
INVESTMENTS IN SERBIAN PIG PRODUCTION – INFLUENCE OF REGIONAL DISPARITIES

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ABSTRACT

Pig production is one of the most important elements of Serbian livestock breeding sector. Although it faces numerous challenges, there is not enough research focused on its economic effectiveness. The goal of this research is to analyze influence of regional disparities on economic efficiency of investments in Serbian pig production. The main methodological approach was to determine the present value of investments in pig production (for Mačva and Šumadija regions). Authors applied sensitivity and scenario analysis, as well. Riskiness of investments is compared using standard deviation and coefficient of variation of the expected present value. The results indicated significant influence of labor costs on net cash flows (especially in Šumadija region). Analysis revealed that (in usual circumstances) investments in pig production in Mačva region are more economically efficient. Nevertheless, rather small increase in pig price could lead to equal present values in both regions. It was determined that investments are riskier in Šumadija region.

Introduction

Although pork is by far the most important type of meat production in Serbia (Statistical Yearbook of the Republic of Serbia, 2022), there is not enough research devoted to Serbian pig production (primarily from the economic standpoint). Having in mind the declining chain indices of pig breeding in 2021 (comparing to 2020), smaller number of pigs in 2021 (comparing to 2020) as well as extreme increase in number of imported pigs (in year 2021 comparing to previous years) (Statistical Yearbook of the Republic

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of Serbia, 2022), it is evident that economic effectiveness of pig production in Serbia requires additional research.

Discussing importance and export potential of Serbian livestock production, Madžar (2014) concluded that there is a decrease in livestock number followed by an increasing import of livestock products. Research covering period from 2001 to 2014 (Mirilović et al., 2015) determined that during the observed period there were five years with negative economic performance of pig production (years 2002, 2003, 2006, 2007 and 2010). Having in mind variability of market prices, Zekić et al. (2007) stated that pig producers have an uncertain position, while the supply of processing industry is unstable. Zekić et al. (2008) determined economic and technological challenges related to the production of piglets and fattened pigs on family farms. Ivanović et al. (2015) indicated that economic evaluation of investments in pig production requires application of modified internal rate of return – MIRR (instead of traditional internal rate of return approach) due to a significant variation of net cash flow in pig fattening operation.

Discussing possibilities for improving pork production, Sviben (2001) focused on prices (pork and pig prices), pig breeds and production process. Zekić et al. (2014) applied simulation methods to analyze economic parameters of pig production, concluding that there is a high level of riskiness related to this production (and consequently there is a need for risk reduction). Ivanović (2013) performed an analysis of economic efficiency of investments in pig production and compared it with beef production, while Jeločnik et al. (2021) calculated gross margin in pig production (pig fattening) and discussed its sensitivity (concerning a decrease of pig price and an increase of variable costs).

Analysing economic performance of various types of livestock production in the EU, Nastić et al. (2017) determined that granivores production (comprising of pigs and poultry production) dominates over the other production types concerning average level of total output and value of total assets. Malak-Rawlikowska et al. (2021) analyzed a new approach to pig farms economic sustainability oriented towards long – term perspective (instead of usually observed short – term span). Authors tested the hypothesis that “closed-cycle farms might be more economically sustainable than those farms that are specialized in piglet production (breeding) or growing–finishing”. As a result, it was concluded that “closed-cycle farms do indeed have advantages in terms of raising healthy animals and having slightly better overall resilience of resources, however breeding and finishing farms appeared to be more sustainable in the areas of profitability, risk management, and reproductive efficiency”. Ruckli et al. (2022) discussed multi-criteria sustainability assessment tool for various types of pig farms (breeding, breeding to finishing and finishing farms). According to the authors, “multi-criteria analysis is a suitable method for assessing the sustainability of pig farms as it allows the coverage of a wide range of topics relevant to sustainability”. Alves et al. (2022) made an effort to develop a standard tool (method) for calculation of costs in pig production (for different production systems). Apart from variable and fixed costs, authors discussed opportunity costs of capital and land, as well.

Besides, there was some research focused on producing pork product with protected origin. Such research is based on the comparison of traditional (Mangalitsa) and modern pig breeds – such are Yorkshire (Large White) (Zekić et al., 2012) or Landrace (Zekić et al., 2012). Discussing gastronomic tourism of Vojvodina, Banjac et al. (2016) mentioned meat – based protected products such as Kulen, Domestic sausage and Salami sausage (all of them from Srem region known by its pork production), Slovakian sausage, Ham from Vršac and Sausage from Svetozar Miletić.

Pig production is currently dominated by the widespread conventional indoor system (Delsart et al., 2020). Conventional indoor systems are less socially acceptable and there is a tendency to replace them with the alternative ones. These alternatives have real advantages, as stated by the authors, but they also have weaknesses which represent major challenges to be faced. Research conducted by Renner et al. (2021) indicates that technologies are on average well adapted to local natural conditions of production with little potential for increasing efficiency and productivity.

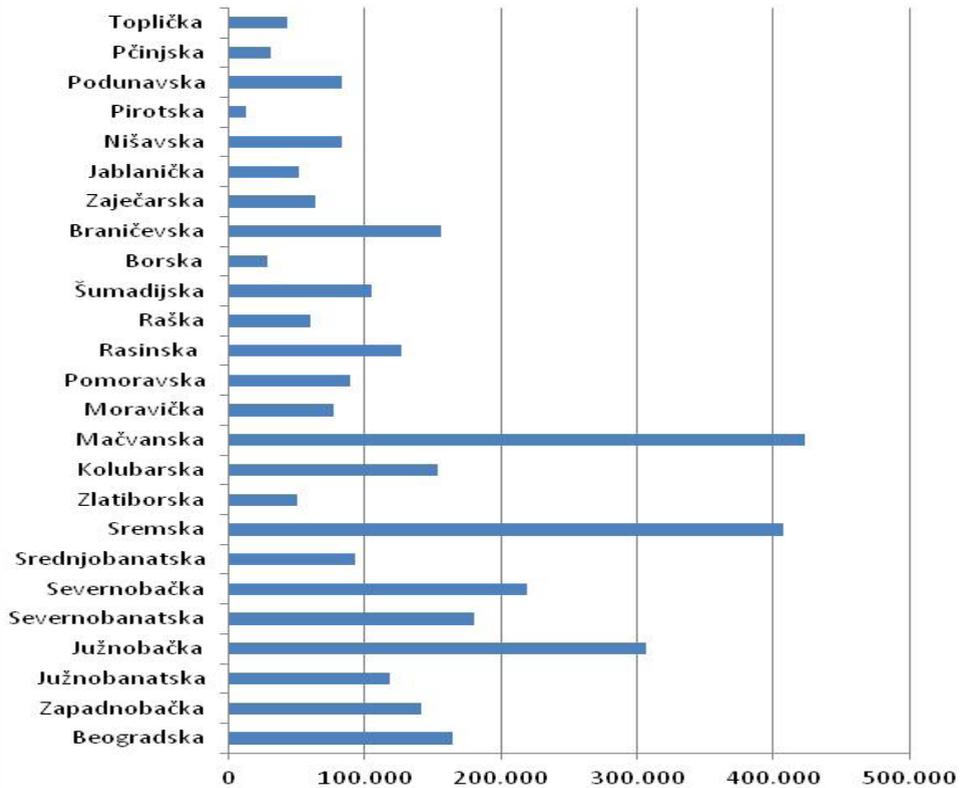
Intensive production is based on an indoor system that functions according to the “all-in all-out” principle, which ensures high animal hygiene conditions, good production results and good management. Depending on the area, there are differences in the intensity of production, which are reflected in the size of the farm, the structure of the farm, breeding and selection, farm technology and equipment, as well as the production results. Economic results in pig production depend on numerous genetic and non-genetic factors, whether it is the production and rearing of breeding pigs, or the production of fattening pigs with a large proportion of meat in the carcass and good physico-chemical and technological properties of the meat (Radović et al., 2018).

The state of pig production in Serbia is not satisfactory and is a consequence of the lack of differentiation in terms of structure, openness of the pig population, non-continuous breeding and selection work, weak productivity control, poor technical and technological solutions, transition and instability of the market (Savić, 2014). Besides, there is a problem of unclassified carcass in Serbia, with all the negative consequences for pig farming, but also for the meat industry (Radović et al., 2018).

The highest number of pigs is present in Serbian lowland regions. According to the data from Farm Structure Survey (which was conducted in 2018), pig production is the most important in regions of Mačva and Srem (Figure 1) (Statistical Office of the Republic of Serbia, 2022). On the other hand, there are some other areas in which pig production is less present, while cattle, sheep or poultry production are dominant.

Authors used data from two regions – Mačva and Šumadija in this analysis. Mačva is the region with the highest level of pig production (due to favorable natural conditions), while Šumadija region is hilly area situated in central Serbia. Considering the number of animals (recorded in Agricultural census in 2012), in Šumadija region sheep and cattle productions are more important than pig production (Statistical Office of the Republic of Serbia, 2013). Therefore, Mačva and Šumadija present regions with different natural conditions and consequently different importance of pig production.

Figure 1. Number of pigs per areas in Serbia in 2018



Source: SORS, 2022

The goal of the paper is to determine how regional differences influence investments in pig production and its riskiness. At the same time, the research covered other important factors related to investments, such as the level of discount rate and labor costs.

Materials and methods

In order to present the importance of pig production of individual regions in Serbia (in the introductory part of the paper) authors used data published by Statistical Office of the Republic of Serbia (which includes data from Agricultural census conducted in 2012 and Farm Structure Survey conducted in 2018). Authors analyzed pig production in two regions – Mačva and Šumadija. The decision to perform the analysis for these regions is based not only on their importance for pig production in Vojvodina and Central Serbia, but also on the availability of data in STIPS database for the analysis.

Authors used STIPS database to acquire data (on monthly basis) regarding prices of pigs, piglets and mercantile corn in analyzed regions. Average prices of these variables for 2022 are applied in the calculations of net cash flows. The analysis was performed on the model of family (finishing) farm producing 300 fattened pigs per year (three

production cycles per 100 pigs). One fattening cycle lasts for 100 days, while pigs are fattened from an initial weight of 25 kg to a final weight of 105 kg. The pigs are sold to the meat processing facilities, which provides eligibility for state subsidies.

Investment analysis is based on an average yearly cash inflow and outflow of pig fattening operation, providing necessary elements for the determination of the present value. The present value indicates a maximal level of investment which is economically acceptable (Gogić, 2014; Ivanović, 2013). Observed economic life of investments in pig production is 40 years. To determine the present value, authors applied various discount rates (2.5%, 5.0% and 7.5%). Apart from the variation of discount rate, authors analyzed an influence of labor costs (as opportunity costs related to the pig production on family farms) on the present value of investment. To analyze the present value of investments in risky circumstances, authors performed sensitivity analysis and scenario analysis. The research conducted by Barjaktarović et al. (2020) indicated that sensitivity analysis is sometimes or always used by a certain number of companies in Serbian agribusiness industry (although the majority of companies in the sample use it very rarely). Scenario analysis was performed assuming three scenarios – pessimistic, optimistic and the most probable one (Ivanović and Marković, 2018). The scenarios differ concerning prices of the above mentioned factors of the analysis (price of pigs, piglets and mercantile corn). Scenario analysis resulted in indicators such as the expected present value and its coefficient of variation. The importance of sensitivity analysis and scenario analysis approach for investment analysis in theory and practice was discussed by a number of authors (Karanovic et al., 2010; Kengatharan, 2016; Gogić, 2021).

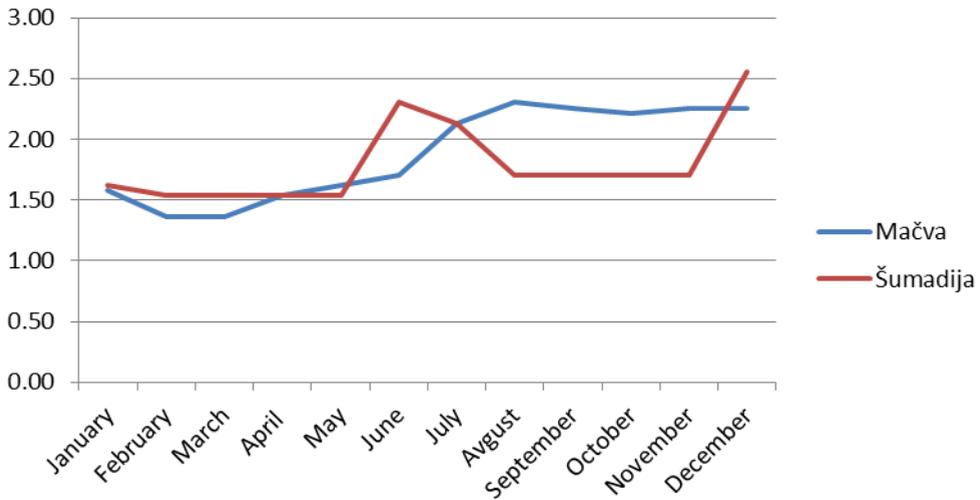
Results and Discussion

Data analysis indicated that average market prices of the most important outputs and inputs in 2022 were lower in Šumadija comparing to Mačva region:

- an average pig price in Šumadija was 4.26% lower than in Mačva region,
- an average piglet price in Šumadija was 2.51% lower than in Mačva region,
- an average corn price in Šumadija was 2.86% lower than in Mačva region.

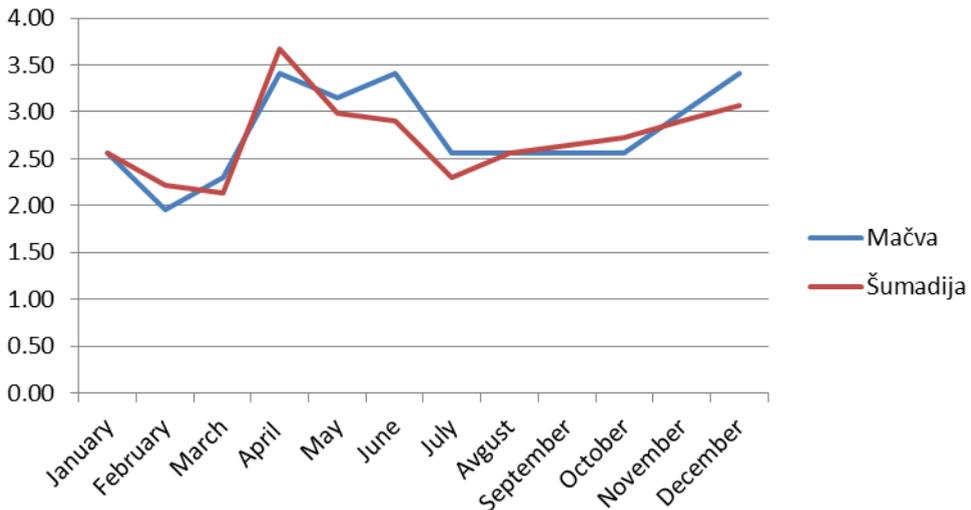
Market price of pigs in Mačva region fluctuated during year 2022 from 1.36 to 2.30 EUR/kg (Figure 2), while an average price was 1.88 EUR/kg. In Šumadija region, market price of pigs varied from 1.53 to 2.56 EUR/kg, while an average price was 1.80 EUR/kg. When it comes to the price of piglets in Mačva region – it was between 1.96 and 3.41 EUR/kg, while an average price was 2.79 EUR/kg (Figure 3). In Šumadija region, prices of piglets varied from 2.13 to 3.67 EUR/kg, while an average market price was 2.72 EUR/kg.

Figure 2. Prices of pigs in Mačva and Šumadija region in 2022



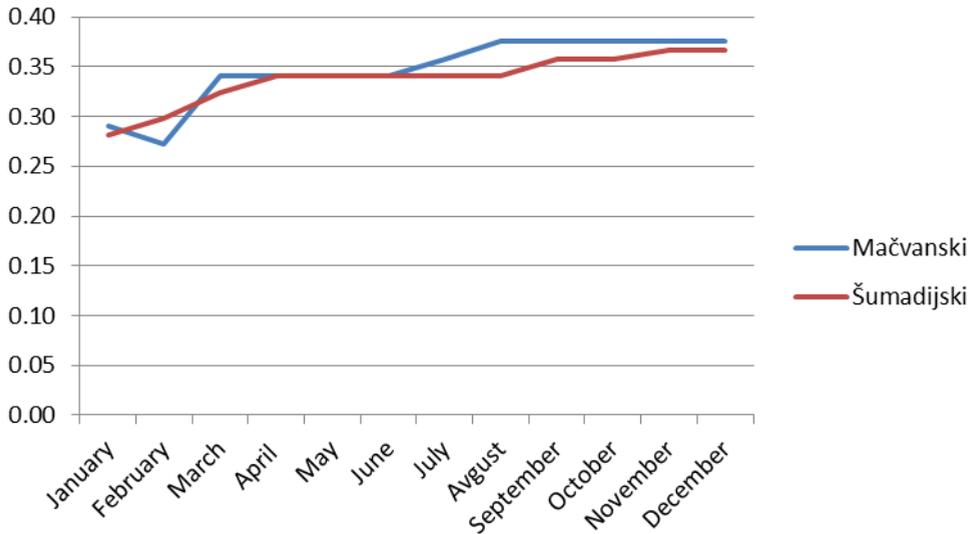
Source: STIPS database

Figure 3. Prices of piglets in Mačva and Šumadija region in 2022



Source: STIPS database

The price of mercantile corn is very important for pig production, because corn participates in feed for pig fattening somewhere around 70%. The analysis revealed that mercantile corn prices were very similar in both regions (Figure 4). Corn price in Mačva region varied from 0,27 to 0,38 EUR/kg in 2022 with an average price of 0,35 EUR/kg. Similarly, corn prices in Šumadija region varied from 0,28 to 0,37 EUR/kg, while an average price in 2022 was 0,34 EUR/kg.

Figure 4. Prices of corn in Mačva and Šumadija region in 2022

Source: STIPS database

The results of investment analysis are influenced not only by the differences in prices between the observed regions, but also by other factors (the most important of them are labor costs). When labor costs (which are equal to minimal net salary in Serbia) are included as an element of cash outflow (Table 1), net cash flow is positive in Mačva region, while it is negative in Šumadija region. Therefore, an assumption that labor costs are included in the analysis implies that an investment in Šumadija region is not economically efficient.

Table 1. Net cash flow if labor costs are taken into account (EUR)

Elements of net cash flow	Mačva	Šumadija
Cash revenues	61.779,00	59.259,00
Fattened pigs	59.220,00	56.700,00
State subsidies	2.559,00	2.559,00
Cash expenses	60.655,61	59.631,40
Feed costs	33.552,96	33.077,52
Water costs	200,00	200,00
Cost of piglets	20.925,00	20.400,00
Veterinary services and medicaments	1.677,65	1.653,88
Electricity costs	700,00	700,00
Labor costs	3.600,00	3.600,00
Net cash flow	1.123,39	-372,40

Source: Authors' calculation

If labor costs are excluded from the analysis (Table 2), net cash flow is positive in both regions, while it is 46.34% higher in Mačva (which provides possibility for a much higher level of investments in pig production).

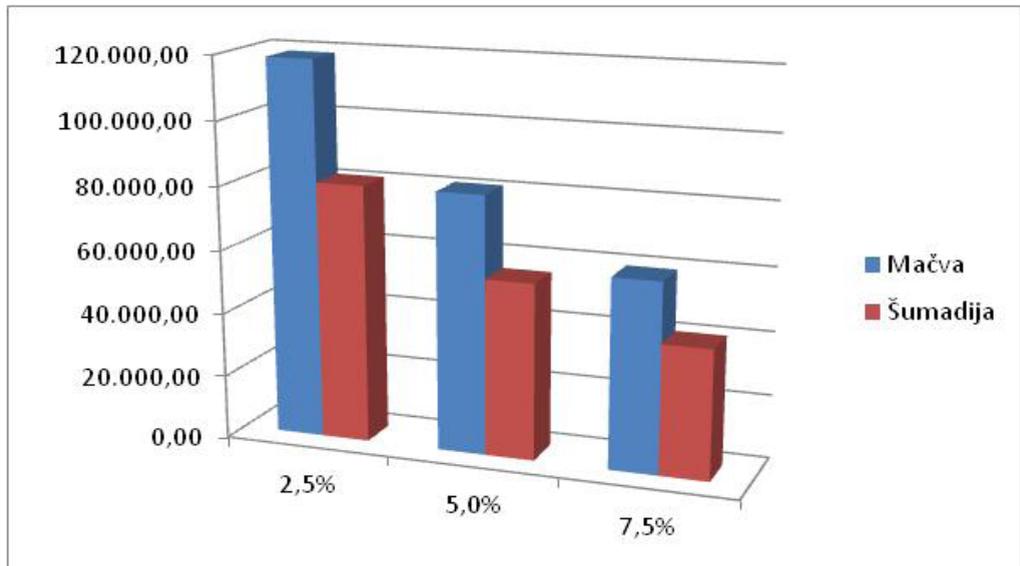
Table 2. Net cash flow if labor costs are not taken into account

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Cash revenues	61.779,00	59.259,00
Fattened pigs	59.220,00	56.700,00
State subsidies	2.559,00	2.559,00
Cash expenses	57.055,61	56.031,40
Feed costs	33.552,96	33.077,52
Water costs	200,00	200,00
Cost of piglets	20.925,00	20.400,00
Veterinary services and medicaments	1.677,65	1.653,88
Electricity costs	700,00	700,00
Labor costs	-	-
Net cash flow	4.723,39	3.227,60

Source: Authors' calculation

Having the above mentioned in mind, the present value is determined (Figure 5) for two investment options – investments in Mačva region and investments in Šumadija region when labor costs are excluded from the analysis. The analysis revealed that the present value of investments in pig production is higher in Mačva region for all observed discount rates. Such results explain higher concentration of pig production in Mačva region.

Figure 5. Present value for different regions and discount rates (EUR)



Source: Authors' calculation

Application of sensitivity analysis approach enabled authors to determine the prices of pigs, piglets and corn in Šumadija region needed to achieve the same level of the present value as it is in Mačva region (Table 3). The basic assumption of the sensitivity analysis is that one factor changes, while all other factors are fixed. According to the results of this analysis, the easiest way to increase the present value of investments in pig production in Šumadija region (and make it equal to the present value in Mačva region) is a slight increase of pig price (only 2.67%). On the other hand, the present value is less sensitive to the changes of other prices relevant to the research.

Table 3. Necessary variation of prices in Šumadija region

Indicator	Present level (EUR/kg)	Necessary level (EUR/kg)	Necessary change
Price of pigs	1.80	1.848	+2.67%
Price of piglets	2.72	2.52	-7.35%
Price of corn	0.34	0,31	-8.82%

Source: Authors' calculation

To explore an economic efficiency of investments in risky circumstances applying scenario analysis, three scenarios were established (pessimistic, the most probable one, optimistic). Different prices (of pigs, piglets and corn) were assumed for each scenario (while other factors were constant) (Table 4).

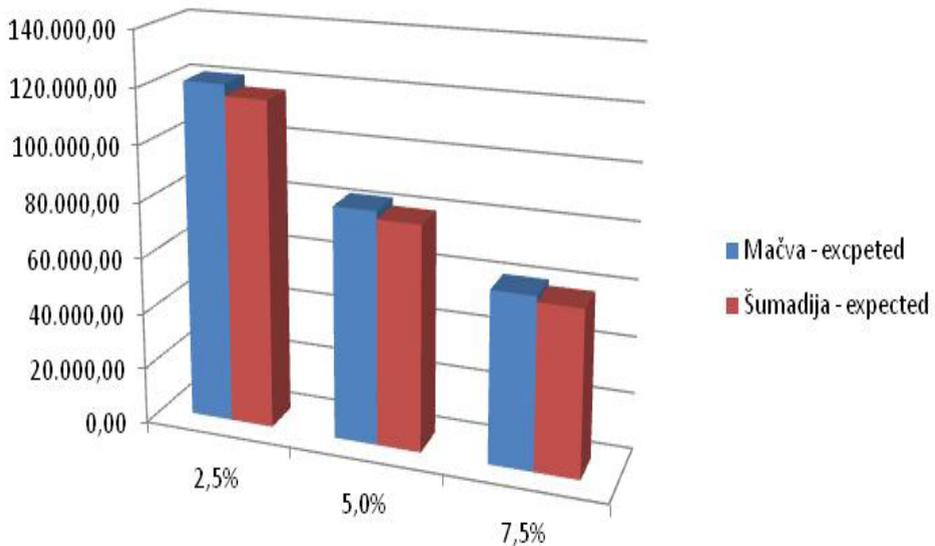
Table 4. Prices used for scenario analysis

Scenario	Pig price (EUR/kg)		Piglet price (EUR/kg)		Corn price (EUR/kg)	
	Mačva	Šumadija	Mačva	Šumadija	Mačva	Šumadija
Pessimistic	1.36	1.53	3.41	3.67	0.38	0.37
The most probable	1.88	1.80	2.79	2.72	0.35	0.34
Optimistic	2.30	2.56	1.96	2.13	0.27	0.28

Source: Authors' calculation

To perform scenario analysis, it was needed to determine probabilities of occurrence of these three scenarios. Having in mind a low level of probability for pessimistic and optimistic scenarios, their probability was assumed to be only 10% each. On the other hand, probability of the third scenario is 80% (which reflects average pig, piglet and corn prices). The scenario analysis was performed only for net cash flow without labor costs (which enabled the comparison of results between two regions). The expected present values of the investments (for various discount rates) were determined as the result of scenario analysis (Figure 6).

The result of scenario analysis indicated almost the same levels of the expected present values in Mačva and Šumadija regions. i.e., in risky circumstances the performance of investments in Mačva region is not as dominant as it was concerning the standard present value approach.

Figure 6. The expected present value for different regions and discount rates (EUR)

Source: Authors' calculation

Nevertheless, appropriate risk indicators (such as standard deviation and coefficient of variation) have a lower value for Mačva region (considering all discount rates) (Table 5).

Table 5. Standard deviation and coefficient of variation for the expected present value

Discount rate	Standard deviation		CV	
	Mačva	Šumadija	Mačva	Šumadija
2,5%	258.113,78	281.393,96	2,14	2,41
5,0%	176.434,36	192.347,61		
7,5%	129.499,03	141.179,00		

Source: Authors' calculation

The results lead to a conclusion that investments in pig production are riskier in Šumadija region comparing to Mačva region, although their expected net present values are very similar. Therefore, it could be concluded that even in risky business environment the advantage should be given to investments in pig production situated in traditional pig production regions.

Conclusions

The use of the present value methodology offers flexibility within the process of investment analysis, providing information on the highest level of investments (in fixed and working assets) which is acceptable for investors. Traditional approach to the analysis (which assumes average business conditions) indicated that it is possible to invest more in pig production in Mačva region, comparing to Šumadija region

(which provides producers in Mačva with more opportunities to invest in technical and technological development). On the other hand, the present value of investments is most sensitive to pig market prices. Therefore, even a slight increase of pig prices in Šumadija can improve their level of the present value to the level recorded for Mačva region. This is why the expected present values of investments in both regions are very similar (although investments in Šumadija region are a bit riskier). The results of the analysis indicated that farm managers in Šumadija have to work not only on achieving a higher pig price, but also on keeping all the prices more stable, to provide investment performance on the level of Mačva region.

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Conflict of interests

The authors declare no conflict of interest.

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