Abstract

Production records for swine producers specializing in niche markets (e.g., natural) are analyzed to determine the factors impacting profitability. The data span a cross section of 42 niche pork producers and record their 2006 production costs. Profitability was measured by the net margin (adjusted for inventory and after all costs) per hundred pounds of pork produced. In comparing the 10 most and 10 least profitable producers, there were statistically significant differences in production costs (feed, labor, and other operational costs) and efficiency (feed conversion, labor intensity, and farrowing frequency). Notably, there was not a statistically significant difference in the price received for market hogs.

Multiple regression analysis shows that 82 percent of the variation in profitability across producers is explained by feed costs, labor efficiency, production efficiency, management experience, and the production of more specialized niche pork (e.g., certified organic). Profit margins were negatively impacted by greater feed prices, feed conversion rates, labor intensity, and veterinary expenses. Profit margins were enhanced by greater farrowing efficiency (pigs per litter and farrowings per year), years of niche pork production experience, and the marketing of "certified organic" pork.

Determinants of Profitability in Niche Swine Production

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Introduction

The industrialization of agriculture has led to larger farm size, fewer farm numbers, and a move toward contracting and other coordinating relationships between farmers and entities further up the supply chain (Boehlje and Lins, 1998). The evidence of this evolving agriculture is probably best illustrated by the massive structural changes in the U.S. pork industry since the early 1990's (Barkema, Drabenstott, and Novack, 2001). In 1992, the U.S. had 236,210 hog operations with less than 1,000 head, accounting for 53 percent of the total hog inventory. In 2002, that number had fallen by more than one-third to 62,693 producers, accounting for only 13 percent of the U.S. inventory. By 2008 that number had stabilized at around 61,000 producers (USDA).

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One of the possible reasons the number of small hog producers has stabilized is the growth in niche pork production (e.g., organic or all natural) which lends itself to smaller production units. There has been growing consumer demand for pork produced from alternatives to modern indoor production systems. In particular, producers have responded to consumer demands for items such as "natural" pork which is raised without the use of antibiotics and relies on bedded pens with outdoor access (Stender, et al., 2008a). Consumer visibility to these products has been raised at the food service level by programs such as Chipotle Mexican Grill's "food with integrity" program.[1] On the retail level, Whole Foods Market's programs for natural and organic meats garners considerable consumer loyalty, while Niman Ranch is one of the more visible producers and processors of natural meats.[2] The trend towards more niche pork products raised in alternative production systems is an opportunity for smaller production units to thrive again in the pork industry. To help facilitate the growth of this segment of pork producers, it is important to understand the key determinants of profitability in niche pork production such that producers can focus on improving in these areas.

Our goal with this research is to provide relevant and usable research results to a growing segment of the swine industry: niche pork producers. In particular, we aim to identify the key determinants of profitability within this production sector. To that end, we examine the production and financial records of 42 niche pork producers to identify the determinants of profitability across producers. It is important to provide these producers with guidance in regards to factors that impact profitability such that they may better understand their production economics and improve their financial performance.

The Niche Pork Data

In 2006, Iowa State University collected data on a cross section of niche pork producers in Minnesota, Iowa, and Nebraska. The producers were asked to maintain detailed production records for a one-year timeframe and complete a survey of management/personal questions (e.g., years of experience, types of production practices). Area extension specialists worked with the producers to assure a consistent set of records and to follow-up on incomplete responses.[3] The anonymous data were made available by Iowa State University through the National Pork Board for use in this research.

Complete financial and production records are available for 42 niche pork producers.[4] While the financial data were relatively complete for all 42 producers, the personal survey data were missing for 16 of the 42 producers (38% missing). So, in the statistical analysis the focus is primarily on the financial and production records. When the personal survey data are utilized (e.g., years of experience) the missing data are replaced by the average of the usable responses.

The sample of niche pork producers varied widely both in terms of scale, practices, and operator experience. For instance, the number of years raising pork ranged from one to 42 years of experience. The size of the operations ranged from an average sow inventory of seven up to 600 head. Some producers used boars for breeding while others practiced artificial insemination. Similarly, some producers finished their hogs in modern finishing buildings while others used hoop structures and still others used an "old building or dirt lot."

Clearly, there is a great deal of variation among production practices and not surprisingly also in financial performance. The least profitable producers lost as much as $20.00 per hundred pounds (cwt.) while the most profitable producers netted in excess of $10.00 per cwt. of production. In the next section we examine characteristics that differ between the categories of the 10 most and 10 least profitable producers.

Categorical Analysis

The data are sorted by profitability (net margin per cwt.) to identify statistical differences between categories of producers. In particular, the 42 producers are categorized as the "top 10" most profitable producers and the "bottom 10" least profitable producers. Then, a difference in means test (two-tailed t-test) is conducted between the two groups assuming unequal variance across the groups.[5]

Profitability Measures

The net profit margin [total revenue-total costs (including inventory adjustments)] per hundred pounds of pork produced serves as our primary measure of profitability. This is consistent with other measures in the literature and with economic theory of the firm which focuses on costs and profits per unit of output. However, other measures of profitability may also be important to producers; so, Table 1 shows profitability measured along a number of other dimensions.

As shown in Table 1, there is a statistically significant $29.04 per cwt. difference in net margins between the average of top 10 and bottom 10 producers. The top 10 producers enjoyed a net profit margin of $11.61/cwt. while the bottom 10 producer had net margins of -

$17.43/cwt. Not surprisingly, the other profit measures show similar results. For instance, the top 10 producers had a 47.6 percent return on capital while the bottom 10 had a -49.5 percent return on capital. Similar results are shown for profit per female, return to labor and management, and net profit per market hog. In all cases the difference in profitability between the most and least profitable categories is statistically significant (10% level).[6]

Cost Measures

Again, the producers are sorted by profitability (net profit margin) and the average cost of production for certain items are calculated for the group as a whole as well as the 10 most profitable and 10 least profitable producers. In Table 2 and all subsequent tables, the first row shows the average net profit margin for each category to remind the reader of the sorting criteria.

In Table 2, the cost of production measures are all presented in $/cwt. of production. The total cost is presented along with the components: feed; labor and management; other operating costs; depreciation, taxes, and insurance; and capital charges. The average producer has a total cost of $53.54/cwt. of pork produced while the top 10 producers' total cost averages only $45.47 and the bottom 10 average $67.85. The difference in total production costs ($22.38) between the top 10 and bottom10 producers is statistically significant at the 10 percent level. Notably, an examination of the individual cost components reveals that the driver and the largest component of total costs is feed costs. All feed costs for the entire group is $26.75 while the top 10 producers have a statistically smaller feed cost ($23.14) than the bottom 10 producers ($33.14). The difference is $10.00/cwt. and statistically different from zero at the 10 percent level.

Feed cost is not the only statistically different cost difference between the top 10 and bottom 10 profitability categories. The top 10 most profitable producers also enjoy lower labor and management costs ($11.40 vs. $19.32) and lower costs for other operating expenses ($6.51 v. $9.43) such as utilities, fuel, and veterinary expenses. These differences are statistically significant with p-values just under 0.10. The top 10 category also has lower costs in the other areas, but the differences with the bottom 10 category are not statistically significant at the 10 percent level.

The results in Table 2 suggest that the best performing producers (those with the highest profits) tend to have lower production costs than other producers. Moreover, the lower costs of production are driven primarily by lower feed costs. Of secondary importance are lower costs for labor and management and also lower other operating expenses (e.g., veterinary costs, utilities, and fuel).

Price and Production Measures

Table 3 shows the market prices faced by the producers in each category. Surprisingly, none of the market prices paid or received by the producer categories are statistically different across the groups. While the top 10 producers received slightly higher prices for their market hogs ($59.41 vs. $54.62), they received lower prices for cull animals ($31.68 vs. $33.37). These results are somewhat surprising as it is often asserted that successful agricultural producers are those that excel in marketing and pricing their output. This does not seem to be a factor among niche pork producers.

Table 3 also shows there was no statistical difference between the number of producers in each category who sold feeder pigs or who had to sell market hogs at a discount. Thirty-three percent of the overall group sold some feeder pigs. This proportion was lower (20%) for the most profitable producers but not statistically different from the 40 percent characterizing the lower profitability group. The top 10 group actually sold more hogs at a discount than the bottom 10 profitability group but not statistically so. Perhaps most surprising, there was not a statistically significant difference in the price paid for feed between the top and bottom 10 profitability groups. The most profitable group had a total feed price of $6.52 per cwt. of feed and the lowest profitability group had a feed price of $7.18. So, while the feed cost per cwt. of pork produced is clearly different across the two groups (see Table 2), the price paid per hundredweight of feed is not (Table 3). This suggests that the efficiency of feed use (feed conversion) must be a key differences across profitability categories.

Efficiency Measures

The average efficiency measures across the entire sample of producers as well as the profitability categories are presented in Table 4. As previously suggested, the efficiency measures can differ markedly across top 10 and bottom 10 profitability categories. Of the efficiency measures considered, the most profitable producers are characterized by the following characteristics significant at the 10 percent level. First, the most profitable producers have more 0.44 more litters weaned per sow per year than the least profitable producers. Second, the top 10 producers total herd death loss is just two versus six percent for the bottom 10 producers. Closely related, the top producers also

have a lower death loss in the breeding herd (2% vs. 6%). Third, the total feed conversion ratio for the most profitable producers (3.56) is markedly lower than that of the bottom 10 profitability group (4.63). While only marginally statistically significant (p-value = 0.11), the top 10 producers also have notable advantages in pigs per litter (6.99 versus 6.24) and in labor hours per unit of output (0.79 vs. 1.29). The top 10 producers have an efficiency advantage in all measures with the lone exception of death loss from birth to weaning. This is fairly strong evidence that production efficiency is a key determinant of profitability in niche pork production.

Overall, the data in Table 4 suggest that the top 10 most profitable producers are characterized by production efficiency: greater output with the same amount of input. In particular, they have statistically significant advantages in managing the sow herd (more litters per sow per year and less death loss) and in finishing market hogs (feed conversion). These efficiencies may arise from management skill, experience, or the scale of operations. These characteristics are explored in the next section.

Scale and Size Measures

Efficiency advantages may accrue to those producers with the greatest scale or size of production. The categorical analysis is extended to measures of scale and size by examining the following factors: total pork produced, market hogs sold, average sow inventory, and the average weight of market hogs sold. In Table 5, there is no statistically significant difference between measures of scale for the top 10 and bottom 10 profitability groups. Indeed, the top 10 producers are actually smaller than the bottom 10 producers by every measure. For instance, the average sow inventory for the most profitable group is 58 while it is 95 for the least profitable group. So, by itself, the size of the operation or scale economies is not a hallmark of profitability. This is somewhat counter-intuitive; but as pointed out by Stender, et al. (2008a) it may reflect management intensive nature of niche pork production as opposed to the capital intensive nature of conventional production methods.

Producer and Management Characteristics

Given the differences in efficiency between top and bottom 10 financial performers, it is logical to expect that management characteristics may also differ across groups. Table 6 shows the averages across categories for the following management characteristics: producer age, years producing all pork, years producing niche pork, proportion for which niche pork is their primary income, proportion utilizing hired labor, proportion marketing very specific niche pork (certified organic or only Berkshires).

Interestingly, the amount of experience of the producer is not materially different across the categories. The average producer of niche pork is about 46 years old with 25 years of experience in all pork production and five years of experience with niche pork. These averages do not deviate significantly across profitability categories. Thirty percent of the top 10 producers rely on niche pork as a primary income source while even more (50%) of the low profitability group rely on niche pork income. This difference is a bit surprising; but it is not statistically significant. Perhaps not unrelated, the most profitable producers are statistically more likely to use hired labor (60%) than the lower profitability producers (10%). The use of hired labor may reflect producers who also have larger conventional pork operations or other enterprises that provide some operational advantages (economies of scope).

Finally, the choice of producing a very specific niche pork product appears to differ across the high and low profitability categories. Specifically, five of the top 10 producers were marketing either certified organic pork and one of the top 10 producers was producing a specific breed (Berkshires). Conversely, only one of the bottom 10 profitability operations were producing for one of these markets. The difference is statistically significant and it suggests that within niche market pork there may be returns to specialization.

Overall, the categorical analysis suggests that the top 10 and bottom 10 profitability groups differ along the following factors: production costs (total feed cost, labor cost, and operating cost); production efficiency (litters per sow per year, total herd death loss, breeding herd death loss, and feed conversion); the use of hired labor; and specialized production. Notably, there was no difference in prices paid for feed or prices received for hogs across the categories. Likewise, manager experience and production scale were not different between the top 10 and bottom 10 financial performers.

While the categorical analysis is informative, it is limited because of the univariate nature of the statistical tests. That is, the linkages or correlations across the characteristics are not considered (producers with greater pigs weaned per litter may have higher capital costs). To evaluate the determinants of profitability accounting for the interaction and correlation among producer characteristics, the net profit margin must be modeled in a multiple regression framework.

Regression Analysis

The regression model explaining profitability was specified based on consistency with economic theory and prior research. For example, Chenoweth et al. (1981) shows that the profitability of low-investment swine operations is closely linked to feed conversion and the volume of production. Similarly, Sharma et al. (1997) find that profitability in non-traditional swine production is dependent on the amount of labor used and pigs weaned per sow per year. Specification of the regression model focused on unique variables that capture these traits.

Importantly, Lawrence, et al. (1999) has shown that cross-sectional differences in profitability can also depend on firm-specific characteristics beyond simple production and price variables. Those characteristics can often be difficult to capture with traditional production and financial records. Therefore, the regression analysis also includes some variables from the survey of management practices and operator experience. For instance, it is possible that certain producers have identified niche markets where consumers are willing to pay premiums for desirable pork traits (Sanders, Moon, and Kuethe, 2007) or they have successfully developed value-added products (Sanders et al., 2004). These arrangements can be captured in the model by using binary or dummy variables as indicators of special marketing arrangements.

After a set of theoretically acceptable variables were identified, a general regression model was specified. Importantly, the model cannot be constructed as a tautological accounting equation (profit = revenue – cost). So, where possible, levels of input use were used as opposed to the actual input cost and the regression did not include direct measures of output price received. Based on this approach, the following general specification is considered, where net profit margins ($/cwt.) are expressed as a function of production costs, efficiency, scale economies, management, and marketing choices.

(1) Net Margin=F(Production Cost, Efficiency, Scale Economies, Management, Marketing)

"Production Cost" variables that were specified included feed cost, capital cost, utility cost, and veterinary cost. "Efficiency" variables were often closely related to production cost measures and included variables such as feed conversion, labor intensity, death loss, and measures of herd efficiency (e.g., pigs weaned per litter). "Scale Economies" were measured with variables that capture the size of the operation such as sow inventory, total pork production, and market hogs sold. The operator's "management" skill – while related to production efficiency – was gauged by their years of all pork production, years of niche pork production, and age. Finally, the survey had information on marketing practices, including: the sale of feeder pigs, sale of cull animals, sale of discounted animals, and the production of further specialized products (e.g., certified organic).

In regards to the production of specialized pork, 33 operators were producing "natural" pork without the use of antibiotics and with bedded pens having outdoor access. These producers are primarily marketing their products to Niman Ranch or Heritage Foods USA. Four producers are strictly raising "natural" pork using only purebred Berkshire hogs and marketing their product through Eden Natural, LLC. Five producers were specializing in "certified organic" in conjunction with Organic Valley. Differences in profitability amongst the specialization are tested using a binary variable equal to unity for producers in that group and equal to zero otherwise.

Importantly, the limiting factor in the data set is the size of the cross-section (42); so, the number of explanatory variables is kept to the smallest number possible to allow for adequate statistical degrees of freedom. The initial model specification included roughly three variables in each area (e.g., efficiency) for a total of 15 explanatory variables. Then, the model was estimated using ordinary least squares (OLS). Cross-sectional differences in variance (heteroskedasticity) were tested using White's test and the null of equal variances could not be rejected. The model was simplified or "tested-down" by systematically removing those variables that were statistically unimportant or that had signs opposite of that suggested by economic theory (which could be caused by multicollinearity with other explanatory variables). The final model specification, coefficient estimates, and summary statistics are shown in Table 7.

The final model included eight explanatory variables and a constant term. The model had an adjusted R-squared of 82 percent. So, the eight variables explain 82 percent of the variation in profit margins across the cross-section of producers. This is comparable to the R-squared of 86 percent reported by Lawrence, et. al (1999) for explaining just the cost variation across conventional producers. The model contains at least one variable from each of the key areas identified in equation (1) above, except for scale economies. A number of measures of scale were tried in the model – including total pork production, female inventory, and market hogs sold.

Surprisingly, these variables tended to be statistically insignificant with negative coefficients that suggested diseconomies of scale; therefore, they were not included in the final model. While this result was unexpected, it is consistent with the data in Table 5 that shows the most profitable producers were on average smaller than the least profitable producers. It is possible that the management-intensive (as opposed to capital intensive) nature of niche pork production does not lend itself to scale economies.

In Table 7, the first five variables represent production costs, production efficiency or some combination of those factors. The feed cost variable was broken into two parts: price paid for all feed ($/cwt.) and the total feed conversion ratio. Both variables are statistically significant and the coefficients have the expected negative sign. A $1.00/cwt. increase in feed prices reduces net margins by $2.77/cwt., holding all else constant. A 1.0 increase in the feed conversion ratio reduces net profit margins by $5.57/cwt., all else equal. Collectively, this shows the dual nature of feed costs on profitability. Producers can improve margins by either identifying or sourcing less expensive feed (perhaps by growing it themselves) or by lowering the feed-to-pork conversion ratio (perhaps by using better genetics, reducing waste, managing marketing weights, and improving overall health).

The number of labor hours (paid and unpaid) needed for each hundred pounds of pork produced also had a statistically significant impact on profit margins. Specifically, for each additional hour of labor, profit margins declined by $7.80/cwt., all else equal. While some of this impact is due to the implicit cost of labor, it may also reflect that producers with greater labor usage have adopted fewer efficiency-enhancing technologies. Still, the result suggests that labor utilization is an important determinant of profitability.

The other cost factor of statistical importance is veterinary cost ($/cwt.). Veterinary expenses were important in the regression analysis when other (larger) cost components such as capital charges and utility expenses were not. A $1.00 per cwt. increase in veterinary costs is associated with a $3.09 per cwt. decline in net margins, all else equal. The importance of this variable and the relatively large magnitude of the coefficient probably reflect both the direct cost of veterinary products as well as an indirect indicator of overall herd health and the corresponding production efficiency. Producers with low veterinary bills are not only saving money on expenses directly, but also indirectly through a more healthy and productive herd.

Of the numerous measures of efficiency that were originally tried in the model (e.g., total herd death loss), the only variables that entered the model specification were litters weaned per sow per year and pigs weaned per litter.[7] Each incremental litter weaned per sow per year increases profit margins by $6.48/cwt. So, if producers can increase litters per sow per year by 0.10 from the average of 1.50, profit margins increase by $0.648 per cwt. Similarly, for each additional pig weaned per litter, profit margins increase by $1.80 per cwt. Since other variables in the model (i.e., feed conversion) capture efficiency of grow-out phase, it makes sense that these variables enter the model as a measure of farrowing-to-weaning efficiency. Collectively, these two variables suggest producers can improve profitability by increasing pigs weaned per sow per year.

In the model, there is a return to management as measured by years of experience producing niche pork. For each incremental year of experience in niche pork production, profit margins increase by $0.98 per cwt., all else equal. This seems like a relatively large return to management experience, and it likely reflects the unique management skills needed to produce and market niche pork and the fact that they are learned on the job.

The final dummy variable indicates the specialization of the producer. Binary variables were defined for the dedicated Berkshire producers (four operators), and the "certified organic" producers (five operations). Both binary variables were initially included in the model to see if these specialized producers had greater returns, all else equal, than the typical producer of "natural" pork. The coefficient estimate on the binary variable for Berkshire producers was not statistically different from zero and dropped from the model. However, the coefficient on the "certified organic" variable was a surprisingly large and statistically significant $13.47 per cwt. So, those producers who market "certified organic" pork to Organic Valley had average profit margins that are $13.47/cwt. greater than the other producers (accounting for all the other variables in the equation).

Margin enhancement for "certified organic" producers may stem from the market value of this more specialized product purveyed by Organic Valley. Alternatively, this company may provide producers with technical expertise that is not captured in the other variables. Or, there may be a common third factor such as proximity to major urban markets that confounds the analysis. However, a simple difference in means test for the average price for market hogs shows that this group

received $19.70 more per cwt. for market hogs than the other producers. The regression analysis clearly shows that at least $13.47 of this premium makes it to the bottom line, all else equal. That is, the higher price received is not completely absorbed by increased production costs needed to meet the "certified organic" specification. Niche pork producers should consider all options when choosing what to produce and with whom to partner.

Overall, the regression results are relatively strong. The specified model explains 82 percent of the cross-sectional variation in profitability (as measured by margin per cwt.). Surprisingly, the model identifies no impact of scale economies. However, the other explanatory variables are consistent with economic theory and prior research. In particular, feed cost (feed price and feed conversion), labor intensity, and veterinary costs all negatively impact profit margins. Production efficiency (pigs per litter and litters per sow per year) and experience raising niche pork (years) are margin enhancing variables. Finally, the choice to further specialize by producing organic pork may enhance profit margins. Producers of niche pork products should closely examine their operations in these areas for the potential to improve their operation's profitability.

Summary and Conclusions

The financial performance and production characteristics of niche pork producers are examined to discover the determinants of profitability. First, the profitability of each producer is measured as the net margin per hundred weight of pork produced (adjusted for inventory and all costs). Then, a categorical analysis is performed where the producers are divided into the top 10 and bottom 10 most profitable producers. Differences in means tests are used to identify characteristics that are statistically different between these two groups of producers. Finally, a multivariate regression model is used to identify the variables that are statistically associated with the cross-sectional variation in net margins.

The categorical analysis suggests that the top 10 and bottom 10 profitability groups differ by production costs (total feed cost, labor cost, and other operating costs) and production efficiency (litters per sow per year, herd death loss, and feed conversion). Notably, there is no difference in prices paid for feed or prices received for hogs across the categories. Likewise, manager experience and operation size are not different between the top 10 and bottom 10 financial performers.

The regression model is a more robust approach to evaluating the determinants of profitability because it takes into account the implicit correlation among variables. The regression model identifies the following important factors: feed cost (feed price and feed conversion), labor intensity, veterinary costs, production efficiency (pigs per litter and litters per sow per year), management experience (years), and the choice of producing further specialized products (certified organic).

It is important to meld the results of both the categorical and regression analysis to try and paint a broader picture of those items which impact the profitability of niche pork producers. A few very consistent themes emerge from the intersection of the categorical and regression analysis. First, feed costs are important. This is obvious given that feed costs are roughly 50 percent of the cost of producing niche pork. While producers can often do very little about feed prices, they may be able to take steps to lower feed usage by improving feed conversion ratios.

Second, efficiency from farrow-to-weaning is a key determinant of profitability in both analyses. The regression analysis shows that both pigs weaned per litter and litters weaned per sow per year are both statistically associated with higher profitability. The categorical analysis shows litters per sow per year are statistically different between high and low profitability producers. So, producers may want to focus intently on the number of litters farrowed per year per sow to improve margins.

Finally, while there is not a statistically significant difference in prices received for market hogs between the high and low profitability producers, there is a difference in prices based on the production of specialize pork products, i.e., certified organic pork. Those producers received $19.70 more per cwt. for market hogs than other producers. The regression analysis shows that this same marketing association resulted in $13.47/cwt. increase in net margins for those producers. So, while producers are price-takers over time, they may be able to shift up their average price and increase profit margins by further specializing their production. Granted, meeting the more rigorous specifications and qualifications for "certified organic" pork is undoubtedly more costly; but, this analysis shows that producers who successfully meet those niche requirements are rewarded with higher net profits.

In summary, the determinants of profitability in niche pork production are not all that different from conventional pork production. Producers should focus on controlling costs, especially feed costs, and improving breeding and farrowing efficiency.

Production efficiency is important throughout the farrow-to-finish enterprise. Feed conversion ratios are key in the grow-out phase and litters weaned per sow per year seem to be the more crucial variable to efficient breeding and farrowing. Years of niche experience (which is beyond the control of the producer) adds to the overall management efficiency of the operation. Finally, the one area where niche production differs from conventional production is supply chain partnering and further specialization of products. Overall firm profitability may be enhanced by carefully choosing marketing partners and targeting specialty markets within the niche pork segment.

Endnotes

[1] See Stender, et al. (2008a) for a more complete description of the data collection process and assumptions regarding capital costs, feed prices, and labor rates.

[2] Stender, et al. (2008a) report 41 usable responses. Personal correspondence with David Stender revealed that one producer was eliminated from their analysis because of uncertainty regarding the accuracy of the reported feed price. Our analysis of the data showed that this producer indeed had the highest feed price in the sample; but, it was reasonably close to a few other produces and in preliminary modeling efforts it did not create an outlier. All tests were conducted with and without this producer; there were not statistically significant changes in the results. Therefore, to maximize the number of observations for analysis this producer is included, bringing our sample to 42 producers.

[3] The results of the categorical analysis are generally consistent with those presented by Stender, et al. (2008a, 2008b). In our analysis we categorize based on a different profitability measure (net margin) and we provide tests of statistical significance between top and bottom performers.

[4] A 10 percent significance level is used for discussions within the paper; however, p-values are provided to the reader for each statistical test.

[5] Clearly these two factors combine to represent pigs weaned per sow per year. However, by breaking this efficiency measure into its components additional detail can be provided to producers about their relative importance.

References

Ahearn, M.C., H.M. Bahn, P.J. Barry, S.M. Cordes, T.I. Hewitt, G.W. Norton, K.R. Smith, and A.P. Thurow. "Doing Good by Choosing Well: Priorities for Agricultural Economics." *Review of Agricultural Economics*. 20(1998): 332-346.

Barkema, A., M. Drabenstott, and N. Novack. "The New U.S. Meat Industry." *Economic Review*. 86(2001):33-56.

Boehlje, M.D. and Lins, D.A. "Risks and Risk Management in an Industrialized Agriculture." *Agricultural Finance Review*. 58(1998): 1-16.

Chenoweth, M., B. Cruz-Galindo, T.G. Baker, and D.H. Bache. "Factors Affecting the Profitability of Low-Investment Farrow-to-Finish Swine Operations." FAO, Station Bulletin Number 327, May, 1981.

Lawrence, J.D. "Factors that Influence Prices Producers Receive for Hogs: Statistical Analysis of Killsheet and Survey Data." Iowa State University, Staff Paper No. 279, March, 1996.

Lawrence, J.D., J. Shaffer, A. Hallam, and T.J. Baas. "Factors Impacting Production and Economic Variability in Tradition Midwest Swine Enterprises." *Journal of American Society of Farm Managers and Rural Appraisers*, 1999, pp. 101-106.

Pindyck, R.S., and D.L. Rubinfeld. *Econometric Models & Economic Forecasts*. Third Edition, McGraw-Hill, New York, 1991.

Sanders, D.R., R. Beck, A. Young, and W. Moon. "Assessing the Potential for a Value-Added Pork Product in Illinois." Submitted to the Illinois Pork Producers Association, December, 2004.

Sanders, D.R., W. Moon, and T. Kuethe. "Consumer Willingness-to-Pay for Fresh Pork Attributes." *Journal of Agribusiness*. 25(2007):163-179.

Sharma, K.R., Leung, P.S., and H.M. Zaleski. "Economic Analysis of Size and Feed Type of Swine Production in Hawaii." *Swine Health and Production*. 5(1997):103-110.

Stender, D., J. Kliebenstein, G. Huber, J. Mabry, and M. Honeyman. "Efficiency of Niche Pork Production in 2006." Iowa State University Animal Industry Report. A.S. Leaflet R2362, 2008a.

Stender, D., J. Kliebenstein, G. Huber, J. Mabry, and M. Honeyman. "Returns and Costs of Niche Pork Production in 2006." Iowa State University Animal Industry Report. A.S. Leaflet R2363, 2008b.

USDA. "Agricultural Statistics, 2004." National Agricultural Statistics Service (http://www.usda.gov/nass/pubs/agr03/03_ch7.pdf), referenced on October 9, 2003.

USDA. "Overview of the U.S. Hog Industry, 2009." National Agricultural Statistics Service (http://usda.mannlib.cornell.edu/usda/current/hogview/hogview-10-30-2009.pdf), referenced on May 3, 2011.

Zeilstra, S.K, G.A. Apgar, D.R. Sanders, and A. AbuGhazaleh. "Performance Comparisons Between Pigs Raised in Hoops and Confinement in Southern Illinois." Abstract, *Journal of Animal Science*. 85(2007):5.

Table 1. Measures of financial performance

Performance Measure	Average	Top 10	Bottom 10	Difference	T-statistic	p-value
Net Profit Margin ($/cwt)	-1.81	11.61	-17.43	29.04	9.16	0.0000
Return on Capital (%)	1.4%	47.6%	-49.5%	97.1%	8.85	0.0000
Net Profit per Female ($/head)	6.00	369.26	-324.90	694.16	11.29	0.0000
Net Return to Labor & Mgmt. ($/hour)	15.88	34.95	-0.12	35.08	8.17	0.0000
Net Profit per Market Hog ($/head)	-6.25	52.21	-69.68	121.89	5.41	0.0000

Table 2. Measures of production cost

Cost Measures	Average	Top 10	Bottom 10	Difference	T-statistic	p-value
Net Profit Margin ($/cwt)	-1.81	11.61	-17.43	29.04	9.16	0.0000
Total Cost ($/cwt)	53.54	45.47	67.85	-22.38	-2.98	0.0093
All Feed Cost ($/cwt)	26.75	23.14	33.14	-10.00	-3.76	0.0027
Labor & Management Cost ($/cwt)	13.53	11.40	19.32	-7.92	-1.80	0.0942
Other Operating Cost ($/cwt)	8.59	6.51	9.43	-2.92	-1.77	0.0936
Depreciation, Taxes, Ins. Cost ($/cwt)	3.70	3.54	4.82	-1.28	-0.89	0.3917
Capital Cost ($/cwt)	1.49	1.57	1.61	-0.04	-0.22	0.8319

Note: All of these variables are dollars per hundred pounds of pork production.

Table 3. Prices and production characteristics

Price and Production Characteristics	Average	Top 10	Bottom 10	Difference	T-statistic	p-value
Net Profit Margin ($/cwt)	-1.81	11.61	-17.43	29.04	9.16	0.0000
Price for Market Hogs ($/cwt)	53.81	59.41	54.62	4.79	0.90	0.3818
Price for Cull Animals ($/cwt)	32.79	31.68	33.37	-1.68	-0.73	0.4748
Proportion Selling Feeder Pigs (%)	33%	20%	40%	-20%	-0.95	0.3561
Proportion Selling Discounted Hogs (%)	43%	50%	40%	10%	0.43	0.6733
Price paid for All Feed ($/cwt feed)	6.48	6.52	7.18	-0.66	-1.43	0.1865

Table 4. Measures of production efficiency

Efficiency and Production Measures	Average	Top 10	Bottom 10	Difference	T-statistic	p-value
Net Profit Margin ($/cwt)	-1.81	11.61	-17.43	29.04	9.16	0.0000
Pigs Weaned per Litter (head)	6.70	6.99	6.24	0.75	1.68	0.1098
Litters Weaned per Sow (number)	1.50	1.75	1.30	0.44	2.66	0.0159
Breeding Herd Turnover (%)	68%	58%	84%	-26%	-1.07	0.3039
Total Herd Death Loss (%)	4%	2%	6%	-4%	-2.33	0.0399
Death Loss of Breeding Herd (%)	6%	2%	6%	-3%	-2.00	0.0657
Death Loss Birth to Weaning (%)	20%	24%	21%	2%	0.53	0.6051
Death Loss Feeder to Market (%)	8%	10%	12%	-2%	-0.68	0.5077
Total Feed for Pork Produced (cwt/cwt)	4.13	3.56	4.63	-1.07	-3.62	0.0021
Labor & Mgt. for Pork Produced (hours/cwt)	0.93	0.79	1.29	-0.50	-1.69	0.1140

Table 5. Measures of size and scale

Measure of Size and Scale	Average	Top 10	Bottom 10	Difference	T-statistic	p-value
Net Profit Margin ($/cwt)	-1.81	11.61	-17.43	29.04	9.16	0.0000
Pork Produced (cwt)	2,152	1,812	1,852	-40	-0.07	0.9479
Market Hogs Sold (head)	669	510	601	-91	-0.44	0.6693
Average Sow Inventory (head)	90	58	95	-37	-1.42	0.1826
Average Weight of Market Hog (cwt)	273	272	274	-2	-0.31	0.7617

Table 6. Producer and management characteristics

Management Characteristics	Average	Top 10	Bottom 10	Difference	T-statistic	p-value
Net Profit Margin ($/cwt)	-1.81	11.61	-17.43	29.04	9.16	0.0000
Average Age of Producer (years)	46.4	45.9	47.1	-1.1	-0.31	0.7640
Experience Producing All Pork (years)	24.7	25.7	24.2	1.5	0.33	0.7463
Experience Producing Niche Pork (years)	4.6	4.5	5.0	-0.5	-0.56	0.5867
Proportion as Niche is Primary Income (%)	40%	30%	50%	-20%	-0.88	0.3880
Proportion using Hired Labor (%)	45%	60%	10%	50%	2.61	0.0197
Proportion Certified Organic or Berkshire	24%	60%	10%	50%	2.61	0.0197

Table 7. Regression Model Results

Dependent Variable: Net Profit Margin ($/cwt.)

Independent Variables	Coefficient Estimate	Standard Error	T-statistic	p-value
Constant Term or Intercept	21.96	11.84	1.86	0.0725
Price paid for All Feed ($/cwt)	-2.77	0.80	-3.47	0.0015
Total Feed for Pork Produced (cwt./cwt.)	-5.57	1.50	-3.72	0.0007
Labor & Mgt. for Pork Produced (hours/cwt.)	-7.80	1.72	-4.54	0.0001
Veterinary Cost ($/cwt.)	-3.09	0.95	-3.26	0.0026
Litters per Female per Year (head/female/year)	6.48	2.16	3.00	0.0051
Pigs Weaned per Litter (head/litter)	1.80	0.87	2.06	0.0474
Experience Producing Niche Pork (years)	0.98	0.39	2.51	0.0171
Producing "Certified Organic" Pork (yes=1, no=0)	13.47	2.53	5.32	0.0000

R-Squared: 0.86

Adjusted R-Squared: 0.82