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**The influences of vertical integration and scale of production  
on profitability of pig production**

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*Paper prepared for presentation at the 99<sup>th</sup> seminar of the EAAE  
(European Association of Agricultural Economists),  
'title', place, country, date as in: August 24-27, 2005*

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# THE INFLUENCES OF VERTICAL INTEGRATION AND SCALE OF PRODUCTION ON PROFITABILITY OF PIG PRODUCTION

## Abstract

The material used in the study concerns 60 farms from the Wielkopolska region. They were divided depending on a degree of the farm integration with the slaughterhouses and on a scale of pigs production. The analyses include calculations of pigs prices, costs of pigs production and profits obtained by the farmers. Besides, the objects of the research are the main pigs production costs (feed and labour) as well as investments realised in the investigated farms.

**Keywords:** pigs, vertical integration, scale of production, investments, production profitability

**JEL:** Q12

## Introduction

Each person or organisation aims at certain achievement undertaking defined kind of activity, by desirable condition or by set up purpose (Baruk, 2000). Intensive model of agricultural and food economy development combain with lower real prices of agricultural products, especially pigs prices means, that farmers cannot think only about higher quantity of production, but how raising economical efficiency of managing. It can be realised by rationally using production resources (Woś, 1993). It requires an ability of selling profitable own production apart from only an ability of production (Wielicki et al., 1998).

The obligatory contracting system was in force in Poland all the 80's. It was completely destroyed when a lot of small private slaughterhouses came into being. In day of growing competition more of them have to try and are trying to increase their own competition state. One of the possibilities is co-operation with farmers.

Vertical integration is the best of way of a successful co-operation with the farmers in economically developed countries. In Poland it is most developed in sugar, milk, fruit and vegetable industries. The co-operation with the slaughterhouses involves different restrictions for the farmers. It concerns a place where pigs are sold, feed processing, a choice of breeds etc., that is why the farmers agree to co-operate with the slaughterhouses, if they have got a strong economical incentive.

Seventy percent of pigs producers in the Wielkopolska region think that the integration processes are the most necessary for pigs production. They expect that the integration give them the biggest capabilities of their development.

Most of big farms have exhausted simple reserves for increasing profits realised mainly by cutting the cost of production. That is why the farmers have become more interested in vertical integration even though they do not know all the costs and profits resulting from it. Therefore, the aim of this paper is an analysis of profitability of pigs production in respect of vertical integration and scale of production in Poland in the years 2001-2004.

## Material and methods

The material used in the study was accumulated through my own investigations conducted in 60 farms in the Wielkopolska region. They produced more than 200 pigs per year and the production was a basic commercial production. They were split into 3 groups depending on a degree of the farm integration with the slaughterhouses and into 4 groups depending on a scale of pigs production. (table 1)

The farms from I division are the farms which sold pigs to regular buyers, but they did not enter into an integration agreement, or to buyers who offered the highest price.

The farms from II division are the farms which sold pigs to buyers with whom they entered into an integration agreement.

Table 1. The scheme of farm division depending on a degree of farm integration with the slaughterhouses and a scale of pigs production.

Farm divisions		Degree of farm integration with slaughterhouses		
		I	II	III
Scale of production	A - 200-500	5	5	5
	B - 501-1000	5	5	5
	C - 1001-2000	5	5	5
	D - pow.2000	5	5	5

Source: Own elaboration

The farms from III division are the farms which sold pigs to buyers with whom they entered into an integration agreement too, but they used professional training, agricultural, zootechnical or veterinary care or bought means of production like breeding materials, piglets, minor and waste products produced or offered by the slaughterhouses.

The analysis includes the calculation of the average pigs prices as well as the level and structure of the costs of pigs production in two variants:

- the farmers' own cereals were calculated at the costs of production (variant I),
- the farmers' own cereals were calculated at the costs of their alternative buying (variant II).

The profit achieved will be presented in conversion to 1 kg of pigs and 1 full-employed. The level and structure of bonus prices for pigs and the structure of investments in analysed farms will be showed too.

## Results

### 1. The profitability of pigs production

The average investigated farm sold 1414 pigs worth 689,9 thousand PLN (1 euro = about 4,3 PLN) and culled sows, he-pigs and piglets worth 12,92 thousand PLN. After taking into consideration a minor production, all the costs of production amounted to 508,39 thousand PLN (3,41 zł/kg). It gave the profits of 181,51 thousand PLN per farm and 1,22 PLN/kg of pigs.

The farms from the investigated divisions sold on average from 1338 pigs in I division, 1406 pigs in II division to 1497 pigs in III division. The worth of sale amounted to between 641 thousand PLN in I division and 734 thousand PLN in III division, thus the difference between I and III division increased from 7,5% for quantity of the sold pigs to 14,5% for worth of sold pigs.

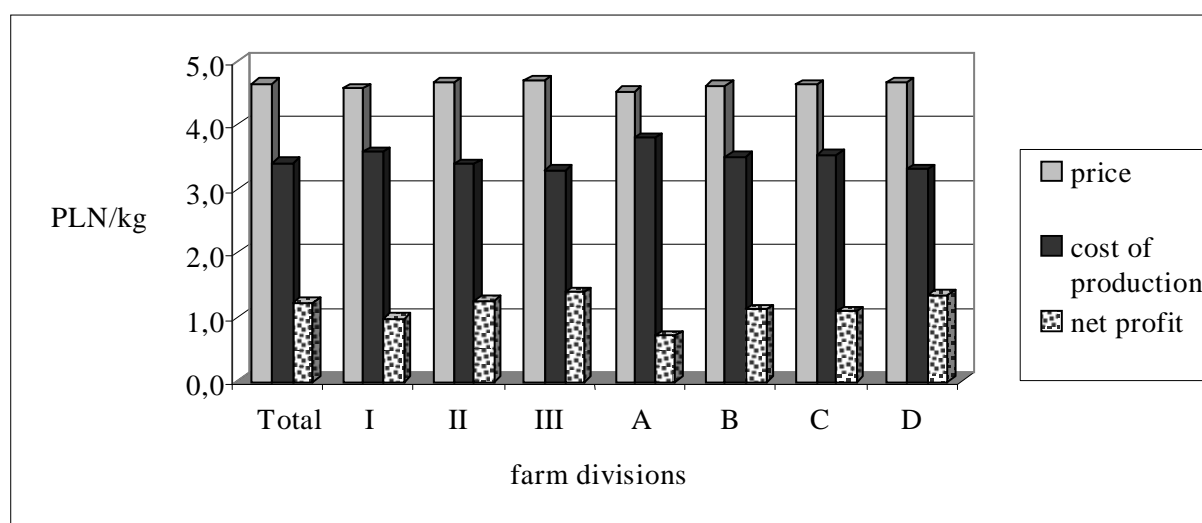


Figure 1. The analysis of pigs prices, unit cost of production and unit net profit in 2001 (variant I – the farmers' own cereals were taken to the calculation at the cost of production).

Source: Own investigations.

The costs of production behaved inversely, namely the difference of the costs of production between I and III division amounted in the first calculated variant to only 2%. In consequence, the difference of received profits increased from 137,69 thousand PLN in I division to 187,21 thousand PLN in II division and to 219,62 thousand PLN in III division. In conversion to 1 kg of pigs the farms received the profit of adequately 0,98 PLN/kg, 1,25 PLN/kg and 1,40 PLN/kg (figure 1).

The similar economic results were received in the second calculated variant, because the farms in III division had the lowest costs (3,46 PLN/kg of pigs) and got the highest prices (4,68 PLN/kg), and that is why received the highest profit (1,22 PLN/kg). Because the cost of cereals production was lower than their market prices, the production cost was higher but in different scale. The farms in I division consumed more their own cereals. The first division farms had lower costs of cereals production than farms in II and III division. That is why if the cost of cereals were calculated against market prices, the costs of pigs production would increase 0,29 PLN/kg in I division farms and 0,18 PLN/kg in III division farms. In consequence, the difference in the level of profits between farms in I and III division would increase from 0,42 PLN/kg to 0,53 PLN/kg. The main results are showed in figure 2. Using the second variant allows to eliminate the profits resulting from the use of the farmers' own cereals, which constituted from 9,34% to 90,34% of all the consumed feed.

The other important factor for the profitability of pigs production was the scale of production. Both pigs price and costs of production were best shaped in the biggest farms. The profit per 1 kg of pigs amounted to 0,72 PLN/kg in the farms which sold 200-500 pigs, whilst in the farms which sold more than 2000 pigs per year the profit amounted to 1,35 PLN/kg. The C division had higher costs than B division because in three farms occurred respiratory system diseases. It caused an increase of pigs lethality and rise of feed intake.

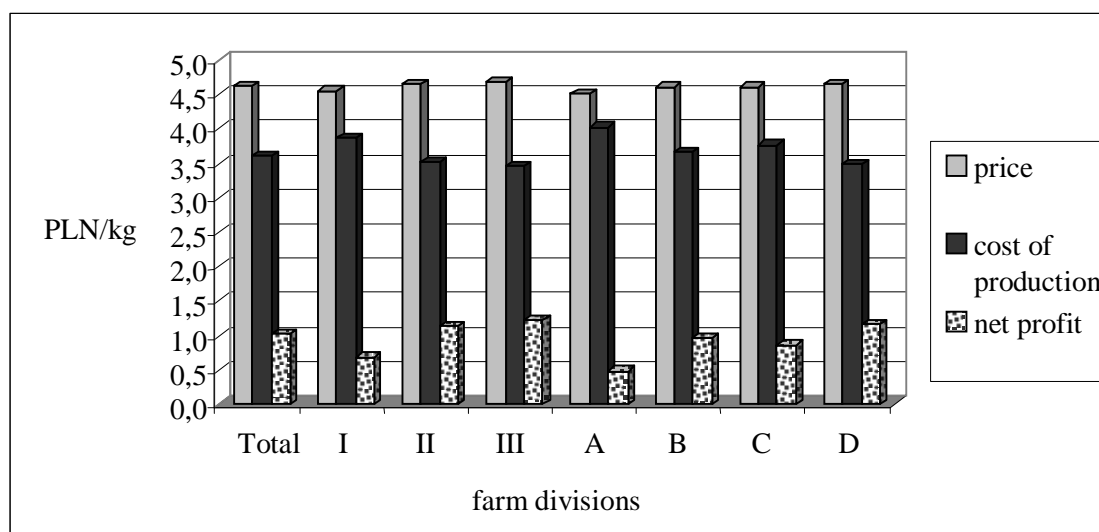


Figure 2. The analysis of pigs prices, unit cost of production and unit net profit in 2001 (variant II – the farmers' own cereals were taken to the calculation at the costs of their alternative buying). Source: Own investigations.

## 2. The factors determining pigs prices

Among main factors which determined the pigs price level are the basic price offered at the given moment and bonus price. The basic price is the price which the slaughterhouses pay without any bonus payments. If the slaughterhouses pay for meatiness, then there is carcass in "R" grade (Wielicki, Pepliński, 2001). The slaughterhouses usually apply similar basic prices. They are established by the biggest slaughterhouses in the region.

As far as bonus prices are concerned, the situation is different. The slaughterhouses use a very differential bonus payment system. It reflects the raw material policy pursued by the slaughterhouses (Pepliński, Majchrzycki, 2002). The analysis showed that the investigated farmers could get the bonus payments at the average level of 0,36 PLN/kg.

The lowest and very differential bonus payments got the farms from I division (on average about 0,20 PLN/kg), whilst in all the other farms these bonus payments amounted to more than 0,40 PLN/kg (figure 3). This regularity was independent of the scale of production.

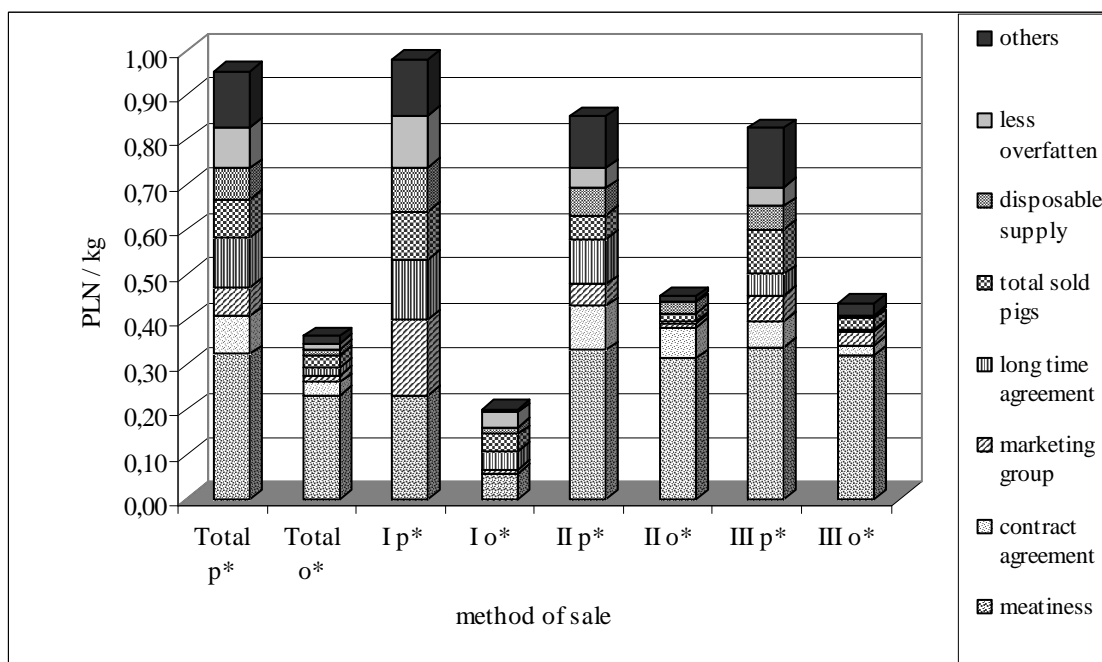


Figure 3. The amount of bonus payments offered to the farmers depending on the method of pigs sale and the amount of bonus payments actually obtained in the investigated farms in 2001 (in the opinion of the investigated farmers).

Source: Own investigations.

\* p – bonus payments possible to receive by the farmers from the slaughterhouses,

\* o – bonus payments actually obtained by the farmers from the slaughterhouses.

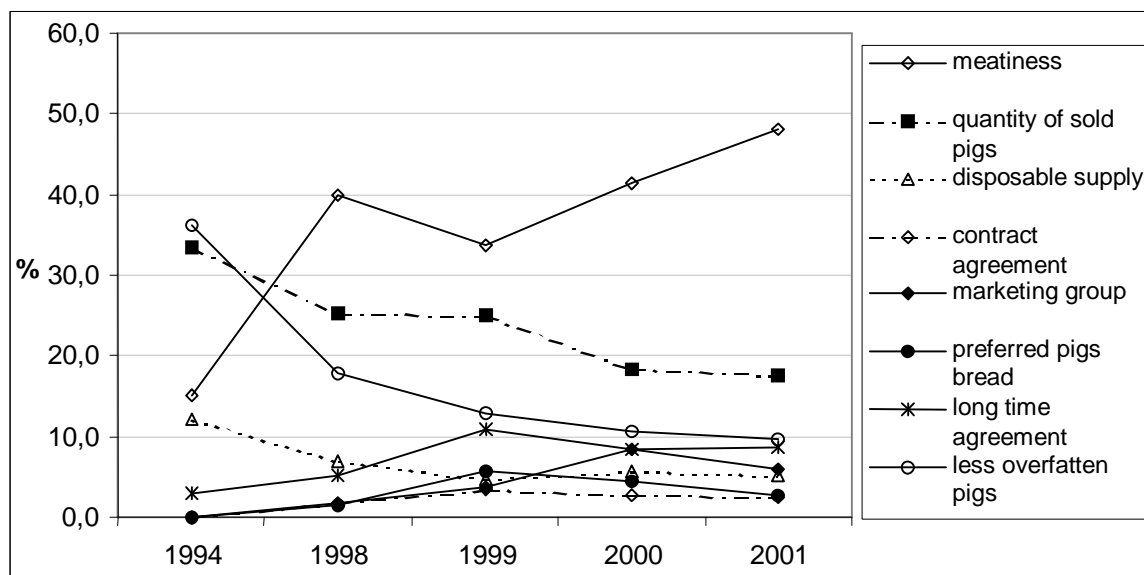


Figure 4. The share of the particular bonus payments in the overall amount of bonus payments in 1994, 1998-2001 (%).

Source: Own investigations.

If the farmers from I division got all the bonus payments offered by the slaughterhouses, they would get near 0,86 PLN/kg, whilst the farmers from II and III division only 0,70-0,75 PLN/kg. It showed that they got only a little more than 20% of bonus payments possible to receive. The farmers

from II division got 0,4515 PLN/kg and from III division got 0,4355 PLN/kg, thus more than 50% of bonus payments possible to receive. Such a great disproportion was connected with the policy of the slaughterhouses, because they gave properly 1,45; 2,75; and 2,55 kinds of bonus payments per one farm. In the all investigated divisions the farmers declared they got on average 2,25 kinds of bonus payments.

The most important bonus payment was the one for meatiness. The slaughterhouses declared that this payment would constitute only 30% of bonus payments possible to receive, but in reality it amounted to more than 60%. It shows that the slaughterhouses more often used this payment in opposite to the others.

This observation is confirmed by the investigation conducted in the slaughterhouses. The research showed that the most often applied and the most important bonus payment was this for meatiness (figure 4). Of great importance were also bonus payments for quantity of sold pigs and for sale of less overfatten pigs. The latter payments lose on importance at the expense of meatiness. The meatiness payments amounted to only 17% of all the bonus payments realised by the slaughterhouses in 1994, while in 2001 they were at the level of near 50%, and their share have been still growing.

### 3. The factors influencing the costs of pigs production

Because the pigs production is a homogeneous production, so in order to gain a competitive advantage the producer (farmer) should focus on gaining this advantage in respect of the concentration of the scale of production or/and try to be a cost leader. In the result of the concentration, the farm can focus on the production of only one or two market products, in which it has the biggest experience or the products which in long time could bring the biggest profits. (Pepliński, et al., 2004).

The general results of the analysis of the costs of pigs production were showed in the figure 2. The detailed results are showed in the figure 5 and figure 6. The biggest share in pigs production had feed costs, which constituted near 59%. The smaller importance had the costs of piglets, sows and boars buying – 12,75% and labour costs – 8,84%. In the calculation the labour costs were estimated at the level of 8,2 PLN per hour (about 2,0 euro/hour). The biggest difference in the share of costs of pigs production occurred in the costs of buying piglets, sows and boars, where it varied from about 11% in II and III division farms to near 16% in I division and from less than 2,5% in the smallest investigated farms to more than 14% in farms which sold more than 1000 pigs per year (C and D division). It was a consequence of shutting down piglets production in some of the farms from I, C and D divisions.

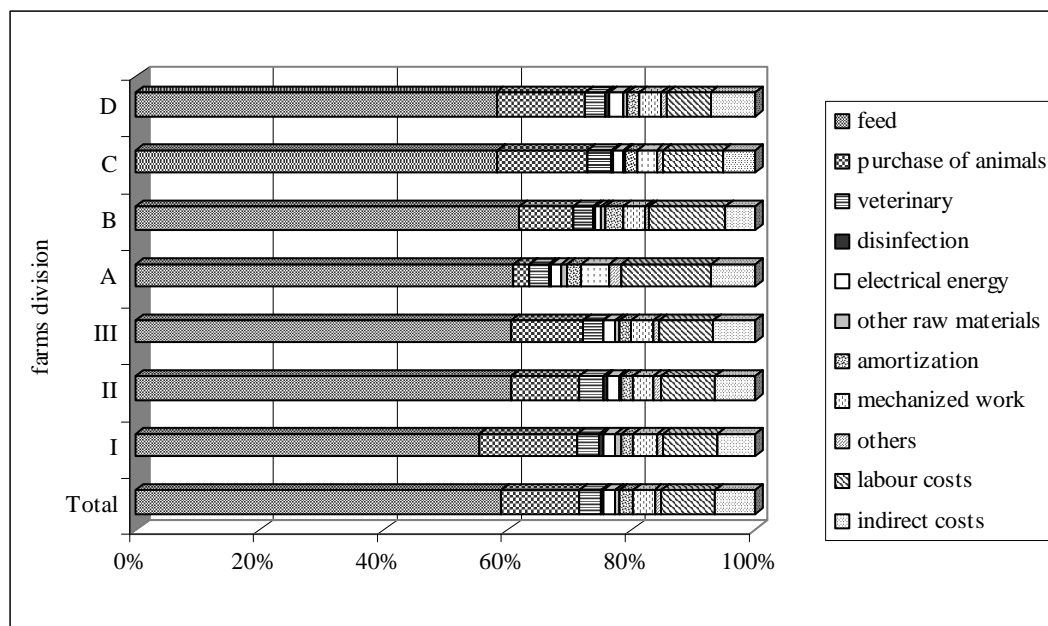


Figure 5. The structure of the costs of pigs production in the investigated farms in 2001 (%). Source: Own investigations.

The similar tendencies were observed in the analysis conducted in absolute values. The biggest differences were in the costs of buying piglets, sows and boars. The costs constituted from 0,40 PLN/kg in II and III division to 0,62 PLN/kg in I division and from 0,10 PLN/kg in A division to 0,56 PLN/kg in C division. The degree of the integration of the farms with the slaughterhouses did not influence the feed and labour in opposition to the scale of production. Together with the increase of the scale of production feed costs decreased from 2,56 PLN/kg in A division to 2,08 PLN/kg in D division, and labour costs from 0,61 PLN/kg in A division to 0,25 PLN/kg in D division, so near 60%. Unexpectedly, the level of veterinary costs was independent of the scale of production and the degree of the integration of the farms with the slaughterhouses and amounted to 0,12-0,14 PLN/kg, thus 3,0-4,0%. There were big differences within this kind of costs. The smallest farms had a similar level of medicine costs and veterinary labour costs.

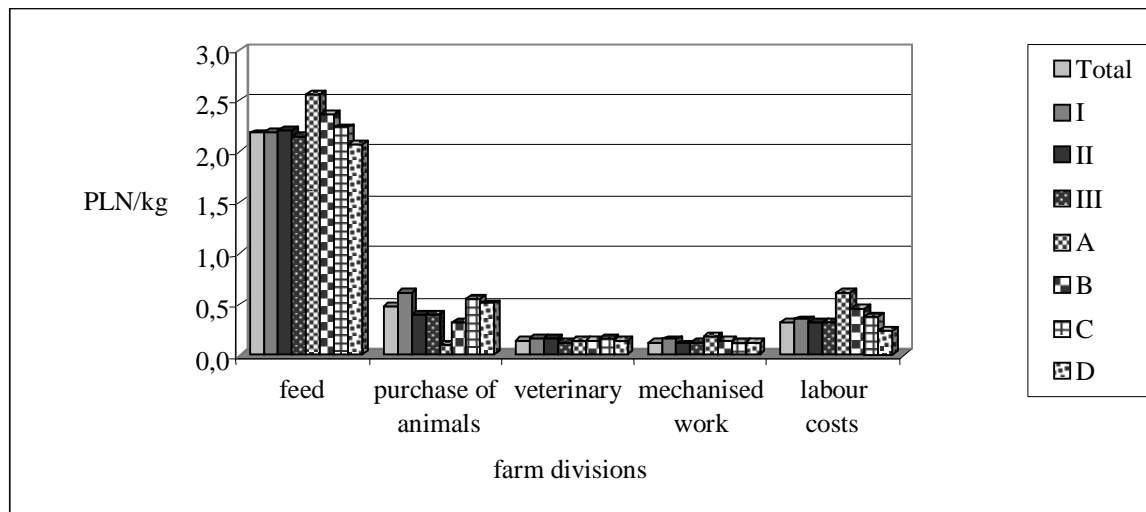


Figure 6. The amount of the costs of production in the investigated farms in 2001 (PLN/kg)  
Source: Own investigations.

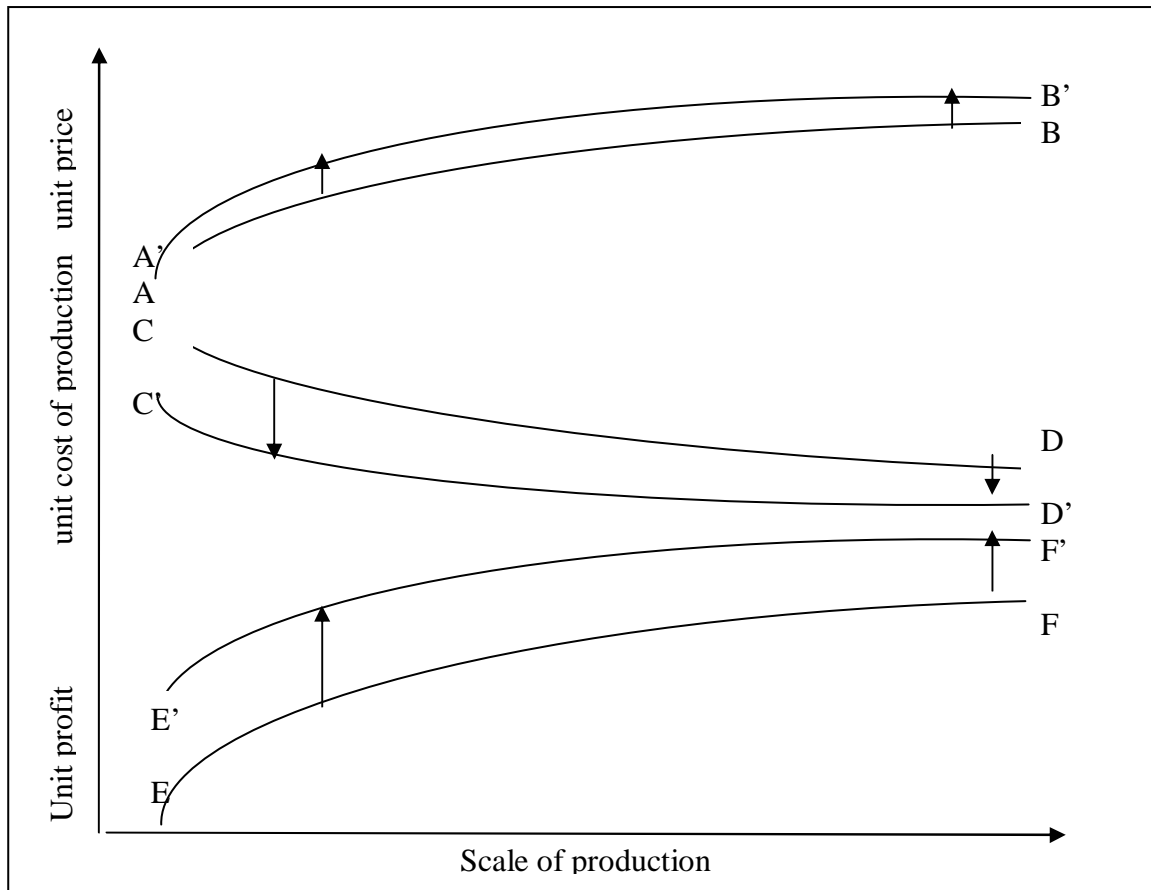
The investigation shows that the increase of the scale of production and the degree of the integration of the farms with the slaughterhouses contributed to the reduction of the unit cost of pigs production and to the increase of obtained prices for pigs. In consequence, the profit for the unit of the sold production increased too. The connection of the scale of production and the degree of the integration of the farms with the slaughterhouses with pigs prices, cost of pigs production and level of unit profit was showed in figure 7.

The investigation shows that in the analysed farms the increase of the scale of production contributed to the decrease of the difference in the level of the obtained prices, costs of production and in consequence the obtained profits between integrated and non-integrated farms. In connection with it, it could be said that together with the increase of the scale of production, the scale of economic stimulus, which could encourage to increase the degree of vertical integration with slaughterhouses, decreases.

Feed costs are the most important costs in pigs production and their level has the greatest impact on the economics of pigs production. The level of the costs depends mainly on feed intake per kg of weight increase (technical production efficiency) and on the unit costs of used feed. These two factors shape economic production efficiency.

High feed costs in non-integrated farms result from high feed intake per kg of weight increase: in open cycle 3,38 kg of feed per kg of weight increase and 4,28 kg in close cycle (including feed eaten by sows). In the farms from III division feed intake was a dozen or so percent lower and amounted to 2,95 kg in open cycle and 2,58 kg of feed per kg of weight increase. Better technical production efficiency was a result of the increase of the scale of production. Feed intake per kg of weight increase constituted from 2,99 kg in open cycle and 3,72 kg in close cycle in the farms which produced more than 2000 pigs per year to 3,68 kg and 4,36 kg in the farms from A division (figure 8).





AB – the level of obtained price by non-integrated producers,

A'B' – the level of obtained price by integrated producers,

CD – the level of the unit cost of production obtained by non-integrated producers,

C'D' – the level of the unit cost of production obtained by integrated producers,

EF – the level of the unit profit obtained by non-integrated producers,

E'F' – the level of the unit profit obtained by integrated producers.

Figure 7. The connection of the scale of production and the degree of the integration of the farms with the slaughterhouses with pigs prices, unit cost of pigs production and level of unit profit.

Source: Own investigations.

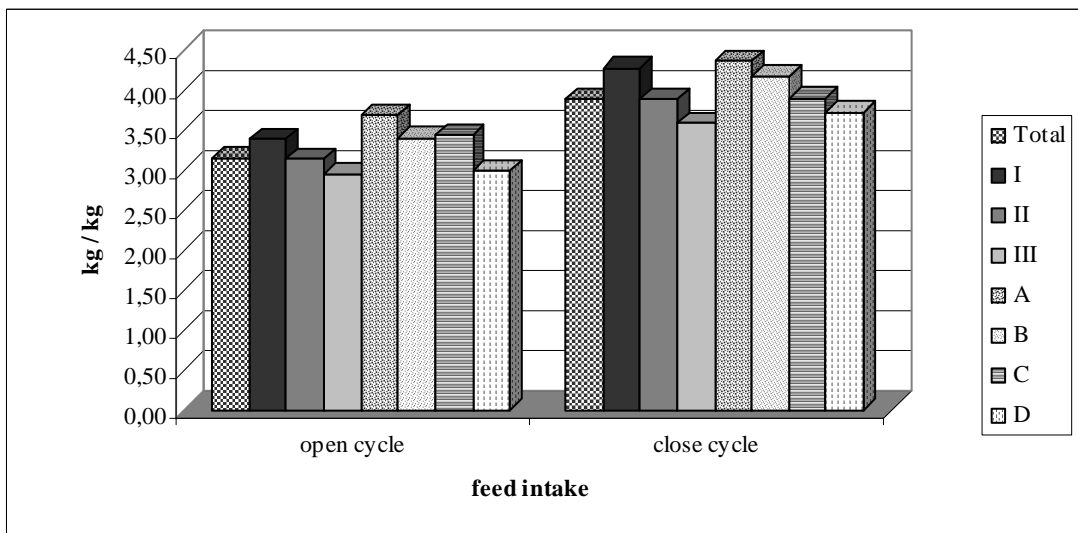


Figure 8. Feed intake per kg of weight increase in open and close cycle in the investigated farms in 2001.

Source: Own investigations.

Lower feed intake is possible not only thanks to more efficient production, but also due to the use of a better quality feed. That is why with increase of the scale of production and the degree of the integration of the farms with the slaughterhouses the more expensive feed were used. The difference was less than 10%, so the purchase (or production in the farms) of more expensive, of better quality and more exactly balanced feed was economically motivated (figure 9).

But if the farmers' own cereals are calculated at their cost of production, the difference in the cost of feed production will increase to 16%, because non-integrated farms used more cereals more cheaply produced in these farms.

The other important costs are labour costs. The investigation showed that agricultural incomes per person fully employed in the researched farms amounted to on average 182,28 thousand PLN and 153,84 thousand PLN from sold pigs.

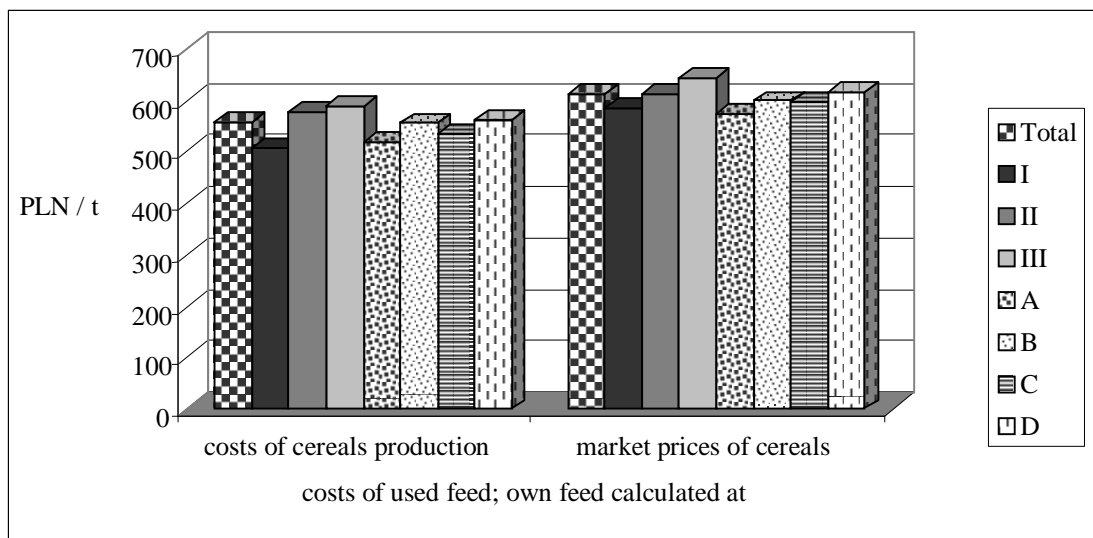


Figure 9. The unit cost of used feed production calculated at the cost of cereals production and the cost of their alternative buying in 2001.

Source: Own investigations.

Both the increase of the scale of production and the degree of integration positively influenced labour productivity. In the farms from D division it amounted correspondingly to 227,07 thousand PLN and 188,24 thousand PLN, thus three times more than in the farms from A division and 227,16 thousand PLN and 201,79 thousand PLN in III division farms up to 146,93 thousand PLN and 105,42 thousand PLN in I division farms. The farms from II and III division which produced more than 2000 pigs per year the productivity was higher than 300 thousand PLN. Even greater differences occurred in respect of the obtained profits and direct surplus from pigs production calculated per person fully employed (figure 10).

The level and kind of realised investments depend on many factors. The most important are:

- the economic situation at the time of the farmers' decision about investments and future economic prospects,
- the farmers' possessed funds,
- the possibilities of taking outside funds and their interest.

The farms in Poland do not usually have problems with taking credits because their debts rate is low. Moreover, if the investigation fulfil specific requirements, the farmer can get preference credits. Boom prosperity at the pigs market caused that in 2001 and 2004 the quantity of the possessed free funds by the farmers changed for better. At the beginning of 2001 and in 2004 the economic prospects of pigs production were promising.

All these factors caused that the level of the investments was quite high and amounted to on average 77,89 thousand PLN per farm (figure 11). From all the 60 researched farms in 2001 49 farms devoted some funds for investments but 24 of them invested more than 50 thousand PLN. The biggest investments were made by the farms from III division. They invested on average 93,53 thousand PLN,

in which 26,70 thousand PLN came from credits. The smallest investments were realised by the farms from II division – 61,10 thousand PLN, in which 7,5 thousand PLN came from credits.

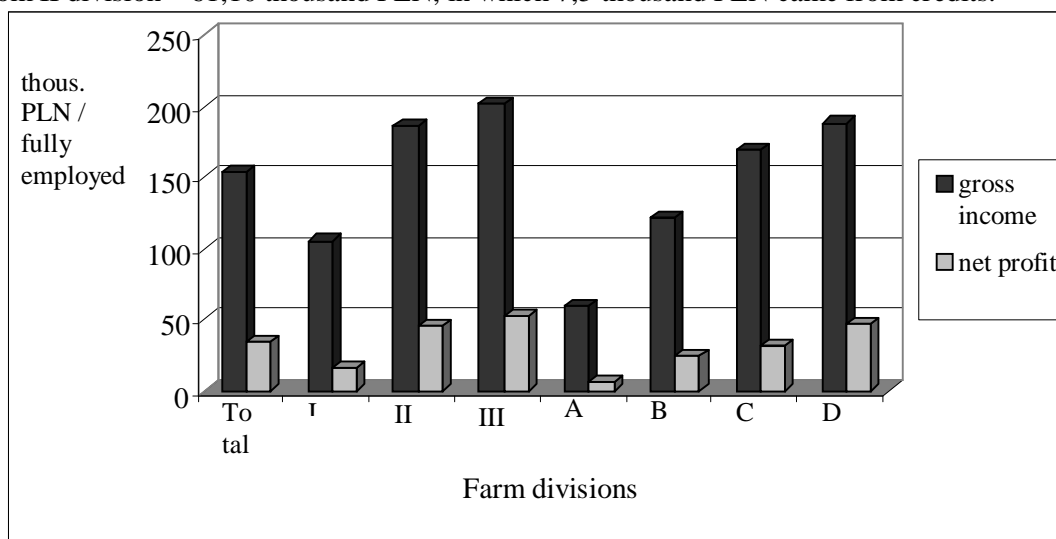


Figure 10. Gross income and net profit from the sale of pigs calculated per person fully employed in the investigated farms in 2001.

Source: Own investigations.

The most important from the investments were these in plant production (a purchase of land and machines) and animal production (building of pigstays together with the equipment). The level of profits obtained in the farms has major influence on the capacity of making the investments. Therefore together with the increase of the scale of production the investments increased. The smallest farms from A division invested 27,92 thousand PLN (only 50% of the researched farms made the investments), whilst the farms from D division invested 150,22 thousand PLN (13 from 15 farms made the investments).

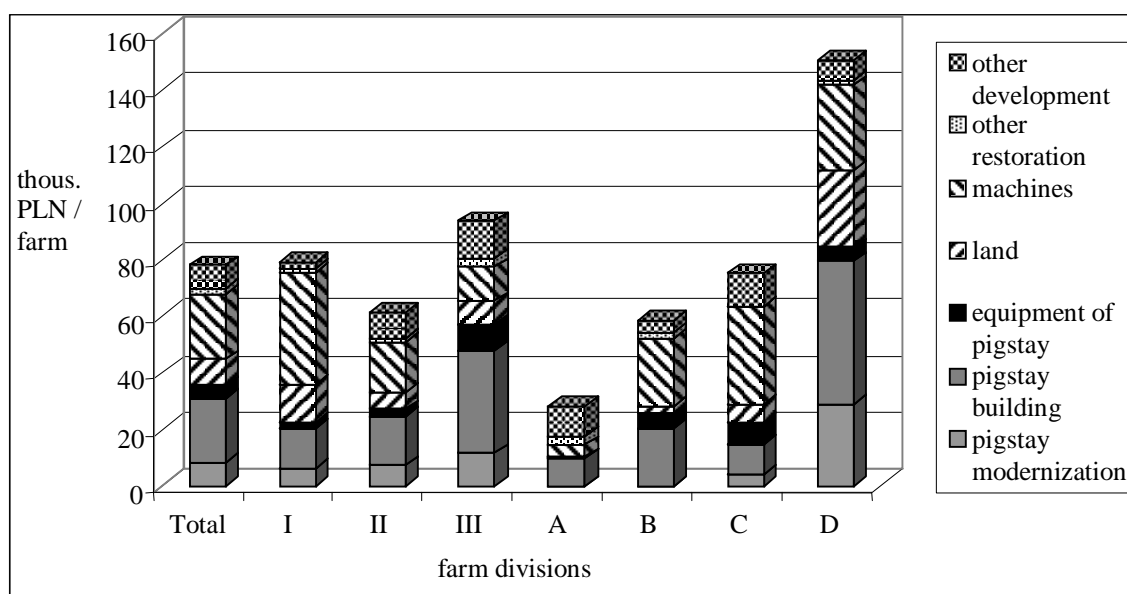


Figure 11. The level of investments in the investigated farms in 2001.

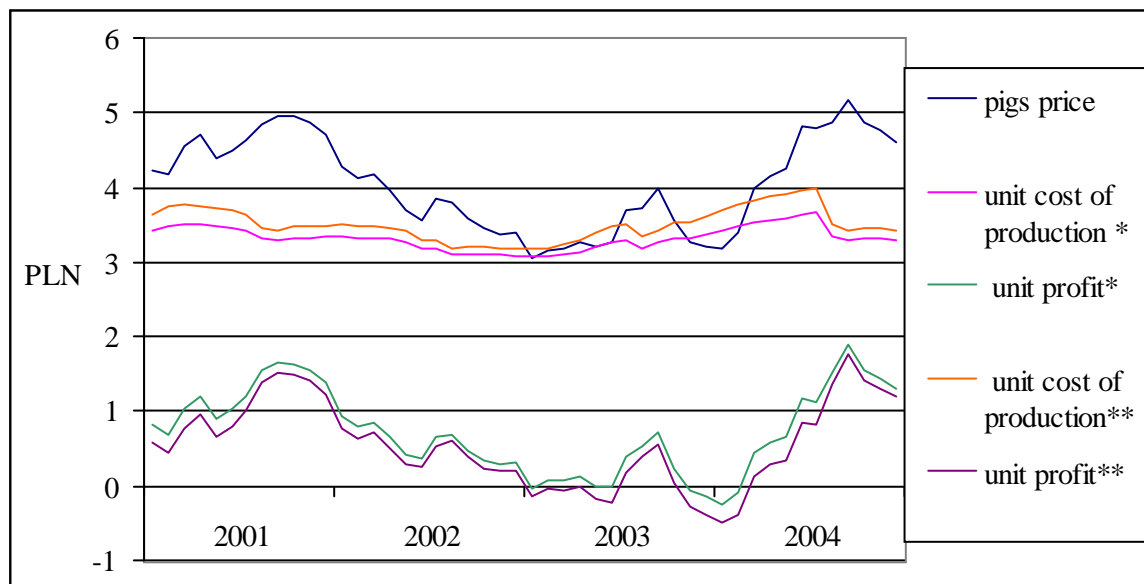
Source: Own investigations.

The scale of production did not have a big influence on the structure of the investments. There were differences among the researched farms depending on the degree of the integration of the farms with the slaughterhouses. The farms which sold pigs without contraction agreements invested more funds in the purchase of land, tractors and machines for plant production, whilst the farms from III

division invested more funds in building pigstays together with the equipment. This regularity agrees with the profitability rate obtained from plant and animal production. The farms from I division had the highest profitability rates in plant production and that is why they connected their own future with the increase of plant production. The farms from III division were more effective in animal production and they linked their future with pigs production.

#### 4. The profitability of pigs production in the 2001-2004 years

The pigs production in Poland is characterised by four-year pigs cycles in which the price amplitude amounts to even 60%. In the latest pigs cycle the lowest price amounted to 3,04 PLN/kg, whilst the highest 4,95 PLN/kg. The investigated farms obtained prices higher by 4% above the average pigs prices in Poland. The average price obtained by the investigated farms amounted to 4,04 PLN/kg in the 2001-2004 years. The highest prices were in September of the years 2001 and 2004 – about 5,00 PLN/kg. The lowest prices were in January of the years 2003 and 2004 – about 3,1 PLN/kg. The average costs of pigs production amounted to 3,32 PLN/kg (if the cereals are calculated at their costs of production in the researched farms) and 3,50 PLN/kg (if all the used cereals are calculated at the market prices). The production was unprofitable in some months of the 2003 year and at the beginning of the 2004 year. The farmers received the highest profits in the third quarters of the 2001 and 2004 years. The average profits per kg in the researched period amounted to 0,73 PLN and 0,54 PLN. The figure 12 shows that the biggest differences in the obtained profits were connected with the highest cereals prices.



\* - cereals calculated at the cost of production in the investigated farms,

\*\* - cereals calculated at the cost of their alternative buying.

Figure 12. The pigs price, the cost of production and net profit in the investigated farms in 2001-2004 (PLN/kg)

Source: Own investigations.

### General conclusions

The analysed period was characterised by higher pigs prices in 2001 and in the second part of 2004 and lower pigs prices at the turn of the years 2002/2003 and 2003/2004.

1. The profitability of production increases with the scale of production. The smallest farms obtained 0,48 PLN of profit/kg while the biggest farms 1,16 PLN of profit/kg. All the researched farms received on average 1,02 PLN profit/kg in 2001.
2. The profitability of production increases with the increase of the degree of the integration of the farms with the slaughterhouses. Non-integrated farms obtained 0,69 PLN of profit per 1 kg of pigs, while the most integrated farms 1,22 PLN/kg.

3. The increase of the scale of production contributed to the decrease of the scale of profits obtained by the integrated farmers. It concerned also pigs prices which the farmers obtained and the cost of pigs production. The difference in profits between the most integrated and non-integrated farms decreases from 0,77 PLN of profit/kg of pigs in the smallest farms to 0,37 PLN of profit/kg pigs in the biggest farms
4. The analysed slaughterhouses offered similar prices for buying pigs, but they offered very diverse bonus systems for each farmer. The integrated farmers received wider and more attractive bonus payment offer. In consequence, they got higher prices for sold pigs.
5. The non-integrated farms invested 70% of money in the purchase of tractors, agricultural machinery, tillage equipment and buying agricultural lands. The most integrated farms invested most (58%) of money in building, equipping or modernisation of pigsties.
6. The most important costs were feed cost (59%), the cost of buying pigs, mainly piglets (12,8%) and labour cost (8,8%). The latter two kinds of costs were most diverse depending on the scale of production and the degree of the integration of the farms.
7. Income and profit per person fully employed increase with the increase of the scale of production (from 60 000 PLN in the smallest farms to 188 000 PLN in the biggest farms) and with the degree of the integration of the farms with the slaughterhouses (from 105 000 PLN for non-integrated farms to 202 000 PLN in the most integrated farms).

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