.92	9.84	14.75	19.67	44.26
Labor Cost	6.56	8.20	8.20	9.84	21.31	45.90

Table A.14: Dairy Farms in the Bottom Quartile of Each Measure, 2007-2011							
	5 years	4 years	3 years	2 years	1 year	0 years	
			("	%)			
CR	6.56	9.84	11.48	8.20	8.20	55.74	
DTA	14.75	6.56	6.56	1.64	8.20	62.30	
ATO	9.84	6.56	6.56	13.11	9.84	54.10	
ROA	1.64	1.64	13.11	24.59	27.87	31.15	
OPMR	1.64	1.64	11.48	27.87	26.23	31.15	
NFI	0.00	1.64	13.11	24.59	36.07	24.59	
Value of Homegrown Feed	6.56	8.20	8.20	8.20	24.59	44.26	
Purchased Feed Cost	6.56	6.56	9.84	14.75	13.11	49.18	
Labor Cost	1.64	8.20	14.75	11.48	22.95	40.98	

Table A.15: Dairy Farms in the Top Quartile of Each Measure, 2008-2012

	5 years	4 years	3 years	2 years	1 year	0 years
			("	%)		
CR	9.09	5.45	5.45	16.36	10.91	52.73
DTA	16.36	7.27	1.82	1.82	7.27	65.45
ATO	10.91	3.64	7.27	14.55	7.27	56.36
ROA	0.00	3.64	12.73	25.45	23.64	34.55
OPMR	1.82	9.09	9.09	12.73	29.09	38.18
NFI	1.82	9.09	10.91	12.73	23.64	41.82
Value of Homegrown Feed	7.27	7.27	10.91	5.45	18.18	50.91
Purchased Feed Cost	5.45	5.45	7.27	18.18	20.00	43.64
Labor Cost	7.27	7.27	5.45	12.73	20.00	47.27

Table A.16: Dairy Farms in the Bottom Quartile of Each Measure, 2008-2012

	5 years	4 years	3 years	2 years	1 year	0 years
			(%)		
CR	3.64	18.18	5.45	5.45	9.09	58.18
DTA	14.55	3.64	7.27	7.27	3.64	63.64
ATO	9.09	7.27	9.09	3.64	18.18	52.73
ROA	3.64	3.64	9.09	20.00	27.27	36.36
OPMR	3.64	3.64	7.27	21.82	29.09	34.55
NFI	1.82	1.82	16.36	16.36	29.09	34.55
Value of Homegrown Feed	7.27	5.45	9.09	9.09	23.64	45.45
Purchased Feed Cost	9.09	5.45	7.27	10.91	16.36	50.91
Labor Cost	3.64	7.27	14.55	5.45	25.45	43.64

Step 1:	Crop	Farm	Resul	ts
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Table A.17: Crop Farms in the Top Quartile of Each Measure, 2002-2006									
	5 years	4 years	3 years	2 years	1 year	0 years			
	(%)								
CR	9.09	9.09	0.00	22.73	9.09	50.00			
DTA	13.64	9.09	0.00	9.09	13.64	54.55			
ATO	9.09	9.09	13.64	4.55	4.55	59.09			
ROA	0.00	4.55	13.64	31.82	13.64	36.36			
OPMR	4.55	9.09	4.55	18.18	27.27	36.36			
NFI	4.55	4.55	9.09	22.73	22.73	36.36			

Table A.18: Crop Farms in the Bottom Quartile of Each Measure, 2002-2006

	5 years	4 years	3 years	2 years	1 year	0 years
			(9	%)		
CR	9.09	13.64	4.55	0.00	22.73	50.00
DTA	18.18	4.55	4.55	4.55	4.55	63.64
ATO	4.55	9.09	18.18	4.55	13.64	50.00
ROA	4.55	9.09	4.55	13.64	36.36	31.82
OPMR	0.00	18.18	4.55	13.64	22.73	40.91
NFI	4.55	4.55	13.64	13.64	27.27	36.36

Table A.19: Crop Farms in the Top Quartile of Each Measure, 2003-2007

	5 years	4 years	3 years	2 years	1 year	0 years			
		(%)							
CR	13.33	3.33	13.33	0.00	13.33	56.67			
DTA	16.67	0.00	10.00	10.00	0.00	63.33			
ATO	13.33	3.33	6.67	16.67	0.00	60.00			
ROA	0.00	6.67	16.67	10.00	36.67	30.00			
OPMR	3.33	16.67	3.33	13.33	13.33	50.00			
NFI	3.33	6.67	16.67	3.33	33.33	36.67			

Table A.20: Crop Farms in the Bottom Quartile of Each Measure, 2003-2007

	5 years	4 years	3 years	2 years	1 year	0 years
			(9	%)		
CR	10.00	6.67	13.33	3.33	10.00	56.67
DTA	16.67	6.67	3.33	3.33	6.67	63.33
ATO	16.67	0.00	13.33	3.33	3.33	63.33
ROA	3.33	6.67	13.33	13.33	23.33	40.00
OPMR	0.00	6.67	20.00	16.67	13.33	43.33
NFI	0.00	10.00	16.67	13.33	16.67	43.33

Table A.21: Crop Farms in the Top Quartile of Each Measure, 2004-2008						
	5 years	4 years	3 years	2 years	1 year	0 years
			(%)		
CR	15.00	0.00	10.00	10.00	0.00	65.00
DTA	10.00	5.00	15.00	5.00	0.00	65.00
ATO	15.00	5.00	5.00	5.00	5.00	65.00
ROA	0.00	10.00	15.00	5.00	30.00	40.00
OPMR	0.00	15.00	10.00	15.00	5.00	55.00
NFI	0.00	0.00	15.00	25.00	30.00	30.00

Table A.22: Crop Farms in the Bottom Quartile of Each Measure, 2004-2008

	5 years	4 years	3 years	2 years	1 year	0 years
			('	%)		
CR	5.00	0.00	25.00	10.00	5.00	55.00
DTA	15.00	5.00	5.00	5.00	5.00	65.00
ATO	15.00	10.00	0.00	5.00	0.00	70.00
ROA	5.00	5.00	10.00	5.00	40.00	35.00
OPMR	5.00	5.00	5.00	10.00	45.00	30.00
NFI	0.00	5.00	5.00	20.00	50.00	20.00

Table A.23: Crop Farms in the Top Quartile of Each Measure, 2005-2009

	5 years	4 years	3 years	2 years	1 year	0 years
			(9	%)		
CR	5.88	11.76	17.65	5.88	5.88	52.94
DTA	17.65	0	11.76	5.88	11.76	52.94
ATO	11.76	0.00	17.65	17.65	0.00	52.94
ROA	5.88	0.00	17.65	17.65	29.41	29.41
OPMR	0.00	0.00	29.41	23.53	11.76	35.29
NFI	0.00	5.88	17.65	17.65	35.29	23.53

Table A.24:	Crop Farms in	the Bottom	Quartile of	Each Measure	, 2005-
2009					

	5 years	4 years	3 years	2 years	1 year	0 years
			(*	%)		
CR	23.53	0.00	5.88	5.88	0.00	64.71
DTA	17.65	11.76	0.00	0.00	11.76	58.82
ATO	17.65	5.88	5.88	5.88	5.88	58.82
ROA	0.00	5.88	5.88	35.29	35.29	17.65
OPMR	5.88	5.88	5.88	17.65	41.18	23.53
NFI	5.88	0.00	23.53	11.76	23.53	35.29

Table A.25: Crop Farms in the Top Quartile of Each Measure, 2006-2010							
	5 years	4 years	3 years	2 years	1 year	0 years	
			()	%)			
CR	14.29	14.29	4.76	0.00	0.00	66.67	
DTA	9.52	14.29	4.76	9.52	4.76	57.14	
ATO	14.29	14.29	0.00	0.00	14.29	57.14	
ROA	9.52	0.00	9.52	19.05	28.57	33.33	
OPMR	4.76	4.76	9.52	19.05	33.33	28.57	
NFI	0.00	4.76	14.29	28.57	23.81	28.57	

Table A.26: Crop Farms in the Bottom Quartile of Each Measure, 2006-2010

	5 years	4 years	3 years	2 years	1 year	0 years
			()	%)		
CR	14.29	4.76	14.29	0.00	9.52	57.14
DTA	19.05	0.00	4.76	4.76	23.81	47.62
ATO	19.05	4.76	0.00	0.00	28.57	47.62
ROA	0.00	4.76	19.05	19.05	28.57	28.57
OPMR	0.00	4.76	14.29	19.05	42.86	19.05
NFI	0.00	4.76	19.05	14.29	38.10	23.81

Table A.27: Crop Farms in the Top Quartile of Each Measure, 2007-2011						
	5 years	4 years	3 years	2 years	1 year	0 years
			("	%)		
CR	10.53	10.53	5.26	5.26	10.53	57.89
DTA	10.53	5.26	15.79	0.00	10.53	57.89
ATO	10.53	5.26	15.79	0.00	10.53	57.89
ROA	0.00	5.26	15.79	21.05	21.05	36.84
OPMR	0.00	15.79	0.00	15.79	36.84	31.58
NFI	0.00	5.26	21.05	10.53	26.32	36.84

Table A.28:	Crop Farms in the Bottom Quartile of Each Measure,	2007-
2011		

	5 years	4 years	3 years	2 years	1 year	0 years
			(9	%)		
CR	15.79	0.00	15.79	0.00	5.26	63.16
DTA	15.79	5.26	0.00	15.79	0.00	63.16
ATO	15.79	0.00	5.26	10.53	15.79	52.63
ROA	0.00	10.53	10.53	15.79	26.32	36.84
OPMR	0.00	5.26	10.53	10.53	57.89	15.79
NFI	0.00	15.79	5.26	0.00	52.63	26.32

Table A.29: Crop Farms in the Top Quartile of Each Measure, 2008-2012							
	5 years	4 years	3 years	2 years	1 year	0 years	
			()	%)			
CR	22.73	0.00	4.55	4.55	0.00	68.18	
DTA	9.09	9.09	13.64	4.55	4.55	59.09	
ATO	13.64	4.55	9.09	9.09	4.55	59.09	
ROA	0.00	0.00	27.27	13.64	27.27	31.82	
OPMR	4.55	4.55	9.09	22.73	22.73	36.36	
NFI	0.00	9.09	18.18	13.64	18.18	40.91	

Table A.30: Crop Farms in the Bottom Quartile of Each Measure, 2008-2012

	5 years	4 years	3 years	2 years	1 year	0 years			
	(%)								
CR	13.64	9.09	4.55	4.55	9.09	59.09			
DTA	13.64	0.00	13.64	13.64	0.00	59.09			
ATO	9.09	9.09	9.09	9.09	9.09	54.55			
ROA	4.55	0.00	13.64	27.27	18.18	36.36			
OPMR	0.00	4.55	18.18	22.73	18.18	36.36			
NFI	0.00	4.55	13.64	22.73	31.82	27.27			

Step Two: Crop and Dairy Farm Results

The results for both the dairy and crop farms were that for each financial performance

measure analyzed there was a statistically significant difference between the farms in the top and

bottom quartiles.

Table A.31: Summary Statistics of ROA Quartiles, Dairy Farms, 2001-2005 **ROA** Quartile First Second Third Fourth p-value ROA (%) 9.87 6.18 3.77 0.42 0.00 (%) CR 5.91 4.95 7.05 3.76 0.44 (%) 29.73 30.27 27.86 32.58 0.57 DTA ATO (%) 36.12 31.75 31.82 25.15 0.01 OPMR 24.88 10.54 0.00 (%) 20.50 (0.01)NFI (\$/cwt) 4.84 4.65 3.26 2.13 0.01 Value of Homegrown (\$/cwt) 3.43 4.38 5.50 6.31 0.01 Feed Purchased Feed Cost (\$/cwt) 3.62 3.39 3.98 3.83 0.51 3.66 (\$/cwt) 4.17 0.05 Labor Cost 4.69 4.68

Step Three: Dairy Farm Results

*The first quartile is represented by farms with the highest ROA.

*If p<0.10 there is a statistical difference, if p>0.10 the difference is not significant

			ROA Quartile							
		First	Second	Third	Fourth	p-value				
ROA	(%)	9.72	5.93	3.83	0.95	0.00				
CR	(%)	10.18	4.32	9.74	3.39	0.17				
DTA	(%)	29.85	32.77	22.33	29.03	0.89				
ATO	(%)	35.15	32.93	32.48	25.84	0.01				
OPMR	(%)	24.16	16.44	12.81	4.53	0.00				
NFI	(\$/cwt)	4.67	3.98	3.35	2.50	0.01				
Value of Homegrown Feed	(\$/cwt)	3.45	4.78	4.51	6.48	0.00				
Purchased Feed Cost	(\$/cwt)	3.67	3.47	3.80	3.78	0.75				
Labor Cost	(\$/cwt)	3.78	3.95	4.33	4.73	0.04				

Table A.32: Summary Statistics of ROA Quartiles, Dairy Farms, 2002-2006
			ROA Quartile					
		First	Second	Third	Fourth	p-value		
ROA	(%)	11.84	7.75	5.58	2.13	0.00		
CR	(%)	4.14	6.80	8.58	5.81	0.62		
DTA	(%)	33.48	25.40	22.14	32.46	0.85		
ATO	(%)	40.96	28.92	30.17	30.05	0.00		
OPMR	(%)	30.38	26.34	18.28	6.27	0.00		
NFI	(\$/cwt)	5.95	6.42	4.56	2.54	0.00		
Value of Homegrown Feed	(\$/cwt)	3.86	7.63	7.26	6.34	0.00		
Purchased Feed Cost	(\$/cwt)	3.95	4.01	4.22	4.12	0.64		
Labor Cost	(\$/cwt)	3.67	3.96	4.30	4.76	0.03		

Table A.33: Summary Statistics of ROA Quartiles, Dairy Farms, 2003-2007

Table A.34: Summary Statistics of ROA Quartiles, Dairy Farms, 2004-2008

			ROA Quartile					
		First	Second	Third	Fourth	p-value		
ROA	(%)	12.17	7.74	5.28	1.73	0.00		
CR	(%)	10.63	5.35	10.34	6.64	0.54		
DTA	(%)	31.72	27.01	22.03	31.50	0.97		
ATO	(%)	41.23	29.35	27.68	29.05	0.00		
OPMR	(%)	30.81	25.47	19.78	6.17	0.00		
NFI	(\$/cwt)	6.51	6.52	4.92	2.22	0.00		
Value of Homegrown Feed	(\$/cwt)	4.92	9.93	9.58	8.08	0.01		
Purchased Feed Cost	(\$/cwt)	4.47	4.07	4.49	5.00	0.14		
Labor Cost	(\$/cwt)	3.85	3.98	4.17	5.24	0.03		

Table A.35: Summary Statistics of ROA Quartiles, Dairy Farms, 2005-2009

			ROA Quartile						
		First	Second	Third	Fourth	p-value			
ROA	(%)	10.56	5.98	3.86	1.18	0.00			
CR	(%)	11.15	5.43	3.89	10.34	0.93			
DTA	(%)	27.93	26.68	28.42	28.10	0.97			
ATO	(%)	35.85	28.11	25.42	28.43	0.05			
OPMR	(%)	30.18	20.31	12.40	2.45	0.00			
NFI	(\$/cwt)	6.46	4.70	3.35	1.62	0.00			
Value of Homegrown Feed	(\$/cwt)	5.81	8.41	8.25	10.75	0.03			
Purchased Feed Cost	(\$/cwt)	4.50	3.92	4.33	5.46	0.01			
Labor Cost	(\$/cwt)	4.14	3.54	4.26	5.39	0.05			

			ROA Quartile					
		First	Second	Third	Fourth	p-value		
ROA	(%)	9.35	5.80	3.55	0.86	0.00		
CR	(%)	5.52	6.69	10.05	3.62	0.39		
DTA	(%)	29.99	24.69	23.55	30.59	0.91		
ATO	(%)	34.26	26.35	26.83	24.01	0.01		
OPMR	(%)	27.21	22.28	10.28	6.28	0.00		
NFI	(\$/cwt)	5.30	4.60	2.96	2.08	0.02		
Value of Homegrown Feed	(\$/cwt)	6.00	8.37	9.36	14.38	0.04		
Purchased Feed Cost	(\$/cwt)	4.47	3.97	4.69	5.26	0.13		
Labor Cost	(\$/cwt)	3.45	3.82	4.19	4.62	0.00		

Table A.36: Summary Statistics of ROA Quartiles, Dairy Farms, 2006-2010

Table A.37: Summary Statistics of ROA Quartiles, Dairy Farms, 2007-2011

			ROA Quartile					
		First	Second	Third	Fourth	p-value		
ROA	(%)	10.03	7.04	4.93	1.16	0.00		
CR	(%)	7.49	5.63	5.57	4.83	0.35		
DTA	(%)	29.99	26.96	24.82	26.73	0.57		
АТО	(%)	33.85	28.82	28.79	25.69	0.01		
OPMR	(%)	28.88	25.48	15.11	3.38	0.00		
NFI	(\$/cwt)	6.07	5.73	4.02	1.71	0.00		
Value of Homegrown Feed	(\$/cwt)	9.08	9.53	11.28	13.24	0.12		
Purchased Feed Cost	(\$/cwt)	4.94	4.70	4.84	5.59	0.21		
Labor Cost	(\$/cwt)	3.63	4.15	4.29	4.09	0.17		

Table A.38: Summary Statistics of ROA Quartiles, Dairy Farms, 2008-2012

			ROA Quartile					
		First	Second	Third	Fourth	p-value		
ROA	(%)	8.53	6.59	4.17	(0.28)	0.00		
CR	(%)	7.55	4.39	7.39	11.44	0.58		
DTA	(%)	25.93	26.42	23.80	31.24	0.30		
ATO	(%)	31.54	28.29	27.87	24.67	0.07		
OPMR	(%)	28.96	23.59	12.43	(2.16)	0.00		
NFI	(\$/cwt)	6.19	5.02	3.55	0.51	0.00		
Value of Homegrown Feed	(\$/cwt)	10.37	9.46	12.11	14.23	0.16		
Purchased Feed Cost	(\$/cwt)	4.94	4.94	4.92	6.17	0.03		
Labor Cost	(\$/cwt)	3.67	4.26	3.78	4.59	0.06		

Step Three: Crop Farm Results

			ROA Quartile					
		First	Second	Third	Fourth	p-value		
ROA	(%)	10.16	6.35	3.60	(0.41)	0.00		
CR	(%)	3.01	7.68	7.49	6.22	0.44		
DTA	(%)	25.77	18.64	22.35	19.44	0.51		
ATO	(%)	45.13	16.57	24.51	14.59	0.09		
OPMR	(%)	35.20	48.20	16.20	(15.72)	0.02		
NFI	(\$/acre operated)	192.42	196.41	96.20	20.81	0.01		

Table A.39: Summary Statistics of ROA Quartiles, Crop Farms, 2002-2006

*The first quartile is represented by farms with the highest ROA.

*If p < 0.10 there is a statistical difference, if p > 0.10 the difference is not significant

 Table A.40:
 Summary Statistics of ROA Quartiles, Crop Farms, 2003-2007

			ROA Quartile				
		First	Second	Third	Fourth	p-value	
ROA	(%)	12.80	6.87	3.01	(0.08)	0.00	
CR	(%)	3.63	4.93	6.90	11.81	0.17	
DTA	(%)	26.07	31.46	22.68	19.67	0.57	
ATO	(%)	46.15	24.95	24.85	24.07	0.11	
OPMR	(%)	45.31	38.34	14.07	(18.02)	0.00	
NFI	(\$/acre operated)	247.48	174.59	100.58	33.60	0.00	

Table A.41: Summary Statistics of ROA Quartiles, Crop Farms, 2004-2008

			ROA Quartile					
		First	Second	Third	Fourth	p-value		
ROA	(%)	14.20	9.33	6.45	1.86	0.00		
CR	(%)	5.02	2.62	6.55	13.46	0.14		
DTA	(%)	22.18	25.01	26.91	12.26	0.39		
ATO	(%)	48.72	34.01	27.41	22.22	0.16		
OPMR	(%)	43.74	39.68	31.60	7.70	0.08		
NFI	(\$/acre operated)	226.89	210.95	186.98	104.97	0.22		

Table A.42: Summary Statistics of ROA Quartiles, Crop Farms, 2005-2009

		_	ROA Quartile					
		First	Second	Third	Fourth	p-value		
ROA	(%)	11.27	7.41	6.10	1.24	0.00		
CR	(%)	5.90	5.22	16.34	9.04	0.46		
DTA	(%)	17.47	27.12	18.00	20.04	0.84		
ATO	(%)	43.59	26.74	16.22	37.81	0.74		
OPMR	(%)	36.35	33.12	43.58	18.87	0.25		
NFI	(\$/acre operated)	219.02	192.64	206.88	115.73	0.23		

			ROA Quartile				
		First	Second	Third	Fourth	p-value	
ROA	(%)	12.35	7.87	5.87	2.56	0.00	
CR	(%)	4.70	2.41	3.71	11.71	0.10	
DTA	(%)	22.62	38.44	36.52	10.83	0.24	
ATO	(%)	41.10	34.37	35.53	31.38	0.57	
OPMR	(%)	40.59	24.28	19.91	11.35	0.13	
NFI	(\$/acre operated)	135.47	177.19	168.02	116.30	0.79	

Table A.43: Summary Statistics of ROA Quartiles, Crop Farms, 2006-2010

Table A.44: Summary Statistics of ROA Quartiles, Crop Farms, 2007-2011

		ROA Quartile					
		First	Second	Third	Fourth	p-value	
ROA	(%)	11.96	8.91	6.74	1.51	0.00	
CR	(%)	5.40	5.81	4.18	13.94	0.17	
DTA	(%)	26.78	37.20	31.98	12.33	0.20	
ATO	(%)	47.57	45.06	27.64	28.39	0.26	
OPMR	(%)	27.78	23.57	24.75	17.94	0.72	
NFI	(\$/acre operated)	207.69	212.34	236.43	22.18	0.15	

Table A.45: Summary Statistics of ROA Quartiles, Crop Farms, 2008-2012

		ROA Quartile										
		First	Second	Third	Fourth	p-value						
ROA	(%)	11.93	8.59	6.44	2.91	0.00						
CR	(%)	10.09	2.21	4.12	9.57	0.92						
DTA	(%)	25.07	42.02	31.59	33.06	0.55						
ATO	(%)	48.60	39.44	27.81	18.01	0.02						
OPMR	(%)	27.41	22.61	22.83	28.33	0.93						
NFI	(\$/acre operated)	275.63	210.83	244.79	51.76	0.12						

Appendix B

Test of Stability Across Years

Langemeier and Yeager (2009) analyzed OPMR and ATO on crop and livestock farms in Kansas between 2003 and 2007. The stated goal of the study was to determine how many years of data were required for accurate benchmarking. They performed t-tests to compare the oneyear average to the two-year average, the two-year average to the three-year average, and so on up to the five-year average. If the p-value was greater than 0.05, they assumed that the financial ratio was stable and the additional year of data was not needed. They found that OPMR stabilized for the group of all farms when comparing the four to five-year averages and concluded that the fifth year of data was not needed. ATO did not stabilize for the group of all farms. ATO did stabilize when looking at only crop farms. The conclusion was that OPMR stabilized more often than ATO.

Their method does not actually estimate the number of years of data a farm needs to use when ranking its performance relative to other farms. Instead, it answers the question, "is a particular farm financial performance measure stable across years?" It reveals whether or not the financial measure converges throughout time. The results will show which financial performance measures vary the most from year to year and which vary the least. Producers will need to use a greater number of years to estimate their long-run average for measures that vary a lot from year to year compared to those that do not vary as much.

The first seven sets of five-year balanced panel data for the dairy farms were used. Within each set of panel data, for each farm, a one-year, two-year average, three-year average, four-year average and five-year average for six variables (ROA, ATO, OPMR, purchased feed cost/cwt, labor cost/cwt, and NFI/cwt) were calculated. For example, for the panel data between

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2001 and 2005, 2001 was used for the one-year data, 2001 and 2002 were used for the two-year average, and so on, with 2001-2005 being used as the five-year average.

 $\overline{v}_{i,f,a}$ = Average for an individual farm for a given financial measure, f, where a=1 for the oneyear average, 2 for the two-year average, 3 for the three-year average, 4 for the four-year average, or 5 for the five-year average.

For each set of panel data, a t-test was conducted using Excel to determine if there was a statistical difference between the one-year and two-year average data, the two-year and three-year average data, the three-year and four-year average data, and the four-year and five-year average data. The measure was considered stable when there was no statistical difference at the 10% level.

For example, when comparing the one-year to two-year average data:

 $\overline{V}_{f,a}$ = Average of all farms for a given financial measure, f

$$\begin{split} H_0: \overline{V}_{f,1} &= \overline{V}_{f,2} \\ H_1: \overline{V}_{f,1} &\neq \overline{V}_{f,2} \\ \alpha &= 0.10 \\ t &= \frac{\overline{V}_{f,1} - \overline{V}_{f,2}}{s_{\overline{V}_{f,1}} - \overline{V}_{f,2}}, \text{ where } s_{\overline{V}_{f,1}} - \overline{V}_{f,2} = \sqrt{\frac{s_{f,1}^2}{N_{f,1}} + \frac{s_{f,2}^2}{N_{f,2}}} \ . \end{split}$$

The average difference between the one-year and two-year average data, the two-year and threeyear average data, the three-year and four-year average data, and the four-year and five-year average data was also calculated.

For example:

 $\overline{V}_{f,2} - \overline{V}_{f,1}$ = Average difference between the one-year and two-year average

The farms were then organized into quartiles and the same process was followed to determine how many years of data were needed before the top and bottom quartiles became stable.

Organize $\bar{v}_{i,f,a}$ across farms into quartiles

 $\overline{W}_{f,a}$ = Average for all of the farms in the top quartile for a given f and a

 $\overline{M}_{f,a}$ = Average for all of the farms in the bottom quartile for a given f and a

A t-test was conducted to compare the top quartile of the one-year average to the top quartile of the two-year average.

 $H_0 \colon \overline{W}_{f,1} = \overline{W}_{f,2}$

 $H_1: \overline{W}_{f,1} \neq \overline{W}_{f,2}$

 $\alpha = 0.10$

$$t = \frac{\overline{W}_{f,1} - \overline{W}_{f,2}}{s_{\overline{W}_{f,1}} - \overline{W}_{f,2}}, \text{ where } s_{\overline{W}_{f,1}} - \overline{W}_{f,2} = \sqrt{\frac{s_{f,1}^2}{N_{f,1}} + \frac{s_{f,2}^2}{N_{f,2}}} .$$

The same process was repeated to compare the top quartile of the two-year average to the top quartile of the three-year average, and so on to the five-year average. The same process was repeated for the bottom quartile.

3.2.1 Model 2: Test of Stability Across Years-Results

It is evident that this method does not arrive at the number of years of data needed for benchmarking. As seen in tables 3.46 - 3.52, many of the financial measures appear to have no statistical difference even when comparing the one-year to two-year average data. Thus, using this method it would be estimated that only one year of data is needed for accurate benchmarking. However, this method is flawed as sometimes a measure will be stable and then with the addition of subsequent years become unstable. For example in table 3.50, ROA and purchased feed cost/cwt have no statistical difference when comparing one-year to two-year average, but then with the addition of a third year of data, the comparison of the two-year to three -year average is statistically different. In Model 2: Stability Across Years, the data appeared to have no statistical difference until 2009 was included. Then many of the measures became statistically significant at the 10% level.

The results do show the variation in a financial performance measure across years. Labor cost and purchased feed cost vary the least, whereas ROA and NFI vary the most. If p>0.10, the variable did not vary significantly between the years according to this test. If p<0.10, the variable was changing significantly from year to year according to this test. This implies that producers can use a lower number of years of data to understand their long-run labor and purchased feed costs whereas they will need data over a longer period of time to determine their long run ROA and NFI. It is important that farm mangers do not use one year of data to obtain their relative ranking as financial performance measures vary from year to year. A farm's performance in a given year may not accurately represent their long-run average. It might be detrimental for a producer to form a strategy for the future based on their performance compared to other farms over only the past year.

											Purchase	d Feed
	OPN	/IR	AT()	RO.	A	Labor Co	ost/cwt	NFI/cwt		Cost/cwt	
All Farms	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.
1 to 2 year average	0.36	4.36	0.26	2.29	0.59	0.61	0.56	0.62	0.98	0.01	0.38	-0.02
2 to 3 year average	0.60	2.20	0.85	0.36	0.43	0.66	0.59	0.50	0.61	0.11	0.88	-0.02
3 to 4 year average	0.82	-0.71	0.74	-0.66	0.63	-0.32	0.89	-0.10	0.85	-0.04	0.19	-0.20
4 to 5 year average	0.98	0.07	0.97	-0.08	0.98	0.02	0.92	-0.06	0.93	-0.02	0.65	-0.07
Top Quartile												
1 to 2 year average	0.99	6.96	0.29	3.23	0.19	6.67	0.74	-0.07	0.73	1.83	0.29	-0.05
2 to 3 year average	0.68	10.84	0.83	0.87	0.06	3.25	0.53	0.00	0.52	2.17	0.55	-0.13
3 to 4 year average	0.99	4.16	0.82	-0.47	0.41	0.24	0.79	0.02	0.76	0.73	0.35	-0.12
4 to 5 year average	0.85	2.27	0.76	0.71	0.80	0.32	0.80	0.03	0.92	0.33	0.33	-0.14
Bottom Quartile												
1 to 2 year average	0.82	-3.72	0.14	0.64	0.31	-4.14	0.71	0.25	0.76	-0.55	0.44	0.12
2 to 3 year average	0.57	-6.31	0.46	0.22	0.72	-1.06	0.78	0.17	0.56	-0.56	0.74	0.11
3 to 4 year average	0.83	-3.64	0.71	-0.44	0.27	-0.72	0.83	-0.07	0.09	-0.47	0.06	-0.24
4 to 5 year average	1.00	-1.63	0.90	-0.17	0.41	-0.41	0.85	-0.09	0.68	-0.14	0.84	-0.02

 TableB.1: P-values and Average Differences for Dairy Farms, 2001-2005

*Diff.=difference *If p<0.10 there is a statistical difference, if p>0.10 the difference is not significant

										Purchased Feed		
	OPM	ſR	ATO		ROA		Labor Cost/cwt		NFI/cwt		Cost/cwt	
All Farms	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.
1 to 2 year average	0.63	-1.90	0.77	-0.57	0.81	0.34	0.31	0.18	0.86	-0.09	0.59	-0.10
2 to 3 year average	0.29	-2.97	0.46	-1.40	0.31	-0.86	0.84	-0.04	0.20	-0.54	0.11	3.44
3 to 4 year average	0.65	-1.12	0.85	-0.35	0.83	-0.16	0.77	-0.05	0.48	-0.29	0.75	-0.06
4 to 5 year average	0.97	0.09	0.71	0.64	0.72	0.23	0.86	-0.03	0.93	0.04	0.79	0.04
Top Quartile												
1 to 2 year average	0.13	11.85	0.89	0.95	0.07	6.52	0.43	0.01	0.17	1.77	0.30	-0.28
2 to 3 year average	0.93	1.25	0.71	-0.61	0.96	0.70	0.88	-0.01	0.48	-0.26	0.10	2.25
3 to 4 year average	0.82	1.17	0.92	0.28	0.66	0.66	0.81	0.02	0.56	-0.30	0.26	-0.16
4 to 5 year average	0.37	2.81	0.49	1.30	0.59	0.79	0.83	-0.04	0.71	0.27	0.94	0.00
Bottom Quarti	le											
1 to 2 year average	0.14	-13.63	0.54	-1.26	0.04	-3.82	0.19	0.36	0.04	-2.13	0.90	0.09
2 to 3 year average	0.19	-5.49	0.09	-1.36	0.03	-1.69	0.90	-0.05	0.22	-0.59	0.02	4.70
3 to 4 year average	0.39	-3.35	0.38	-0.84	0.14	-1.18	0.57	-0.13	0.62	-0.35	0.90	0.04
4 to 5 year average	0.75	-2.20	0.83	0.14	0.96	0.01	0.82	-0.05	0.93	-0.00	0.48	0.13

 Table B.2: P-values and Average Differences for Dairy Farms, 2002-2006

											Purchase	d Feed
	OPN	ЛR	AT	0	RO	А	Labor Co	ost/cwt	NFI/cwt		Cost/cwt	
All Farms	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.
1 to 2 year average	0.18	-5.11	0.37	-1.79	0.06	-1.66	0.43	-0.17	0.08	-1.06	0.05	-0.39
2 to 3 year average	0.94	-0.29	0.97	-0.07	0.94	-0.06	0.60	-0.12	0.71	-0.23	0.85	-0.04
3 to 4 year average	0.70	1.14	0.59	0.97	0.54	0.42	0.80	-0.06	0.69	0.22	0.63	0.09
4 to 5 year average	0.39	-2.09	0.69	-0.70	0.14	-0.95	0.96	-0.01	0.27	-0.55	0.23	-0.21
Top Quartile												
1 to 2 year average	0.64	-2.63	0.91	0.86	0.06	-0.65	0.27	-0.30	0.38	-0.72	0.03	-0.56
2 to 3 year average	0.91	3.57	0.63	0.94	0.53	0.95	0.76	-0.12	0.88	-0.05	0.38	-0.16
3 to 4 year average	0.50	5.09	0.36	1.87	0.11	1.58	0.63	-0.11	0.55	0.82	0.95	0.00
4 to 5 year average	0.94	-0.18	0.87	-0.30	0.11	-0.50	0.97	-0.01	0.49	-0.44	0.00	-0.23
Bottom Quartil	le											
1 to 2 year average	0.10	-11.14	0.03	-2.72	0.03	-3.09	0.59	-0.06	0.04	-1.69	0.12	-0.20
2 to 3 year average	0.39	-3.79	0.59	-0.54	0.27	-1.20	0.52	-0.16	0.41	-0.54	0.68	0.14
3 to 4 year average	0.86	-1.94	0.84	0.20	0.90	-0.15	0.86	-0.06	0.89	-0.15	0.35	0.18
4 to 5 year average	0.19	-3.08	0.53	-0.85	0.08	-0.99	0.85	-0.01	0.18	-0.63	0.00	-0.26

 Table B.3: P-values and Average Differences for Dairy Farms, 2003-2007

											Purchase	d Feed
	OPN	ſR	AT	0	RO	A	Labor Cost/cwt		NFI/cwt		Cost/cwt	
All Farms	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.
1 to 2 year average	0.75	1.54	0.59	1.06	0.53	0.55	0.77	-0.07	0.85	0.16	0.56	0.12
2 to 3 year average	0.45	2.69	0.34	1.79	0.24	0.89	0.88	-0.04	0.40	0.55	0.37	0.17
3 to 4 year average	0.46	-2.10	0.72	-0.66	0.15	-0.98	0.94	0.02	0.29	-0.59	0.22	-0.23
4 to 5 year average	0.29	5.33	0.79	0.50	0.58	0.38	0.84	-0.06	0.65	0.26	0.21	0.24
Top Quartile												
1 to 2 year average	0.90	9.06	0.56	2.76	0.47	2.17	0.99	-0.04	0.77	1.37	0.89	-0.01
2 to 3 year average	0.46	9.57	0.32	3.00	0.09	2.88	0.61	-0.14	0.42	1.74	0.84	0.00
3 to 4 year average	0.99	0.42	0.86	-0.49	0.44	-0.06	1.00	-0.03	0.43	-0.68	0.32	-0.23
4 to 5 year average	0.58	3.28	0.95	0.20	0.70	0.52	0.99	-0.03	0.85	0.38	0.34	-0.22
Bottom Quartile												
1 to 2 year average	0.76	-6.36	0.88	-0.05	0.15	-1.80	0.74	-0.12	0.68	-1.07	0.11	0.41
2 to 3 year average	0.28	0.88	0.53	0.89	0.33	0.18	0.82	0.01	0.32	0.05	0.16	0.32
3 to 4 year average	0.30	-3.92	0.74	-0.51	0.11	-1.17	0.97	-0.01	0.19	-0.65	0.22	-0.21
4 to 5 year average	0.29	16.91	0.73	0.48	0.33	0.41	0.81	-0.16	0.25	0.29	0.09	-0.38

 Table B.4: P-values and Average Differences for Dairy Farms, 2004-2008

								,			Purchase	d Feed
	OPN	1R	AT	0	ROA		Labor Cost/cwt		NFI/cwt		Cost/cwt	
All Farms	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.
1 to 2 year average	0.25	4.05	0.26	2.08	0.16	1.31	0.94	-0.02	0.17	0.87	0.27	0.22
2 to 3 year average	0.24	-3.12	0.45	-1.32	0.05	-1.44	0.95	-0.02	0.14	-0.82	0.05	-0.37
3 to 4 year average	0.37	5.48	0.86	0.30	0.62	0.35	0.71	-0.11	0.77	0.17	0.12	-0.32
4 to 5 year average	0.61	3.83	0.25	1.95	0.03	1.41	0.90	-0.04	0.10	0.97	0.93	0.02
Top Quartile												
1 to 2 year average	0.05	16.81	0.13	3.86	0.00	5.50	0.29	-0.36	0.02	3.18	0.90	-0.07
2 to 3 year average	0.79	2.38	0.58	-1.14	0.09	-0.64	0.96	0.01	0.45	-0.63	0.14	-0.39
3 to 4 year average	0.48	4.95	0.99	0.01	0.37	0.91	0.94	-0.02	0.86	0.53	0.15	-0.29
4 to 5 year average	0.37	4.10	0.16	2.93	0.04	1.67	0.28	-0.25	0.49	1.04	0.89	-0.03
Bottom Quartile												
1 to 2 year average	0.90	-3.12	0.41	1.16	0.33	-1.22	0.98	0.16	0.31	-0.65	0.04	0.66
2 to 3 year average	0.19	-6.32	0.51	-1.45	0.01	-2.05	0.99	0.06	0.00	-1.17	0.04	-0.39
3 to 4 year average	0.40	16.61	0.79	0.24	0.96	-0.46	0.70	-0.29	0.44	0.09	0.06	-0.37
4 to 5 year average	0.94	0.03	0.55	0.95	0.11	1.04	0.66	0.41	0.13	0.72	0.91	0.04

 Table B.5: P-values and Average Differences for Dairy Farms, 2005-2009

											Purchase	d Feed
	OPI	MR	ATO		ROA		Labor Cost/cwt		NFI/cwt		Cost/cwt	
All Farms	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.
1 to 2 year average	0.14	-5.15	0.12	-2.94	0.00	-2.62	0.91	0.03	0.07	-1.72	0.00	-0.68
2 to 3 year average	0.56	1.54	0.89	0.26	0.47	0.54	0.98	0.01	0.57	0.52	0.09	-0.40
3 to 4 year average	0.02	5.56	0.21	2.30	0.01	1.92	0.56	-0.11	0.02	1.48	0.81	0.06
4 to 5 year average	0.96	0.13	1.00	0.00	0.97	0.02	0.61	0.09	0.95	0.03	0.93	0.02
Top Quartile												
1 to 2 year average	0.87	1.05	0.17	0.17	0.02	-1.66	0.85	-0.13	0.26	-2.33	0.03	-0.58
2 to 3 year average	0.35	7.64	0.97	0.97	0.24	1.67	0.79	-0.08	0.44	2.41	0.19	-0.31
3 to 4 year average	0.45	3.90	0.10	0.10	0.02	2.41	0.04	-0.37	0.14	2.57	0.98	-0.03
4 to 5 year average	0.58	2.07	0.80	0.80	0.60	0.41	0.41	0.12	0.75	0.44	0.89	-0.05
Bottom Quartile	e											
1 to 2 year average	0.02	-13.07	0.16	0.16	0.00	-4.16	0.76	0.17	0.02	-2.04	0.00	-0.49
2 to 3 year average	0.35	-4.35	0.89	0.89	0.30	-0.94	0.45	0.30	0.49	-0.98	0.01	-0.56
3 to 4 year average	0.00	3.74	0.50	0.50	0.00	1.25	0.25	0.32	0.00	1.06	0.87	0.09
4 to 5 year average	0.61	-1.79	0.91	0.91	0.67	-0.29	0.48	0.15	0.53	-0.31	0.95	0.04

 Table B.6: P-values and Average Differences for Dairy Farms, 2006-2010

										Purchased Feed		
	OPM	ſR	AT	0	ROA		Labor Cost/cwt		NFI/cwt		Cost/cwt	
All Farms	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.
1 to 2 year average	0.05	5.27	0.33	1.92	0.03	2.14	0.97	0.01	0.11	1.49	0.34	-0.27
2 to 3 year average	0.00	8.44	0.06	3.32	0.00	2.82	0.65	-0.10	0.00	1.94	0.30	0.28
3 to 4 year average	0.98	0.06	0.95	-0.11	0.97	0.02	0.46	0.14	0.91	0.07	0.69	0.10
4 to 5 year average	0.25	-2.77	0.50	-1.09	0.15	-0.93	1.00	0.00	0.19	-0.74	0.40	-0.21
Top Quartile												
1 to 2 year average	0.03	16.63	0.46	2.83	0.03	5.41	0.45	-0.14	0.13	4.46	0.10	-0.50
2 to 3 year average	0.06	7.61	0.03	5.26	0.01	3.62	0.05	-0.48	0.07	2.88	0.71	0.05
3 to 4 year average	0.35	3.14	0.78	0.60	0.38	1.01	0.38	0.13	0.63	0.53	0.99	-0.04
4 to 5 year average	0.24	-0.99	0.37	-1.85	0.23	-0.48	0.79	0.03	0.22	-0.69	0.47	-0.17
Bottom Quartile												
1 to 2 year average	0.47	-6.33	0.51	0.56	0.95	-1.65	0.70	0.28	0.40	-0.75	0.21	-0.15
2 to 3 year average	0.00	8.46	0.51	1.03	0.00	2.17	0.14	0.51	0.00	1.18	0.10	0.52
3 to 4 year average	0.52	-3.50	0.88	-0.73	0.48	-0.73	0.32	0.25	0.46	-0.34	0.60	0.19
4 to 5 year average	0.19	-3.98	0.64	-0.77	0.26	-0.97	0.96	0.02	0.04	-0.78	0.31	-0.25

 Table B.7: P-values and Average Differences for Dairy Farms, 2007-2011

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