



Key Performance Indicators in Pork Production: An International Comparison Using 2021 Data

Derald J. Holtkamp, Dermot J. Hayes, and Lee L. Schulz
Respectively: Professor, Department of Veterinary
Diagnostic and Production Animal Medicine, Professor,
Department of Economics and Department of Finance,
and Associate Professor, Department of Economics; Iowa
State University



This is the fourth in a series of reports from the Global Swine Benchmarking project that benchmarks international pork production. The first report was based on 2018 data and this report updates the comparison to data for 2021. The series of reports allowed us to document and describe the roller-coaster impact of the 2018 outbreak of African Swine Fever Virus (ASFV) in China on the finances of pork producers worldwide. These reports have also spanned the COVID-19 pandemic and the 2021 outbreak of ASFV in domestic herds in Germany. Incidence of ASFV has also occurred in several other countries in the Global Swine Benchmarking project including the Czech Republic, Hungary, Italy, South Korea, and Vietnam. Prior reports have consistently shown an impressive level of animal productivity in Denmark and the Netherlands and documented the lowest production costs in Brazil and the USA. The reports also estimate the value of improving key performance indicators in each country and describe the key indicators that drive financial performance. In this report, we also compare changes in key indicators between 2020 and 2021.

The raw data comes primarily from an international benchmarking network known as InterPIG. The representatives of the eighteen participating countries, listed in Appendix A, come from scientific institutions and extension services of producer organizations and have built the database over several years.¹ Members meet once per year to update and actualize the dataset and ensure that the cross-country comparisons are accurate. They use production and financial data from farm records to measure the countrywide average performance of representative pork farms. Definitions have been standardized across countries using a glossary of terms so, for instance, a "gilt" is defined in the same way in every data set, and carcass weights are adjusted.

to reflect whether the head is left on or removed. The InterPIG network also functions as a forum for information exchange.

Several key pork importing countries do not participate in InterPIG. Representative data for four of them, China, Japan, South Korea, and Vietnam, was obtained with help from industry consultants in each country and MSD Animal Health (Merck Animal Health in the United States and Canada) technical, marketing, and sales staff. The intention is to add additional countries in future years.

The compiled data for the countries in Asia do not necessarily represent averages for all farms in each country. The data for Japan are for modern commercial farms of various sizes. The data for Vietnam and South Korea are for modern commercial farms of various sizes free of ASFV. The data for China is for modern, large-scale, single-story, non-filtered farms that were free of ASFV. In 2021, ASFV was present in China, Vietnam, and South Korea but not in Japan. While the data for China, Vietnam, and South Korea was representative of farms free of ASFV, several values, such as market pig and feed prices, were significantly affected by the presence of the virus in those countries in 2019 through 2021. Once the Chinese swine herd recovered from ASFV Chinese pork imports and world pig prices plunged.

¹The structure of the InterPIG network means that it is open to members of all important pig producing countries. But, access presupposes that each member contributes all data from his/her country required by the network.

Productivity on farms free of ASFV, but where the disease was present in a country, was affected due to changes in the use of animal health products, marketing decisions, the source of gilts for breeding, and other changes made in response to the presence of the virus in each country.

The source of data for the countries in Asia is from published and unpublished farm records and other sources. In some cases, estimates were made from personal communication with consultants familiar with production in each country.

Outline of the Report

This report begins with a look at the raw data. All comparisons are for 2021, and the results are presented in U.S. dollars. Much of the information is available from reports written by InterPIG members, so the value-added here is the inclusion of China, Japan, South Korea, and Vietnam and our approach used to compare pig production across countries. Namely, we analyze which factors gave each country a competitive advantage or disadvantage. These calculations, which provide a novel approach to evaluating competitiveness, help us isolate how much advantage or disadvantage each factor conveys to each country. Year-over-year comparisons were made to compare changes in key indicators between 2020 and 2021. We then calculated the marginal value of changes in key performance indicators.

There is no consensus on how performance should be measured. Breeding companies are interested in performance per breeding female, pig farmers evaluate performance per pig produced, and those interested in international trade measure performance based on kilograms of meat. We, therefore, present results using all three measures. Most of the values are presented based on a breed-to-market system, where the breeding, nursery (rearing), and finishing (fattening) phases are combined. However, some values, such as feed prices, are presented individually for the breeding and wean-to-market (nursery and finishing combined) production phases.

Part 1: The Raw Data

Figure 1 shows the total carcass weight produced per breeding female, the average carcass weight, and the number of pigs marketed per year. As was true in previous years, Italy had the heaviest carcasses and led in carcass weight marketed per breeding female. The Netherlands and Belgium produced the next highest carcass weight per breeding female. The Netherlands, the Czech Republic, and Denmark all exceeded 30 pigs marketed per female per year. Countries in Asia lagged in terms of productivity and marketed the least carcass weight per breeding female. Major exporters such as the USA, Spain, Canada, and Brazil have surprisingly poor animal productivity when compared to countries in the European Union.

Figures 2, 3, and 4 show the revenue, cost, and profit for each country in 2021. The results are presented on a per kg of carcass weight sold, per pig sold, and per breeding female basis in Figures 2, 3, and 4, respectively. Figure 2 (bars) shows that Japan and South Korea had the highest production costs per kg of pork sold. China and Vietnam also had very high production costs. The states of Santa Catarina and Mato Grosso in Brazil, the USA, and Denmark had the lowest overall costs. Brazil has two data points because of the vast

differences between the traditional pig farming state of Santa Catarina (SC) and the new frontier in Brazilian pork production, Mato Grosso (MT). Santa Catarina is free of foot and mouth disease virus (FMDV) and is eligible to export to a wide range of countries. In 2021, Mato Grosso was not free of FMDV and could only export to a very limited list of importers. During the COVID-19 pandemic in 2020, the Brazilian currency (Real) fell by about 25% and it has not recovered. As a consequence, Brazilian prices expressed in U.S. dollars are lower than they would have been had the value of the Real not fallen relative to the U.S. dollar. Consequently, Brazil is now the world's low-cost supplier. In prior years, the USA was about even or slightly lower than Santa Catarina.

Figure 2 also shows the market pig price (line) and net profit (shaded area) for each country. Market pig prices were highest in Japan, South Korea, China, and Vietnam. Chinese pig prices started out 2021 at a high level and fell rapidly as the year progressed. Net profit was greatest in South Korea, China, Vietnam, and the USA. Most other countries experienced negative profits in 2021 as Chinese pork output recovered and exports from these countries fell. The USA was not as dependent on China as other countries because it faces a 25% retaliatory duty left over from the trade war. The horizontal red line shows the average net profit across all countries, calculated as a simple average of profitability in all countries. In 2021, producers lost an average of US\$0.10, down from a profit of US\$0.43 per kg of carcass weight in 2020.

Figure 3 shows that South Korea, Japan, Italy, and China had the highest costs when measured on a per pig sold basis. This reflects the heavy carcass weights, low productivity, and high feed costs in Italy and low productivity and high feed costs in South Korea and Japan. Results for other countries are similar to those in Figure 2. Figure 4 shows the same data but on a per breeding female basis. Italy and Japan had the highest costs per breeding female. China is more competitive in this measure. As can be seen in Figure 1, Chinese breeding females were less productive than in other countries, with the fewest pigs weaned and marketed per breeding female, which explains why China is ranked so poorly in terms of the cost per pig sold or per kg of carcass weight and yet is more competitive when the cost is expressed on a per breeding female basis.

Figures 5, 6, and 7 (bars) provide additional detail on the breakdown of costs. Feed made up a large portion of costs in all countries, particularly in Asia. All of the countries in Asia import feed, and their feed markets are at import parity, which is determined by the import price plus tariffs and transport costs. Low feed costs in the USA and Brazil provided these two countries with a significant advantage in the cost of production. This advantage was enhanced by lower energy, labor, and fixed costs. Brazilian costs are low because of a climate that allows for low-cost construction. This cost advantage for Brazil was offset, to a certain degree, by relatively low market pig prices. USA pig prices were relatively strong in large part because of government stimulus programs that stimulated pork demand. The information in Figures 5, 6, and 7 can also be expressed in percentage terms available in Appendix B. Each cost component as a percentage of the total cost does not vary when the results are reported on a per kg of carcass weight, per pig sold, or per breeding female basis.

Therefore a single table with the breakdown of costs by component as a percentage of the total cost is provided.

Figure 8 compares feed prices on a dollars per metric tonne basis for feed in the breeding and wean-to-market phases of production. Feed prices were highest in Asia, especially in Japan and China, and lowest in the USA and Finland. The Finish data may not include costs of running on farm feed mills which are more expensive on a per unit basis than commercial feed mills. Feed prices for countries in Europe and Brazil, with the exception of Finland, fell in the middle. Countries with lower feed prices also had lower market pig prices, here again the USA is an exception in 2021 because of strong domestic pork demand. In general, low feed prices will stimulate production in these countries until pig prices fall to equal the cost of production. It is also true that countries with high feed prices erect trade barriers to protect domestic production.

Figure 9 compares labor cost per hour, or wage rate, against labor productivity, measured as the hours of labor used per breeding female for all production phases (breed-to-market). The Netherlands, Denmark, and Sweden had the highest labor cost per hour, and the USA, the Netherlands, and Spain had the highest labor productivity (lowest labor usage). The USA had modest labor costs per hour and comes in first in terms of labor productivity. Vietnam, Hungary, the Czech Republic, Brazil (SC), and China had low labor productivity (high labor usage) but also had low hourly labor costs. Brazil stands out as having extremely low labor cost per hour which was magnified by the devaluation of the Real in 2021. Generally, the higher the cost of labor per hour in a country, the higher the labor productivity (low labor usage). The USA and Spain are exceptions in that they had relatively high labor productivity and modest costs of labor per hour. Japan, Italy, and South Korea had relatively low labor productivity despite higher labor costs per hour.

Figure 10 shows whole herd feed conversion which is calculated as kilograms of feed in all phases of production per kilogram of carcass weight sold. Japan, Italy, South Korea, China, Canada, and the USA performed poorly on this measure. Higher sow, suckling piglet, and wean-to-market mortality were a drag on whole herd feed conversion in these countries. The heavy market weight of pigs in Italy contributes to the poor whole herd feed conversion in that country.

Figure 11 shows mortality rates of pigs and breeding females. Birth-to-market mortality is reported as the number of pig deaths from birth-to-market expressed as a percentage of the number of pigs born alive. The USA, South Korea, Spain, China, and Denmark performed poorly on this measure while producers in Brazil performed the best. The USA, Spain, and Denmark also had relatively high breeding female mortality rates.

Part 2. Sources of Competitive Advantage

Here we explore the factors that gave producers a leg up, measured by profit, over producers in other countries. We did this by setting each country's costs, prices, and productivity to the same value—the average for all countries. The only values that varied for each country are those for the factor evaluated. Each factor was evaluated alone, one at a time. Therefore, any differences in profitability are due strictly to the country differences in the values for that factor. As an example, one of the factors evaluated was feed prices. For that factor, feed prices in the breeding, nursery (rearing), and finishing (fattening) phases of production were set to the values reported for each country. All other values were the same for every country, set to the average value of all countries. For each factor, the relative advantage or disadvantage is measured as the difference in profitability relative to a hypothetical country with average values for the factor evaluated. An advantage (disadvantage) is reported as a positive (negative) contribution to profitability above (below) the hypothetical average country. This data is color coded with dark green shading representing the greatest advantage and dark red shading the greatest disadvantage. In order to reduce the number of figures to evaluate, we present results on a dollars per kg sold basis (Table 1). The table is sorted according to the second column, which is the overall profit advantage (disadvantage) of each country compared to the average profitability of all the countries in 2021. The results expressed on a per pig sold (Table C.1) and per breeding female (Table C.2) basis are in Appendix C.

The factors that contributed to the highest relative advantage or disadvantage were market pig prices, feed prices, and productivity. The relative advantage or disadvantage for the other factors evaluated, wage rates, labor productivity, and fixed costs were lower but still important.

The third column in Table 1 evaluates the contribution of market pig prices to profitability in 2021. Countries in Asia, especially Vietnam, China, and South Korea, benefited from high market pig prices in 2021. Brazil, Hungary, Belgium, Czech Republic, Germany, and the Netherlands lost out in this regard. High market pig prices in China and South Korea gave producers there a respective US\$2.19 and US\$2.41 per kg of carcass weight advantage over a country with average market pig prices. China's advantage over the USA was US\$2.20 since the USA had a US\$0.01 disadvantage relative to the average. This means that, if somehow China and the USA were made equal by every measure except market pig prices, with the same costs, same productivity, etc., producers in China would have earned US\$2.20 per kg of carcass weight more than those in the USA in 2021 because of the higher market pig prices they received.

The fourth column in Table 1 provides the same comparison for feed prices. The USA, Canada, and Brazil (MT) in the Americas, as well as Denmark, Finland, Hungary, and the Czech Republic benefited from low feed prices while countries in Asia fared poorly on this measure. Low feed prices in the USA and Canada gave producers a respective US\$0.24 and US\$0.16 per kg of carcass weight advantage over a country with average feed prices.

The fifth column in Table 1 evaluates the importance of genetics, health, nutrition, and animal husbandry, (i.e., productivity in breeding, nursery (rearing), and finishing (fattening)). Here Denmark, Ireland, the Czech Republic, and the Netherlands led while China, Japan, and South Korea lagged. Producers in Denmark had the highest productivity giving them a US\$0.31 per kg of carcass weight advantage over a country with average productivity. Producers in China were at a \$0.88 per kg of carcass weight disadvantage to a country with average productivity.

The sixth column in Table 1 evaluates the impact of fixed costs, which are determined primarily by building costs, estimated lifetime of buildings and equipment, and maintenance costs, on relative profitability. Low fixed costs provided the greatest competitive advantage to producers in the Americas and Spain. Higher fixed costs provided the largest competitive disadvantage to producers in Austria, Sweden, and particularly South Korea where the concrete brick style of construction has increased building costs in recent years. Producers in Brazil had some of the lowest fixed costs giving them a US\$0.15 per kg of carcass weight advantage over a country with average fixed costs.

The seventh column in Table 1 evaluates labor productivity, measured as the hours of labor used per breeding female for all phases of production (breed-to-market). The Netherlands, the USA, Spain, France, and Denmark performed well under this measure, while Vietnam, China, Hungary, Brazil (SC), and the Czech Republic lagged. The eighth column in Table 1 shows the other part of the labor equation by comparing the cost of labor per hour or wage rate. Countries with low labor productivity, including Vietnam, Brazil (SC and MT), Hungary, China, and the Czech Republic had low wage rates. The Netherlands, Denmark, and Sweden had the highest wage rates. To evaluate labor costs, labor productivity and wage rate are evaluated together (ninth column). Vietnam fared well on this measure because its very high labor usage was more than offset by the low cost of labor per hour in that country. Brazil (MT and SC), the USA, and Spain also fared well, and South Korea, Italy, and Japan did poorly. Producers in the state of Mato Grosso in Brazil had the lowest labor costs giving them a US\$0.12 per kg of carcass weight advantage over a country with average labor costs.

Part 3. Year over Year Comparisons 2021 versus 2020

Table 2 compares several key productivity and financial measures between 2020 and 2021. Hungary and China saw the largest decreases in total carcass weight per female and in the number of pigs marketed. In 2021, producers were taking steps to eradicate PRRSV from the country which likely created some uncertainty around the estimates of productivity. Hungary's decrease in productivity in 2021 may be due, at least in part, to an overestimate in 2020 that was corrected in 2021. Furthermore, Hungary has changed its data sample to include larger, well-managed farms with improved genetics and productivity. While this improves the representativeness of the data, it makes year-over-year comparisons of the data challenging. In China, the productivity levels are for a farm that was free of ASFV. The productivity reductions in 2021, may be related to less use of animal health drugs due to perceived fears that injections may transmit the virus and the use of breeding gilts that would otherwise have been intended for meat production.

The financial measures on the right-hand side of Table 2 show that 2021 was a bad year compared to 2020, with most countries except the USA and Canada experiencing lower market pig prices, steady to higher costs, and lower profitability. While many countries experienced steady to lower market pig prices, all countries experienced higher feed prices. The simple averages of the market pig price and profitability for all countries fell by US\$0.17 and US\$0.54 per kg of carcass weight, respectively. Total cost and feed prices increased by US\$0.36 and US\$0.29, per kg of carcass weight, respectively, in 2021 compared to 2020.

Part 4. Marginal Values of Key Performance Indicators

When producers in any country consider changes in feed diets, genetics, or animal health interventions to improve productivity, they are conducting some sort of cost-benefit analysis, whether formal or informal. This is not easy because the value of productivity improvements depends on market pig prices, feed prices, fixed costs, and other factors and, therefore, will vary over time and from one country to another. For example, what is the value of reducing mortality from wean-to-market by one percent? The answer is different for each country depending on the market pig prices, feed prices, fixed costs, and other factors for that country in 2021. The results reported in this section are intended to help producers make better cost-benefit calculations for decision-making, such as whether to use a vaccine or antimicrobial to reduce disease and improve productivity.

The model used for this analysis links all phases of production from breeding to market. We can, therefore, change any productivity measure and calculate the impact on profits from breed-to-market. To operationalize this, we incrementally changed litters farrowed per female per year by 0.05, pigs born alive per litter farrowed by 0.25, pre-wean mortality and wean-to-market mortality by a negative one-percentage point, average daily gain by 0.01 kg per day, and feed conversion by a negative 0.025 kg of feed per kg of gain. In order to isolate the impact of each, these marginal changes in productivity measures were done individually, with all other factors remaining at their original values for each country. The outcome is the benefit, measured as the increase in profitability, given the incremental change in the productivity measure for each country. The results are summarized in Table 3.

The differences between countries are substantial. A 0.25 pig increase in the number of pigs born alive per litter farrowed in South Korea, for example, yielded a marginal increase in profit of US\$56.65 per breeding female per year. In the Netherlands, the same incremental improvement in pigs born alive per litter farrowed yielded a marginal increase in profit of only US\$2.61 per breeding female per year. This has significant implications for resource allocation and investment decisions made by producers. To breakeven, a producer in South Korea could spend US\$56.65 on an intervention to get a 0.25 pig increase in the number of pigs born alive per litter farrowed, while producers in the Netherlands, could only spend US\$2.61 to get the same 0.25 pig increase in the number of pigs born alive per litter farrowed. Unfortunately for German producers, an increase in productivity had a negative impact because it meant more pigs were fed to market weight with variable costs that exceeded market prices.

Germany discovered ASFV in a domestic herd in July 2021 and the resulting export market closures impacted domestic market pig prices. When market pig prices are too low to cover variable production costs, it does not pay to improve productivity to increase the number of pigs to be raised.

The degree to which an increase in all of the productivity measures, except the wean-to-market feed-to-gain ratio, will increase profit is a function primarily of 1) fixed costs, 2) market pig prices, and 3) feed prices (the main variable cost). When market pig prices are high relative to feed prices, the profit earned on each pig or kg of pork sold is relatively high. The value of weaning extra pigs, lowering mortality, or increasing average daily gain to increase the kg of pork sold is greater when raising pigs is already profitable. As the number of pigs weaned and kg of pork sold goes up, the incremental increase in profitability will be greater in countries with higher fixed costs since those higher fixed costs are spread over more pigs, i.e., economies of scale. The extent to which an increase in the wean-to-market feed-to-gain ratio will increase profit on a per pig sold basis depends on feed prices and the weight of pigs at market. The marginal value of improving the feed-to-gain ratio is highest when feed prices are high and when pigs are marketed at heavier weights.

The relatively large marginal values reported in Table 3 for countries in Asia occurred because market pig prices were highest in these countries (Figures 2, 3, and 4). The value of improving the wean-to-market feed-to-gain ratio is highest in Asia with relatively high feed prices (Figure 8) and Italy with high feed prices and pigs marketed at very heavy weights (Figures 1 and 8).

Conclusions

The questions that continue to motivate this work are, who are the world's best pork producers and why? How can competitiveness best be measured? What is the value of improving key performance indicators in each country, and what are the key factors that drive financial performance? The answers to these questions are that it depends. If we compare pork producers based on profitability, as we do when we evaluate companies, then Vietnam, China, South Korea, and the USA come out on top. If we use animal husbandry and productivity as a performance measure, then Denmark and the Netherlands rank at the top. If we use production costs as a metric, Brazil is the most competitive. This latter measure makes most sense if we are interested in trade in pork meat, and in this regard, Mato Grosso can be ruled out because they are prohibited from exporting to the most lucrative import markets. The source of the competitiveness of producers in the USA is not just cheap feed. The USA has high labor productivity even though the cost of labor per hour is below that of countries that use similar amounts of labor. The USA also has low fixed costs. Understanding the competitive advantages and disadvantages of countries is an ongoing pursuit. Changes occur annually as country-specific situations change (e.g., policy directives, disease outbreaks), and global market conditions evolve.

Acknowledgements

This study was funded by MSD Animal Health (Merck Animal Health in the United States and Canada). The authors thank Hongyao Lin with MSD Animal Health in Asia Pacific and Sub Saharan Africa for his assistance in collecting data for the countries in Asia. Special thanks to Di Gao with MSD Animal Health in China, Prof. Le Thi Thanh Huyen with the National Institute of Animal Science in Vietnam, Dr. SeungYoon Lee with HanByol Farm Tech in South Korea, Kyoko Akashi with MSD Animal Health in Japan and Itsuro Yamane with AgriINFO Co., Ltd. in Japan for their assistance in collecting data.

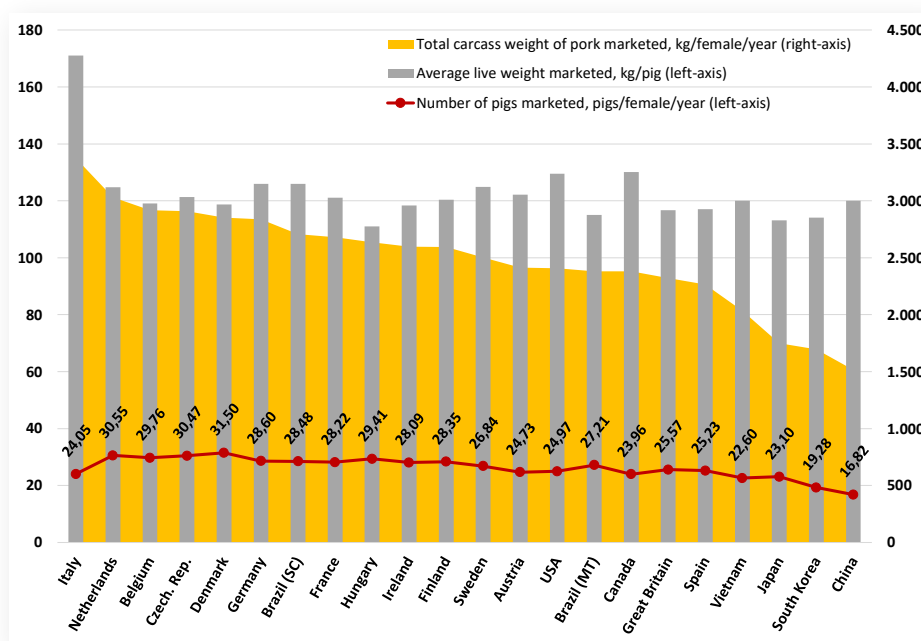


Figure 1. Total carcass weight produced per breeding female, average live weight, and number of pigs marketed—2021

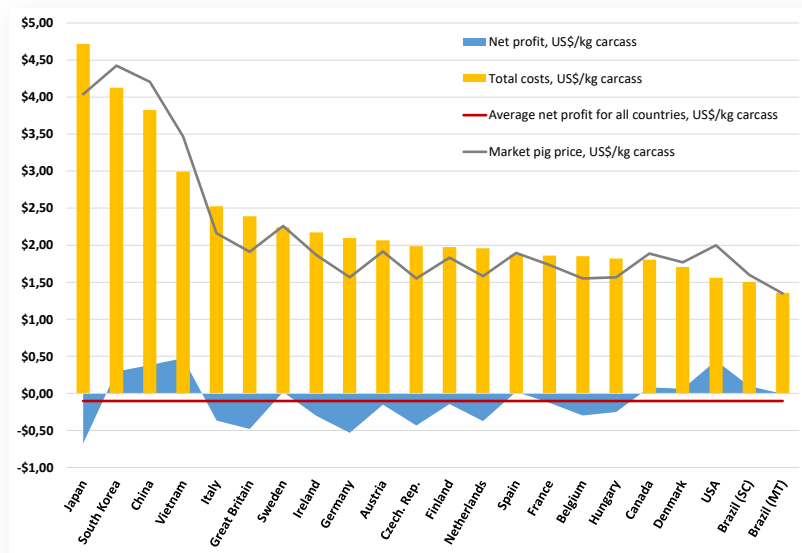


Figure 2. Revenue, cost, and profit per carcass kg sold—2021

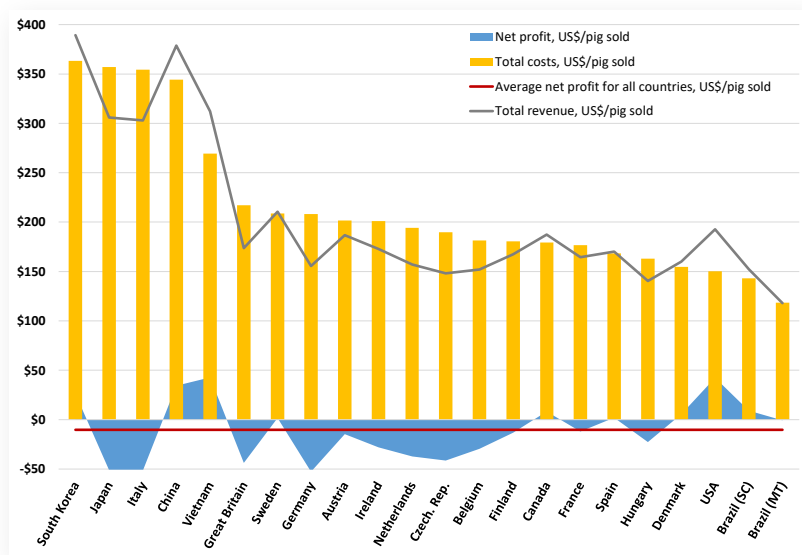


Figure 3. Revenue, cost, and profit per pig sold—2021

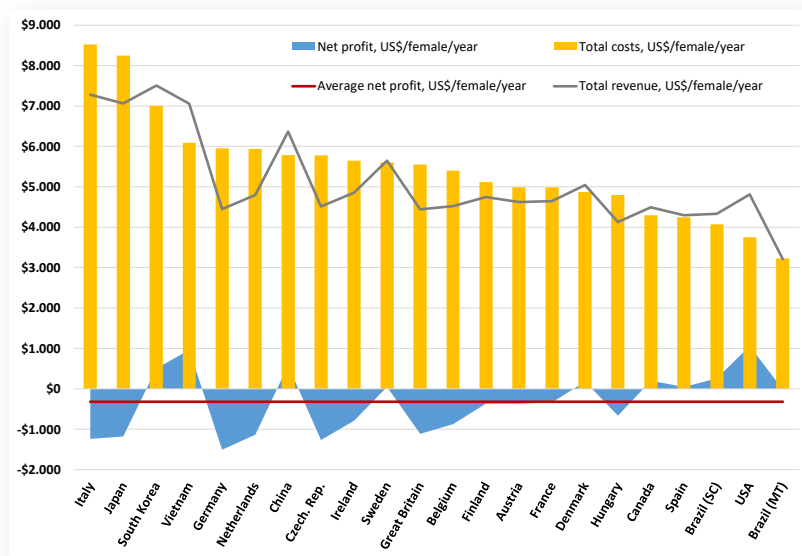


Figure 4. Revenue, cost, and profit per breeding female—2021

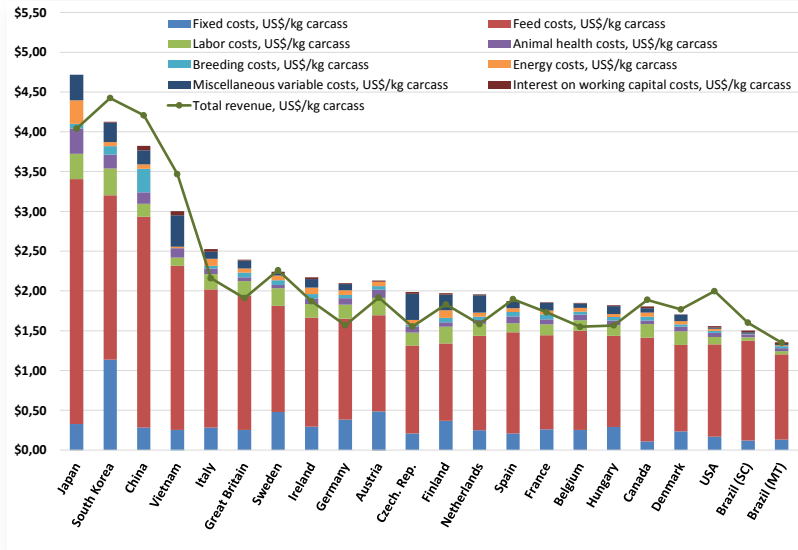


Figure 5. Detailed costs per carcass kg sold—2021

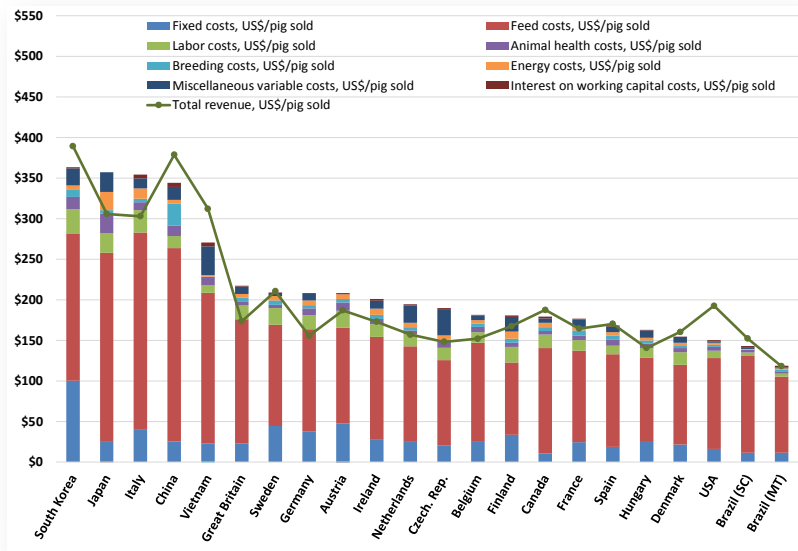


Figure 6. Detailed costs per pig sold—2021

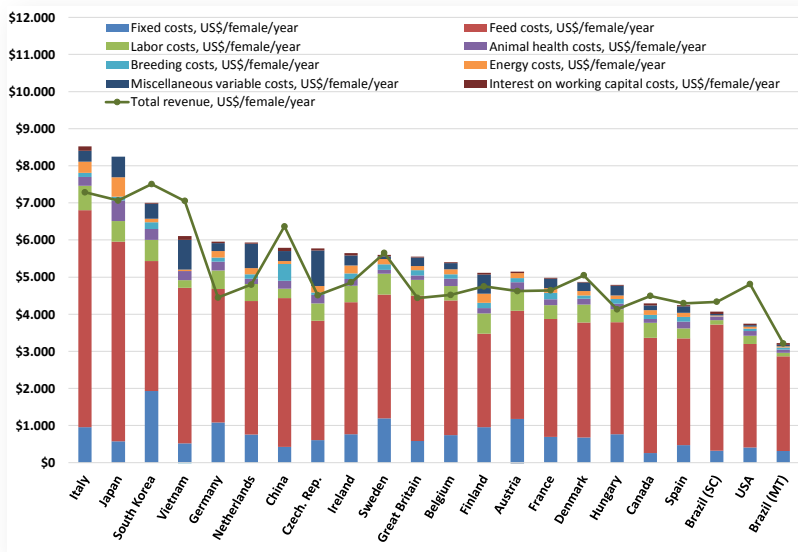


Figure 7. Detailed costs per breeding female—2021

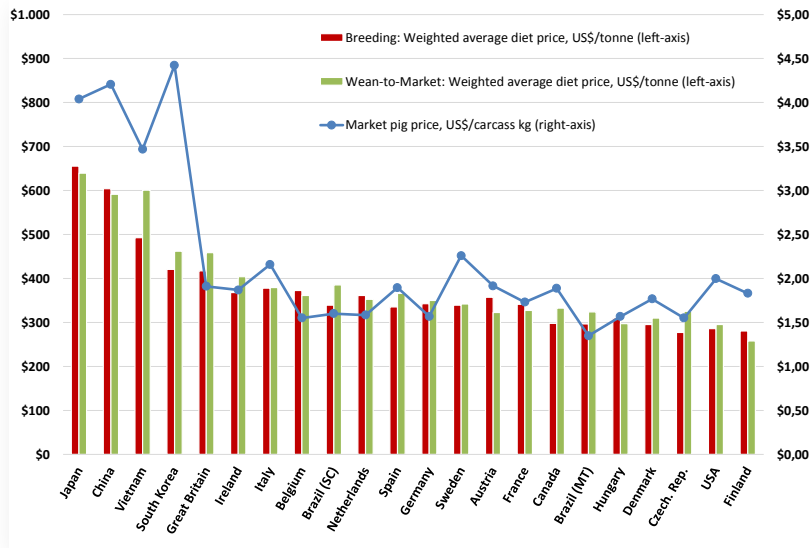


Figure 8. Feed costs by phase of production and market pig prices—2021

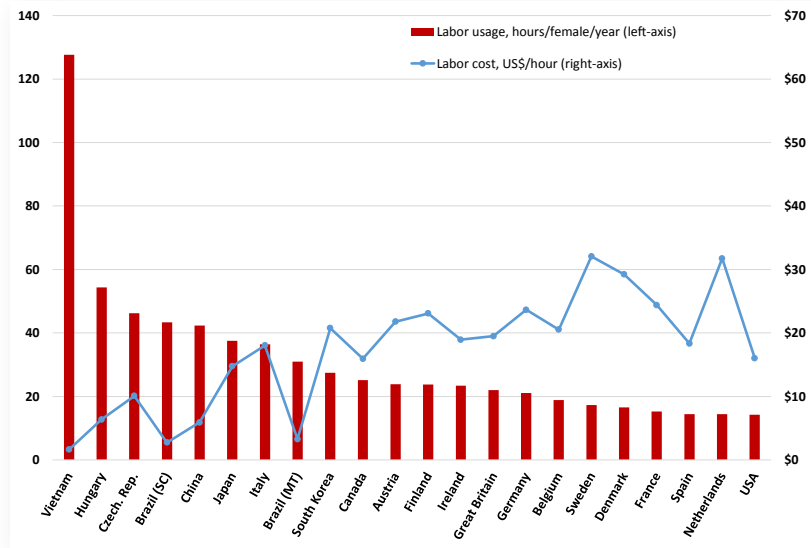


Figure 9. Labor usage and cost—2021

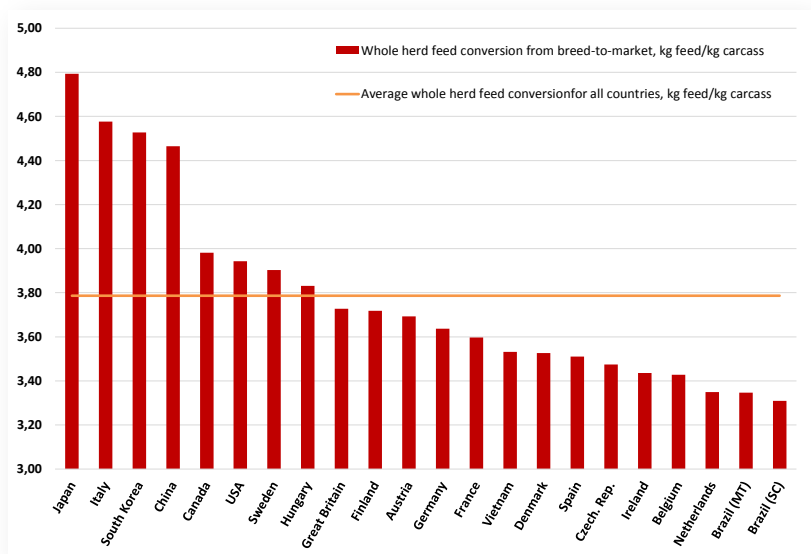


Figure 10. Whole herd feed conversion—2021

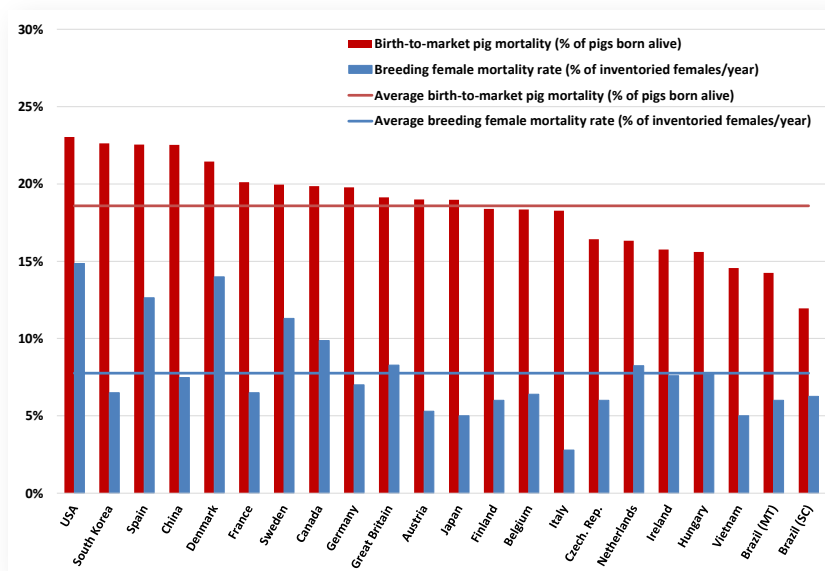


Figure 11. Mortality rates—2021

Table 1. Profit advantage of select factors, all other variables held constant, US\$ per carcass kg sold basis, 2021

Country	Profit advantage over average	Market pig prices	Feed prices	Productivity	Fixed costs	Labor usage	Wage rates	Labor Usage & Wage Rates
Vietnam	\$0.58	\$1.46	-\$0.81	-\$0.01	\$0.04	-\$0.81	\$0.21	\$0.07
USA	\$0.54	-\$0.01	\$0.24	-\$0.12	\$0.10	\$0.09	\$0.02	\$0.07
China	\$0.49	\$2.19	-\$0.85	-\$0.88	\$0.04	-\$0.17	\$0.16	\$0.04
South Korea	\$0.40	\$2.41	-\$0.33	-\$0.60	-\$0.64	-\$0.04	-\$0.04	-\$0.11
Brazil (SC)	\$0.20	-\$0.41	-\$0.05	\$0.20	\$0.15	-\$0.10	\$0.20	\$0.11
Canada	\$0.19	-\$0.12	\$0.16	-\$0.09	\$0.16	\$0.01	\$0.02	-\$0.01
Denmark	\$0.16	-\$0.24	\$0.25	\$0.31	\$0.03	\$0.08	-\$0.15	-\$0.02
Spain	\$0.12	-\$0.12	\$0.00	-\$0.07	\$0.08	\$0.09	-\$0.01	\$0.05
Sweden	\$0.12	\$0.25	\$0.11	\$0.10	-\$0.20	\$0.07	-\$0.19	-\$0.06
Brazil (MT)	\$0.10	-\$0.66	\$0.20	\$0.21	\$0.15	-\$0.02	\$0.19	\$0.12
France	-\$0.02	-\$0.28	\$0.16	\$0.12	\$0.01	\$0.08	-\$0.09	\$0.02
Finland	-\$0.04	-\$0.18	\$0.43	\$0.21	-\$0.09	\$0.03	-\$0.07	-\$0.05
Austria	-\$0.05	-\$0.10	\$0.17	\$0.05	-\$0.22	\$0.02	-\$0.05	-\$0.05
Hungary	-\$0.15	-\$0.44	\$0.25	-\$0.11	-\$0.02	-\$0.17	\$0.15	\$0.03
Belgium	-\$0.20	-\$0.46	\$0.02	\$0.15	-\$0.01	\$0.07	-\$0.04	\$0.02
Ireland	-\$0.20	-\$0.14	-\$0.06	\$0.29	-\$0.02	\$0.03	-\$0.01	-\$0.01
Italy	-\$0.26	\$0.15	-\$0.06	-\$0.33	-\$0.13	-\$0.08	\$0.00	-\$0.11
Netherlands	-\$0.27	-\$0.43	\$0.05	\$0.28	\$0.00	\$0.10	-\$0.18	-\$0.01
Czech. Rep.	-\$0.33	-\$0.46	\$0.20	\$0.29	\$0.05	-\$0.11	\$0.10	-\$0.02
Great Britain	-\$0.38	-\$0.10	-\$0.28	\$0.11	\$0.03	\$0.03	-\$0.02	-\$0.01
Germany	-\$0.43	-\$0.44	\$0.08	\$0.14	-\$0.14	\$0.05	-\$0.08	-\$0.03
Japan	-\$0.57	\$2.03	-\$1.02	-\$0.85	\$0.02	-\$0.09	\$0.04	-\$0.07

Table 2. Year-over-year comparisons of key indicators, 2021 vs. 2020

Country	Total carcass weight of pork marketed (kg/female/year)	Average live weight marketed (kg/pig)	Number of pigs marketed (pigs/female/year)	\$/kg carcass weight			
				Net profit	Market pig price	Total cost	Total feed cost
China	-195.52	-5.00	1.46	-4.10	-2.94	1.16	0.82
Vietnam	185.70	0.00	2.06	-1.44	-1.07	0.37	0.36
South Korea	17.01	1.60	0.22	-1.09	-0.40	0.69	0.44
Japan	-2.60	-1.80	0.06	-1.00	-0.26	0.74	0.42
Great Britain	93.22	4.05	1.14	-0.56	-0.03	0.54	0.45
Germany	27.11	3.00	0.40	-0.50	-0.20	0.30	0.25
Hungary	-263.58	-7.15	0.97	-0.43	-0.19	0.24	0.16
Denmark	-5.54	0.00	0.06	-0.38	-0.23	0.15	0.13
Belgium	-47.35	1.04	0.08	-0.34	-0.12	0.22	0.22
Spain	-37.28	0.10	0.44	-0.31	-0.04	0.27	0.19
Ireland	104.08	3.10	0.37	-0.29	-0.09	0.20	0.15
Netherlands	127.65	0.10	1.20	-0.29	-0.10	0.19	0.17
Finland	-29.55	-0.81	0.13	-0.27	-0.02	0.26	0.19
Czech. Rep.	26.45	-0.73	0.46	-0.26	-0.14	0.12	0.12
Sweden	35.32	1.62	0.03	-0.21	0.20	0.41	0.29
France	-7.08	-0.42	0.02	-0.20	0.00	0.20	0.17
Austria	17.98	-0.10	0.20	-0.19	-0.06	0.12	0.17
Brazil (MT)	97.15	5.00	0.07	-0.18	0.03	0.21	0.20
Italy	93.41	0.52	0.60	-0.13	0.25	0.37	0.32
Brazil (SC)	125.20	3.20	0.80	-0.13	0.18	0.31	0.30
Canada	-124.61	0.00	0.00	0.14	0.71	0.57	0.47
USA	36.18	0.22	0.31	0.31	0.66	0.35	0.34
Average	12.43	0.34	0.12	-\$0.54	-\$0.17	\$0.36	\$0.29

Table 3. Marginal value of incremental changes in KPI,* 2021

	US\$/breeding female/year			US\$/pig placed		
	Litters farrowed / female / year	Pigs born alive / litter farrowed	Prewean mortality (% of pigs born alive)	Wean-to-market Mortality (% of pigs placed)	Wean-to-market Average daily gain (kg / day)	Wean-to-market Feed-to-gain ratio (kg feed / kg gain)
Increment	0.05	0.25	-1.0%	-1.0%	0.01	-0.025
South Korea	\$62.23	\$56.65	\$29.23	\$1.95	\$2.89	\$1.12
China	\$56.57	\$48.52	\$25.27	\$2.00	\$2.51	\$1.58
Vietnam	\$38.89	\$38.89	\$19.30	\$1.36	\$1.65	\$1.63
USA	\$39.20	\$34.68	\$22.28	\$1.10	\$1.06	\$0.87
Sweden	\$37.21	\$27.35	\$19.88	\$0.97	\$1.03	\$0.97
Japan	\$12.59	\$11.01	\$6.40	\$0.93	\$1.46	\$1.62
Denmark	\$31.48	\$19.70	\$16.63	\$0.74	\$0.76	\$0.83
Canada	\$24.36	\$21.55	\$13.22	\$0.87	\$0.80	\$1.00
Austria	\$22.75	\$19.72	\$12.25	\$0.77	\$1.00	\$0.90
Spain	\$23.34	\$18.55	\$12.42	\$0.77	\$0.89	\$0.96
Finland	\$23.53	\$17.45	\$12.48	\$0.63	\$1.01	\$0.71
France	\$20.94	\$16.16	\$11.47	\$0.68	\$0.79	\$0.90
Brazil (SC)	\$19.68	\$16.66	\$10.02	\$0.69	\$0.45	\$1.13
Italy	\$4.32	\$3.68	\$2.18	\$0.87	\$0.93	\$1.50
Ireland	\$14.64	\$11.31	\$7.47	\$0.61	\$0.66	\$1.10
Brazil (MT)	\$14.41	\$13.29	\$7.78	\$0.53	\$0.39	\$0.87
Hungary	\$12.15	\$9.39	\$6.35	\$0.49	\$0.66	\$0.75
Belgium	\$9.80	\$7.55	\$5.31	\$0.52	\$0.54	\$0.97
Great Britain	\$5.69	\$4.39	\$2.87	\$0.55	\$0.42	\$1.20
Netherlands	\$3.46	\$2.61	\$1.85	\$0.40	\$0.58	\$1.01
Czech. Rep.	\$4.89	\$3.53	\$2.51	\$0.40	\$0.55	\$0.90
Germany	-\$1.60	-\$1.19	-\$0.87	\$0.35	\$0.47	\$1.01
Average	\$21.84	\$18.25	\$11.20	\$0.83	\$0.98	\$1.07

*The marginal value of the incremental changes in KPI is measured as the change in profit as each KPI is changed by the increment indicated while holding all other values constant. Wean-to-market values on a per pig placed basis.

Appendix A. InterPig membership

InterPIG is a collaborative network involving the following organizations and countries:

Great Britain – Agriculture and Horticulture Development Board (AHDB)

Austria – VLV Upper Austria

Belgium – Flemish Government and Boerenbond Belgie

Brazil – Embrapa Swine and Poultry

Brazil submits data for two regions: Mato Grosso (MT) and Santa Catarina (SC)

Canada – Canadian Pork Council

Czech Republic – Institute of Agricultural Economics and Information (UZEI)

Denmark – SEGES

Finland – Atria

France – IFIP

Germany – Thuenen Institute and Interessengemeinschaft der Schweinehalter (ISN)

Hungary – AKI Research Institute of Agricultural Economics

Ireland – Teagasc

Italy – Research Centre for Animal Production (CRPA)

Netherlands – Wageningen Economic Research

Spain – SIP Consultors

Sweden – Svenska Pig

USA – Iowa State University

Appendix B. Breakdown of total costs by component, 2021

Country	Fixed costs	Feed cost	Labor costs	Animal health costs	Breeding costs	Energy costs	Miscellaneous variable costs	Interest on working capital costs
Italy	11.2%	68.7%	7.7%	2.8%	1.2%	3.6%	3.5%	1.4%
Japan	7.0%	65.2%	6.7%	6.8%	1.2%	6.3%	6.8%	0.0%
South Korea	27.6%	50.0%	8.1%	4.2%	2.6%	1.3%	5.8%	0.3%
Vietnam	8.5%	68.8%	3.4%	4.0%	-0.4%	0.6%	13.2%	1.7%
Germany	18.2%	60.5%	8.4%	3.9%	2.0%	2.8%	3.7%	0.6%
Netherlands	12.8%	60.5%	7.7%	2.4%	2.1%	2.7%	11.1%	0.6%
China	7.4%	69.3%	4.3%	3.8%	7.8%	1.4%	4.6%	1.5%
Czech. Rep.	10.5%	55.7%	8.1%	4.0%	1.1%	3.0%	16.6%	1.0%
Ireland	13.6%	63.0%	7.8%	3.2%	2.6%	3.8%	4.8%	1.1%
Sweden	21.4%	59.6%	9.9%	1.9%	2.6%	2.6%	1.3%	0.7%
Great Britain	10.6%	70.5%	7.7%	2.1%	2.5%	2.0%	4.2%	0.5%
Belgium	13.8%	67.2%	7.2%	3.7%	2.1%	2.5%	3.1%	0.4%
Finland	18.6%	49.3%	10.7%	2.8%	2.8%	4.8%	10.0%	0.9%
Austria	23.6%	58.5%	10.4%	5.0%	2.2%	2.8%	-3.2%	0.7%
France	14.0%	63.7%	7.4%	3.2%	3.5%	2.5%	5.2%	0.5%
Denmark	13.9%	63.6%	10.0%	3.3%	1.8%	2.4%	4.7%	0.3%
Hungary	15.9%	63.0%	7.2%	3.2%	2.5%	2.0%	5.5%	0.5%
Canada	6.0%	72.4%	9.3%	2.4%	2.6%	2.9%	3.0%	1.3%
Spain	11.2%	67.7%	6.2%	4.4%	3.0%	2.6%	4.1%	0.7%
Brazil (SC)	8.0%	83.4%	2.9%	2.3%	0.3%	0.4%	1.1%	1.6%
USA	10.9%	74.4%	6.1%	3.3%	1.7%	1.5%	1.1%	1.1%
Brazil (MT)	9.8%	78.9%	3.1%	2.5%	1.9%	1.0%	1.2%	1.6%

Appendix C. Sources of competitive advantage on a per pig sold and per female basis

Table C1. Profit advantage of select factors, all other variables held constant, per pig sold basis, 2021

Country	Profit advantage over average (\$/pig sold)	Market pig prices	Feed prices	Productivity	Fixed costs	Labor usage	Wage rates	Labor Usage and Wage Rates
Vietnam	\$53.03	\$135.71	-\$75.89	-\$4.02	\$3.87	-\$75.45	\$19.71	\$6.16
USA	\$52.69	-\$1.32	\$22.59	-\$13.68	\$9.69	\$8.11	\$2.19	\$6.30
China	\$44.70	\$204.47	-\$79.01	-\$62.25	\$3.77	-\$16.11	\$14.48	\$3.40
South Korea	\$36.34	\$224.72	-\$30.85	-\$49.36	-\$59.26	-\$3.51	-\$3.59	-\$10.26
Brazil (SC)	\$19.41	-\$38.34	-\$4.92	\$15.68	\$13.65	-\$9.13	\$18.34	\$10.68
Canada	\$18.50	-\$11.53	\$14.50	-\$11.82	\$15.09	\$0.54	\$2.30	-\$0.66
Denmark	\$15.84	-\$22.72	\$23.20	\$29.12	\$2.86	\$7.60	-\$13.88	-\$1.66
Spain	\$12.20	-\$10.89	\$0.28	-\$7.56	\$7.10	\$7.95	-\$0.63	\$4.88
Sweden	\$12.00	\$23.01	\$10.36	\$5.94	-\$18.55	\$6.38	-\$17.33	-\$5.55
Brazil (MT)	\$9.70	-\$61.76	\$19.04	\$16.12	\$13.66	-\$2.13	\$17.70	\$11.20
France	-\$1.80	-\$26.15	\$14.81	\$7.62	\$0.59	\$7.91	-\$8.00	\$1.52
Finland	-\$2.77	-\$16.90	\$40.07	\$17.15	-\$8.41	\$2.78	-\$6.39	-\$4.63
Austria	-\$4.47	-\$9.02	\$16.14	\$1.23	-\$20.09	\$1.63	-\$4.81	-\$4.99
Hungary	-\$12.30	-\$41.46	\$22.98	-\$10.67	-\$1.41	-\$15.42	\$13.92	\$2.76
Ireland	-\$17.82	-\$13.36	-\$5.59	\$26.19	-\$2.14	\$2.90	-\$1.35	-\$0.99
Belgium	-\$19.22	-\$43.06	\$1.46	\$10.21	-\$0.64	\$6.12	-\$3.30	\$1.51
Netherlands	-\$26.96	-\$39.96	\$4.69	\$23.49	-\$0.08	\$8.86	-\$16.95	-\$0.77
Czech. Rep.	-\$31.24	-\$42.95	\$19.09	\$25.98	\$4.80	-\$10.48	\$9.41	-\$1.40
Great Britain	-\$33.38	-\$9.41	-\$25.93	\$6.68	\$3.17	\$3.09	-\$2.04	-\$1.26
Japan	-\$40.90	\$188.95	-\$95.50	-\$57.42	\$2.02	-\$8.00	\$3.73	-\$6.83
Italy	-\$41.14	\$13.75	-\$5.52	-\$31.80	-\$12.41	-\$7.08	-\$0.27	-\$10.71
Germany	-\$42.41	-\$41.35	\$7.27	\$9.79	-\$12.68	\$4.48	-\$7.09	-\$2.79

Table C.2. Profit advantage of select factors, all other variables held constant, per breeding female basis, 2021

Country	Profit advantage over average (\$/female/year)	Market pig prices						Labor Usage and Wage Rates
		Market pig prices	Feed prices	Productivity	Fixed costs	Labor usage	Wage rates	Rates
USA	\$1,378.66	-\$35.73	\$610.55	-\$421.60	\$261.87	\$219.28	\$59.10	\$170.27
Vietnam	\$1,285.79	\$3,667.74	-\$2,050.98	-\$138.46	\$104.47	-\$2,039.17	\$532.58	\$166.56
China	\$898.54	\$5,526.20	-\$2,135.45	-\$1,112.78	\$101.86	-\$435.31	\$391.35	\$91.94
Brazil (SC)	\$579.72	-\$1,036.21	-\$133.09	\$372.89	\$368.88	-\$246.66	\$495.70	\$288.70
South Korea	\$822.22	\$6,073.40	-\$833.69	-\$1,023.47	-\$1,601.73	-\$94.73	-\$96.94	-\$277.37
Canada	\$516.75	-\$311.71	\$392.00	-\$346.44	\$407.89	\$14.52	\$62.12	-\$17.85
Denmark	\$495.05	-\$614.12	\$627.06	\$843.23	\$77.40	\$205.46	-\$375.01	-\$44.77
Spain	\$368.05	-\$294.21	\$7.51	-\$263.14	\$191.79	\$214.74	-\$17.16	\$131.78
Sweden	\$365.88	\$621.84	\$279.88	\$91.79	-\$501.46	\$172.35	-\$468.47	-\$149.94
Brazil (MT)	\$303.88	-\$1,669.28	\$514.60	\$375.21	\$369.16	-\$57.50	\$478.37	\$302.72
France	-\$20.96	-\$706.77	\$400.18	\$138.71	\$16.07	\$213.80	-\$216.16	\$41.04
Austria	-\$45.07	-\$243.79	\$436.21	-\$24.25	-\$542.88	\$44.06	-\$129.98	-\$134.76
Finland	-\$50.19	-\$456.68	\$1,083.07	\$415.74	-\$227.23	\$75.14	-\$172.78	-\$125.23
Hungary	-\$344.21	-\$1,120.42	\$621.12	-\$415.92	-\$38.00	-\$416.79	\$376.18	\$74.56
Ireland	-\$469.51	-\$361.12	-\$151.13	\$674.14	-\$57.93	\$78.51	-\$36.61	-\$26.77
Belgium	-\$558.12	-\$1,163.73	\$39.43	\$218.64	-\$17.31	\$165.51	-\$89.13	\$40.73
Great Britain	-\$796.57	-\$254.26	-\$700.77	\$112.35	\$85.59	\$83.41	-\$55.19	-\$34.04
Netherlands	-\$818.01	-\$1,079.98	\$126.63	\$636.55	-\$2.16	\$239.42	-\$458.21	-\$20.88
Japan	-\$862.56	\$5,106.62	-\$2,581.02	-\$1,370.92	\$54.71	-\$216.34	\$100.73	-\$184.71
Italy	-\$917.17	\$371.65	-\$149.19	-\$838.26	-\$335.44	-\$191.30	-\$7.43	-\$289.42
Czech. Rep.	-\$945.01	-\$1,160.76	\$515.92	\$711.60	\$129.78	-\$283.32	\$254.33	-\$37.95
Germany	-\$1,187.15	-\$1,117.53	\$196.50	\$202.47	-\$342.62	\$121.02	-\$191.74	-\$75.41