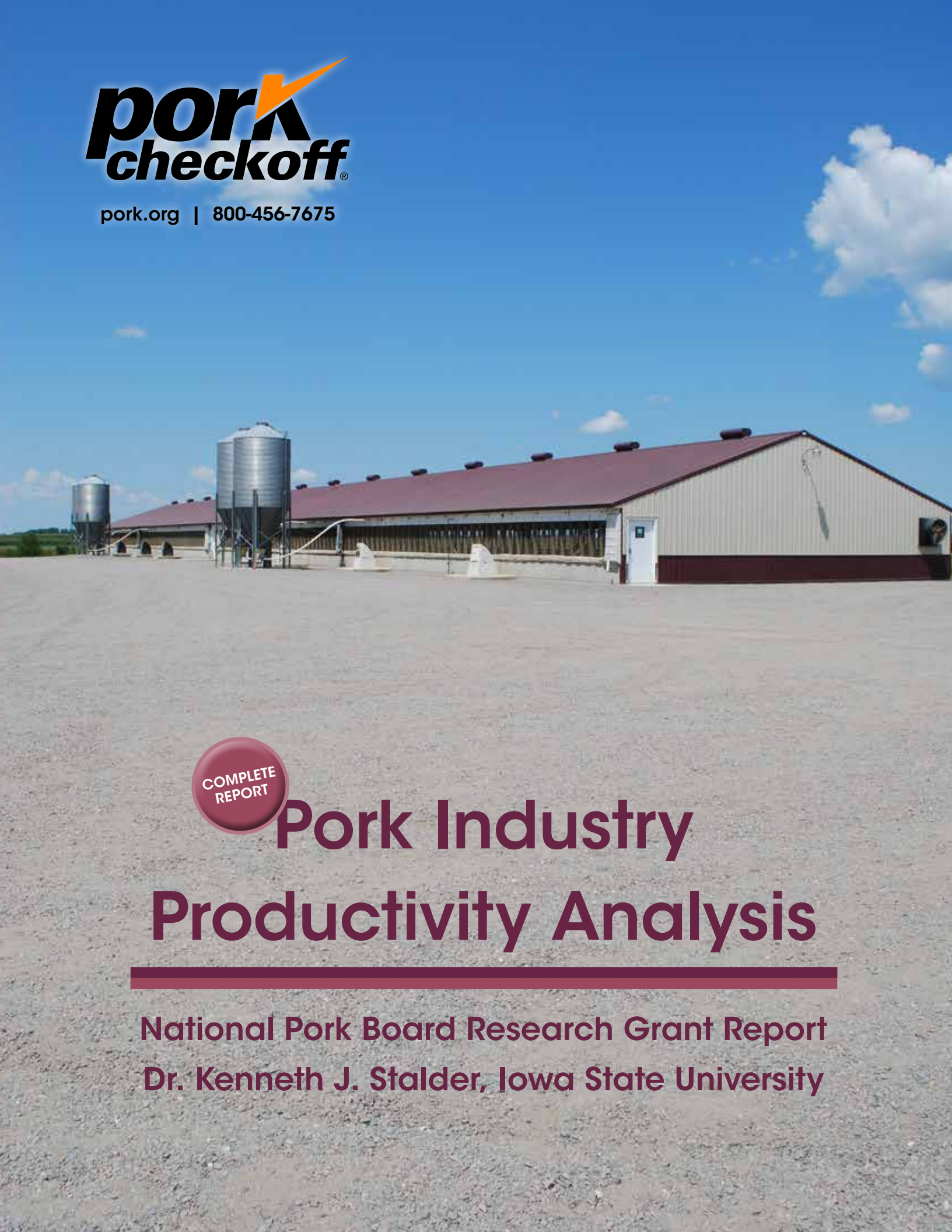**pork checkoff**®

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COMPLETE REPORT

Pork Industry Productivity Analysis

National Pork Board Research Grant Report
Dr. Kenneth J. Stalder, Iowa State University

Industry Summary

The swine industry, like any industry, strives to continually increase production efficiency over time. Additionally, it is known that seasonal effects impacting productivity in the swine industry exist. In order to quantify the overall improvement in the industry and to determine how seasonality impacts the industry as a whole, a national database must be analyzed for production changes between seasons, across years, and among different production systems. The results presented in this study are based on a group of pork production companies representing approximately 35% of the U.S. swine industry. The study objective was to quantify the annual production levels and the variation associated with several key performance indicators for the swine industry in all swine production phases (i.e. sow farm, nursery, wean-to-finish, and conventional finisher facilities) from 2007 to 2012 as well as to quantify seasonal effects associated with the key performance indicators.

The results of this industry analysis indicate that the swine industry has been successful in improving production efficiency; however there are some performance indicators, such as pre-weaning mortality, that may need to be focused on in the upcoming years. Changes have been made to increase the pounds of pork produced in a given time frame while reducing finishing mortality. This along with increased litter size has increased the throughput of the swine industry as a whole. The industry improvements over time can be attributed to better genetics, health, management, etc. The results from this analysis can used to determine when management practices need to be improved and/or maintained to ensure the maximum performance level for each swine production stage based on where each farm ranks for a given performance indicator. Knowing when production levels decreased will allow producers and researchers to focus efforts on improving production practices during that time to increased production levels, improve production efficiency, and ultimately improve operational profitability.

Scientific Abstract

The swine industry, like any industry, strives to continually increase production efficiency over time. Additionally, it is known that seasonal effects impacting productivity in the swine industry exist. In order to quantify the overall improvement in the industry and to determine how seasonality impacts the industry as a whole, a national database must be analyzed for production changes between seasons, across years, and among different production systems. The results presented in this study are based on a group of pork production companies representing approximately 35% of the U.S. swine industry. The objective of this study was to quantify the annual production levels and the variation associated with several key performance indicators for the swine industry in all swine production phases (i.e. sow farm, nursery, wean-to-finish, and conventional finisher facilities) from 2007 to 2012 as well as to quantify seasonal effects associated with the key performance indicators.

To determine the industry trends over time raw means and standard deviations were used. To determine the seasonality effects, a linear model with fixed effects of year and company was used. Start age, start days, and days in facility were used as covariates for production information from nursery, grow-finish, and wean-to-finish facilities. Weaning age was used as a covariate for the sow farm production indicators.

The results of this industry analysis indicate that the swine industry has been successful in improving production efficiency; however there are some production indicators, such as pre-weaning mortality, that represent opportunities where improvement could increase production efficiency for the farm, company, and U.S. industry levels. Changes have been made to increase the pounds of pork produced in a given time frame while reducing finishing mortality. This along with increased litter size has increased the throughput of the swine industry as a whole. The industry improvements over time can be attributed to better genetics, health, management, etc. The results from this analysis can used to determine which management practices need to be improved and/or maintained to ensure the optimum performance for each swine production stage based on where each farm ranks for a given performance indicator. Knowing when production levels decreased will allow producers and researchers to focus efforts on improving production practices during that time to increased production levels to reduce the seasonality typically observed in the swine industry.

Report

The swine industry, like any industry, strives to continually increase production efficiency over time. Additionally, it is known that seasonal effects impacting productivity in the swine industry represent substantial economic loss. In order to quantify the overall improvement in the industry and to determine how seasonality impacts the industry as a whole, a national database was evaluated for production changes between seasons. The results presented in this study are based on information submitted to a national benchmarking system that represents approximately 35% of the U.S. swine industry. The objective of this study was to quantify the annual production levels and the variation associated with several key performance indicators for the swine industry in all swine production phases (i.e. sow farm, nursery, wean-to-finish, and conventional finisher facilities) from 2007 to 2012 as well as to quantify seasonal effects associated with the production indicators.

One way these data may be utilized by companies and individual producers is establishing production benchmarks and targets (goals). Benchmarks are used to describe achievable performance levels for various production indicators. Benchmarks can be used to make performance comparisons between countries, companies, and farms. These comparisons can then be used to set goals for increasing herd performance. Producers can determine which production indicators need to be improved relative to the benchmark values. It is important to set attainable goals where improvements can be made incrementally. Once goals are set a plan must be defined and implemented to achieve the desired performance.

Seasonal effects can appear in all production phases. They result when production levels vary based on the time of year. For example, heat stress can have detrimental effects on production levels. Understanding seasonal effects can help producers to understand causes of lower production and levels, and then, they can make focus or improve management for specific issues during certain parts of the year. For example, monitoring when curtains are open versus closed may be more important in cooler seasons when the temperature is more variable compared to summer months when curtains should be opened constantly. Understanding and making changes to deal with seasonality can improve the production efficiency for swine operations.

To begin the large dataset evaluation, the number of companies and farms by year was tallied by year. The number of companies and the number of farms in each production stage is shown in Table 1. The farms represent the multiple sites owned by an overarching company. The dataset increased in size from year to year, especially when looking at the number of companies contributing or reporting wean-to-finish data. The number of conventional finishing companies increased from 29 in 2007 to 50 in 2012. This is a 72.4% increase in the number of companies reporting data from conventional grow-finish facilities. Similar trends can be observed for the number of farms recording conventional grow-finish facilities doubled from 2007 (849 farms) by 2012 (1744 farms). This resulted in a 105.4% increase in the number of farms recording conventional grow-finish production data. Additionally, the number of companies with wean-to-finish facilities has shown tremendous growth increasing from 17 in 2007 to 28 in 2012 which is a 64.7% increase in the number of companies reporting wean-to-finish production information.

Similarly, the number of farms recording wean-to-finish production information increased from 251 in 2007 to 830 in 2012 over a 3-fold increase in just 5 years. The number of companies and farms reporting nursery data followed the trends of the number from the conventional grow-finish production information. The number of companies owning sows stayed relatively steady from 2007 to 2012 only increasing by 2 companies; however, from 2011 to 2012, 7 new companies owning sows were adding to the database. This added over 200 farms in the same time frame.

The key production indicators analyzed for conventional finishers and wean-to-finish facilities were percent mortality in finisher, finishing weight, days in finisher, and finisher feed conversion. Similar production indicators were analyzed for the nursery facilities. The sow farm measures analyzed were pigs/mated sow/year, litters/mated sow/year, total born, still born and mummies, number born alive, number weaned, percent pre-weaning mortality, weaning weight, and weaning age.

Records were reported monthly for each production stage. For finisher and nursery data, averages within a month are based on animals exiting the facility in that month. For sow farm data, averages within a month are based on litters weaned in the month. A separate model was analyzed for each production indicator. All models contained company and month as fixed effects and year as a covariate. Additionally, effects for sow farm production indicators were adjusted for weaning age and effects for the nursery and both finisher types were adjusted for starting weight, starting age and days in the facility. Company means are not reported.

The increase in the number of companies and farms represented in the dataset indicates a tremendous improvement in the volume of information and the interpretations that can be made from the wean-to-finish production data. This data suggests that the U.S. pork industry was becoming much more data driven during this time period as indicated by the tremendous increases in the number of companies and farms reporting in the grow-finish and wean-to-finish production phases. Furthermore, data trends suggests that grow-finish and wean-to-finish producers were becoming much more like their sow farm counterparts where decisions at the farm level needed to become much more data driven and the industry needed to move in a direction where data needed to make these decisions was collected whether the questions centered around employee, financial, health, nutritional, genetic or some combination of issues that needed to be addressed.

Tables 2-5 report the average and standard deviation for the key production indicators by year for each production stage. Tables 6-9, 10-13, and 14-17 contain the average and standard deviation for each production indicator for the top 10%, top 25% and bottom 25% of farms in each production stage, respectively. The farms in each percentile were determined for each production indicator meaning that the farms in each percentile were not the same for each production indicator. The top and bottom were defined as desirable and undesirable for each trait rather than numerically higher and lower.

Finishing mortality has decreased by about 2% for both types of finisher facilities (grow-finish and wean-to-finish) from 2007 to 2012. Finishing weights have increased over time for both conventional finisher and wean-to-finish facilities; however, days in finisher remained the same for conventional finishers and increased for wean-to-finish facilities. Wean-to-finish facilities had higher mortality compared to conventional finishers, but this would be expected as wean-to-finish producers are dealing with a newly weaned pig that is not accustomed to eating dry feed and may or may not be familiar with water access and is much lighter body weight compared to pigs in grow-finish facilities. Additionally, pigs housed in wean-to-finisher facilities for a longer period of time compared to conventional finishers which can contribute to the greater mortality when compared to conventional finishers. A 2% improvement in finishing mortality for a 1000-head finishing facility would be equivalent to $3,240 each time the barn is turned assuming a 270 lb finishing weight and $60/cwt live market price. Along with this, the average daily gain increased for conventional finishers and remained relatively unchanged for wean-to-finish facilities. Since finishing weights are similar for conventional and wean-to-finish facilities due to the amount of time pigs spend in each facility, average daily gain is greater for conventional finishers (effect of 50 – 270 lb. pig in conventional finishing vs. 12 – 270 lb. pig in wean-to-finish barns). Feed conversion has slightly improved for both finisher types from 2007 through 2011. Nursery production levels have changed little over the same time period when compared to finishers.

Pigs/mated sow/year has increased by almost 2 pigs from 2007 to 2012. This can be attributed to better management and/or improved genetics. The top 10% of farms in pigs/mated sow/year average 28.5 pigs. While many people like to advertise how they have been able to achieve 30 pigs/mated sow/year, this data clearly points out that few producers are able to achieve this productivity level and more importantly most producers are not able to sustain that high production level for any length of time. Clearly, producers should benchmark where they are currently at and identify areas where improvement could help them improve production efficiency in their operation or any phase of their operation. Litters/mated sow/year has changed little suggesting that most of the increase in pigs/mated sow/year has been a result of increasing litter size. Total born has increased by over a pig from 2007 to 2012 with some of the increase being still born and mummies so that number born alive has only increased by 1 pig. Number weaned has increased by 0.8 pigs. Unfortunately, percent pre-weaning mortality has increased. The increase in pre-weaning mortality represents lost opportunity for the pork industry, production companies and individual production farms where pre-weaning mortality was not maintained at previous levels (or even improved) and increased number of piglets born alive occurred over time. Weaning age has increased by 2 days and weaning

weight has increased by 1 lb. from 2007 to 2012. This indicates a shift from early weaning to weaning an older, as a heavier pig is more desirable to move into today's wean-to-finish production systems.

Figures 1-24 graphically depict the change over time for the top 25%, overall, and bottom 25% average for each production indicator in each production stage in the red, black, and blue lines, respectively. This visual representation clearly depicts traits that are changing in the same direction for all three groups, but each group may have different slopes (rate of change) depending on the trait being evaluated.. For example, litter size averages have increased at almost the same rates for top 25%, overall, and bottom 25% groups. This suggests that a litter size limit has yet to be reached. On the other hand, the variation between the three groups in percent finisher mortality has substantially decreased over time. This could be the result of increased importance or focus placed on reducing mortality by owners, barn managers and barn workers as well as new vaccination developments.

The top 10% tables can be used to understand performance levels of the very best swine operations for each production indicator. These levels show what production level is possible to achieve. The top 25% tables show the production values for farms performing above average. These levels can be used to set attainable goals for operations performing at an average level for most production indicators. Producers ranking in the bottom 25% for one or more key performance indicators can focus on those measurements where performance is not acceptable and set goals based on the average production level for the given measurement.

Tables 18-21 depict the yearly change in each key performance indicator as well as the monthly effects relative to January production levels. Based on the results shown in Table 18, it is clear that litter size has increased by approximately 1 pig from 2007 to 2012; however, pre-weaning mortality has increased. Pre-weaning mortality was greatest among litters weaned in February and lowest in litters weaned in June. Additionally, weaning weight was greatest among litters weaned in May and lowest in litters weaned in August. Number born alive was greatest among litters weaned in September and lowest among litters weaned in January. Producers can use this information to determine if factors that occur from when the time sows are mated all the way through farrowing contribute to the seasonality experienced on each farm to better understand how and when seasonality will impact litter size and thus, production flow in later production phases.

Nursery mortality has decreased and nursery exit weight has increased from 2007 to 2012 as shown in Table 19. Nursery mortality was best for pigs exiting the facility in July and poorest for pigs exiting in March. Exit weight was greatest in December and lowest in June. Feed conversion was poorest for pigs exiting in February and best for pigs exiting in June. Producers can use this type of nursery mortality and feed efficiency information to develop management plans to address time periods when mortality is the greatest or when feed efficiency is the poorest. At times, a simple reminder to barn works is sufficient to bring focus on certain traits in order to bring about improvement.

The results in tables 20 and 21 show that market weight has increased and finisher mortality has decreased from 2007 to 2012 in both finisher types (grow-finish and wean-to-finish facilities). Market weight was lowest in August for both finisher types and highest in December for conventional and wean-to-finish facilities. Mortality in conventional finishers was best for pigs marketed in November and poorest for pigs marketed in February. Mortality in wean-to-finish facilities was highest in for pigs marketed in July. There was less variation between months for wean-to-finish facilities compared to the variation between months for conventional finishers. Since producers are moving towards more wean-to-finish barn use, focus on many of the same things that improve nursery mortality and performance if implemented on wean-to-finish facilities would result in similar improvements.

Bar graphs of the 2011 least square means for the monthly average production level for each of the performance indicators are shown in Figures 25-43. The least square means were estimated using the model described previously. The graphs plainly show the decreased production seen in during certain times of the year an effect commonly known in the industry as seasonality. Decreased performance resulting from seasonality represents substantial productivity and economic losses for swine operations and the U.S. swine industry. Developing methods to alleviate the effects of seasonality would have a large financial impact on the entire swine industry. For example, lower finishing weights directly impact an operation's revenue. The black horizontal line in Figure 37 represents the average finishing weight for conventional finishers. Clearly, finishing weights were below average June through October

with almost a 6 lb lower finishing weight in August. If the finishing weight could be increased by 1 lb during those months, a producer could have $600 in increased revenue for every 1,000 pigs marketed assuming a live market hog price of $60/cwt. In general, lowest production levels at the finishers were seen during summer months. Sow farms had lowest production for litters weaned during winter months (sows experience hot weather and then express the effects during the winter months). Except for nursery mortality, seasonality had less impact on nursery performance relative to the other production stages.

The results of this industry productivity analysis indicate that the swine industry has been successful in improving production efficiency across all swine production phases; however there are some production indicators, such as pre-weaning mortality, that may require additional focus in the upcoming years. Changes have been made to increase the pounds of pork produced in a given time frame while reducing finishing mortality. This along with increased litter size has increased the throughput of the swine industry as a whole. The industry improvements over time can be attributed to better genetics, health, management, etc.

The results from this analysis can used to determine when management practices need to be improved and/or maintained to ensure the optimal level of performance for each swine production stage. Knowing when production levels decreased will allow producers and researchers to focus efforts on improving production practices during that time to maintain production levels and improve overall operation production and financial efficiency.

Table 1. Number of companies and farms used in analysis for each facility type by year.[a]

Year		Conventional Finisher	Wean-to-Finish	Nursery	Sow
2007	Companies	29	17	29	31
	Farms	849	251	398	507
2008	Companies	46	23	41	39
	Farms	1339	385	719	708
2009	Companies	49	20	41	40
	Farms	1376	334	679	683
2010	Companies	43	19	36	33
	Farms	1350	527	571	526
2011	Companies	44	21	35	33
	Farms	1382	775	594	564
2012	Companies	50	28	45	40
	Farms	1744	830	796	766

[a]More than one farm can be managed by the same company. A farm represents a single production site.

Table 2. Conventional finisher average (±standard deviation) productivity from 2007 to 2012[a]

	2007	2008	2009	2010	2011	2012
Percent Mortality	6.98 (±5.61)	6.29 (±4.60)	5.12 (±3.44)	4.70 (±3.05)	4.48 (±2.49)	5.03 (±3.30)
Finishing Weight (lbs)	260.1 (±17.0)	261.2 (±16.1)	265.0 (±14.9)	268.7 (±13.4)	271.5 (±12.8)	269.2 (±14.1)
Days in Finisher	124.2 (±11.0)	125.7 (±11.0)	124.3 (±11.4)	124.6 (±10.3)	122.7 (±9.7)	121.5 (±10.8)
Avg. Daily Gain (lbs)	1.71 (±0.16)	1.69 (±0.16)	1.75 (±0.15)	1.76 (±0.14)	1.81 (±0.14)	1.81 (±0.15)
Feed Conversion[b]	2.75 (±0.26)	2.82 (0.32)	2.76 (±0.27)	2.77 (±0.25)	2.71 (±0.24)	2.68 (±0.23)

[a]All farms were given equal weighting. [b]Feed conversion is defined as feed to gain.

Table 3. Wean-to-finish average (±standard deviation) productivity from 2007 to 2012[a]

	2007	2008	2009	2010	2011	2012
Percent Mortality	8.25 (±4.64)	7.92 (±4.91)	7.61 (±4.79)	6.30 (±3.55)	6.33 (±3.96)	6.39 (±4.79)
Finishing Wt. (lbs)	262.2 (±12.5)	261.7 (±12.5)	264.2 (±11.0)	270.5 (±13.5)	273.6 (±12.8)	270.1 (±12.9)
Days in Finisher	161.5 (±10.8)	162.5 (±11.4)	164.2 (±10.7)	167.9 (±10.3)	166.4 (±9.0)	164.3 (±9.9)
Average Daily Gain (lbs)	1.55 (±0.12)	1.54 (±0.13)	1.54 (±0.11)	1.54 (±0.11)	1.57 (±0.10)	1.57 (±0.11)
Feed Conversion[b]	2.52 (±0.17)	2.51 (±0.17)	2.54 (±0.18)	2.52 (±0.20)	2.50 (±0.20)	2.50 (±0.18)

[a]All farms were given equal weighting.   [b]Feed conversion is defined as feed to gain.

Table 4. Nursery average (±standard deviation) productivity from 2007 to 2012[a]

	2007	2008	2009	2010	2011	2012
Percent Mortality	4.42 (±4.12)	5.82 (±5.71)	4.68 (±4.41)	4.12 (±3.62)	4.32 (±4.32)	3.80 (±3.01)
Exit Weight	48.0 (±7.5)	49.0 (±9.2)	49.4 (±8.4)	50.7 (±9.1)	50.3 (±9.3)	50.7 (±8.4)
Days in Nursery	47.1 (±5.0)	47.4 (±6.8)	46.2 (±5.4)	46.2 (±5.5)	46.0 (±6.1)	46.0 (±5.1)
Avg. Daily Gain (lbs)	0.76 (±0.12)	0.78 (±0.14)	0.80 (±0.13)	0.82 (±0.14)	0.81 (±0.14)	0.82 (±0.13)
Feed Conversion[b]	1.51 (±0.23)	1.54 (±0.30)	1.53 (±0.29)	1.52 (±0.28)	1.53 (±0.25)	1.48 (±0.19)

[a]*All farms were given equal weighting.* [b]*Feed conversion is defined as feed to gain.*

Table 5. Sow farm average (±standard deviation) productivity from 2007 to 2012[a]

	2007	2008	2009	2010	2011	2012
Pigs/Mated Sow/Year	22.6 (±2.8)	22.8 (±2.9)	23.2 (±3.0)	23.5 (±2.7)	24.1 (±3.1)	23.9 (±2.8)
Litters/Mated Sow/Yr	2.36 (±0.22)	2.35 (±0.23)	2.34 (±0.21)	2.33 (±0.20)	2.33 (±0.22)	2.31 (±0.22)
Total Born	12.3 (±0.9)	12.5 (±0.9)	12.8 (±0.9)	13.0 (±1.0)	13.4 (±1.1)	13.4 (±1.0)
Stillborn/Mummies	1.19 (±0.42)	1.23 (±0.49)	1.20 (±0.46)	1.22 (±0.48)	1.24 (±0.49)	1.17 (±0.46)
Number Born Alive	11.1 (±0.8)	11.3 (±0.8)	11.6 (±0.9)	11.8 (±0.9)	12.1 (±1.0)	12.3 (±0.9)
Number Weaned	9.5 (±0.7)	9.7 (±0.7)	9.9 (±0.8)	10.0 (±0.7)	10.2 (±0.7)	10.3 (±0.7)
Pre-weaning Mortality %	14.2 (±5.6)	14.2 (±5.5)	14.5 (±5.6)	14.6 (±5.8)	15.5 (±5.9)	15.5 (±5.7)
Weaning Weight (lbs)	12.3 (±1.3)	12.4 (±1.3)	12.8 (±1.5)	13.0 (±1.4)	13.1 (±1.4)	13.2 (±1.6)
Weaning Age (d)	19.5 (±1.7)	19.7 (±1.8)	20.5 (±2.0)	20.8 (±2.1)	20.9 (±2.5)	21.5 (±2.8)

[a]*All farms were given equal weighting.*

Table 6. Conventional finisher average (±standard deviation) productivity from 2007 to 2012 for farms in the top 10% for each production indicator[a]

	2007	2008	2009	2010	2011	2012
Percent Mortality	1.97 (±0.54)	1.90 (±0.56)	1.50 (±0.46)	1.44 (±0.42)	1.37 (±0.41)	1.62 (±0.44)
Finishing Weight (lbs)	291.2 (±9.8)	291.3 (±10.2)	292.8 (±8.8)	291.3 (±6.9)	293.9 (±7.8)	292.7 (±11.4)
Days in Finisher	105.4 (±7.8)	106.0 (±5.5)	105.0 (±5.5)	106.8 (±5.0)	105.0 (±5.2)	103.5 (±5.7)
Average Daily Gain (lbs)	1.98 (±0.10)	1.95 (±0.08)	2.00 (±0.09)	2.00 (±0.07)	2.05 (±0.09)	2.05 (±0.07)
Feed Conversion[b]	2.40 (±0.11)	2.34 (±0.14)	2.35 (±0.13)	2.39 (±0.10)	2.38 (±0.08)	2.35 (±0.08)

[a]*All farms were given equal weighting.* [b]*Feed conversion is defined as feed to gain.*

Table 7. Wean-to-finish average (±standard deviation) productivity from 2007 to 2012 for farms in the top 10% for each production indicator[a]

	2007	2008	2009	2010	2011	2012
Percent Mortality	3.14 (±0.97)	2.80 (±0.67)	2.54 (±0.65)	2.28 (±0.58)	2.34 (±0.44)	1.94 (±0.51)
Finishing Weight (lbs)	282.6 (±5.3)	282.2 (±6.7)	282.2 (±4.7)	294.1 (±4.8)	295.5 (±3.5)	293.3 (±4.5)
Days in Finisher	142.7 (±7.1)	144.6 (±6.1)	146.8 (±6.6)	149.0 (±5.8)	152.1 (±2.9)	147.5 (±5.4)
Avg. Daily Gain (lbs)	1.77 (±0.08)	1.75 (±0.05)	1.73 (±0.08)	1.74 (±0.06)	1.74 (±0.04)	1.76 (±0.06)
Feed Conversion[b]	2.24 (±0.11)	2.23 (±0.12)	2.24 (±0.09)	2.23 (±0.05)	2.19 (±0.05)	2.21 (±0.04)

[a]*All farms were given equal weighting.* [b]*Feed conversion is defined as feed to gain.*

Table 8. Nursery average (±standard deviation) productivity from 2007 to 2012 for farms in the top 10% for each production indicator[a]

	2007	2008	2009	2010	2011	2012
Percent Mortality	0.83 (±0.30)	1.06 (±0.36)	0.93 (±0.31)	0.95 (±0.34)	0.91 (±0.31)	0.94 (±0.28)
Exit Weight	63.2 (±7.4)	68.7 (±8.5)	66.1 (±7.4)	68.5 (±9.1)	69.0 (±9.4)	65.8 (±4.2)
Days in Nursery	38.2 (±3.1)	36.6 (±3.9)	37.3 (±3.4)	38.3 (±3.9)	35.8 (±4.2)	36.3 (±3.3)
Avg. Daily Gain (lbs)	1.00 (±0.09)	1.05 (±0.11)	1.05 (±0.08)	1.09 (±0.09)	1.08 (±0.11)	1.04 (±0.06)
Feed Conversion[b]	1.12 (±0.16)	1.07 (±0.19)	1.11 (±0.18)	1.08 (±0.21)	1.16 (±0.15)	1.16 (±0.16)

[a]All farms were given equal weighting. [b]Feed conversion is defined as feed to gain.

Table 9. Sow farm average (±standard deviation) productivity from 2007 to 2012 for farms in the top 10% for each production indicator[a]

	2007	2008	2009	2010	2011	2012
Pigs/Mated Sow/Year	27.4 (±1.2)	27.5 (±1.4)	27.6 (±1.2)	27.7 (±1.2)	29.2 (±3.1)	28.5 (±2.0)
Litters/Sow/Year	2.74 (±0.13)	2.71 (±0.14)	2.67 (±0.13)	2.64 (±0.14)	2.69 (±0.17)	2.65 (±0.11)
Total Born	14.0 (±0.4)	14.1 (±0.7)	14.2 (±0.4)	14.7 (±0.5)	15.3 (±0.6)	15.1 (±0.4)
Stillborn/Mummies	0.61 (±0.15)	0.59 (±0.14)	0.60 (±0.12)	0.62 (±0.10)	0.61 (±0.11)	0.55 (±0.13)
Number Born Alive	12.6 (±0.4)	12.6 (±0.3)	12.9 (±0.4)	13.3 (±0.5)	13.9 (±0.6)	13.8 (±0.4)
Number Weaned	10.7 (±0.3)	10.9 (±0.3)	11.0 (±0.3)	11.2 (±0.4)	11.4 (±0.3)	11.5 (±0.3)
Pre-weaning Mortality %	4.9 (±3.8)	5.2 (±3.4)	5.8 (±2.9)	4.6 (±4.3)	5.8 (±2.2)	5.6 (±3.5)
Weaning Weight (lbs)	12.6 (±1.2)	12.6 (±1.2)	13.0 (±1.3)	13.2 (±1.3)	13.3 (±1.2)	13.5 (±1.4)
Weaning Age (d)	19.8 (±1.5)	20.1 (±1.5)	20.9 (±1.8)	21.1 (±1.9)	21.3 (±2.1)	22.0 (±2.5)

[a]All farms were given equal weighting.

Table 10. Conventional finisher average (±standard deviation) productivity from 2007 to 2012 for farms in the top 25% for each production indicator[a]

	2007	2008	2009	2010	2011	2012
Percent Mortality	2.69 (±0.71)	2.61 (±0.72)	2.16 (±0.65)	2.03 (±0.58)	1.96 (±0.58)	2.25 (±0.63)
Finishing Weight (lbs)	281.1 (±10.6)	281. 4 (±10.5)	283.8 (±9.5)	284.9 (±7.0)	287.2 (±7.5)	285.4 (±9.5)
Days in Finisher	111.0 (±6.9)	111.9 (±6.2)	110.5 (±5.8)	111.9 (±5.4)	110.3 (±5.6)	108.4 (±5.5)
Average Daily Gain (lbs)	1.91 (±0.10)	1.88 (±0.08)	1.93 (±0.08)	1.93 (±0.07)	1.98 (±0.08)	1.98 (±0.08)
Feed Conversion[b]	2.49 (±0.11)	2.46 (±0.14)	2.45 (±0.12)	2.48 (±0.10)	2.46 (±0.09)	2.43 (±0.08)

[a]All farms were given equal weighting. [b]Feed conversion is defined as feed to gain.

Table 11. Wean-to-finish average (±standard deviation) productivity from 2007 to 2012 for farms in the top 25% for each production indicator[a]

	2007	2008	2009	2010	2011	2012
Percent Mortality	4.08 (±1.03)	3.65 (±0.85)	3.44 (±0.89)	3.04 (±0.76)	2.98 (±0.64)	2.65 (±0.70)
Finishing Weight (lbs)	276.9 (±6.05)	276.39 (±6.6)	277.5 (±5.0)	287.5 (±6.5)	290.2 (±5.2)	286.7 (±6.5)
Days in Finisher	148.1 (±6.5)	149.6 (±5.8)	152.0 (±5.8)	155.1 (±6.4)	155.7 (±3.6)	152.1 (±5.1)
Average Daily Gain (lbs)	1.71 (±0.08)	1.69 (±0.06)	1.67 (±0.07)	1.67 (±0.07)	1.69 (±0.05)	1.70 (±0.06)
Feed Conversion[b]	2.32 (±0.10)	2.31 (±0.11)	2.33 (±0.09)	2.29 (±0.64)	2.25 (±0.06)	2.26 (±0.06)

[a]All farms were given equal weighting. [b]Feed conversion is defined as feed to gain.

Table 12. Nursery average (±standard deviation) productivity from 2007 to 2012 for farms in the top 25% for each production indicator[a]

	2007	2008	2009	2010	2011	2012
Percent Mortality	1.32 (±0.48)	1.63 (±0.56)	1.42 (±0.48)	1.43 (±0.47)	1.36 (±0.45)	1.36 (±0.41)
Exit Weight	57.8 (±6.5)	61.4 (±8.2)	60.4 (±6.7)	62.4 (±7.7)	62.2 (±8.2)	61.4 (±4.6)
Days in Nursery	41.3 (±3.3)	40.1 (±4.0)	39.8 (±3.0)	40.0 (±03.6)	39.5 (±3.9)	36.5 (±3.5)
Avg. Daily Gain (lbs)	0.92 (±0.09)	0.96 (±0.11)	0.97 (±0.08)	1.00 (±0.10)	0.99 (±0.11)	0.98 (±0.07)
Feed Conversion[b]	1..26 (±0.16)	1.24 (±0.18)	1.25 (±0.17)	1.25 (±0.20)	1.28 (±0.14)	1.28 (±0.13)

[a]*All farms were given equal weighting.*   [b]*Feed conversion is defined as feed to gain.*

Table 13. Sow farm average (±standard deviation) productivity from 2007 to 2012 for farms in the top 25% for each production indicator[a]

	2007	2008	2009	2010	2011	2012
Pigs/Mated Sow/Year	26.0 (±1.4)	26.2 (±1.4)	26.5 (±1.2)	26.6 (±1.2)	27.5 (±2.4)	27.2 (±1.4)
Litters/Mated Sow/Year	2.62 (±0.13)	2.60 (±0.13)	2.56 (±0.12)	2.55 (±0.1)	2.58 (±0.15)	2.55 (±0.11)
Total Born	13.5 (±0.5)	13.7 (±0.6)	13.9 (±0.4)	14.2 (±0.5)	14.7 (±0.6)	14.7 (±0.5)
Stillborn/Mummies	0.76 (±0.16)	0.75 (±0.17)	0.74 (±0.14)	0.75 (±0.13)	0.76 (±0.15)	0.70 (±0.16)
Number Born Alive	12.2 (±0.4)	12.3 (±0.37)	12.6 (±0.4)	12.9 (±0.5)	13.4 (±0.6)	13.4 (±0.4)
Number Weaned	10.4 (±0.3)	10.6 (±0.3)	10.7 (±0.3)	10.9 (±0.4)	11.1 (±0.4)	11.2 (±0.3)
Pre-weaning Mortality %	7.6 (±3.3)	7.7 (±3.0)	8.2 (±2.7)	7.6 (±3.7)	8.4 (±2.6)	8.4 (±3.3)
Weaning Weight (lbs)	12.8 (±1.1)	12.8 (±1.1)	13.3 (±1.3)	13.5 (±1.2)	13.7 (±1.1)	13.8 (±1.3)
Weaning Age (d)	20.2 (±1.3)	20.4 (±1.3)	21.3 (±1.8)	21.6 (±1.8)	21.8 (±1.9)	22.6 (±2.3)

[a]*All farms were given equal weighting.*

Table 14. Conventional finisher average (±standard deviation) productivity from 2007 to 2012 for farms in the bottom 25% for each production indicator[a]

	2007	2008	2009	2010	2011	2012
Percent Mortality	14.34 (±6.69)	12.06 (±5.72)	9.28 (±4.32)	8.40 (±3.75)	7.63 (±2.53)	8.98 (±4.21)
Finishing Weight (lbs)	238.8 (±9.4)	241.9 (±9.3)	247.1 (±8.7)	251.7 (±8.6)	255.9 (±8.0)	252.1 (±10.2)
Days in Finisher	137.3 (±7.5)	139.2 (±6.8)	138.5 (±7.9)	137.1 (±7.2)	134.3 (±5.4)	135.2 (±6.8)
Avg. Daily Gain (lbs)	1.51 (±0.09)	1.48 (±0.08)	1.57 (±0.08)	1.58 (±0.09)	1.64 (±0.08)	1.63 (±0.09)
Feed Conversion[b]	3.06 (±0.27)	3.21 (0.26)	3.10 (±0.20)	3.11 (±0.20)	3.02 (±0.22)	2.99 (±0.16)

[a]*All farms were given equal weighting.*   [b]*Feed conversion is defined as feed to gain.*

Table 15. Wean-to-finish average (±standard deviation) productivity from 2007 to 2012 for farms in the bottom 25% for each production indicator[a]

	2007	2008	2009	2010	2011	2012
Percent Mortality	14.18 (±5.20)	14.43 (±5.36)	13.63 (±5.65)	10.87 (±3.91)	11.26 (±4.79)	12.21 (±6.18)
Finishing Weight (lbs)	245.9 (±8.2)	246.4 (±10.0)	249.9 (±6.2)	253.5 (±7.8)	257.6 (±7.4)	254.1 (±7.5)
Days in Finisher	175.2 (±5.2)	176.8 (±9.4)	178.2 (±5.8)	180.3 (±6.6)	178.1 (±5.6)	176.7 (±5.5)
Avg. Daily Gain (lbs)	1.41 (±0.05)	1.39 (±0.08)	1.41 (±0.05)	1.41 (±0.06)	1.44 (±0.06)	1.43 (±0.06)
Feed Conversion[b]	2.72 (±0.13)	2.73 (±0.10)	2.75 (±0.15)	2.78 (±0.17)	2.75 (±0.12)	2.73 (±0.10)

[a]*All farms were given equal weighting.*   [b]*Feed conversion is defined as feed to gain.*

Table 16. Nursery average (±standard deviation) productivity from 2007 to 2012 for farms in the bottom 25% for each production indicator[a]

	2007	2008	2009	2010	2011	2012
Percent Mortality	9.67 (±5.16)	13.14 (±7.15)	10.31 (±5.53)	8.61 (±4.72)	9.36 (±6.02)	7.70 (±3.56)
Exit Weight	39.9 (±3.0)	39.6 (±3.1)	39.8 (±3.1)	40.6 (±4.1)	40.2 (±4.1)	40.1 (±4.2)
Days in Nursery	52.3 (±4.9)	55.1 (±7.3)	52.1 (±5.2)	52.5 (±4.8)	52.7 (±6.2)	51.7 (±3.4)
Avg. Daily Gain (lbs)	0.62 (±0.05)	0.64 (±0.05)	0.65 (±0.06)	0.66 (±0.06)	0.66 (±0.05)	0.66 (±0.05)
Feed Conversion[b]	1.76 (±0.19)	1.89 (±0.32)	1.84 (±0.33)	1.80 (±0.32)	1.79 (±0.29)	1.71 (±0.15)

[a]*All farms were given equal weighting.*   [b]*Feed conversion is defined as feed to gain.*

Table 17. Sow farm average (±standard deviation) productivity from 2007 to 2012 for farms in the bottom 25% for each production indicator[a]
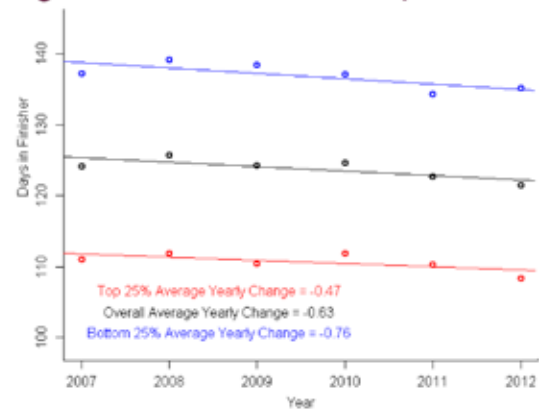
	2007	2008	2009	2010	2011	2012
Pigs/Mated Sow/Year	19.1 (±1.9)	19.0 (±2.0)	19.3 (±2.7)	20.0 (±2.1)	20.4 (±2.4)	20.1 (±2.4)
Litters/Mated Sow/Year	2.09 (±0.15)	2.07 (±0.17)	2.09 (±0.20)	2.09 (±0.15)	2.07 (±0.15)	2.04 (±0.18)
Total Born	11.2 (±0.4)	11.4 (±0.4)	11.7 (±0.4)	11.8 (±0.5)	12.1 (±0.5)	12.1 (±0.5)
Stillborn and Mummies	1.70 (±0.45)	1.80 (±0.57)	1.78 (±0.48)	1.84 (±0.51)	1.83 (±0.54)	1.74 (±0.47)
Number Born Alive	10.1 (±0.5)	10.3 (±0.5)	10.5 (±0.6)	10.7 (±0.5)	11.0 (±0.6)	11.4 (±0.6)
Number Weaned	8.6 (±0.6)	8.7 (±0.6)	8.9 (±0.8)	9.1 (±0.6)	9.3 (±0.7)	9.4 (±0.6)
Pre-weaning Mortality %	21.2 (±3.6)	21.2 (±3.2)	21.5 (±4.4)	21.6 (±3.7)	22.9 (±4.1)	22.5 (±3.4)
Weaning Weight (lbs)	10.9 (±0.6)	11.0 (±0.7)	11.2 (±0.6)	11.5 (±0.5)	11.5 (±0.5)	11.5 (±0.5)
Weaning Age (d)	17.3 (±0.8)	17.6 (±1.0)	18.3 (±0.8)	18.5 (±0.8)	18.0 (±1.4)	18.3 (±1.1)

[a]*All farms were given equal weighting.*
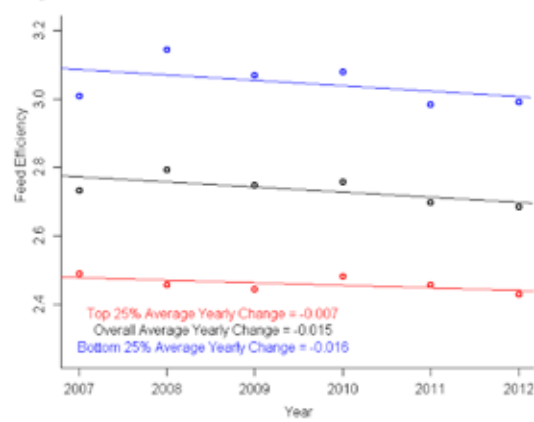

Avg. Conventional Finisher Finish Wt. by Yr

Top 25% Average Yearly Change = 1.15
Overall Average Yearly Change = 2.29
Bottom 25% Average Yearly Change = 3.22

Avg. Conventional Finisher Days in Finisher by Yr

Top 25% Average Yearly Change = -0.47
Overall Average Yearly Change = -0.63
Bottom 25% Average Yearly Change = -0.76

Avg. Conventional Finisher Daily Gain by Yr

Top 25% Average Yearly Change = 0.018
Overall Average Yearly Change = 0.024
Bottom 25% Average Yearly Change = 0.030
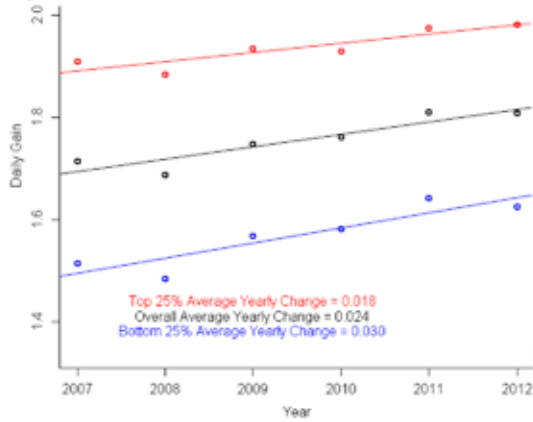
Avg. Conventional Finisher Feed Efficiency by Yr

Top 25% Average Yearly Change = -0.007
Overall Average Yearly Change = -0.015
Bottom 25% Average Yearly Change = -0.016

Avg. Conventional Finisher % Mortality by Yr

Top 25% Average Yearly Change = -0.12
Overall Average Yearly Change = -0.44
Bottom 25% Average Yearly Change = -1.17
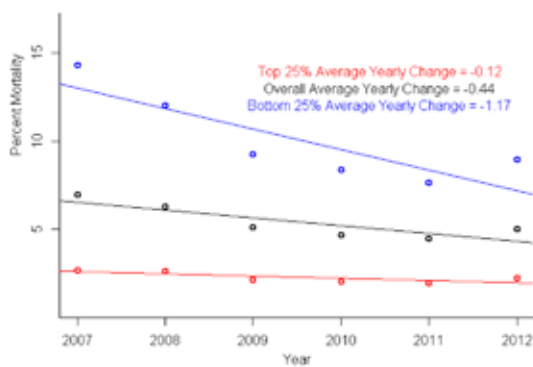
Avg. Wean-to-Finish Weight by Year

Top 25% Average Yearly Change = 2.86
Overall Average Yearly Change = 2.33
Bottom 25% Average Yearly Change = 2.23
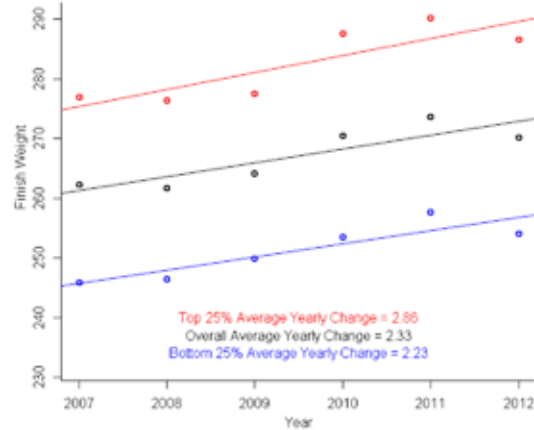
Avg. Wean-to-Finish Days in Finisher by Year

Top 25% Average Yearly Change = 1.17
Overall Average Yearly Change = 0.83
Bottom 25% Average Yearly Change = 0.40
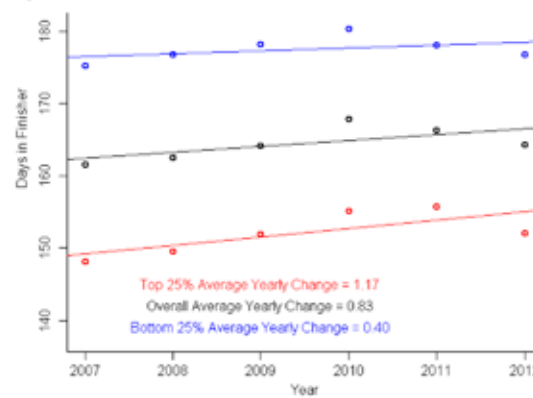
Avg. Wean-to-Finish Daily Gain by Year

Top 25% Average Yearly Change = 0.000
Overall Average Yearly Change = 0.005
Bottom 25% Average Yearly Change = 0.006
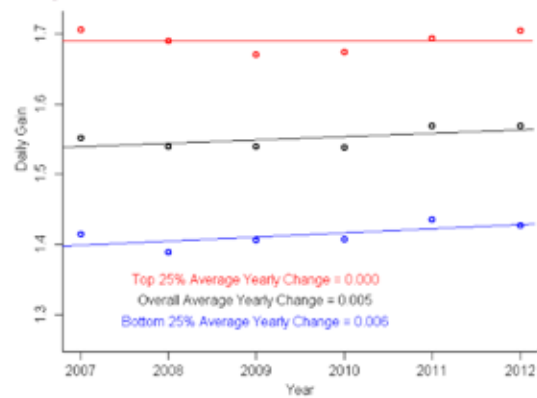
Avg. Wean-to-Finish Feed Efficiency by Year

Top 25% Average Yearly Change = -0.015
Overall Average Yearly Change = -0.004
Bottom 25% Average Yearly Change = 0.006

Avg. Wean-to-Finish % Mortality by Year

Top 25% Average Yearly Change = -0.27
Overall Average Yearly Change = -0.44
Bottom 25% Average Yearly Change = -0.63
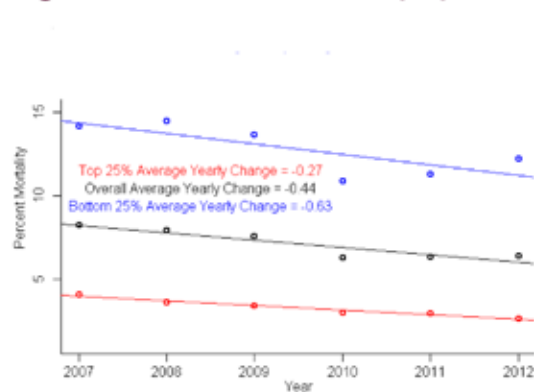
Avg. Nursery Exit Weight by Year

Top 25% Average Yearly Change = 0.64
Overall Average Yearly Change = 0.53
Bottom 25% Average Yearly Change = 0.11
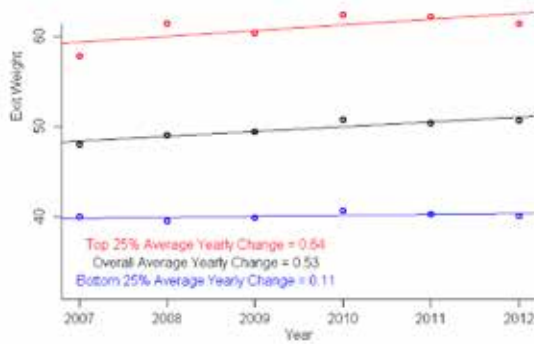
Avg. Days in Nursery by Year

Top 25% Average Yearly Change = -0.29
Overall Average Yearly Change = -0.28
Bottom 25% Average Yearly Change = -0.29
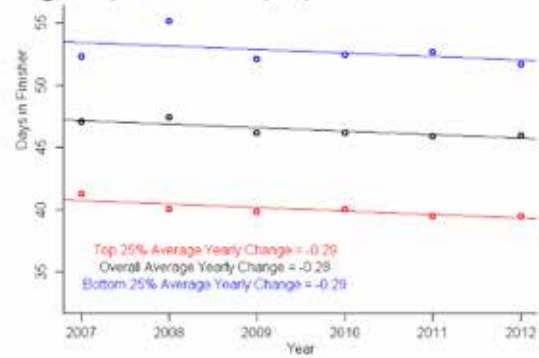
Avg. Daily Gain in Nursery by Year

Top 25% Average Yearly Change = 0.011
Overall Average Yearly Change = 0.011
Bottom 25% Average Yearly Change = 0.009
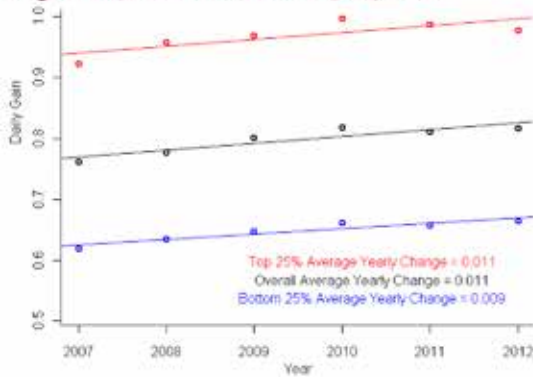
Avg. Nursery Feed Efficiency by Year

Top 25% Average Yearly Change = 0.007
Overall Average Yearly Change = -0.005
Bottom 25% Average Yearly Change = -0.012
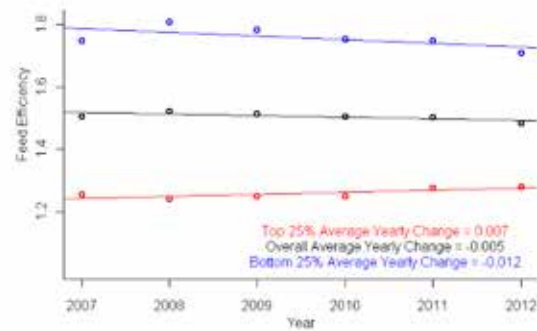
Avg. Nursery Percent Mortality by Year

Top 25% Average Yearly Change = -0.02
Overall Average Yearly Change = -0.23
Bottom 25% Average Yearly Change = -0.65

Avg. Pigs/Mated Sow/Year by Year

Top 25% Average Yearly Change = 0.3
Overall Average Yearly Change = 0.29
Bottom 25% Average Yearly Change = 0.29

Avg. Litters/Mated Sow/Year by Year

Top 25% Average Yearly Change = -0.012
Overall Average Yearly Change = -0.009
Bottom 25% Average Yearly Change = 0.006
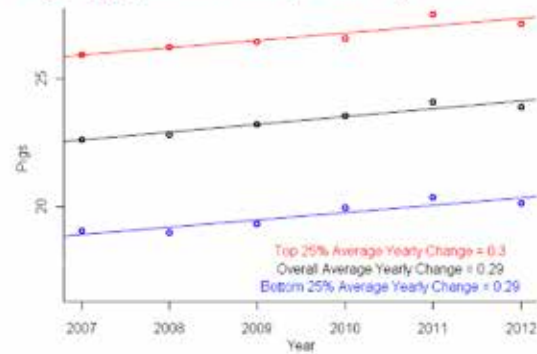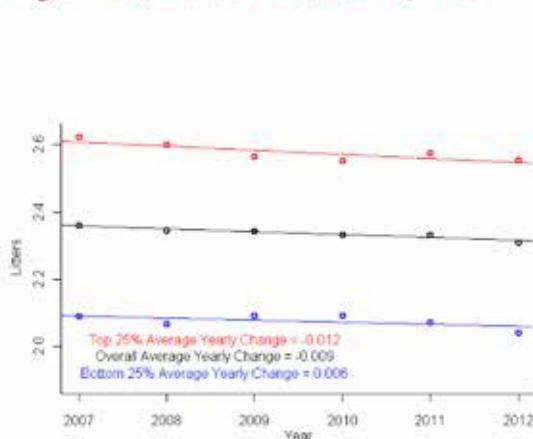
Avg. Total Born per Litter by Year

Top 25% Average Yearly Change = 0.27
Overall Average Yearly Change = 0.24
Bottom 25% Average Yearly Change = 0.18

Pork Industry Productivity Analysis
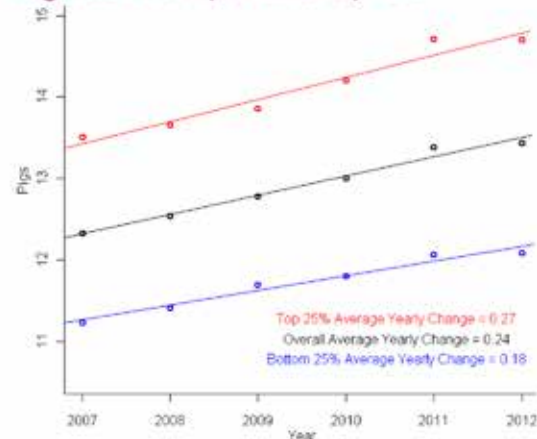
Table 18. Seasonal effect estimates for sow facilities adjusted for weaning age

	Year	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Pigs/Mated Sow/Yr	0.39*	0.89*	1.14*	1.00*	1.04*	1.43*	1.58*	1.42*	1.31*	0.90*	2.19*	-1.99*
Litters/Mated Sow/Yr	0.004*	0.072*	0.081*	0.047*	0.037*	0.074*	0.096*	0.096*	0.077*	0.044*	-0.010*	-0.041
Total Born	0.22*	0.13*	0.13*	0.16*	0.13*	0.19*	0.20*	0.23*	0.21*	0.13*	0.01	0.02
Stillborn/Mummies	0.010*	0.034*	0.006	-0.015	-0.022*	-0.007	-0.011	-0.005	-0.030*	-0.034*	-0.052*	-0.027*
Number Born Alive	0.21*	0.10*	0.13*	0.17*	0.15*	0.19*	0.22*	0.23*	0.24*	0.17*	0.06*	0.04*
% Pre-Weaning Mortality	0.17*	0.13	-0.20	-0.61*	-1.17*	-0.96*	-0.63*	-0.04	-0.33*	-0.67*	-0.79*	-0.40*
Weaning Wt (lbs)	0.09*	0.00	0.05	0.09*	0.12*	0.10*	0.02	-0.15*	-0.09*	0.03	0.02	0.06*

Indicates effect is significantly different from 0 compared to January production (P<0.05). Company was included in the model as a fixed effect.

Table 19. Seasonal effect estimates for nursery facilities adjusted for start weight, start age, and days in nursery

|	Year	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
% Nursery Mortality	-0.07*	0.12	0.26	-0.05	-0.07	-0.78*	-1.21*	-1.18*	-1.13*	-1.10*	-0.76*	-0.45*
Nursery Exit Weight (lbs)	0.22*	-0.04	-0.32	-0.48*	-0.47*	-0.66*	-0.50*	-0.61*	-0.35*	0.13	0.18	0.20
Avg. Daily Gain (lbs)	0.004*	-0.000	-0.007*	-0.009*	-0.010*	-0.017*	-0.014*	-0.015*	-0.009*	0.002	0.005	0.005
Feed Conversion Ratio (feed/gain)	-0.007*	0.013	0.004	-0.008	-0.004	-0.031*	-0.026*	-0.019*	-0.009	-0.012	-0.018*	-0.011

Indicates effect is significantly different from 0 compared to January production (P<0.05). Company was included in the model as a fixed effect.

Table 20. Seasonal effect estimates for conventional facilities adjusted for start weight, start age, and days in finisher

	Year	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
% Finishing Mortality	-0.32*	0.18	0.10	0.17	-0.06	-0.19	-0.25*	-0.39*	-0.28*	-0.28*	-0.48*	-0.38*
Finishing Weight (lbs)	2.28*	-1.48*	-1.12*	-1.00*	-1.77*	-4.16*	-7.74*	-10.10*	-8.17*	-3.46*	-0.81*	2.19*
Average Daily Gain (lbs)	0.018*	-0.018*	-0.009*	-0.009*	-0.014*	-0.034*	-0.064*	-0.083*	-0.066*	-0.029*	0.007*	0.019*
Feed Conversion Ratio (feed/gain)	-0.03*	0.01	-0.01	-0.02	-0.04	-0.05	-0.05	-0.06*	-0.10*	-0.12*	-0.10*	-0.07*

Indicates effect is significantly different from 0 compared to January production (P<0.05). Company was included in the model as a fixed effect.

Table 21. Seasonal effect estimates for wean-to-finish facilities adjusted for start weight, start age, and days in finisher

	Year	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
% Finishing Mortality	-0.34*	0.35	0.37	0.38	0.83*	0.86	0.97	0.28	0.53	-0.06	0.11	0.57*
Finishing Weight (lbs)	1.12	-0.06	-0.71	0.99	-0.28	-2.23*	-3.79*	-5.66*	-3.25*	0.14	0.99	1.74*
Avg. Daily Gain (lbs)	0.006*	0.000	-0.002	0.007	0.001	-0.012*	-0.022*	-0.032*	-0.018*	0.002	0.005	0.011*
Feed Conversion Ratio (feed/gain)	-0.01*	-0.00	0.01	0.00	-0.00	-0.01	-0.03*	-0.04*	-0.05*	-0.07*	-0.07*	-0.05*

Indicates effect is significantly different from 0 compared to January production (P<0.05). Company was included in the model as a fixed effect.

Pigs/Mated Sow/Year by Month
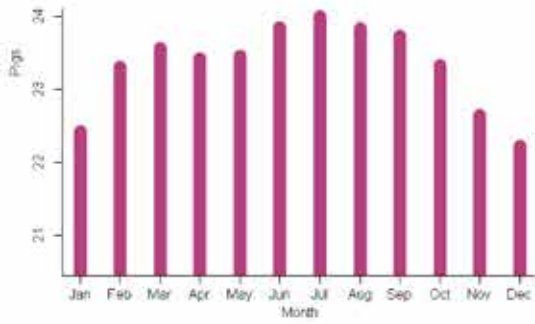
Litters/Mated Sow/Year by Month

Total Born per Litter by Month

Stillborn/Mummies per Litter by Month
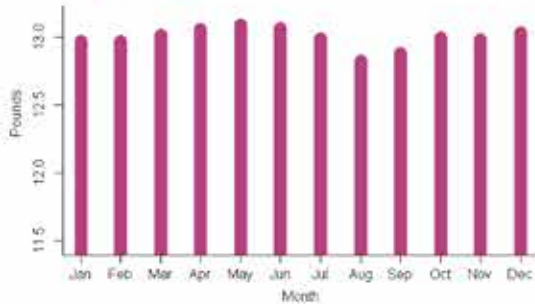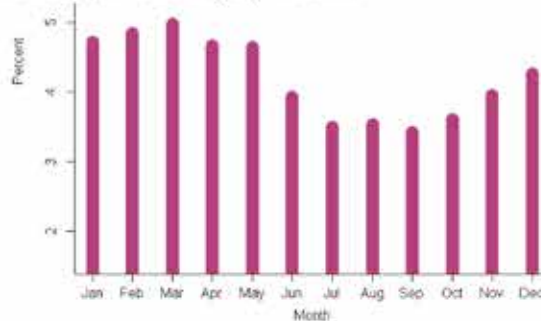

Number Born Alive per Litter by Month

Percent Pre-Weaning Mortality by Month

Weaning Weight by Month

Nursery Mortality by Month

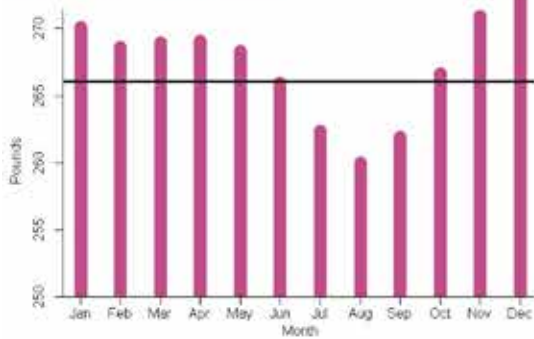## Nursery Exit Weight by Month

Nursery Average Daily Gain by Month
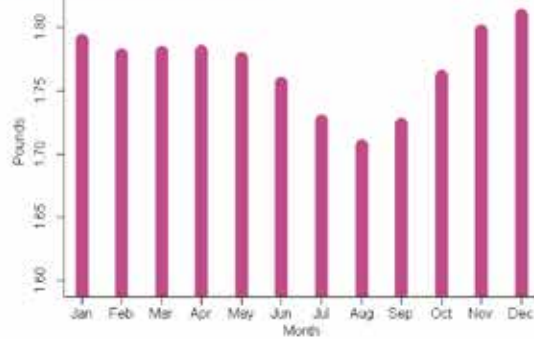
Nursery Feed Conversion Ratio by Month

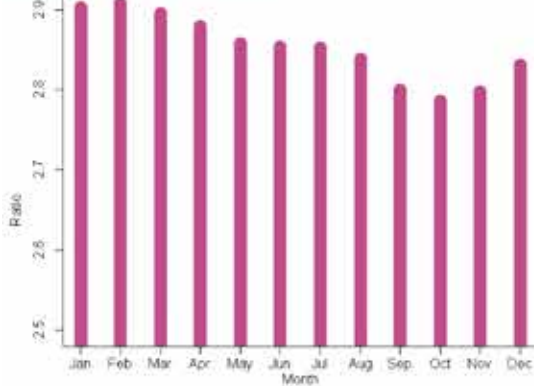## Finishing Mortality by Month
Conventional Finisher

Finishing Weight by Month
Conventional Finisher

Finishing Avg. Daily Gain by Month
Conventional Finisher

Finishing Feed Conversion Ratio by Month
Conventional Finisher
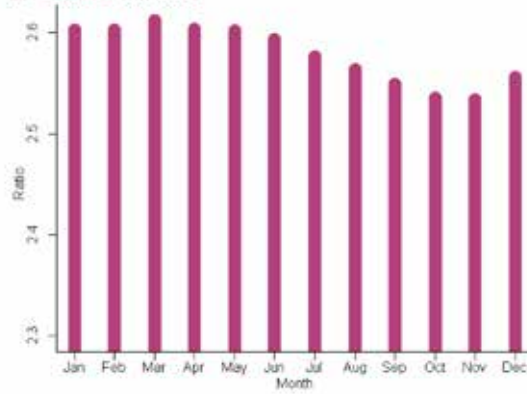

Finishing Mortality by Month
Wean-To-Finish

Finishing Weight by Month
Wean-To-Finish

Finishing Avg. Daily Gain by Month
Wean-To-Finish

Pork Industry Productivity Analysis

Finishing Feed Conversion Ratio by Month
Wean-to-Finish

National Pork Board
1776 NW 114th St, Des Moines, IA 50325
pork.org | 800-456-7675