

The theses of the PhD dissertation

**A COMPLEX ECONOMIC ANALYSIS OF WHEAT
PRODUCTION, CROP MANIPULATION AND FLOUR
PRODUCTION**

István Kiss

Supervisor:

Dr. habil. István Szűcs

associate professor



UNIVERSITY OF DEBRECEN

**Ihrig Károly Doctoral School of Management and Business
Administration Studies**

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1. THE ANTEDECENTS AND GOALS OF THE RESEARCH

The significance of the chosen topic is proven by the fact that several scientific papers have been written in relation to the production of cereals both abroad and in Hungary in the past decades. From among the international literature, I put a special emphasis on the paper by MEYER and KIRSTEN, who modelled the production of wheat in South Africa (MEYER and KIRSTEN, 2005). They examined the production, the consumption, the export of wheat, the closing stock and the entire internal use of wheat and also the limitation of import as a political aspect (MEYER and KIRSTEN, 2005). GUTIERREZ and PIRAS devised a global wheat market model to analyse the export prices of wheat (GUTIERREZ – PIRAS, 2013).

The above mentioned product path models served macro level examinations, while the present dissertation focuses on the micro level. International literature has examples of such research. The economic research of each phase in the supply chain can also be considered significant internationally (MORADI et al. and TIBERTI). MORADI et al. examined the cost efficiency of wheat production in Iran by using econometric methods. Their examinations were based on a database compiled through primary data collection. Based on these data, they devised the cost functions of production (MORADI et al., 2013). Similarly, by using econometric methods, TIBERTI examined the costs of wheat production in Italy. A general production cost model (GECOM) was devised to examine the costs of production (TIBERTI, 2013).

In Hungary, there are several research projects related to the production of cereals. POTORI's studies should be mentioned which describe the international and the national scenes and give analysis of the market processes (POTORI, 2010).

The storage of cereals is a very significant aspect in Hungary. In this respect, the importance of public storage and the role of the

intervention storage prior to the changes of the EU intervention rules should be emphasized. In connection to this, several research results have been published in the past decade. From among these the research of RIEGER, KOZÁR and BÁCS should be mentioned (RIEGER, 2007, 2009; RIEGER and SZÓKE, 2008; KOZÁR, 2004; BÁCS and KOZÁR, 2002).

In relation to the national aspects of my immediate field of research, I should mention the research of HOLLÓSY who examined the income relations of the product path and the conditions necessary to improve the efficiency of this sector (HOLLÓSY, 2000 and 2004). HOLLÓSY's research embraced a broader field, since it examined the line of wheat – flour – bread and studied the relationship and integration features of the product path in detail. My research does not include bakery or the integration relationships. My research differs from HOLLÓSY's results, since I wish to prove that the biggest problems of Hungarian flour mills come from external factors and the solution of competitiveness issues is in the hands of political factors and not the participants of the product path.

I also have a personal point of touch to the topic, since my family and I have been working in agriculture, more closely in wheat production, for almost two decades now (since 1994). In the plant growth of Hungary, the growth of wheat has an important role. Each year, wheat is grown on an area of about one million hectares. There are several scientific studies and results regarding the relationships of cost and income in the phases of production and I have also written several papers in this subject in the past few years. In case of the cost and income relationships of the product path, there is little literature available. Some related data are not public or difficult to access.

The flour mills of the EU and Hungary must face serious problems. These are the following: partnership risks, price changes and the low-level income capability. (WILLEY and MARTIELLI, 2012). The flour mills in the EU lost significant market share in exporting flour to Kazakhstan and Turkey. These

two competing countries have major advantages in flour production (KISS, 2013). Such advantages are the cheap labour force, low energy costs, high levels of state subsidies and the cheaper raw materials. (WILLEY and MARTIELLI, 2012).

With regard to the above mentioned facts, I thought that the economic examination of the product path phase shown in Figure 1 might be useful. These examinations would give answers to such questions as whether the competitiveness problems of the Hungarian and the EU flour mills could be solved or the solution is in the hands of variables independent of the product path participants. Of course, I will not examine the European sector, since the field of research had to be limited. However, the economic and corporate economy laws work similarly in other countries as well.

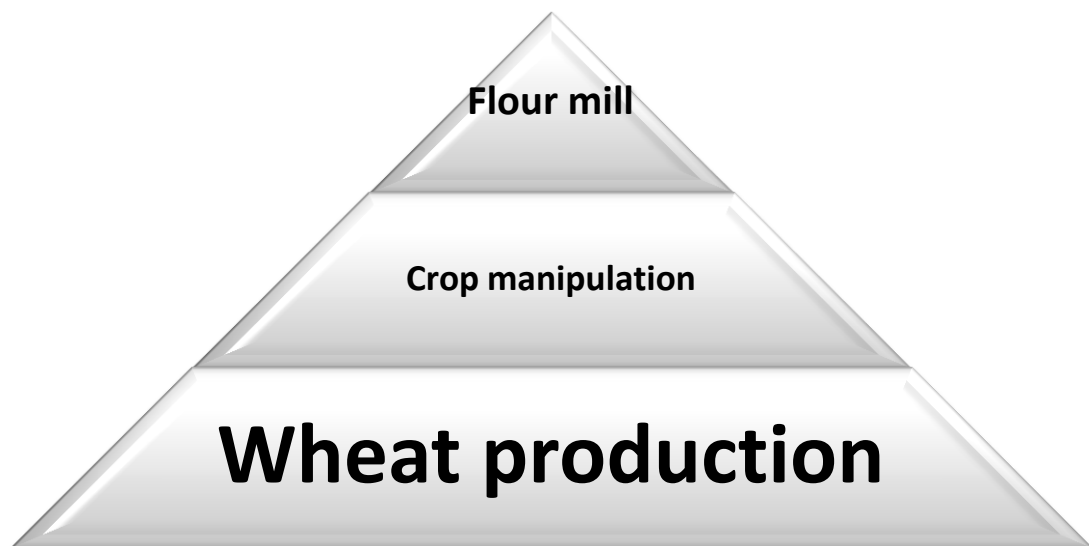


Figure 1: The demonstration of the studied product path phase within the wheat supply chain

Source: the author's own compilation, 2013

The narrowing feature of *Figure 1* refers to the number of participants in each phase. Based on Figure 1, I examine the production phase, the crop manipulation stage and flour production in my dissertation. These product path phases can be considered as the limitation of my research work as well. At the production phase, I do not deal with durum wheat, at the manipulation phase I do not examine the drying or trading of

wheat. The reason for this is that drying is not peculiarly significant in the production. Generally speaking, the drying of wheat is not usually done in Hungary, except in years with extreme weather conditions. I do not examine the trade because this phase itself is so significant that an individual research project and analysis might be carried out. Due to limitations in extent, the subject of the present dissertation had to be limited.

One of the goals of my thesis is the presentation of the cost and income relationship of the product path phases shown in Figure 1. Also, I wish to reveal the incidental reserves of each phase and the possibilities of improving competitiveness in each phase. To do this job, I drew up the following questions: which elements of cost affect production results and which elements need supplement of expenses? What are the factors affecting production costs and prime cost significantly? How does an increase of 1% in the cost elements affect the prime cost? Are the participants of the product path capable of influencing the factors causing significant changes? Is the competitiveness of the product path in the hands of the participants or is it influenced by independent factors?

Based on the above mentioned questions, I drew up my hypotheses that I wish to confirm and prove in my research. These are my hypotheses:

Hypotheses:

H₁: The amount of income and its safety in the product path phases of wheat production – manipulation – flour production is mostly influenced by factors independent of the product path participants.

H₂: The amount of income created in the product path phases of crop manipulation and flour production shows significant differences between each phase (in cost proportions).

To confirm my hypotheses, I am going to perform the

following tasks:

- processing the subject properly in details based on literature,
- a complex collection of economic data in relation to the phases of the product path,
- making a calculation model based on parameter cost estimates; the input of the model is based on primary research,
- calculation of price income, production value and income which appears as output,
- based on the model results, an analysis of cost and profit, classic economic analysis, examining sensitivity, analysis of scenarios and examining flexibility.

The hypotheses can be proven and the set goals can be achieved by carrying out the above mentioned tasks.

2. RESEARCH MATERIAL AND METHODS

2.1. Database

My results are based on modelling. When making the models, I was using databases based on primary data collection.

In case of primary data collection, various levels of the product path may and has to be defined. The first level is wheat production. The collection of data regarding wheat production embraced average yield data and the size of wheat fields between 2008 and 2012. During the collection of data I sized up 16 wheat producing farms. The area of wheat fields cultivated by the 16 producers was exactly 6,008.44 hectares in 2012, while in 2008 it was 5,382.44 hectares altogether. I have had a personal acquaintance with all the 16 wheat producers and my survey cannot be considered representative. These producers are family farms, individual businesspeople and various economic companies (limited liability companies and private limited companies).

The areas of wheat fields in the case of each wheat producer show a wide range. One company grew wheat on 35.8 hectares in average during the five years, while another farm grew wheat on almost 1,800 hectares. These two examples are the two extreme

values (minimum and maximum) on the scale of wheat production areas. During the five years the average area of wheat production per capita was 336.4 hectares.

In the case of all the farms taking part in the data collection, more than 50% of the overall wheat production was at least food-quality wheat between 2008 and 2012. Several farms produced only enhancing or food-quality wheat between 2008 and 2012. The area limitation of the data collection performed at the first level of the product path: the farms sized up can be found within the boundaries of several counties of Hungary (see Figure 2).

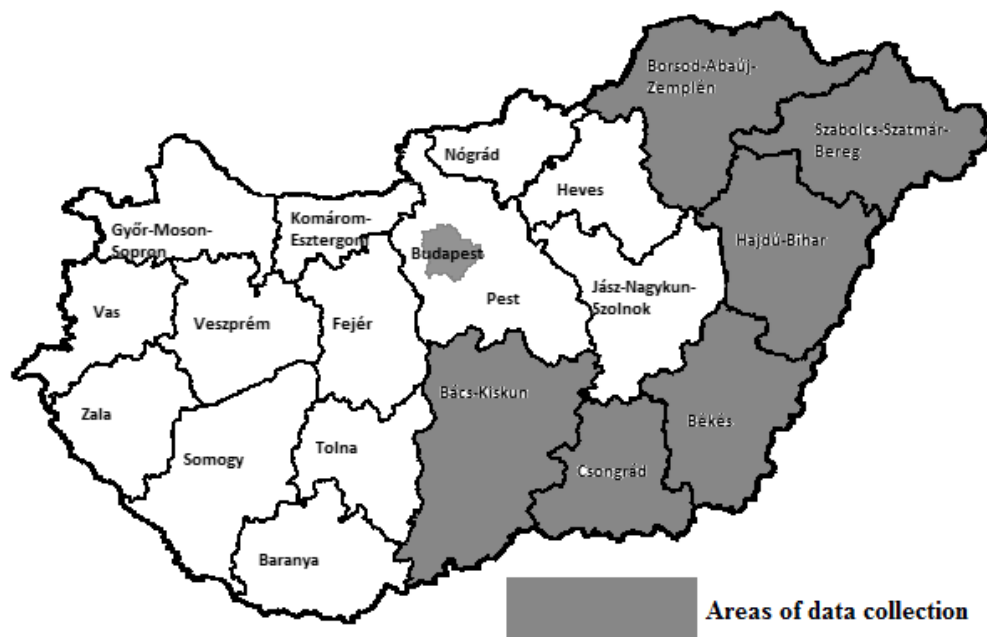


Figure 2: The territorial extension of the data collection at the production phase

Source: the author's own compilation, 2013

At the other two phases of the product path, I also contacted farms to build a database. Within the crop manipulation module, based on the new historical cost of the manipulation phases, I used the data of two farms which were to have investments in winnowing and storage capacity. I also contacted winnowing dealers at the winnowing phase.

I looked for flour mills which have defining market role in mill processing in Hungary. The workers of these mills helped me to draw up the parameter cost estimates of the flour mill phase. At

this phase, I used not only the data of the farms since the cost-income calculations made for the mill processing are usually public.

The results of the modelling based on the data collection made for the various elements of the supply chain can be generally accepted in case of extensive data collection, since it is not representative.

2.2. Methodology

I drew up an economic model embracing the product path phases shown in Figure 1 to confirm the results of my dissertation. The operation of this model is shown in Figure 3. A product path drawn up along similar reasoning has been made earlier by APÁTI, CEHLA and SZÖLLŐSI (APÁTI, 2007; CEHLA, 2011; SZÖLLŐSI, 2008). The above mentioned authors demonstrated the operation logic of their model in a similar figure compiled by them. Thus, such kind of depiction has not been invented by the author of the present dissertation and is not new in the discipline concerned here.

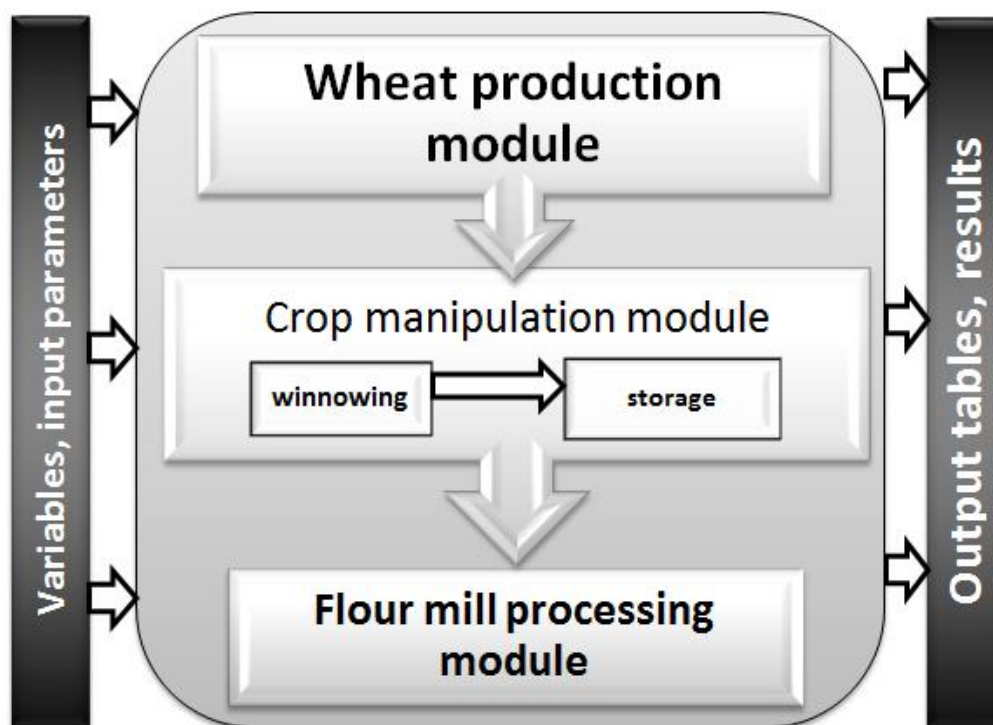


Figure 3: The logic of the operation of the model

Source: the author's own compilation, 2013

Within the model, there are three separate modules which are connected to each of the product path phases: wheat production, crop manipulation processing and mill processing. These modules interact with one another and there is a process of delivery and reception. Thus, this model can handle the examined product path phases in an aggregated way. There are two types of delivery and reception. In the first case, the delivery and reception is realized at the market price between the phases while, in the second case, it is realized at the prime cost price and the profit centre is the mill processing phase.

The input parameters and variables of the model are presented at each phase. The input parameters of the wheat production module are: average yield, area-based subsidies, and gasoline subsidies applied technology, the costs of operating machines per one hectare, transportation costs, natural expenses, land rental rates, input prices and output prices. Output results are: average production costs, cost structure, revenue, production value, net income on one's own and rented land, net income with and without subsidies, the extent of elasticity of each variable and input.

At the second phase of the product path, there are two separate modules within the crop manipulation module. I performed a parameter cost estimate based on the data collected during winnowing. From this estimate, I defined the prime cost at which the winnowing of one metrical tonne of crop can be performed. When performing the parameter cost estimate, I took it into account that the production cost per an hour and per one metrical tonne depended on capacity utilization. Thus, I drew up various scenarios regarding the production cost and the prime cost. The variable factor in this case was the capacity utilization of the winnowing machine and other devices.

At the crop storage module, the variable parameters are: the prices of input items, capacity utilization and service prices. The capacity utilization was between 20% and 100%, while the storage fees were between 200 and 400 HUF per metrical tonne.

The output items are: the cost-income data, revenue data, cost structure and the extent of elasticity in case of the various variables and input items.

At the flour mill phase, I made a module in which the effects of changes in the price of wheat, the price of flour, the flour yield, the price of electricity and the personal costs become quantifiable. The effect of the wheat price on the prime cost was examined with the help of Microsoft Excel Scenario Manager. The results of the comparative report are shown in a diagram, then I analysed these results using classic economic analysis. After then, due to the “**elimination of the crop year effect**” principle, I performed scenario analysis of average wheat and flour prices of several years regarding the flour mill production prime costs and net income, with and without the sales of by-products. The reason why the income from the by-products was distributed to that of flour because flour production is the main activity and in order to get a real and reliable picture, we have to regard all incomes as that of the end-product. I defined the price of the by-products at 33% of the wheat price. I did so because the discussions with the participants showed that the price of the by-products as about one third of the wheat price in the past few years. Because of this, the by-product prices follow the wheat price changes. Thus, the increase in costs caused by wheat prices brings along an increase in the value of the by-products as well. On the output side, the following data appear: cost-income data, revenue data, cost structure and the extent of elasticity of the variables and input items.

Having accomplished the above mentioned examinations, I performed the elasticity analysis of the the major variables which determine the income on the entire product path phase. During an elasticity analysis, we can define the percentage of change in the affected factor if a variable or affecting factor changes by 1%. The affected factors are the production costs and the net income created in the various scenarios. The affected factors are parameters which are defining within the cost structure, like flat prices of the input items, or parameters which definitely affect the

created income based on a preliminary assumption. Such affecting factors are the average yield, technological parameters or sales prices.

Then I rated each factor based on the extent of their effects as extremely significant, significant, less significant and insignificant. This kind of rating has already been used by several authors before. Among others, SZÖLLŐSI has performed similar analysis when modelling the elasticity of each technological parameters in the case of the product path of broiler chickens. Regarding rating, based on KOPÁNYI's work, SZÖLLŐSI emphasized that elasticity always depends on the value of the basis of comparison (KOPÁNYI, 1999; SZÖLLŐSI, 2008). In this aspect, I agree with SZÖLLŐSI's viewpoint which states that the classification of factors should be done not according to the absolute value of each indicator but the rates of the indicators compared to one another (SZÖLLŐSI, 2008). Thus, I followed this principle when performing the rating. Beside the extent of the effects, I classified the examined variables based on the fact whether or not the participants of the product path phases have any effect on these factors. Within this, I created three separate groups: dependent, partly dependent and independent. This kind of classification of the factors is not new either. SZÖLLŐSI had dependent and independent groups earlier (SZÖLLŐSI, 2008). In my analysis, I went beyond the classification applied by the above mentioned author. The main reason is that there are several varying factors on the product path of wheat production – crop manipulation – flour production which are only partly variables and partly independent ones.

3. THE MAIN FINDINGS OF THE DISSERTATION

3.1. The elasticity analysis of each product path phase

In this chapter, I am going to have a look at the elasticity of the major variables affecting the income of the examined product path phases. I am going to examine elasticity *ceteris paribus* (all other things being equal). The effects are compared to the given basic parameters. These basic values have no extreme ranges.

When preparing the results presented in this chapter, I assumed that each phase work on a market basis, so there is not a separation of cost and profit centres at each product path phase. At the end of the chapter, I rate and describe the factors affecting the income of each product path phase and I also discuss the opportunities for the participants of the product path.

3.1.1. The “ceteris paribus” elasticity analysis of the major affecting factors influencing the production cost and net income of wheat

In this chapter, I present the “ceteris paribus” effect of the change of the major affecting factors by 1% on the economic indicators. The extent of the change is given as a percentage value. The results are shown in Table 1. I performed the elasticity analysis related to the production costs (by assuming production on one's own land and on rented land) and to the cost categories as well. Based on the data of the farms, I quantified the extent of change. The average yield data were the average yield of the 16 farms in 2012. I handled the 1% change of the average yield and that of the flat prices separately at the level of the 16 farms providing the data. This is because the use of artificial fertilizers and the use of pesticides showed significant heterogeneousness within the statistical population. Thus, they cannot be averaged.

When quantifying the effect on net income, I used the national average yield of 2012 and the average sales prices between 2008 and 2012 as the basis of the calculations. I also examined the net incomes with subsidies and without subsidies. I took the cost change caused by the different average yields into account.

It is necessary to emphasize the average yields, the sales price of wheat and the subsidies among the affecting factors, since these three factors affect the production incomes the most. The increase in average yields by 1% on one's own land induces an increase in net income by 1.5%. In case of production on rented land, the increase of average yields by 1% results an increase by more than 2%.

Table 1: The effect of the increase of affecting factors by 1% on economic parameters

THE EFFECT ON EACH PARAMETER (%)	AFFECTING FACTORS						
	Average yield	Wheat price	Subsidies	Unit price of sowing-seed	Unit price of artificial fertilizer	Unit price of pesticides	
	Production cost (on one's own land)	0.0327%	not applicable	not applicable	0.157%	0.317%	0.094%
	Production cost (on rented land)	0.0273%	not applicable	not applicable	0.131%	0.265%	0.079%
	Machine costs	0.0899%	not applicable	not applicable	not applicable	not applicable	not applicable
	Material cost	not applicable	not applicable	not applicable	0.266%	0.536%	0.160%
	Net income with subsidies (on rented land, at a wheat price of 42,737.22 HUF/tonne)	2.286%	2.344%	0.777%	-0.279%	-0.562%	-0.168%
	Net income with subsidies (on one's own land, at a wheat price of 42,737.22 HUF/tonne)	1.693%	1.736%	0.576%	-0.207%	-0.416%	-0.124%
	Net income without subsidies (on rented land, at a wheat price of 42,737.22 HUF/tonne)	10.279%	10.541%	not applicable	-1.259%	-2.530%	-0.757%
	Net income without subsidies (on one's own land, at a wheat price of 42,737.22 HUF/tonne)	3.996%	4.097%	not applicable	-0.489%	-0.984%	-0.294%

Source: the author's own calculation and compilation, 2013

The effect of average yield change on net incomes without subsidies is much more powerful. On rented land, it is more than 10%. Regarding the sales prices, similar changes can be observed. Based on the data above, the net income of wheat production is slightly affected by the change in average yields or sales prices.

When examining the elasticity of subsidies, I used the SAPS and the sum of the gasoline excise tax return in 2012 as the basis. I quantified the effect of change by increasing the absolute values of these two data by 1%. Regarding the change in the sums of subsidies, the effect on the net income is medium-sensitive, since the subsidies represent a large portion within the incomes of wheat production. When we examine the increase of major input items by 1%, it turns out that the effect on incomes including subsidies is between 0.10% and 0.56%.

Here we can see significant variations depending on the production performed on rented land or on one's own land. The effect on net incomes without subsidies induces a change between 0.7% and 2.5%. The effect of the three major variables (average yield, sales price and the sums of subsidies) can be considered serious, since the multiple of change is realized within the income category, while the extent of change in the case of the other affecting factors by 1% is lower in case of the indicators.

As for the effect on income, the three major variables (average yield, sales price and subsidies) play the most significant role. However, the effect cannot be considered significant in either relative or absolute value. It is caused by the income of wheat production which is good regarding the proportions of costs. The high cost proportion income comes from the favourable sales prices and the high sums of subsidies. Without subsidies, the average yield and the price are extremely significant.

3.1.2. The elasticity analysis of the major factors affecting the net income of winnowing

During the elasticity analysis of the net income winnowing, I considered three parameters as variables. The basic values of these are shown in Table 2.

Table 2: The basic parameters for the variables of the elasticity analysis

	Value	Unit of measurement
Price of electricity	47.3508	HUF/kW
Wages	174,382	HUF/month/person
Winnowing fee	700	HUF/tonne

Source: the author's own compilation, 2013

These variable parameters are: the flat price of electricity, wages and the winnowing fee. During the crop-cleaning process, the constant costs are dominant and the capacity utilization essentially determines the success of the activity. Based on this, I performed the analysis on a scenario having three different capacities.

The results of the analysis are shown in Table 3. During the crop-cleaning process, the biggest effect on the net income is caused by the change in the winnowing fee. Thus, this factor has a defining role in this activity. The change in the winnowing fee causes varied effects in case of different capacities. In case of winnowing in one shift, the income increases by 2.9% with the boundary conditions applied in this analysis. In case of a two- or three-shift operation, the effect is still significant, since it is 1.99% and 1.80% respectively.

From among the two other variables, the change in wages seems dynamic but this and the price of electricity cannot be considered

significant. In case of these two variables, the analysis obviously confirms that these factors affect the income-raising capability of this phase.

Table 3: The “ceteris paribus” effect of the major affecting factors on the net income of winnowing

Capacity utilization	Price of electricity	Wages	Winnowing fee
1 shift	-0.392%	-0.602%	2.900%
2 shifts	-0.270%	-0.414%	1.996%
3 shifts	-0.245%	-0.375%	1.808%

Source: the author's own calculation, 2013

3.1.3. The elasticity analysis of the factors affecting the income of crop storage

As opposed to winnowing, in case of crop storage there are more technological and external market factors parameters which can be considered as variables. Thus, in this phase I performed the elasticity analysis of five variables. These variables are: capacity utilization, wages, the unit price of electricity, the fees of removal and storage and the service price of storage. The variables and their basic values are shown in Table 4.

Table 4: The basic parameters of the elasticity analysis

Name	Value	Unit of measurement
Capacity utilization	65.00	%
Wages	174,382	HUF/month/person
The price of electricity	47.3508	HUF/kW
Removal and storage fee	400	HUF/tonne/occasion
Storage fee	350	HUF/tonne/month

Source: the author's own compilation, 2013

The analysis was performed on two scenarios. At the first scenario, the effects were quantified based on the assumption of free removal and storage. In the second case, the fees of removal and storage shown in Table 4 were taken into account in the calculation of income. The difference between the two scenarios has merely theoretic significance, since free removal and storage rarely occurs in practice.

Table 5: The “ceteris paribus” effect of the 1% increase of the major affecting factors on the net income of storage

	Capacity utilization	Wages	The price of electricity	Removal and storage fee	Storage fee
Net income in case of free removal and storage	5.16%	-3.39%	-4.97%	0.00%	9.19%
Net income with the income from removal and storage	1.14%	-0.74%	-2.19%	2.32%	2.03%

Source: the author's own data collection and calculation, 2013

The aim of the analysis with two different scenarios was to prove the significance of the removal and storage fees. The results are shown in Table 5. First, the results with free removal and storage are shown. In this case, the factors having the biggest effects in a descending order are the following: storage fee, capacity utilization, the price of electricity and wages. The storage fee causes the biggest effect in this scenario. It is more than 9%. The other three variables cause significant change in creating income as well, since in case of free removal and storage, the capacity utilization is 5.16% and the price of electricity causes a change of 4-97%.

When the income from removal and storage is taken into account,

it can be observed that the effects are slighter but the removal and storage fee, the price of electricity and the storage fee are still outstanding. In this scenario, these variables can induce a more than 2% of change in the income. The service prices are influenced by the actual market conditions so this is a partly external factor. The storage facilities currently operate with low levels of capacity utilization. In case of the price of electricity, the participants of the product path phase are bound by the service providers. The liberalization of the energy market gives some freedom to pick the service provider. Capacity utilization is significant too but it falls behind the other factors.

3.1.4. The elasticity analysis of the major factors affecting the income of flour production

I carried out an elasticity analysis of the major variables in order to quantify their effect on the income of flour production. These affecting factors are: the price of wheat, the price of flour, the flour yield index and the flat price of electricity.

Table 6: The basic parameters of the variables used in the elasticity analysis

	Value	Unit of measurement
Wheat price	44,922	HUF/tonne
Flour price	73,320	HUF/tonne
Flour yield index	78.00	%
Capacity utilization	65.00	%
Wages	174,382	HUF/person/month
Electricity price	27.31	HUF/kW

Source: the author's own compilation, 2013

During the analysis, I increased the basic values of the factors by 1% “ceteris paribus”. The increase of the examined factors (the wheat price, the flour price, the flour yield index, the capacity utilization of the mill, the wages and the price of the electricity)

induced a change of 0.27% to 15% in the net income calculated with the by-products. The basic values of the parameters used as variables in the analysis are shown in Table 6.

The wheat and the flour prices are the average prices of 2011 and 2012 published in AKI PAIR. I used these prices and not the 2012 prices because the price changes in 2012 were so extreme that those data would give false results. The basic value of the flour yield index was 78%, which is characteristic of modern flour mills and an essential condition of competitiveness. The capacity utilization was at a level of 65%, which is the minimum level of utilization in order to be competitive. The wages were the average wages in the industry as stated by the Hungarian Central Statistical Office (KSH), while the price of electricity was company data. The results are shown in Table 7. There were two scenarios in the analysis. The first scenario shows the results including the income from the sales of by-products, while the second scenario shows results without income from the by-products.

First, I present the effects calculated with the by-products. The biggest change within the net income was induced by the flour price, since its increase by 1% caused an improvement of more than 15% in the net income “ceteris paribus”. The change in wheat price caused a decrease of 11% in the net income. In relation to this, it can be stated that the net income of flour production reacts extremely sensitively to the changes of wheat and flour. These factors are external condition for the product path, so the participants have very limited influence on these factors.

An increase by 1% in the flour yield index caused a change of 11% in the net income. Modern flour mills have nearly 78% of a flour yield index, while older mills have an index of 74%. The big difference in percentage means a disadvantage in competitiveness that is almost impossible to catch up with. The competition between mills using modern and older technologies could be

decided by the 4% difference if the black economy did not deform the market conditions. The increase of capacity utilization by 1% caused an increase of 2.34% in the net income compared to the basic value “ceteris paribus”. At the first glance, the increase of 2.34% does not seem much, however, the proper level of utilization could be a decisive advantage in competition. The increase of wages and the price of electricity by 1% caused a very slight change in the income of the product path phase.

Table 7: The “ceteris paribus” effect of increase of the major factors by 1% on the net income, with and without the sales of by-products

(average wheat prices of 2011 and 2012, the other cost factors are at the 2012 price level)

	Wheat price	Flour price	Flour yield index	Capacity utilization	Wages	Price of Electricity
Net income, including by-products	-11.03%	15.14%	10.23%	2.34%	-0.46%	-0.27%
Net income without by-products	-87.04%	110.81%	103.30%	17.13%	-3.33%	-1.98%

Source: the author's own data collection and calculation, 2013

Note: source of wheat prices: AKI PAIR, 2011 and 2012

The effects on the net income without by-products exceed 80% in three cases. This can be considered as an incredibly big change. This is because the cost-proportional profitability of this product path phase would be very poor without the sales of by-products. Thus, every slight increase in costs will seriously “avenge” themselves in the results. This is a merely theoretical scenario since by-products are almost always sold in practice. However, the result is in accordance with the earlier research where other

authors also found that the sales of by-products proved to be a key factor in production.

3.1.5. The rating of variables which determine the income of the product path phases

The rating and classification of the factors determining the income of each product path phase are shown in Table 8.

Table 8: The major variables examined in the elasticity analysis and their relationship with the decision-makers of the product path phases

	ON THE DECISION-MAKERS OF THE PRODUCT PATH PHASES		
	DEPENDENT	RATHER DEPENDENT	INDEPENDENT
Phases	VARIABLES		
WHEAT PRODUCTION		Average yield	Wheat price Subsidies
			The price of the sowing-seeds
			The price of the artificial fertilizer The price of the pesticides
WINNO-WING		Capacity utilization, number of shifts	The price of electricity
		Winnowing fee	Wages
STOR-AGE	Capacity utilization	Removal and storage fee	The price of electricity
		Storage fee	Wages
MILLS	Flour yield index	Capacity utilization	Wheat price Flour price
			The price of electricity Wages

Legend:

Extremely significant
Significant
Less significant or insignificant

Source: the author's own classification and compilation, 2014

When performing the classification, I took the effect of the variables on the income of the given product path phase into account. I also took the relationship of the variables with the decision-makers of the phase into account. I rated the effects of each variable based on the extent of change they induce within the given product path phase.

The rating was performed based on elasticity analysis. Regarding the relationship between the phases and the decision-makers, I separated three categories: dependent, rather dependent and independent. The dependent relationship exists in case of factors where the value of the given factor depends on the decisions of the participants, that is, the participants are able to influence the factor without any external limitations. The rather dependent groups include the factors which are influenced by the decision-makers of the phases but external factors are needed to achieve the required values. Such external factor can be the weather. The independent variables include those parameters which are entirely independent external factors. The classification is shown in Table 8.

Most of the variables examined in the wheat production phase can be considered independent. It is only the average yield which can be influenced to some extent. That is why it is a rather dependent variable, since we cannot deny the fact that weather has as much determining role in the specific yield results as the decision-makers of the phase do. It must be noted here that in this phase the average yield and the wheat price can be considered extremely significant even though these factors induced only changes of 2% to 3%. It is because in the elasticity analysis the net income including subsidies was taken into account. Thus, subsidies decreased the effect of these two factors. The sum of subsidies was also a significant variable, which can be considered an independent variable. The rating of subsidies as significant variables is not surprising since the net income including the subsidies increased by 40% to 100% in the different scenarios. The elasticity analysis of the three most important input items

induced a less significant change. The input items can be considered independent of the decision-makers of the phase.

In the winnowing phase, three variables were examined. From among these, the capacity utilization and the winnowing fee can be considered significant and they are rather dependent factors of the examined activity. In this phase, there are not any extremely significant variables even though the above mentioned two factors determine the success of the operation. The capacity utilization is a rather dependent factor but the participants of the phase have a rather limited influence here. It is because the cleaning of the crop is not constant all year and cannot be considered as completely dependent of the decision-makers. The price of the electricity and the wages are less significant and they are independent of the decision-makers of the phase. It must be noted here that the decision-makers of this phase may have influence on both the price of electricity and the wages but it is a general, nationwide increase of the energy prices and the wages also affects the entire product path, independently of the participants' will. This is why these factors are classified as independent. The wages and the average wages of the industry also bind the participants. If they do not pay off the labour force, the fluctuation might grow, which might cause further increase in costs at the corporate level. Based on the above mentioned reasons, these factors are listed among the independent variables in the rest of the phases.

In case of storage, one out of the five examined variables was significant. Capacity utilization was rated as a significant and dependent factor since capacity utilization depends on the type of the given warehouse. This factor may be determined during the investment by the decision-makers of the product path phase. In accordance with this, the decision-makers may decide to build a warehouse with alternative utilization capacity. If the warehouse has been built earlier, its type is only a factor but there is still a chance to secure it for the entire year. Especially in the case of the model drawn up for the present dissertation where there is a connection regarding each product path phase. Thus, the

participants' influence is clear since the raw material for the mill phase needs to be stored. The fee of removal and storage and the storage fee are also significant parameters but they depend only partly on the product path phase participants because the market condition is dominant in their case. We can find the price of electricity and the wages among the independent variables. The price of electricity can be considered significant because the author calculated with a monthly change of the stock. Thus, a change in the price of electricity affects the income of storage very much. The effect of the changes in wages was not significant.

In the mill phase, three out of the examined variables were extremely significant, one is dependent and two factors are independent of the participants of the product path phase. The flour yield index is dependent of the technological circumstances of the given mill. It is necessary to keep the technological parameter at a high level to maintain competitive flour production. However, this one factor only is not sufficient. The other two variables, the wheat price and the flour price, are independent of the participants of the product path phase. In relation to the elasticity analysis, it can be stated that that an increase of the three extremely significant variables by 1% can induce a change of nearly 36% in absolute value in the net income. 26% is caused by the factors independent of the participants of the product path. The price of electricity and the wages are less significant factors.

In summary, it can be stated that that the changes and values of 13 factors (out of the examined 21) are independent of the participants of the product path phases, 6 of them are partly dependent since in those cases the external factors and influences are important. Only two variables are entirely dependent on the participants.

4. NEW AND NOVEL RESULTS OF THE DISSERTATION

Based on the examination results which are in relation to the set goals and hypotheses stated in my dissertation, the new and novel scientific results of the present dissertation are the following:

- 1 I made up an economic model embracing the examined product path phase during my research. As a result, I defined the extent of income created in each product path phase, the relevant costs and cost structures and the elasticity of the major variables. During the analysis of the cost structures, where it was possible, I made suggestions regarding the improvement of efficiency.
- 2 During the elasticity analysis of the major factors, I proved which factors have the most effect on the income of the product path phases and on the entire product path. Also, I rated each factor based on their effect and I drew up a classification in which the variables were rated according to the influence of the decision-makers of each product path phase on these factors.
- 3 I proved that the income and safety of a product path phase are mostly influenced by factors independent of the participants. Thus, the influence of the participants can be considered limited.

The conclusions and suggestions based on these new and novel scientific results may contribute to the improvement of the efficiency of the examined product path phase and revealing its problems. The practical use of the present dissertation is in the information presented in it. The presentation of the cost-income relations may help those who are about to start an investment to make well-founded decisions. The dangers and the market chances of such investments are also presented which might make the project-makers' job easier.

5. PUBLICATIONS IN THE TOPIC OF THE PRESENT DISSERTATION

PUBLICATIONS WHICH CAN BE TAKEN INTO ACCOUNT ACCORDING TO THE REGULATIONS:

International publications:

Publications in impact-factor international journals (according to the regulations of the doctoral school, the doctoral school recognizes impact-factor journals as category “A” international publications)

- 1 **KISS, I.** (2012): *Economic modelling and analysis of Hungarian wheat production in the marketing year 2011* In: **Abstract** Vol. 6. Numbers 5-6. 2012 HU-ISSN 1789-221X ISSN 1789-7874 p63-67. Information Publishing House, Budapest, Hungary IF: 0,045 <http://top/top.journals.simple.html>
http://ageconsearch.umn.edu/bitstream/147416/2/10_Kiss_Istvan_Economic_Abstract.pdf
- 2 **KISS, I.** (2011): *Significance of wheat production in world economy and position of Hungary in it* In: **Abstract** Vol. 5. Numbers 1-2. 2011 HU-ISSN 1789-221X ISSN 1789-7874 p115-120. Agroinform Publishing House, Budapest, Hungary IF: 0,010 <http://ideas.repec.org/top/top.journals.simple.html>
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International refereed scientific journal (publication with individual consideration)

- 3 **KISS, I. – BENCZE, SZ.** (2012): *Sustainability Aspects of the Wheat Sector* In: **Chinese Business Review**, May 2012, Vol. 11, No. 5, ISSN 1537-1506, p451-459. David Publishing Company, El Monte, USA
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Publications in Hungary:

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- 4 FEHÉR, I. – **KISS, I.** (2013): *Main characteristics of trade of the Hungarian cereals and oil crops between 2000 and 2010 and the effects of changes in intervention rules to the Hungarian COP sector from 2004 to 2010* In: **Apstract** Vol. Numbers 2013. HU-ISSN 1789-221X ISSN 1789-7874 p1-15. Agroinform Publishing House, Budapest, Hungary IF: 0,018 (megjelenés alatt)
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AUTHOR’S DECLARATION

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Kiss István s.k.

PhD student, Beneficiary of the National Excellence Program