Comparative Analysis of Profitability, Solvency and Liquidity of Dairy Farms in Pennsylvania, Michigan, New York and Wisconsin[1]

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Executive Summary

This component of the *Study to Support Dairy Growth and Competiveness* compares the financial performance of Pennsylvania farms to those in three other states with similar agronomic resources (Michigan, New York and Wisconsin) and across farm size categories regardless of the state. Data for these comparisons are from voluntary farm-financial records programs in each of the states, and thus do not represent the average farm characteristics or performance for any of the states. In particular, farms analyzed tend to own a larger number of cows with higher productivity than average. However, this is true for each of the states. We compare three measures of farm financial performance—profitability, solvency and liquidity—during the period 2011 to 2016, using Return on Assets (ROA), Debt-to-Asset Ratio (D/A) and Current Ratio, respectively.

Our key findings are:

- Pennsylvania farms tended to have lower Return on Assets, higher Debt-to-Asset Ratios and lower Current Ratios than analyzed farms in other states, although in some cases the differences are relatively small. These differences exist both for overall average values during 2011 to 2016 and many of the individual years, and when considering farm size and milk per cow;
- Overall, these measures suggest that larger and more productive Pennsylvania farms may be less resilient in the face of economic stress than similar types of farms in other states;
- However, our analysis does not directly indicate the underlying causes of these differences and their practical management or programmatic implications. Additional analyses of data for a broader range of farms—facilitated by a collaborative multi-state data collection effort is therefore suggested to address these limitations.

[1] The analyses described in this document are one component of the *Study to Support Growth and Competitiveness of the Pennsylvania Dairy Industry*, which has been funded by the Pennsylvania Department of Agriculture and the Center for Dairy Excellence.
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Overview and Study Objectives

The overall purpose of this document is to provide a comparative assessment of selected farm financial performance indicators in Pennsylvania and other nearby states with similar agronomic resources. Farm business analysis records were used to compare farm-level performance and trends among the states to glean insights about what underlies performance and what support might be provided to improve it. It is important to note that the farms included in this analysis were not randomly selected and the number of farms per state is small as a proportion of the total farms. For Pennsylvania, data were provided anonymously for 168 farms by AgChoice Farm Credit[3]. For New York, Wisconsin and Michigan, farm data were obtained from farm business analysis summary programs that are participating in the development of a multi-state comparison project that will shortly make them available through the online tool "FarmBench"[4] . The farms included in the analysis tend to be larger and more productive than the average farm in each of the state, but comparison of the financial information from these operations, however, is useful in understanding the performance trends and current levels of financial stress that dairy farms in these states are experiencing.

We assess farm financial performance based on information from balance sheets and accrual adjusted income statements. Three measures of provide an overall assessment of farm financial performance: *profitability* (measured by Return on Assets), *solvency* (measured by the Debt-to-Asset Ratio) and *liquidity* (measured by the Current Ratio). Overall, farm financial feasibility requires all three of these indicators to be within workable ranges. Although we assess only overall averages by state or farm size in this document, there is a good deal of variation among farms that would be relevant to the assessment of state-level performance.

Farm Descriptive Characteristics

The average size and milk production by state during the five-year period from 2011 through 2016 indicate that the participating New York farms had the highest average cow numbers (Table 1), and that the average Pennsylvania farm had about double the state's overall average farm size. Milk per cow for the participating Pennsylvania farms is substantially larger than the average for all Pennsylvania farms (which was about 20,000 per cow during 2011 to 2016) and is roughly comparable to milk per cow in the other participating states. The participating farms in Wisconsin had the smallest average milk sold per cow. Milk per cow tends to be positively correlated with herd size, so it is not surprising that the largest herds had the highest average productivity. It is also important to note that the reporting of average values masks a great deal of underlying variation among farms.

[3] The authors extend their appreciation to Mike Hosterman of AgChoice Farm Credit for his efforts to make these data available for the purposes of the project.

[4] The FarmBench project initially seeks to streamline the collection and summary of farm financial data from the Center for Dairy Profitability at the University of Wisconsin, Cornell's Dairy Farm Business Program and Michigan State's Telefarm data. This expanded effort will also look to partner with additional Land Grant universities as well as commercial interests who want to access broader financial benchmarks for the farm data they can supply. The FarmBench project will be operational in late 2018.

Table 1. Summary Averages During 2011-2016 for Farms Analyzed, by State and Herd Size for Pennsylvania

State and Farm Size Category	Number of Farms Analyzed	Herd Size (cows/farm)	Milk per cow (lbs/cow/yr)	Return on Assets (ROA, %)	Debt to Asset Ratio	Current Ratio[a]
Michigan	120	315	23,486	6.3	0.276	3.1
New York	244	662	23,524	6.5	0.306	2.5
Wisconsin	582	205	21,906	4.2	0.285	4.9
Pennsylvania	168					
All herds	1,114	222	22,450	4.8	0.301	2.2
<200 cows		113	21,592	4.4	0.304	2.2
200-499 cows		271	22,316	5.2	0.288	2.1
500+ cows[b]		673	24,297	5.0	0.317	2.6

[a] The current ratio is defined as the current total assets of a farm (both liquid and illiquid) relative to that farm's current total liabilities. It is therefore a liquidity ratio that measures a farm's ability to pay short-term liabilities.

[b] For Pennsylvania herds with 500+ cows, the averages are for only the years 2013 to 2016.

Comparative Farm Profitability Assessment

A profitable farm can be thought of as one that is generating a sufficient return to the unpaid labor, management and capital for the dairy operation. Profitability here is measured using Rate of Return on Farm Assets (ROA) which is the ratio of operating profit to total farm asset value. Using a ratio allows us to compare across farms and over time as it adjusts for farm size. As a benchmark, the long-run average ROA value on dairy farms generally is between 6 and 7 percent.

The average ROA values for Pennsylvania during the five years studied are lower than those for New York and Michigan farms (Table 1). Even for farms of comparable size measured by cow numbers, profitability is lower for Pennsylvania farms. For example, the ROA for NY farms (with an average of 662 cows) is 1.5% higher than for the largest Pennsylvania farms (with an average of 673 cows). Michigan farms (average 315 cows) have an ROA 1.1% higher than Pennsylvania farms with 200 to 499 cows (average of 271 cows). However, the average ROA during these years for the smallest PA farm size (less than 200 cows, average 113 cows) was slightly higher than for average for Wisconsin farms with an average of 205 cows.

Although the numbers of farm observations is relatively small, it is instructive to consider the relationship between ROA and two associated variables, herd size and milk per cow. There is a positive association[5] between farm size measured by cow numbers and ROA (Figure 1), and

[5] A "positive association" means that the variables have a positive correlation. That is, as one variable increases, the other also increases. This does not imply that one variable CAUSES another (i.e., that larger farm size causes higher ROA) because other factors that affect ROA are not controlled for. It would not be the case that just increasing cow numbers would improve ROA without appropriate modifications to farm management that underlie farm profitability. Still, it is useful to consider the associations.

this relationship appears to be nonlinear. This figure illustrates that Pennsylvania farms have profitability lower than NY and MI farms of similar sizes. The ROA also does not increase for Pennsylvania farms as farm size increases—the average ROA for the largest Pennsylvania farms is less than that for a farm with 200-499 cows. There is also a positive association between milk per cow and ROA (Figure 2). For this relationship also, Pennsylvania farms have lower ROA for a given farm size, and the ROA does not increase with higher milk per cow in the same manner as it does for the overall relationship. Further analysis of the reasons for these differences (for example, cost structures and milk prices) would be appropriate.

It is also helpful to consider profitability measures over time, which we do for the four respective states during 2011 to 2016—a period that included both record high prices (2014) and the troughs of two price cycles (2012 and 2016). The pattern was quite similar in all four states with 2011 and 2014 being higher return years and 2015 and 2016 exhibiting very low returns (Figure 3). Although overall Pennsylvania farms had better ROA over time than WI, their ROA was lower than that observed on NY and MI farms for five of six years (except 2012 for NY and 2016 for MI). Pennsylvania farms also realized the lowest average returns in 2015 and second lowest (after MI, which has a negative ROA value) in 2016.

Farms in all states exceeded the benchmark of 6% ROA in 2014, a year with record high prices, but the average ROA for all states during 2015 and 2016 was below this level. Given the comparative patterns over time, Pennsylvania farms appear to be about as resilient in terms of profitability as farms in other states, with higher ROA in high price years and low ROA in low-price years.

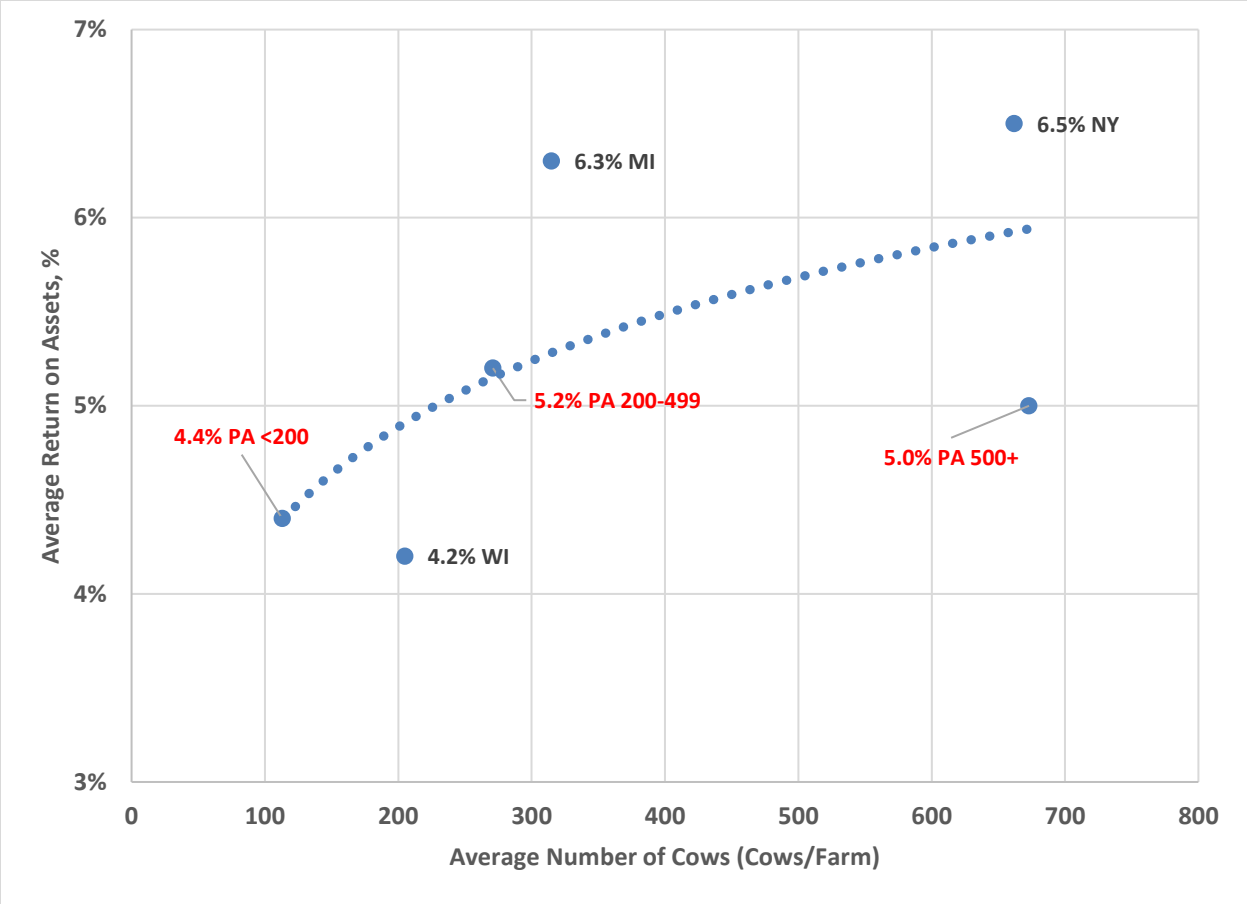

Figure 1. Observed Relationship Between Average Cows Per Farm and Average Return on Assets for Participating Farms, 2011 to 2016

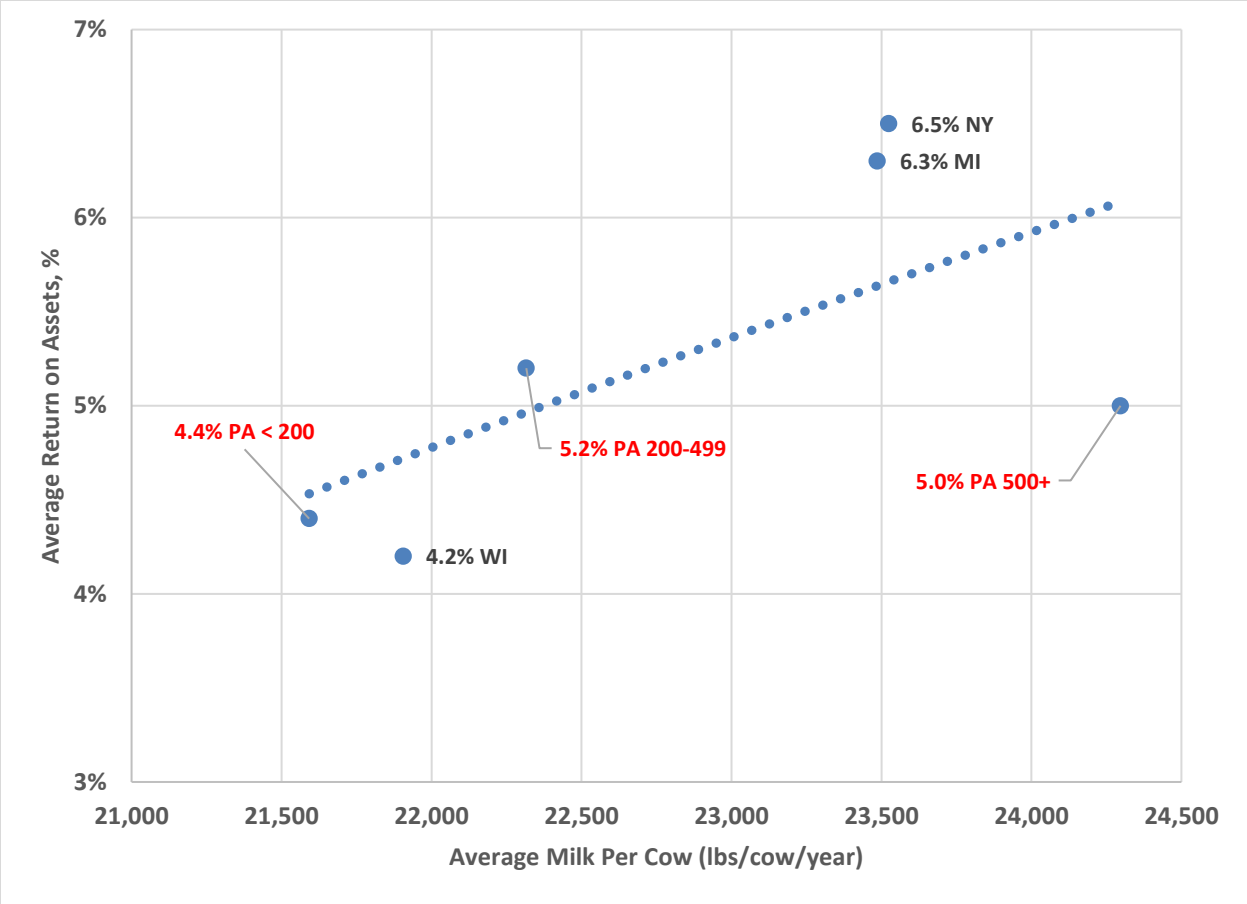

Figure 2. Observed Relationship Between Average Milk Per Cow and Average Return on Assets for Participating Farms, 2011 to 2016

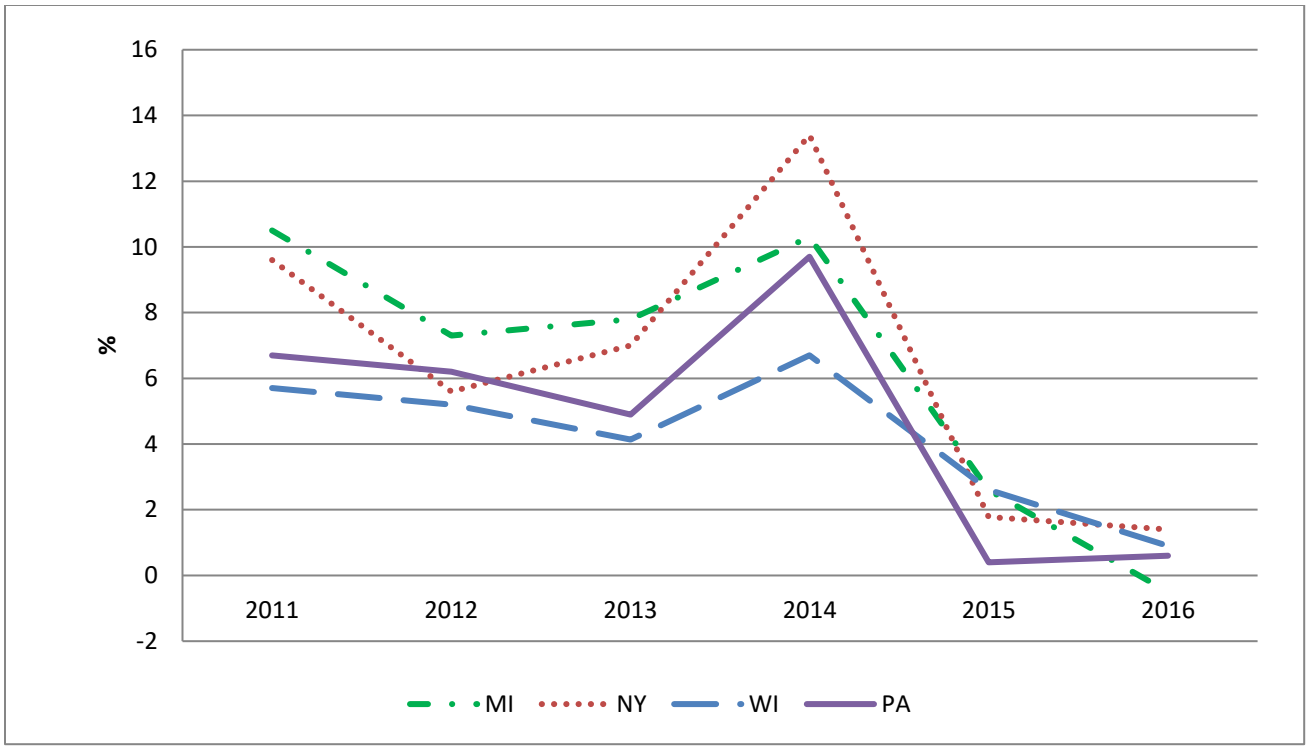

Figure 3. Average Annual Rate of Return on Assets, By State, 2011 to 2016

Combining the data for other three states and dividing the farms by herd size helps facilitate a further understanding of the differences in profitability over time between those states and Pennsylvania dairy farms. For each state, we define the herd size categories are <200 cows ("Small"), 200-499 cows ("Medium", and 500+ cows ("Large"). Michigan, New York, and Wisconsin herds were combined and averaged for comparison to Pennsylvania herds. Note that because of small number of observations, the values for 500+ cow herds from Pennsylvania were not available for 2011 and 2012.

During the five-year period analyzed, larger herds were more profitable based on ROA (thus, even when controlling for the value of business assets). In general, the large herds tend to be more profitable in good years (2011 and 2014) and converge towards the same level as smaller herds in poor years (2016). With the exception of 2014 for medium farms), the average ROA for medium and large Pennsylvania farms was below that of the average of the other three states. The smaller Pennsylvania herds were more profitable than small herds in the other three states for years other than 2015. Perhaps surprisingly, the ROA for small Pennsylvania farms was higher than that for the medium and large farms in 2016 (when the ROA was negative for the two larger Pennsylvania farm size categories).

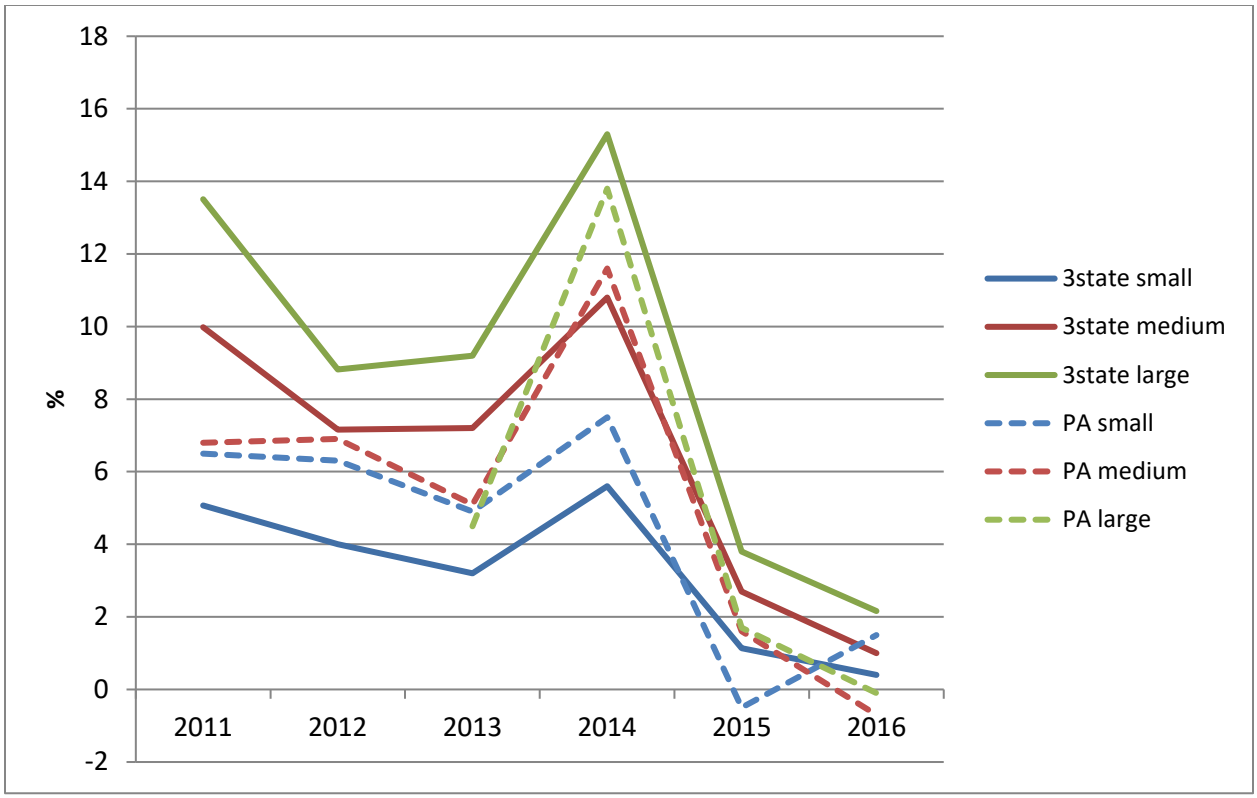

Figure 4. Average Annual Rate of Return on Assets, Pennsylvania Compared to Average of Three Other States, by Herd Size Category, 2011 to 2016

Comparative Farm Solvency Assessment

Solvency means that the farm business possesses positive equity with total farm asset value exceeding total farm liabilities. Solvency can be measured using the Debt-to-Asset (D/A) ratio defined as farm asset value divided by farm liabilities. Higher D/A indicates more risk of insolvency and has financial consequences for farm operations. For example, for farms above 60 or 70 percent D/A, borrowed capital becomes substantially more expensive. The long-run average D/A is about 30 percent for all US farms and for these dairy farms as well. There are significant life-cycle effects of D/A as it tends to rise when major expansions are undertaken and fall near retirement as operators are hesitant to take on new debt obligations.

The average value of the Debt-to-Asset ratio for Pennsylvania farms is generally higher than those for other states, except for category with 200-499 cows (Table 1). For farms of similar sizes and milk per cow, average Debt-to-Asset ratio values are larger for Pennsylvania than for other states, although the differences are relatively small (Figures 5 and 6). For example, the medium size Pennsylvania farm with an average or 271 cows has a D/A ratio of 0.288, whereas the value for all farms in WI with an average of 205 cows, is not substantively different at 0.285. Although the relationship is not a particularly close one, the D/A ratio tends to increase with farm size (Figure 5) and with milk per cow (Figure 6). As for the analysis of profitability, additional

insights could be gained through examination of the variation in D/A ratios and an assessment of underlying factors.

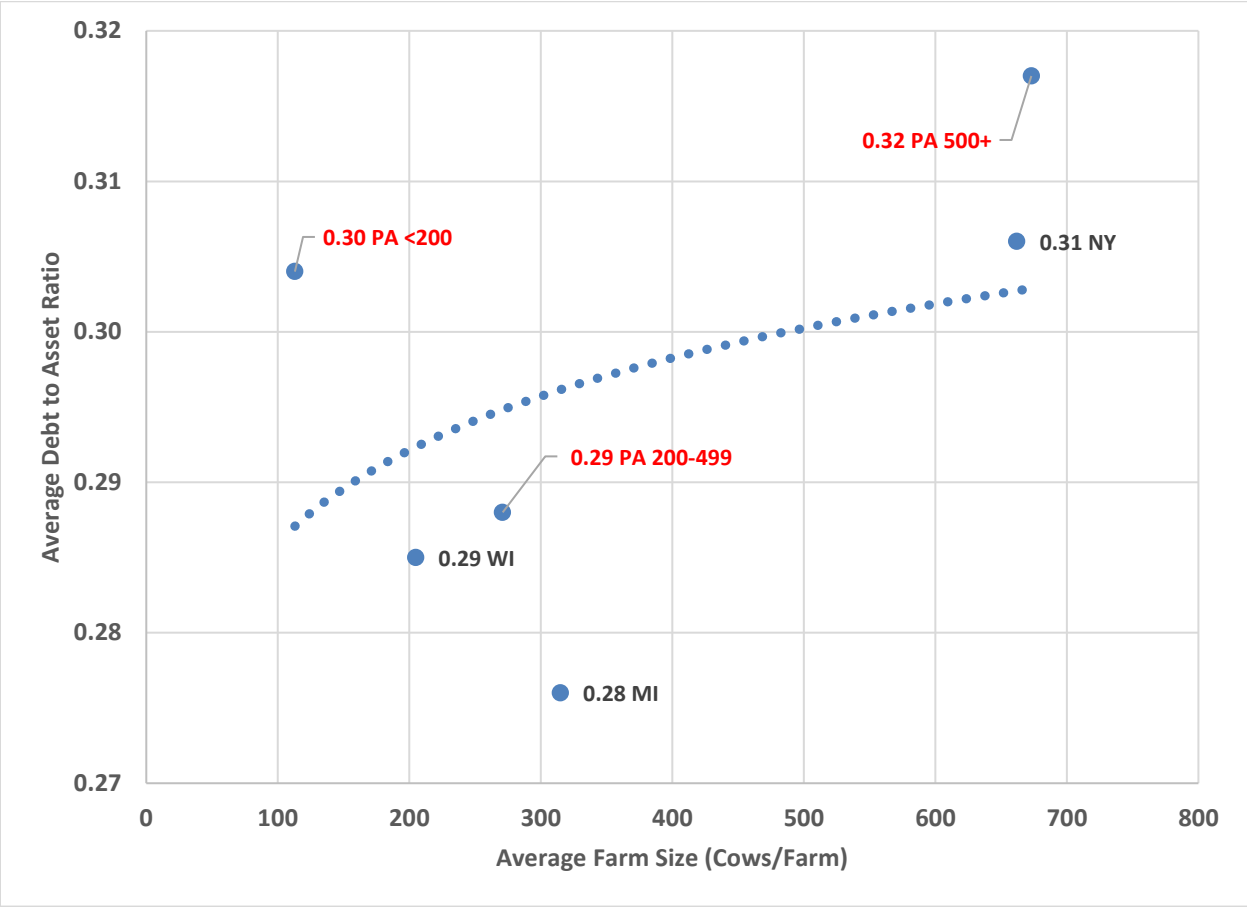

Figure 5. Observed Relationship Between Average Cows Per Farm and Average Debt-to-Asset Ratio for Participating Farms, 2011 to 2016

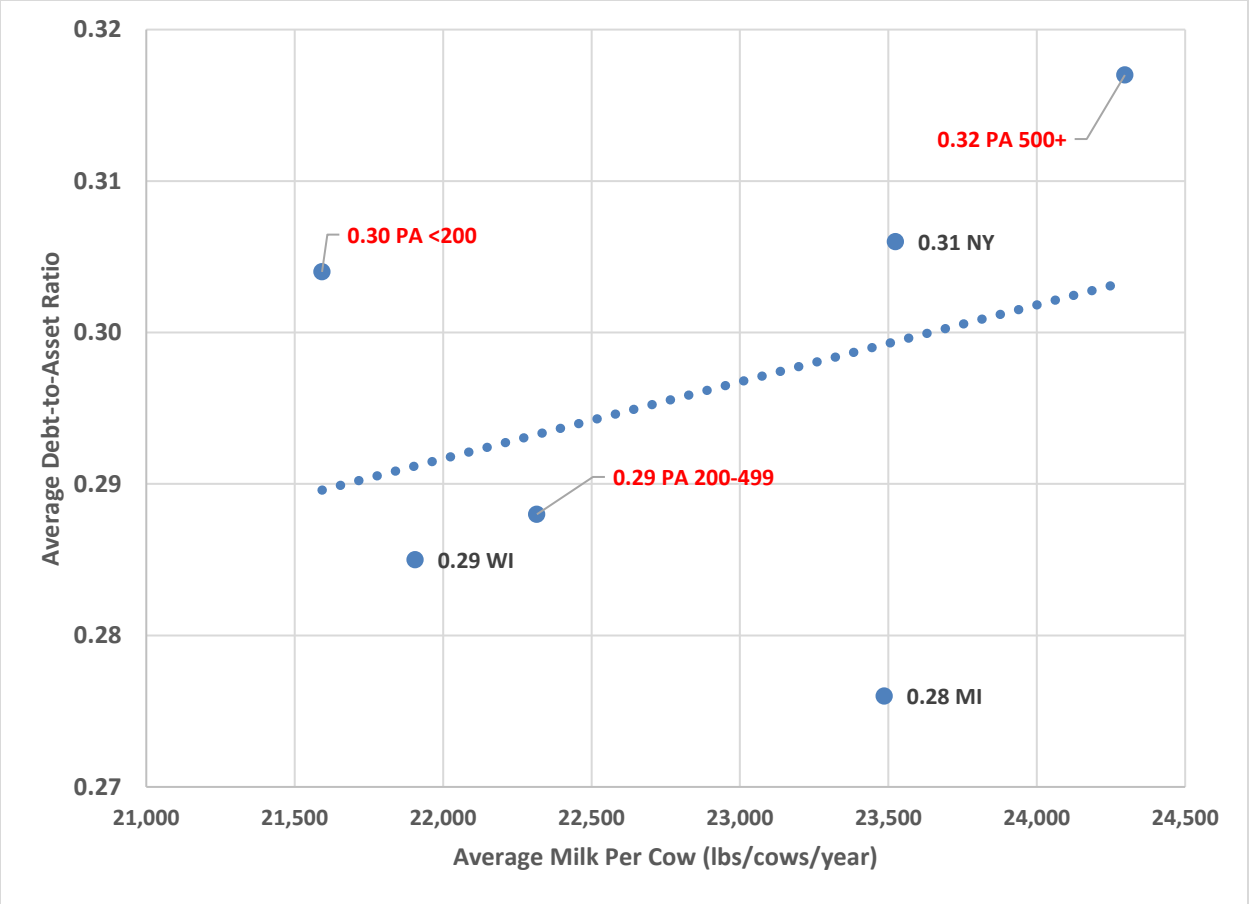

Figure 6. Observed Relationship Between Average Milk Per Cow and Average Debt-to-Asset Ratio for Participating Farms, 2011 to 2016

As for farm profitability, it is also helpful to consider solvency measures over time, which we do for the four respective states during 2011 to 2016. Although the pattern of D/A ratio over time was roughly similar in the four states, this measure tended to be somewhat more variable over time for Pennsylvania farms (Figure 2). The average value for all states decreased in 2014, a high profit year that allowed operations to pay down debt and lower the D/A ratio. The D/A ratio increased in all states as profitability decreased in 2015 and 2016. Pennsylvania farms exhibited rapidly increasing average D/A in 2015 and 2016, reflecting the financial stress of those years. The increase in average D/A ratio was somewhat more than other states. This value increased from under 0.28 in 2014 to more than 0.33 in 2016 for Pennsylvania, but only from 0.24 to 0.275 in Wisconsin. However, D/A value for Pennsylvania farms showed a pattern quite similar that for New York farms during 2014 to 2016 (although reporting New York farms are considerably larger on average).

Large- and medium-sized herds had the most debt relative to assets, likely reflecting debt undertaken for farm expansion (Figure 7). The small herds for the three states had a very low level of relative debt. Small herds in Pennsylvania had more debt and thus less solvency. However, none of these averages would tend to indicate a concerning level of debt. It is worth

noting that the high levels of profitability in 2014 led to a more solvency (i.e., less debt) and that solvency has been eroding quite quickly for all sizes of dairy farms in 2015 and 2016.

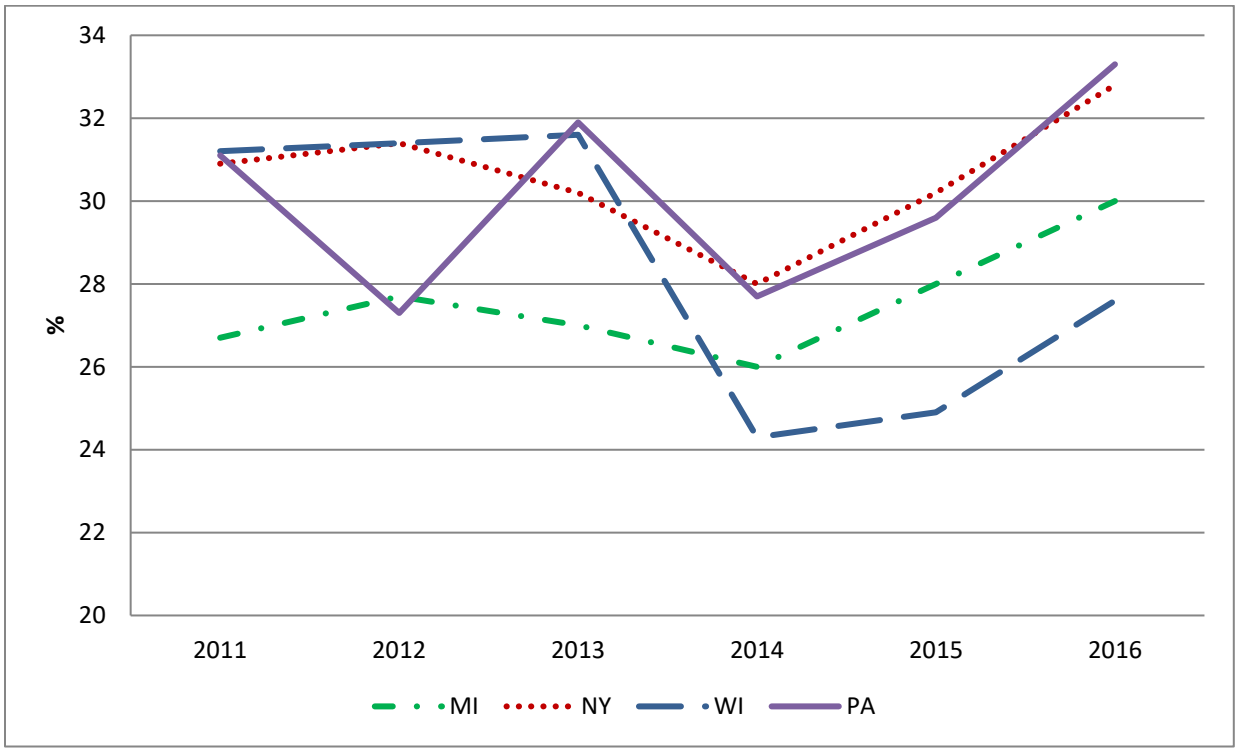

Figure 7. Average Debt-to Asset Ratio, By State, 2011 to 2016

As for the analysis of profitability, combining the data for other three states and dividing the farms by herd size helps facilitate a further understanding of the differences in solvency over time between those states and Pennsylvania dairy farms. The average D/A ratio for the small farm size category in Pennsylvania was considerably higher than the that for the average small farm value in the three other states (Figure 8). In contrast, for medium and large size farms, Pennsylvania average values were lower than those in other states in each of the five years (or three years, for the large farm category). The average D/A ratio increased for all farm categories during the lower-profitability years 2015 and 2016, but the size of the impact differed among categories. In particular, the average D/A ratio rose rapidly for the small farm category in Pennsylvania during 2015 and 2016, whereas the (lower) value for small farms in other states increased much. Overall, these results suggest that Pennsylvania farms are probably about as resilient in the face of adverse economic conditions as farms in other states.

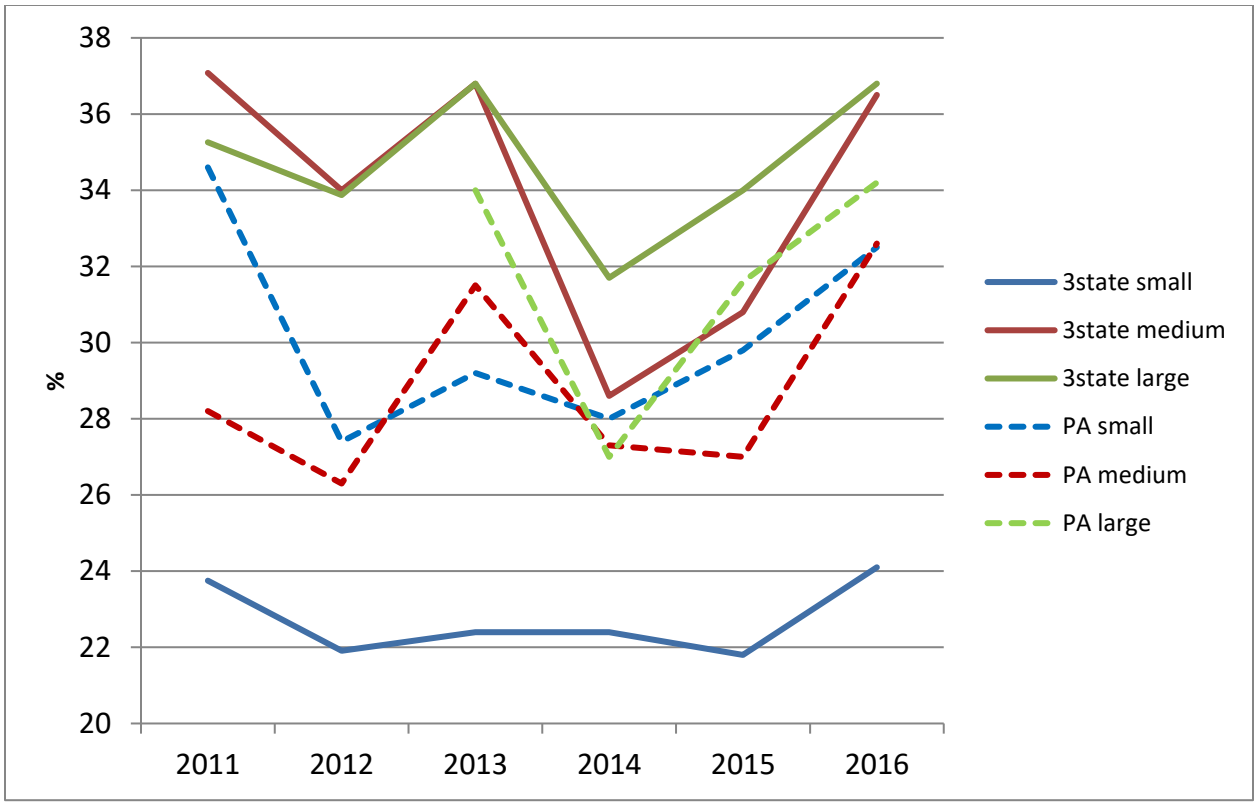

Figure 8. Average Debt-to-Asset Ratio, Pennsylvania Compared to Average of Three Other States, by Herd Size Category, 2011 to 2016

Comparative Farm Liquidity Assessment

Liquidity measures the ability to pay bills. The Current Ratio (CR) is the ratio of current farm assets (cash and assets expected to be converted to cash in the next year) to current farm liabilities (bills and debt due in the next year including the current portion of term debt). A higher ratio indicates more liquidity. If the value were one, for example, current farm assets and liabilities are equal and there is no margin of error to pay bills due in the next year. Lenders have been encouraging higher amounts of liquidity and often use a CR value of 2.0 as the minimum desired level. Excessive liquidity may not be desirable, however, as there is an opportunity cost to holding too many liquid assets, which could be invested in more productive assets.

The average value of the current ratio exceeded the often-recommended guideline of 2.0 for all states (and farm sizes for Pennsylvania), but differences existed between states. The average value of the Current Ratio for Pennsylvania farms is generally lower than those for other states, except for category with more than 500 cows, which was similar to that for New York (Table 1). For farms of similar sizes and milk per cow, average Current Ratio values are smaller for Pennsylvania than for other states, except for the largest Pennsylvania farms. Although the relationship is not a particularly close one, the Current Ratio tends to decrease with farm size

(Figure 5) and with milk per cow (Figure 6). As for the analysis of profitability, additional insights could be gained through examination of the variation in Current ratio values and an assessment of underlying factors.

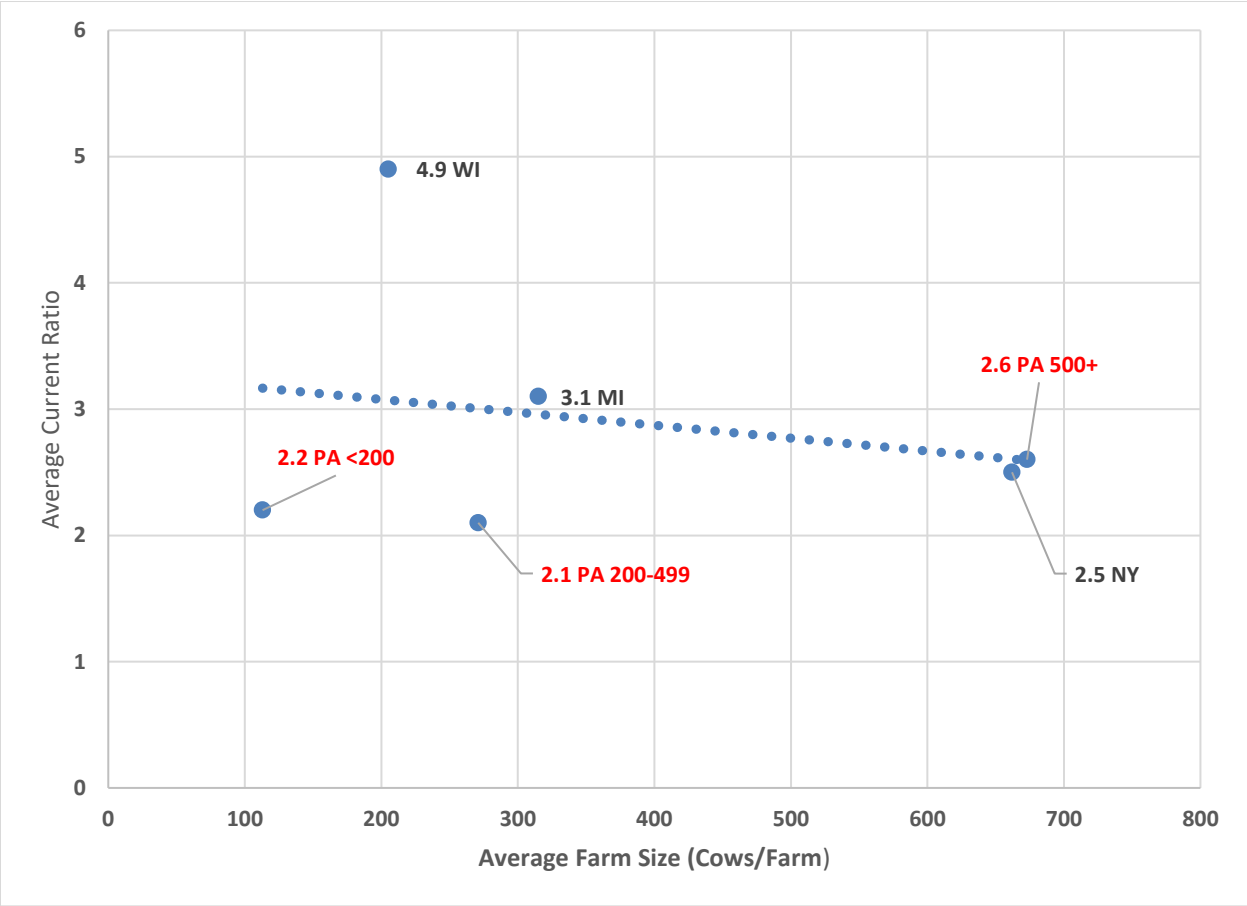

Figure 9. Observed Relationship Between Average Cows Per Farm and Average Current Ratio for Participating Farms, 2011 to 2016

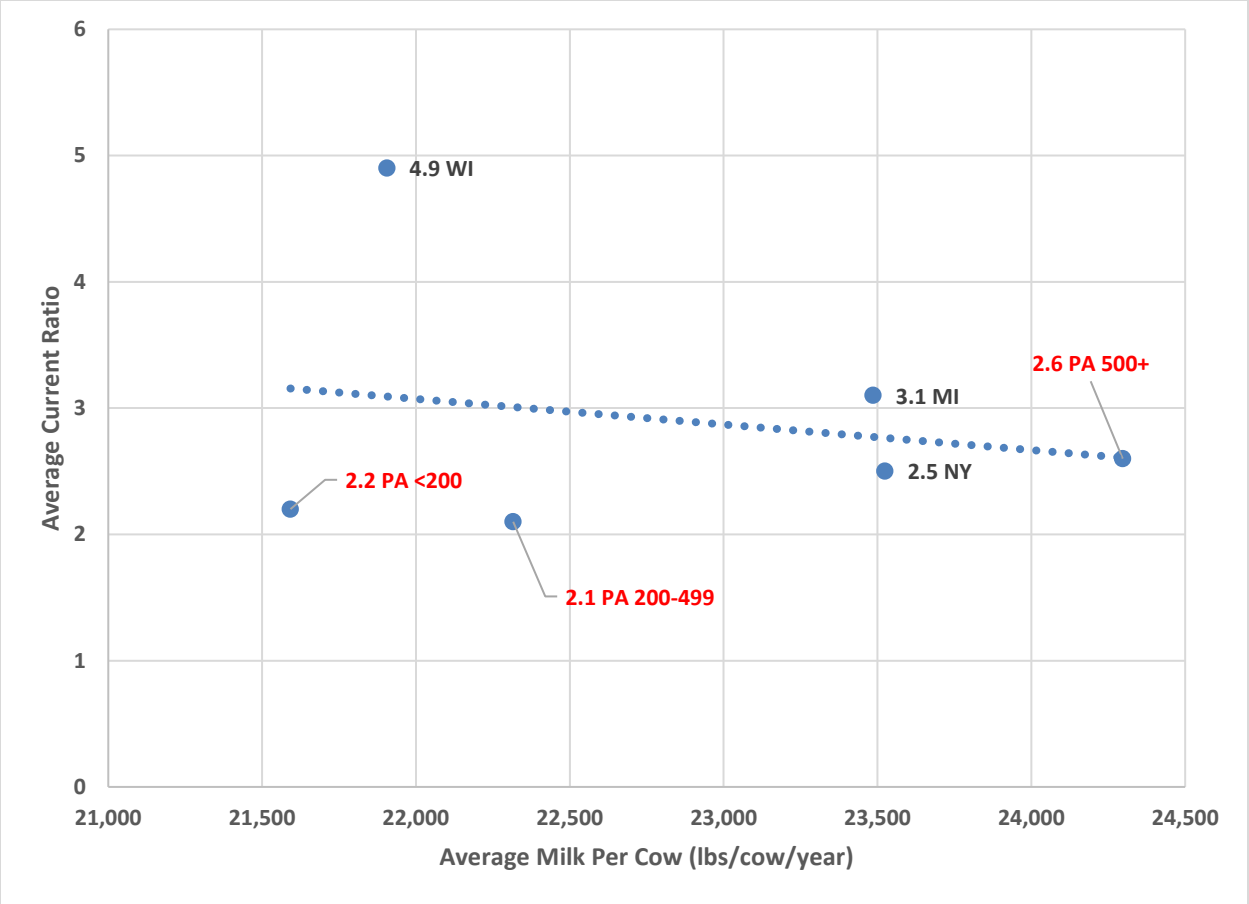

Figure 10. Observed Relationship Between Average Milk Per Cow and Average Current Ratio for Participating Farms, 2011 to 2016

As for the previous two measures of farm financial performance, it is also helpful to consider liquidity measures over time. The average values for all states were generally above 2.0 in all years (Figure 11)—although the average for Pennsylvania farms fell below this benchmark value in 2011 and again in 2016. It is again important to note that these averages mask significant variation among farms. The average value for Pennsylvania farms was always below the average value in other states. That is, Pennsylvania herds had relatively less liquidity than those in New York, Michigan and Wisconsin. The average values also reflect the stress of the past couple of years in all states, as they have trended downward indicating an increasing amount of financial risk. In particular, the average current ratio for small and medium sized herds was quite low to finish 2016. Financial stress tends to manifest initially as low liquidity. However, although the starting points and patterns differ, the decrease in Current Ratio for Pennsylvania farms is similar to that in other states from 2014 to 2016.

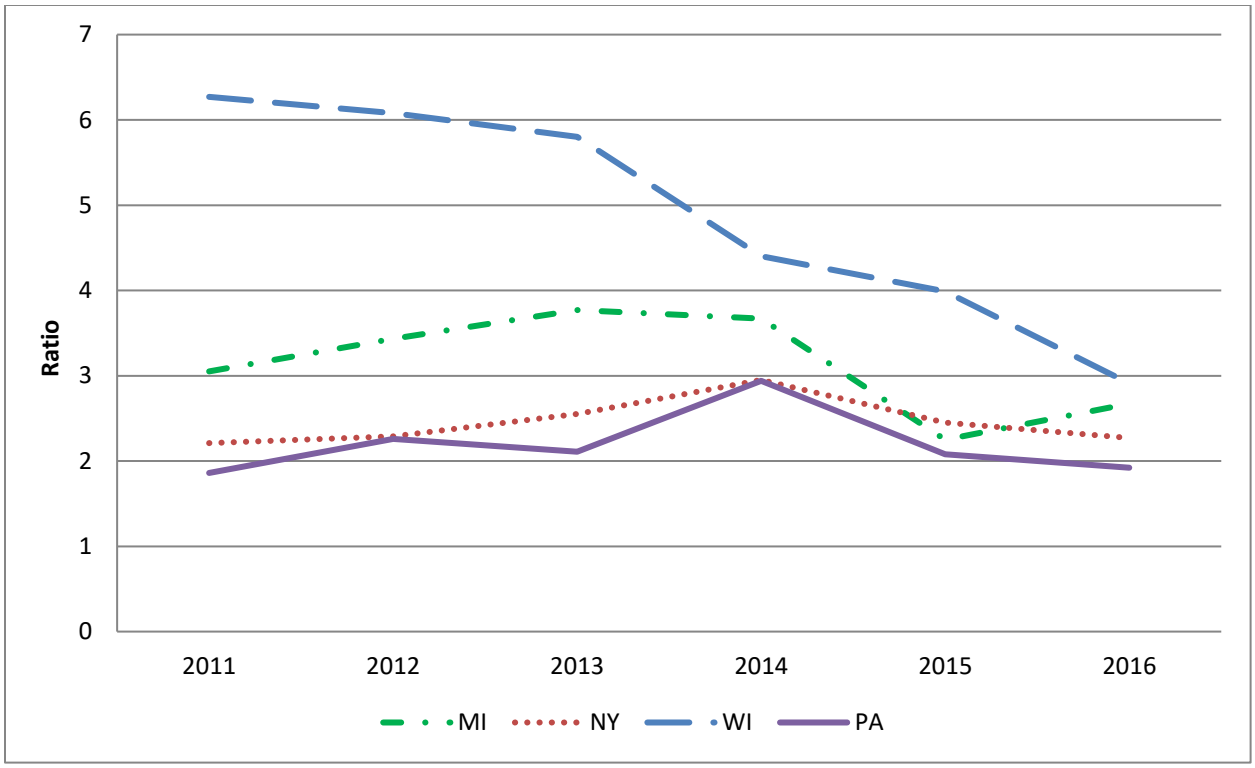

Figure 11. Average Current Ratio, By State, 2011 to 2016

As for the analysis of the other farm financial performance measures, combining the data for other three states and dividing the farms by herd size helps facilitate a further understanding of the differences in liquidity over time between those states and Pennsylvania dairy farms. The average value of the Current Ratio tends to be lower for Pennsylvania farms in a given size category than the average of farms in the three other states for most years. For the smallest farm size category in Pennsylvania, the Current Ratio dropped below 2.0 during both 2015 and 2016, whereas the value for the small farms in other states did not. The average value of the Current Ratio for medium-sized Pennsylvania farms never rose above 2.8 during this five year period and was well below 1.5 during both 2011 and 2016. The largest Pennsylvania farm size category also experience a value below 2.0, in 2013. Overall, these results suggest that Pennsylvania farms are somewhat less resilient than those in other states—as measured by liquidity—when under financial greater degrees of financial stress.

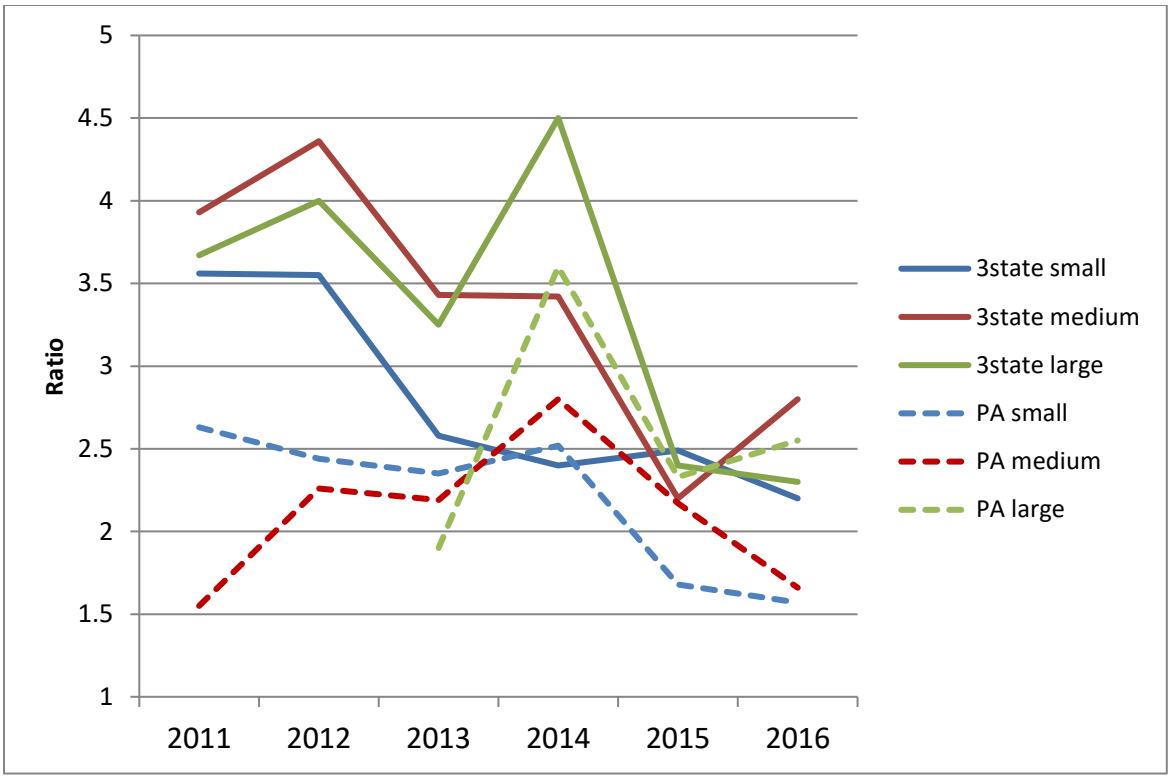

Figure 12. Average Current Ratio, Pennsylvania Compared to Average of Three Other States, by Herd Size Category, 2011 to 2016

Implications and Limitations

The foregoing analyses suggest that larger and more productive Pennsylvania farms do not, in general, have the same level of financial performance—and likely not the same degree of resilience in the face of financial stress—as larger and more productive farms in other states. As relevant as this comparative result is, there are two key limitations that could usefully be addressed by future analyses. First, these results in and of themselves do not identify the underlying causes of these differences, and thus provide limited direct guidance on what might be done from a managerial or programmatic perspective to improve performance. Second, the analysis does not include many of the more typical farms in each of the states, and this would be particularly important for Pennsylvania given the large number of smaller farms with lower milk per cow—for which these analyses may provide limited insights. Thus, a key recommendation is for further analysis of existing data, and implementation of a more comprehensive data collection and analysis mechanism that would track the financial performance of a broader range of farms over time, and allow more detailed assessment of underlying causes and potential responses. The *FarmBench* online data platform currently under development may serve as a centralized data collection effort that could provide these outcomes at minimal additional cost.