Marginal Economic Values For Pig Production In Different Countries

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Introduction

Selection in pig breeding programs focuses on reduction of production costs and increase in carcass value to improve efficiency of pork production. In general, a selection index as a function of the predicted breeding values of economically relevant traits and marginal economic values (MEVs) is used. The MEVs of the traits are calculated as change in predicted profit, holding all other traits constant. However, large differences can be found between countries (Fowler, 2007; Fowler, 2009), but also between farms within countries (Agrovision, 2009). The objective of this study was to evaluate the impact of heterogeneity of international pork production on marginal economic values for traits included in the breeding goal. Further, it was investigated if dedicated genetic lines are needed to provide sufficient genetic progress for the different production systems.

Material and methods

Production systems around the world. Technical and financial data from major pig producing countries were used to study their effect on MEVs. Dutch pork production was compared with production in Spain, Germany, US and Brazil, based on country averages as published by Fowler (2007, 2009). Results of organic pork production in the Netherlands were also included, based on figures presented by Hoste (2009). As production costs (e.g. feed price) and technical results change over time, relative differences were used with the Dutch average as a reference.

Economic model. To calculate costs for pork production the economic model developed by ASG (2010) was adapted. MEVs were obtained by differentiating the profit equation with respect to it, for the different production systems. To study the effect of technical parameters on MEVs, a sensitivity analysis was performed for the Dutch production system, based on technical figures from top and bottom 20% farms (Agrovision, 2009).

Genetic progress. The genetic progress was calculated based on the MEVs dedicated to the production systems using the selection index theory (Hazel, 1943). A general pig breeding program was simulated considering selection in specialised dam and sire lines to produce crossbred finishers. MEVs for leanness were not available for Spanish and Brazilian production systems. Therefore, relative MEVs were set equal to Germany and US respectively, based on general market information.

Results and discussion

Production costs in alternative production systems. An overview of the average production levels in the different countries is given Table 1. Number of piglets raised/sow/year ranged from 20.8 in organic production to 26.6 in commercial production in

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the Netherlands. Considering the finishing performance, FCR ranged from 2.99 in the Netherlands to 3.26 in the US. However, the feed prices were lowest in the US.

Table 1: Average production performance

	Netherl.	Organic	Spain	Germany	US	Brazil
Litter size	13.1	13.7	11.6	12.0	11.5	11.5
Litter mortality	13.0%	25.5%	11.5%	15.0%	12.3%	7.2%
Litter index	2.38	2.12	2.35	2.30	2.41	2.05
Piglets raised/sow/year	26.6	20.8	23.2	22.8	23.5	21.2
Daily gain	779	691	722	666	762	795
Feed conversion[1]	2.99	3.07	3.16	3.08	3.26	2.82
Lean meat%	56.20	56.30	58.00	56.50	56.80	57.20
Feed price[1]	€ 0.204	€ 0.408	€ 0.226	€ 0.201	€ 0.153	€ 0.211

[1] Based on Net energy, relative to the net energy of 1 kg of barley.

The production costs as given in Table 2 ranged from €1.17 per kilogram carcass weight in the US to €3.47 in organic production. Feeding costs as a portion of total production costs ranged from 45% (Germany) to 73% (Brazil). Next largest were the building and finance costs which ranged from 20% (Brazil) to 42% (Germany). These were followed by labour costs of 4% (Brazil) to 11% (organic production in the Netherlands).

Table 2. Pork production costs

	Netherl.	Organic	Spain	Germany	US	Brazil
€/kg carcass	€ 1.61	€ 3.47	€ 1.89	€ 1.87	€ 1.17	€ 1.19
Relative costs						
Feeding	51%	54%	54%	45%	58%	73%
Other variable costs	5%	3%	6%	6%	4%	3%
Labour	7%	11%	5%	7%	7%	4%
Building, finance, misc.	37%	31%	34%	42%	32%	20%

Marginal economic values. The MEVs for the different countries are presented in Table 3. The MEVs for the Netherlands are given in Euros per trait unit (=100%). For the other production systems, MEVs are presented as relative values compared to the Netherlands after correction for level of production costs.

In the organic production, the MEVs were higher especially for litter mortality and litter index which were at a lower level in comparison with other production systems. In Spain, most striking MEV was found for daily gain (55%) due to low building costs. In Germany, feeding costs were relatively low resulting in low MEV for FCR while the MEV for lean meat was extremely high. In the US, it was other way around with a very low MEV for lean meat. Feeding costs dominated the production costs in Brazil. Therefore, the MEV for FCR was very high. Labour and housing costs were relatively low, resulting in low MEVs for daily gain and reproduction performance.

Table 3. Marginal economic values[1]

	Netherl.	Organic	Spain	Germany	US	Brazil
Litter size	3.143	113%	102%	126%	113%	91%
Litter mortality	-0.474	137%	89%	118%	98%	75%
Litter index	17.55	132%	91%	120%	98%	93%
Daily gain	0.0211	95%	55%	127%	114%	48%
Feed conversion rate	-18.96	91%	90%	84%	110%	130%
Lean meat%	0.782	161%	n.a.	151%	45%	n.a.

[1] Based on: Agrovision 2009; Fowler 2007, 2009; Hoste, 2009.

Table 4 shows the sensitivity of MEVs to production levels. In general, improvement of an individual trait decreases its MEV. In other words, improved technical figures become less critical in the efficiency of pork production. This statement did not hold for FCR, which showed the opposite. MEV for FCR is constant to production level (linear function). Because MEVs were corrected for production costs the relative MEV increased with increase in FCR. Higher sensitivity of MEV for production level was found for lean meat percentage. This was caused by the non-linear payment system used in the calculations as no extra premium is paid for extreme lean carcasses, leading to decrease in relative MEV to 50%.

Table 4. Sensitivity of economic values to technical changes

	Production level[1]		Relative MEV	
	Bottom 20%	Top 20%	Bottom 20%	Top 20%
Litter size	12.3	14.0	111%	89%
Litter mortality	9.3	17.1	108%	93%
Litter index	2.27	2.47	108%	94%
Daily gain	723	836	108%	87%
Feed conversion (EW)	3.28	2.74	96%	103%
Lean meat%	54.4	57.5	187%	50%

[1] Based on: Agrovision 2009.

Genetic progress. Annual genetic progress based on the MEVs (Table 3) is shown in Table 5. Finisher performance was improved by increased daily gain and reduced FCR in all production systems. Although, MEVs were quite different for daily gain and FCR in different production systems, genetic progress was quite similar. This can be explained by the fact that these traits are genetically strongly correlated. Lean meat content increased in all production systems to improve carcass value. Progress ranged from 0.21 (US) to 0.44 (Spain). Although the difference in MEV was large between Germany and Brazil, genetic progress was quite similar due to the high genetic correlation between FCR and lean meat percentage. In Brazil selection on leanness did not directly improve carcass value but reduced feed costs. Reproduction performance was improved by increased litter size in all production systems. Genetic progress in litter mortality was quite different between the production systems. In case of high MEV (e.g. organic production) the litter mortality decreased while in case of low MEV (e.g. Brazil) the opposite was found. There was an undesirable increase in the interval between weaning to 1st insemination due to unfavourable genetic correlations with litter size.

Table 5. Expected annual genetic progress

	NL	Organic	Spain	Germany	US	Brazil
Daily gain (g/d)	12	10	10	11	14	11
FCR (g/g)	-0.044	-0.042	-0.044	-0.043	-0.042	-0.046
Lean meat (%)	0.34	0.39	0.44	0.37	0.21	0.33
Number born alive	0.18	0.16	0.19	0.19	0.20	0.20
Litter mortality	-0.09	-0.27	0.07	-0.03	0.00	0.09
Int. weaning - 1st insem. (%)	0.09	0.06	0.11	0.10	0.12	0.09

Maximum genetic progress could be possibly attained by lines selected for the specific production system. However, large investments are required to successfully maintain even a single breeding line. Therefore, the relative advantage of using the same genetics compared to dedicated genetic lines was investigated. The genetic progress in the different production systems was evaluated for the different breeding goals. Obviously, maximum genetic progress (100%) was obtained when the breeding goal exactly matched the production system. However, in most combinations, the genetic progress was higher or equal to 98%. Lowest results were found by using the Spanish breeding goal in US production system (and visa versa) with a genetic progress still as much as 94%.

Ignored in this analysis is the adaptation of lines to specific environments, whether this is climate, disease, quality of feed or lack of human intervention (piglet mortality). Also ignored are potentially different farming styles, like family farm against large scale production or personal choices to put more emphasis on specific traits (animal welfare).

Conclusion

These results show that there are large differences in MEVs according to the production systems. However, there is a relatively small effect of a specific selection strategy on reduction in production costs in different markets. Ultimately, the ease of production and efficiency of transforming plant protein into meat are relevant for all production systems.

Therefore, diversity in genetic lines is not directly needed, although adaptation of lines to specific environments or farming styles is still necessary.

References

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