Impact of piglet birthweight on post-weaning performance and system profitability

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Introduction

Profitability of commercial swine producers is dependent upon several key factors: reproduction, post-weaning performance, carcass quality, health, and cost-management. Reproduction can be broken down into several factors as well: farrowing rate, litter size at birth and weaning, pre-weaning mortality/morbidity, litter weight at birth and weaning, lactation feed intake, wean-to-service interval, farrowing interval, lactation length, and parity distribution are examples. Some of these traits also have a marked impact on both subsequent reproductive performance as well as post-weaning performance of pigs in the litter in addition to lifetime reproductive performance of gilts in the litter.[1]

Litter size at birth has been improved through genetic selection, but piglet size at birth has become smaller and generally more variable.[2] It is well documented lighter piglets at birth have a lower probability of survival to weaning and greater probability of becoming a less than full-value market pig.[3] Greater mortality and morbidity, reduced growth rate and/or more days on feed are a drag on the productivity and profitability of a system. Systems designed for producing a certain number of pigs, marketed in specific weight windows, in a specified period of time would have the added expense of additional sows and/or additional finishing spaces or in some cases purchase extra pigs to fill holes in production.

The goal of this analysis is to show the relationship between litter size and birth weight in a commercial test herd, the impact of birth weight on subsequent pig performance, and the variation that exists in performance across progeny of known sires in a commercial setting.

Materials and Methods

Data from a Commercial Test Herd (CTH) was utilized in this study. Commercial pedigreed Yorkshire x Landrace females were bred to known pedigreed purebred Duroc boars via single-sire inseminations. Piglets were identified at birth and tracked through the system to market. Birth and weaning weights were collected by litter (not individuals). Cross-fostering was performed to balance litters, but was not tracked for individual pigs – therefore data for number weaned and weaning weight will not be shown and no inferences will be made. Removals were recorded and noted in on-farm herd management software. Pigs were reared in commercial facilities where weight, 10^{th} rib off-midline backfat and loin muscle depth was collected and lean percentage was calculated. Groups were off-tested on a single day to minimize extra labor.

A total of 27,350 piglet birth records, sired by 126 Duroc sires, from 1,772 dams and 2,349 litters were utilized in the study. Litter birth (LBWT) and weaning weights were averaged by number born alive and number weaned, respectively. Age at removal (AR) was calculated as days from birth to removal. Days to market (DAYS), backfat (BF), loin muscle depth (LD), and lean percentage (LP) were adjusted to 127 kg. Pigs born, pigs marketed, and percent marketed were calculated for each sire. Sire-group averages were also calculated for Total Number Born (TNB) and Number Born Alive (NBA) per litter and Average Piglet Birth Weight (ABWT). Numerical differences were also calculated for TNB, NBA, Litter Birth Weight (LBWT), and ABWT, based on their litter of birth, between pigs marketed and pigs removed. Removals were also divided based on the age at removal into groups corresponding to stage of production: day 1 – 21 (PWM), day 22 – 56 (NW), and day 57+ (FM).

Results and Discussion

Descriptive statistics are shown in Table 1. Utilizing raw means, traits have similar variability as reported by Fix.[3] However, when reporting sire-group averages the variability calculated is reduced (Table 2). When graphing these results, the impact of birthweight on growth and carcass traits indicate the relationship is weak or non-existent – we believe this is an artifact of the data structure and not a true result. Results in Table 2 also indicate that on average pigs are being removed prior to weaning, where the pig is the least valuable (ie hasn't consumed expensive feed yet). Figure 1 shows the impact of litter size on average piglet birth weight. The impact is similar to the result reported by Patterson[1], however, using sire-group averages instead of individual piglet weight, shows the impact is reduced. We would propose this is simply a data collection and data structure issue and not a true reduction in the impact of litter size on piglet birth weight.

Table 1. Descriptive statistics for litter reproductive measures (1,772 dams) and post-weaning performance

	Number	Average	St. Deviation
Total Born	2,349	13.43	2.97
Born Alive	2,349	12.59	2.83
Litter Birth Weight, kg	2,349	19.94	4.38
Average Birth Weight, kg	2,349	1.61	0.29
Removal Age, d	5,765	19.94	28.02
Days to 127 kg, d	21,585	191.3	20.1
Backfat @ 127 kg, mm	21,374	22.47	5.01
Loin Depth @ 127 kg, cm	21,374	6.25	0.49
Lean percentage @ 127 kg, %	21,374	51.58	0.03

Figure 1. Sire-group average mean piglet birth weight vs. Total number born per litter

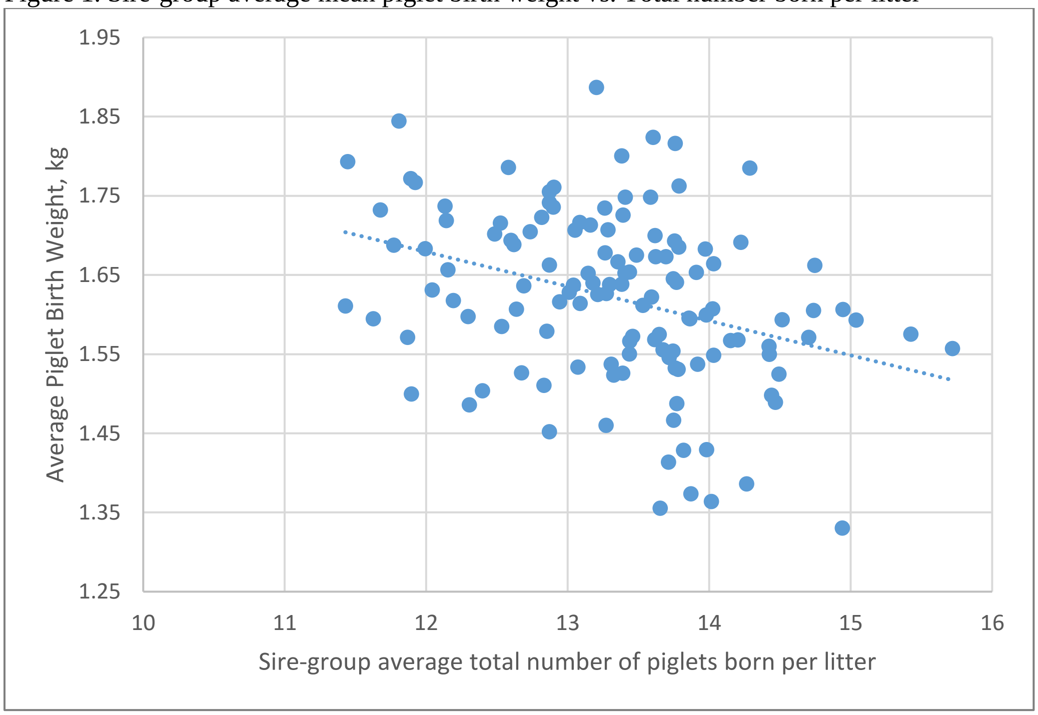

Table 2 illustrates the differences in performance across sire groups. In terms of percent marketed (born alive to market weight), pigs from the best sires survive to market almost 90% of the time, while pigs from the worst are more than 30% lower. These results also indicate some sires lose most of their pigs prior to weaning and others are substantially older when removed. Our goal is to reduce mortality and removals, and the most expensive removals are closer to market weight when pigs have all of the fixed costs in addition to almost all of the variable costs associated with each market pig. This can be seen more clearly in Figure 2, where sire-groups were ranked by percent marketed (as a deviation from the mean) and plotted against age at removal. The desirable sires are those at the far right of the graph, but even those can be sorted by age at removal – those in the right quarter with the lowest age at removal would prove more valuable to the system. There also exists differences from best to worst sires in terms of growth (30 days to market) and carcass lean (6%) (Table 2).

Table 2. Descriptive Statistics for Sire-group averages from 126 Purebred Sires of commercial offspring

	Average	St. Deviation	Minimum	Maximum
Pigs Born Alive	217.1	60.3	102	469
Pigs Marketed	171.3	49.9	73	356
Percent Marketed, %	78.8	5.8	56.3	87.4
Removal Age, d	19.7	9.3	5.89	59.42
Total Born	13.34	0.85	11.42	15.72
Born Alive	12.50	0.80	10.42	14.87
Birth Weight, kg	1.62	0.11	1.33	1.89
Days to 127 kg, d	191.5	7.7	175.8	209.6
Backfat @ 127 kg, mm	22.10	2.47	10.11	27.39
Loin Depth @ 127 kg, cm	6.19	0.37	3.40	6.68
Lean percentage @ 127 kg, %	51.7	1.25	48.5	54.5

Figure 2. Sire-group average percent marketed as deviated from the mean and age at removal

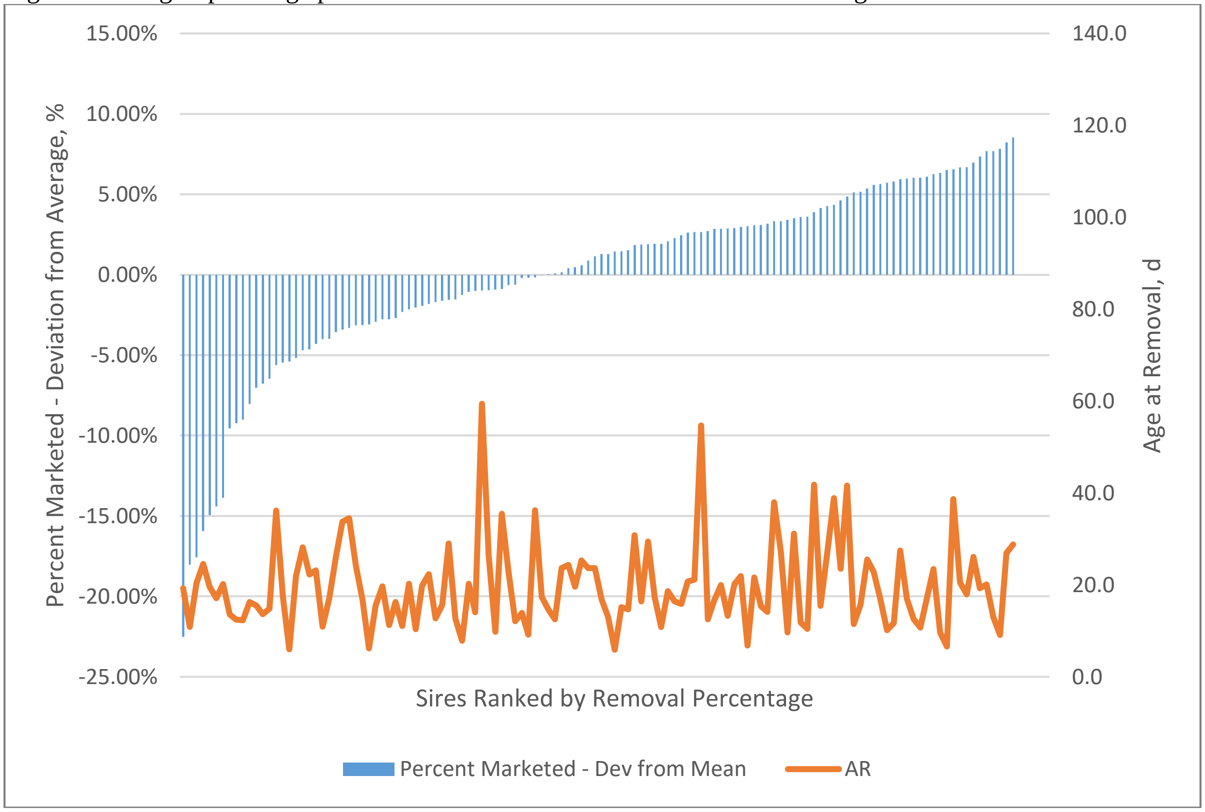

Table 3 shows results for average performance differences between pigs marketed and pigs removed. We only investigated litter of birth records, because the pigs removed don't have performance testing information. Pigs surviving to market tended to be from slightly smaller litters for both TNB and NBA, but were slightly heavier at birth (0.03 kg).

Table 3. Differences in reproductive performance of their birth litter between pigs marketed and pigs removed

	Difference[1]
Total Born	-0.41
Born Alive	-0.33
Litter Birth Weight, kg	-0.09
Average Birth Weight, kg	0.03
Number Weaned	0.43

Number marketed = 21.585; Number removed = 5,765
[1] Difference = Marketed – Removed

Correlation coefficients between litter traits, removal and post-weaning traits are illustrated in Table 4. As expected, TNB was highly correlated with both NBA and LBWT, but negatively correlated with ABWT. The same holds true for the relationship between NBA, LBWT, and ABWT. Larger litters tend to be heavier at birth (as a whole), but average piglet birth weight is reduced. TNB and NBA are also positively correlated with DAYS, indicating pigs from larger litters tend to grow more slowly. The relationship between ABWT and DAYS (-0.11) shows there is a negative (beneficial) correlation between the two; heavier pigs at birth grow faster, taking fewer days to reach 127 kg. Results also indicate heavier pigs at birth may indeed be leaner at the 10th rib and have slightly greater lean percentage.

Table 4. Pearson correlation coefficients between birth, removal, and post-weaning traits

	NBA	LBWT	ABWT	AR	DAYS	BF	LD	LP
TNB	0.92	0.61	-0.46	-0.06	0.07	0.03	0.01	-0.03
NBA		0.69	-0.45	-0.05	0.06	0.04	0.03	-0.03
LBWT			0.31	0.03	-0.02	-0.07	-0.02	0.06
ABWT				0.10	-0.11	-0.13	-0.06	0.12

TNB = Total number born; NBA = Number born alive; LBWT = whole litter birth weight, kg; ABWT = Average piglet litter birth weight, kg; AR = Age at removal, d; DAYS = Days to 127 kg; BF = 10th rib off-midline backfat depth adjusted to 127 kg, mm; LD = 10th rib off-midline loin depth adjusted to 127 kg, cm; LP = Lean percentage adjusted to 127 kg

Table 5 demonstrates differences in litter traits from pigs removed based on age at removal. Piglets removed prior to weaning are from larger litters (both TNB and NBA), from slightly lighter litters, and are smaller, on average, at birth. Pigs removed during the nursery and finishing phase appear to be from litters of similar size and weight. As expected, a majority of the removals occur prior to weaning, accounting for over 65% of total removals.

Table 5. Average litter of birth performance for pigs removed during different phases of production

	TNB	NBA	LBWT	ABWT	AR	%RM
PWM	13.87	12.97	19.9	1.56	7.81	65.6
NM	13.53	12.61	20.2	1.63	26.75	27.1
FM	13.44	12.65	20.4	1.65	103.72	7.3

PWM = Removal age < 21 d; NM = Removal age from 22 to 56 days; FM = Removal age > 56 d; TNB = Total number born; NBA = Number born alive; LBWT = whole litter birth weight, kg; ABWT = Average piglet litter birth weight, kg; AR = Age at removal; %RM = Percentage of removals in each stage of production

Summary

In conclusion, results indicate our study's data structure was not conducive to determining the true impact of birthweight on subsequent pig performance; within litter variation in piglet birthweight cannot be estimated. This may also be due in part to larger than average piglet birth weight compared to industry average and extremely good post-weaning performance. Small effects of average piglet birthweight on survival and post-weaning performance were detected but individual piglet birthweight data is needed to define the true impact on post-weaning performance and survival, and detect differences of economic importance between sires or sire lines. However, results do show large amounts of variability across sires for traits of economic importance – survival possibly being the most valuable (percent marketed and age at removal). Utilizing a commercial testing program can exploit this variability to add survival to an already robust breeding objective to further enhance genetic progress. Testing offspring from known sires in a commercial environment may be key to making rapid genetic progress that consistently reaches the commercial level of production as quickly as possible.

References

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