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ECONOMIC ANALYSIS OF A COMPLEX PIG FARM

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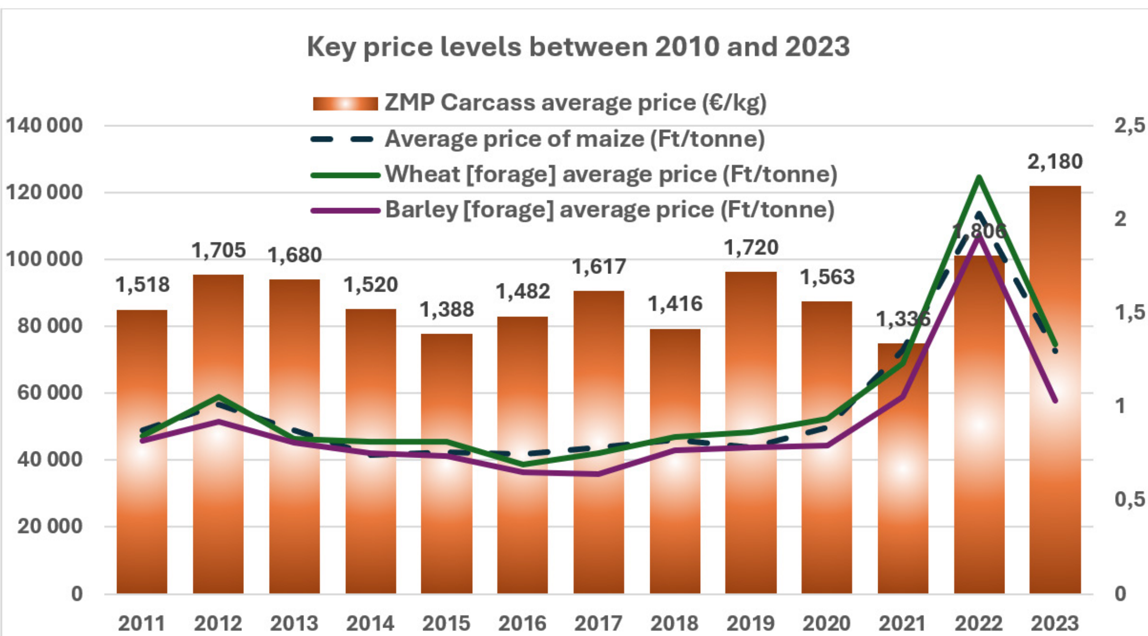
Abstract: *The objective of this study is, beyond presenting the production and economic indicators of a complex pig farm established as a brownfield investment, to analyze its cost-income and profitability relations. The Authors conducted their calculations based on primary data collection and a preliminary calculation model. The technological equipment of the presented pig farm is competitive at the European level, and its production indicators also show favorable results. The capital investment demonstrates adequate profitability, as the internal rate of return (IRR) is 12.35%, while the net present value (NPV) of the investment at the end of the 15th year is HUF 1.36 billion. According to the model, the results indicate that, on the one hand, the investment is capital-intensive, but at the same time, large-scale livestock farms equipped with similarly advanced technology are definitely necessary, as they greatly contribute to improving the sector's efficiency. There is further potential for achieving competitive advantages through increasing economies of scale. Appropriate human resources with the necessary expertise, genetics, and feeding must accompany the technological advancement.*

Keywords: *pig sector, investment analysis, case study*
(JEL code: Q56, D12)

INTRODUCTION

The intensive price fluctuations in recent periods have significantly affected livestock farmers, including pig breeders. Figure 1 below tracks the evolution of average prices that play a role in the formation of the two primary factors determining the profitability of pig farming, namely the sales price and the feed cost.

Figure 1. Key price levels



Source: own compilation, based on ZMP prices published by https://www.schuttert.nl/ and data from KSH (2023)

Evaluating the data, it can be stated that the purchase prices of the three main cereal crops involved in pig feeding — maize, feed wheat, and feed barley — moved together in the period between 2011 and 2020, with values showing relatively small year-to-year fluctuations. Compared to the movements of feed prices, the German ZMP quotation, which functions as a reference in setting the sales price of slaughter pigs, already showed greater volatility. Following the data in the figure, in the period 2021-2023, it can be observed that in 2021, the German ZMP quotation decreased on an annual average to €1.336 per carcass kg, forming the lowest average price of the past 10 years; only in 2015 was a similar magnitude recorded, with €1.338 per carcass kg. At the same time, the purchase prices of cereals began to increase intensively due to various reasons, and in 2022, grain prices soared, causing absolute disproportions in the output–input price relations of pig farming.

Further analyzing the data, Table 1 compares the intense and sometimes explosive prices of 2021, 2022, and 2023 to the average prices of 2011-2020.

Table 1. Changes in the average price of ZMP and major grain crops between 2011 and 2023

Name	2011–2020 average	2021	2022	2023	Year 2021 / 10-year base	Year 2022 / 10-year base	Year 2023 / 10-year base
ZMP average price (€/kg)	1,561	1,336	1,806	2,180	86%	116%	140%
Corn (Ft/t)	46 353	72 823	113 683	72 602	157%	245%	157%
Feed wheat (Ft/t)	47 186	68 927	124 678	74 529	146%	264%	158%
Feed barley (Ft/t)	42 941	58 872	107 211	57 755	137%	250%	134%

Source: own compilation, based on data from ZMP and KSH (2023)

The German ZMP quotation, which plays a central role in setting pig prices, reacted much later to the intensive and explosive increases occurring on the input side, practically creating a crisis situation in pig farming. Regarding the year 2023, it can be said that price levels consolidated from a livestock farming perspective; however, it is important to note that in 2021 and 2022, financial reserves used to survive were depleted, and there is a lack of resources for replenishing these reserves and launching further developments.

Consequently, it is an important and timely question to evaluate the cost and income relations of a new and efficiently operating pig farm, thereby forecasting the return on investments, which this study undertakes based on a preliminary calculation model.

In our investigation, we set out to answer the following questions: how does the cost structure and profitability of a newly built pig farm, operating with the best housing and feeding technology, develop, and within what time frame does the investment pay off? Related to this, our hypotheses were formulated as follows:

(H1) A pig farm operating efficiently both technologically and in physical terms functions profitably.

(H2) The discounted cash flow generated ensures a payback period of less than 10 years.

LITERATURE REVIEW

Pig Meat Production

In 2022, the EU-27 member states accounted for 12.4% of global meat production, exceeding a self-sufficiency level of 100%, reaching an average of 111% in 2023. In total, eight member states, including Hungary, exhibited above-average self-sufficiency in 2023. A significant portion of the export market was represented by pork, accounting for 61.7% in 2022, while poultry meat exports were nearly 30% (EC, 2024). It can be stated that meat production in the EU-27 increased over the past twenty years, although at different rates and magnitudes depending on the type of meat: poultry production increased the most, while beef and pork production showed more modest growth (Meat Atlas, 2022).

Following poultry, pork is globally the most produced meat type by volume, and according to ten-year forecasts, no significant changes are expected in its production trends, as pork and poultry meat will continue to hold a leading position — jointly accounting for 74.8% (OECD-FAO, 2024). The EU-27's pork production fell by 5% in 2022 compared to 2021, amounting to 22.5 million tonnes. Production decreased in both Germany and Spain, the two largest pork-producing countries. Germany saw a 9.6% decline in 2022, while Spain experienced a 2.2% reduction. The most significant reductions occurred in Poland and Denmark; however, production levels were also lower in other member states. This means that production in 2022 nearly reached the low point recorded in 2009 (OECD-FAO, 2023). A similar trend was observed in per capita meat consumption, with a 5.2% decrease in pork consumption. The background to this lies in changing attitudes related to health, stricter environmental policies in the EU, and their societal perception (EUROSTAT, 2024).

Production Costs

Beyond the current problems of pig breeding, it is important to highlight that specialization is not a general characteristic among Hungarian producers, despite the fact that specialization can significantly increase farm efficiency. Pig breeding consists of two production processes: one is sow keeping and piglet rearing, while the other is fattening, which results in slaughter pigs (Apáti-Szőllősi, 2018). In light of this fact, it is worth examining the production costs of pig production in an international comparison, presented in Table 2. The largest cost item is feed, which accounted for 57% in Hungary in 2022. Due to the automation of pig farms, relatively few human resources are required to manage large-scale farms. Therefore, in Hungary, labor costs accounted for 5.8% of the total cost in pig production in 2022.

Table 2. Evolution of production costs in pig production, 2022

Country	Animal feed (€/kg)	Other operating expenses (€/kg)	Labour costs (€/kg)	Depreciation and other financial costs (€/kg)	Total (€/kg)
Italy	1,82	0,44	0,15	0,48	2,89
United Kingdom (closed)	1,82	0,27	0,17	0,29	2,55
United Kingdom (open)	1,83	0,31	0,18	0,22	2,54
Sweden	1,74	0,18	0,18	0,38	2,48
Finland	1,26	0,42	0,20	0,35	2,23
Germany	1,44	0,32	0,15	0,31	2,22
Ireland	1,47	0,29	0,15	0,28	2,19
Netherlands	1,33	0,39	0,13	0,23	2,08
Spain	1,46	0,30	0,10	0,20	2,06
Hungary	**1,16**	**0,26**	**0,12**	**0,50**	**2,04**
Austria	1,38	0,06	0,20	0,40	2,04
Belgium	1,42	0,23	0,12	0,23	2,00
France	1,28	0,25	0,13	0,26	1,92
Denmark	1,20	0,26	0,17	0,23	1,86
USA	1,31	0,18	0,10	0,21	1,80
Brazil, southern region	1,28	0,11	0,04	0,17	1,60
Brazil, central-western region	1,09	0,10	0,04	0,18	1,41

Source: own compilation, based on data from ZMP and KSH (2023)

The volume of investments taking place in agriculture is influenced, in addition to the national economic situation, by the condition of agriculture and its output. Hungarian agricultural output in 2023 exceeded HUF 4.3 billion, which was 6.6% higher than a year earlier. Among the reasons for the increase was a 25% growth in total production volume, of which crop production was 45% higher, while livestock production decreased by 0.5% (KSH, 2023). The domestic development needs are significant, as competitiveness often lags behind that of Western European countries.

The Growth Loan Program was a major financing factor for many years, while market-based lending came back to the fore in 2016. Another source of financing is the Rural Development Programme (RDP) 2014-2020 (Prime Minister's Office, 2015). Unlike previous programs, in this case, sectors creating higher added value became the focus, which also have a significantly greater labor demand (animal husbandry, horticulture), so machinery investments (large-scale tractors related to arable farming) were excluded from the support system. Additionally, a significant change was that the object of investment determined the evaluation of support intensity. 10-15% of pig farmers benefited from decisions supporting the modernization of pig farms. It is likely that the developments did not affect all facilities of the farms, but due to the high coverage, the effect of support is reflected in the competitiveness of the entire sector (Bíró et al., 2020).

MATERIALS AND METHODS

Primary data collection was based on a pig farm built in 2023 as a brownfield investment in Hungary, using a preliminary calculation model. The natural parameters were calculated considering values realized during previous investments of the organization, already equipped with new and modern technology, similarly for individual cost elements.

The planned sales price of slaughter pigs was determined as follows: for setting pig prices, the reference price of the German ZMP quotation was planned at €2.1 per carcass kg, which, applying a conversion factor of 1.238 between carcass and live weight and an exchange rate of HUF 395/€, corresponds to a price level of HUF 670 per live weight kg. As part of the investment, the following production capacities were built:

Figure 1. Key price levels

Source: own photograph

The pig farm, operating since the 1970s, was demolished in 2022, and a modern pig farm consisting of four livestock buildings was built on the site. In a building of 2,730 m² gross area, breeding sows were housed in both group and individual housing systems. The breeding building was equipped with 456 group gestation spaces ("gestation house"), 258 individual sow stalls (breeding stalls), and 64 gilt accommodation spaces. For incoming gilts, an additional 8 pens are available, accommodating 64 animals, and there is space for 4 teaser boars with separate housing. Another building was designed for farrowing pens over 2,340 m² and for nursery rooms totaling 1,590 m². In the six farrowing rooms, each has 36 farrowing crates of 6.24 m², so-called "free-farrowing" pens, which already exceed future animal welfare standards, providing better comfort and well-being for breeding animals during farrowing and piglet rearing. (This is the first large-scale farrowing capacity in the organization examined, built with loose housing systems.) As a result, the piglets selected for weaning are more vigorous and better developed and can adapt more efficiently to conditions in subsequent production phases. Breeding sows moved from the more comfortable and freer farrowing pens can stay productive for longer and, due to their better physical condition, are capable of higher milk production, reflected in the growth of the offspring herd. The nursery, consisting of 6 rooms with 16 pens each, totaling 2,976 places, and the finishing barns built in two buildings of 4,510 m² each, totaling 8,640 places, are lagoon-based systems, with external thermal insulation, reinforced concrete walls, wooden roof structures, sandwich panel roofing, and, of course, include mechanical, storage, and electrical rooms. With an average sow stock of 800, the farm will produce 25,000 slaughter pigs per year, with an average live weight of 118 kg, amounting to 2,950 tons of output.

The selected housing technology features a lagoon system whose main components include a pen system, an automated feed delivery system, and an automated ventilation system. Heating is supported by a heat pump system. The building is equipped with the most modern ventilation technology. Through central air inlets, fresh, temperature-controlled air, both in winter and summer, is directed into underfloor air ducts, from where it is delivered in a regulated quantity and speed into the animal housing space via air distribution columns, so-called exatops. Exhaust fans remove used air from the housing areas, ensuring that the amount and temperature of fresh air entering the individual rooms precisely meet the animals' needs. The feeding of breeding sows and piglets is ensured by dry feed delivery and distribution systems, while the finishing barns' feeding is provided by a well-controlled liquid feeding system.

In examining the payback of the investment, we applied the following four dynamic investment profitability indicators: Net Present Value (NPV), Discounted Payback Period (DPP), Internal Rate of Return (IRR), and Profitability Index (PI). When preparing the model, we took into account the financing structure of the investment.

Among indicators supporting investment decisions, NPV is one of the most frequently used. This difference-type indicator expresses how much return is generated by subtracting the initial cash outflow from the discounted total of post-tax cash flows, i.e., the net profit of the investment over its entire duration expressed in discounted value. Due to the specific situation of agriculture, it is advisable to use NPV after careful examinations, keeping sector-specific characteristics in mind (Karácsonyi, 2007). Using the DPP, we obtain the number of periods during which the funds invested in the project are recovered. The IRR calculation is also based on the net present value, as it indicates the interest rate at which the present value of net returns generated in the future equals the present value of the investment (Ulbert, 2018).

The PI indicator expresses the cost-benefit ratio, representing the present value of the investment relative to the initial cash outflow.

RESULT AND DISCUSSION

Cost and Income Relations

The examined farm applies Topigs-Norsvin (Dutch–Swedish) genetics under the following natural parameters. Table 3 summarizes the various production indicators.

Table 3. Development of key production indicators at the site under review

Suckling piglet mortality (%)	8,0%
Piglet mortality (%)	2,2%
Fattening pig mortality (%)	2,0%
FCR [battery] (kg/kg)	1,50
FCR [fattening] (kg/kg)	2,55
FCR [farm] (kg/kg)	2,61
Body weight gain [farrowing] (g/day)	425
Body weight gain [fattening] (g/day)	850
Average number of sows	812,8
Number of piglets selected per sow per year	31,10
Fattening pigs sold per sow per year	30,48

Source: based on own data collection (2024)

Table 4 presents the modeled production values of the farm, showing production value and production costs. It can be established that the complex pig farm operates profitably, with a cost-to-income profitability ratio of 15.61%.

Table 4. Production values of the pig farm under review, 2023

Name		Total settlement (thousand HUF/year))	Specific value per 1 kg of weight sold (Ft/kg)	Unique value per sow (thousand HUF/sow)
1.	Revenue	1 985 790	665,56	2 443
2.	Subsidies	73 493	24,63	90
3.	Production value	2 059 283	690,19	2 534
4.	Direct costs	1 615 373	552,57	1 987
5.	General + financing costs	122 513	41,06	**151**
6.	Production costs	1 737 886	582,47	2 138
7.	Profit	321 397	107,72	395
8.	Depreciation (excluding breeding animals)	259 456	86,96	319
9.	EBITDA	580 853	194,68	715
10.	Rerurn on production value		15,61%	
11.	EBITDA on production value		28,21%	

Source: own compilation, based on data from ZMP and KSH (2023)

The cost structure of the production at the examined pig farm is illustrated in Table 5. The most significant cost item is feed costs, which account for more than 52%, followed by depreciation costs at 14.93%, representing HUF 259 million annually for buildings, machinery, and technology. The depreciation of breeding animals is shown on a separate line, accounting for nearly 4%. Personnel expenses include the salaries and social contributions of the farm manager and eleven employees. The cost of services used constitutes 8.48% of all direct costs, while energy costs similarly appear with a share of 8.38%.

Table 5. Cost structure of the pig farm under review, 2023

	Cost structure	Thousand HUF/year	Ratio
1.	Feed costs	909 272	52,32%
2.	Fertilizing material	7 647	0,44%
3.	Energy costs	145 635	8,38%
4.	Veterinary medicine and hygiene materials	39 971	2,30%
5.	Other material costs	9 906	0,57%
6.	Cost of services used	147 373	8,48%
7.	Personnel expenses	149 806	8,62%
8.	Depreciation of breeding animals	68 820	3,96%
9.	Depreciation (buildings, machinery, technology)	259 456	14,93%
10.	Total direct costs	1 737 886	100,00%

Source: based on own data collection (2024)

Sensitivity Analysis (Cross-tabulation Analysis)

Based on the preliminary calculation model, considering the cost and income situation, we performed cross-tabulation analyses, which allow examination of two variables simultaneously. In the sensitivity analysis, we examined how changes in the two factors we consider the most important, namely feed prices and the sales price of slaughter pigs, affect the result and the EBITDA value. We analyzed the results in the function of feed prices varying between HUF 80–150 per kg and slaughter pig sales prices ranging from HUF 500–725 per kg. The results suggest that in the economic year 2023, to cover a feed price of HUF 140/kg, a sales price of HUF 650/kg or higher was necessary for slaughter pig sales to remain profitable.

including (Terry and Ogg, 2017; Birthal et al., 2021; Koide et al., 2021; Vo et al., 2021), emphasising the significance of irrigation in agricultural practices.

Table 6. Cross-tabulation analysis of results based on feed prices and slaughter pig sales prices

Income (thousand HUF/year)	Feed price (HUF/kg)							
Slaughter pig sales price (HUF/kg)	80	90	100	110	120	130	140	150
500	75 386	-800	-76 987	-153 174	-229 360	-305 547	-381 734	-457 921
525	148 470	72 284	-3 903	-80 090	-156 276	-232 463	-308 650	-384 837
550	221 555	145 369	69 182	-7 005	-83 191	-159 378	-235 565	-311 752
575	294 639	218 453	142 266	66 079	-10 107	-86 294	-162 481	-238 668
600	367 724	291 538	215 351	139 164	62 978	-13 209	-89 396	-165 583
625	440 808	364 622	288 435	212 248	136 062	59 875	-16 312	-92 499
650	513 893	437 707	361 520	285 333	209 147	132 960	56 773	-19 414
675	586 977	510 791	434 604	358 417	282 231	206 044	129 857	53 670
700	660 062	583 876	507 689	431 502	355 316	279 129	202 942	126 755
725	733 146	656 960	580 773	504 586	428 400	352 213	276 026	199 839

Source: own data collection and calculations (2024)

Continuing the logical calculation, we also performed the cross-tabulation analysis regarding EBITDA (Table 7). In this case, at a feed price of HUF 140/kg, a sales price of HUF 550/kg was sufficient for production not to be loss-making.

Table 7. Cross-tabulation analysis in terms of EBITDA, depending on feed prices and slaughter pig sales prices

EBITDA (Th HUF/Year)	Feed price (HUF/kg)							
Slaughter pig sales price (HUF/kg	80	90	100	110	120	130	140	150
500	334 842	258 656	182 469	106 282	30 096	-46 091	-122 278	-198 465
525	407 926	331 740	255 553	179 366	103 180	26 993	-49 194	-125 381
550	481 011	404 825	328 638	252 451	176 265	100 078	23 891	-52 296
575	554 095	477 909	401 722	325 535	249 349	173 162	96 975	20 788
600	627 180	550 994	474 807	398 620	322 434	246 247	170 060	93 873
625	700 264	624 078	547 891	471 704	395 518	319 331	243 144	166 957
650	773 349	697 163	620 976	544 789	468 603	392 416	316 229	240 042
675	846 433	770 247	694 060	617 873	541 687	465 500	389 313	313 126
700	919 518	843 332	767 145	690 958	614 772	538 585	462 398	386 211
725	992 602	916 416	840 229	764 042	687 856	611 669	535 482	459 295

Source: own data collection and calculations (2024)

Evaluation of the Investment's Payback

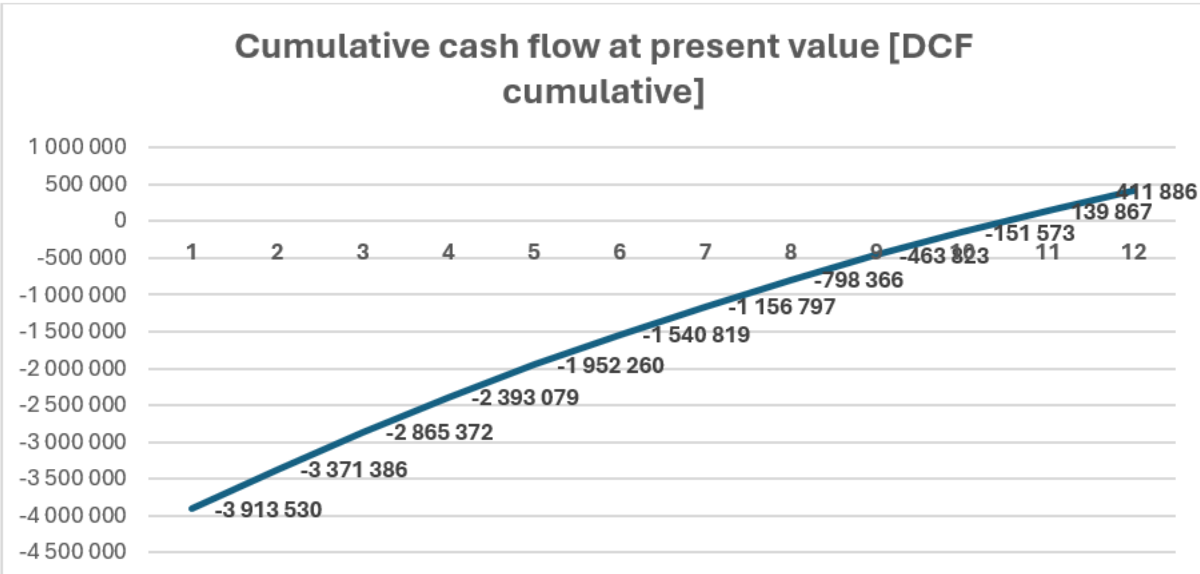
Regarding the composition of the financing sources for the investment, the total cost of the project was HUF 6.13 billion, of which 36.65% was a non-refundable subsidy. Accordingly, own resources amounted to HUF 3.88 billion, consisting of equity and investment loans, representing a share of 63.35%.

Table 8. Influence of traditional risk management on the association of farm business risk and repayment status

	Thousand HUF	Ratio
Total investment cost	6 130 000	100,0%
Non-refundable subsidy	2 246 470	36,65%
Total own resources	3 883 530	63,35%
of which - own contribution	1 226 000	20,00%
- investment loan	2 805 000	45,76%

Source: own data collection and calculations (2024)

Figure 3. Key price levels



Source: own calculations (2024)

According to our calculations, the net present value (NPV) of the investment at the end of the 15th year from the investment date is HUF 1.36 billion, with a discounted payback period (DPP) of 9.5 years. The internal rate of return (IRR) is 12.35%. Overall, we are dealing with a capital-intensive investment, considering the structure of financing (36.65% non-refundable subsidy, 45.76% investment loan), which significantly improves the examined indicators from the company's perspective. Including subsidies in the financing structure results in more favorable returns under the income relations examined since a pig farm investment implemented purely from own resources would not be able to achieve payback even within ten years.

CONCLUSION

In our study, we presented a complex pig farm established as a brownfield investment in 2023, analyzing it in terms of cost and income relations. The results obtained were presented, among other things, using a preliminary calculation model. It can be stated that the production indicators of the examined pig farm are competitive even in an international context, representing a high technological standard, equipped with an automated feed distribution system and modern ventilation. Thus, we accept our first hypothesis (H1) that a pig farm operating with modern technology and physical efficiency can operate profitably.

Our investigation also highlighted that implementing an operation considered competitive and modern in an international context requires extraordinary capital, which purely from own resources would not ensure even a 10-year payback period. For this reason, it is definitely necessary to further improve support policies and investment financing for enterprises because making Hungarian pig breeding more efficient is indispensable. Therefore, we accept our second hypothesis (H2) that the discounted cash flow produced ensures a payback period of less than 10 years.

In our opinion, in the future, through similar efficiency-enhancing investments and technological developments, a reduction in production costs can be observed, thereby increasing competitive positions, in line with the results of numerous other researchers (Nábrádi et al., 2009; Kirkaya, 2020; Szántó et al., 2020). The use of modern production technologies and genetic progress is expected to increase productivity positively.

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