Relations between prices, subsidies and income in various economic size farms

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Abstract

Agriculture is considered to be a risky business. Among many different kind of risk that make farm income volatile, price risk is the most significant. The aim of the paper is to answer the question to what extent agricultural commodity prices influence farm income. Using FADN data from selected EU member states about farmers' income the author found out that there is high correlation between key agricultural commodity prices and farm income. However there are significant differences among various EU member states, different types of production, economic size of farms. It was also proven that income-price correlation is higher for bigger farms.

Keywords: price risk, farm income, EU agriculture

Зависимости между цени, субсидии и доход при различните по икономически размер ферми

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Резюме

Селското стопанство се счита за рисков бизнес. Всред многото видове риск, които създават несигурност за фермата, ценовият риск е най-значителен. Целта на доклада е да отговори на въпроса до каква степен цените на земеделските стоки влияят на фермерския доход. Използвайки данни от СЗСИ за избрани страни - членки на ЕС относно фермерския доход, авторът прави извод, че съществува корелация между цените на ключови земеделски стоки и фермерския доход. Въпреки това има значителни разлики при различните страни – членки, в зависимост от различните типове производство и от икономическия размер на фермите. Доказано е също, че корелацията доход – цена е по-висока за по-големите ферми.

Ключови думи: ценови риск, фермерски доход, селско стопанство на ЕС

INTRODUCTION

Agricultural business has always been distinguished as this type of economic activity where production and economic results volatility is very high (Hardaker et al., 2004). Agricultural economists emphasize that farming risk is likely to grow further in the future mostly due to greater price risk (Chand 2010; Gilbert 2010). Usually price risk is identify especially with agricultural commodity price volatility (Revoredo-Giha Zuppiroli 2013; Prakash 2011; Figiel et al. 2012; Klimkowski and Rembisz, 2014). It is especially true in the XXI century when price volatility of agricultural goods rose significantly in comparison to previous decades in European Union (Ledebur Schmitz, 2009) and world markets as well (Pop and Ban, 2011). For instance, Benni and Finger (2012) using data of Swiss farms found that price risk plays the crucial role in determining farm income variability. Results of their study show that price risk is especially important among more intensively producing farms.

Price volatility on agricultural markets play fundamental role in variability of farm income. However the level of income received by farmers is a result of many different factors. Prices of means of production, costs incurred by farmers are also determining farmers income. In the European Union the level of subsidies should not be neglected (Rizov et al., 2013). Taking all this into account it is worth to know to what extent prices of agricultural goods influence changes in farm income and if there are differences in this dependence among farms of different type of production and various economic size. So, the main aim of the paper is to measure correlation between key commodity prices and income of different types of farms in the European agriculture. To achieve it FADN data relating to income and its fundamental component were used. High level of income-price correlation would indicate that price risk is indeed very important in agricultural sector. On the other hand, low correlation coefficients would suggest that importance of price volatility is impeded by changes in other factors, mostly subsidies and prices creating costs incurred by farmers.

This analysis can improve understanding of relation between agricultural prices and farmers' income, since there are no many papers that are concerned with problem of correlation between agricultural prices and farm income. The problem was approached by Melchior [2016] who used data from India and Gong and Meng [2007] for Chinese prices. However these two approaches focus on a different aspects of the problem.

METHODOLOGY AND DATA

Two kinds of data are used. The first one is data referring to income gained by farmers. All data are taken from FADN European Database. Income is identified with FADN Gross Farm Income (measure SE410). Subsidies received by farmers – with Balance current subsidies & taxes (measure SE600). Cost incurred by farers is Total intermediate consumption (measure SE275). Distinguishing between different types of production is carried out using TF8 methodology. FADN methodology defining different economic sizes is also used.

Data for period 2004-2013 from every available country in the database are used. The only exception is Bulgaria, for which data for years 2007-2013 are used. The number of EU member states taken into accounts for particular types of production depends on accessibility of the data. In the case of field crops farms data from 24 countries is employed. For pig livestock there are representatives from 15 countries, for milk farms – 22 countries, and for cattle specialists farms – 18 countries. Due to clarity of presentation in the first part of result sub-section detailed results for every country are presented only for field crops farms. In the last part where results are presented by economic size of the farms there are no figures presented for pig livestock farms since there were no enough countries with representatives for at least 3 different economic size groups.

Data referring to prices are taken from two sources. Yearly indexes of cereal, pig livestock, cattle livestock, and milk producer prices for analyzed countries are taken from FAOSTAT database. Wheat monthly prices for selected EU member states are taken from EUROSTAT database.
Since analyzed time series are very short (10 observations of average income or one of its element for every country) no sophisticated method is employed. All results depend on simple correlation coefficient.

RESULTS

As it is presented in figure 1. In the case of farms specializing in cereal production changes of income that is calculated on a yearly basis follow more or less changes of domestic wheat prices. However there are strong differences among four presented countries. In Germany farm income follow price changes accurately. In case of French farms there are years when changes in income were opposite to price changes (year 2011). It is even stronger in the case of Polish farms. This intuitive relation between prices and income is more strongly disturbed when we take Italian farms into consideration. There are no adequate reflection of significant changes of wheat prices after year 2008 are to changes in farm income in the same period.

As it is presented in the table 1. there is a significant positive correlation between cereal prices and income of fieldcrops farms in most of the EU member states. Despite the fact, that level of prices of agricultural commodities is only one of many factors influencing farmers' income, it seems that It plays crucial role in determining the level of average income in the whole country. This is true for small (eg. Estonia, Lihuania) as well as for big (eg. France, Germany) member states. In 9 countries out of 24 analyzed the correlation coefficient is higher than 0,8. Only in 5 EU member states the correlation coefficient is lower than 0,4 and only in Italy and Slovenia there is no correlation between prices and income at all.

Even higher level of correlation between farmers' income and key commodity price applies for farms producing milk. In 8 out of 22 analyzed member states the correlation coefficient is higher than 0,8 (the highest for Sweden – 0,95; Italy – 0,92; Poland – 0,89). The lowest level of correlation is for Slovakia (0,29), and Czechia (0,20). There is only 5 member states for which correlation is lower than 0,5.

The correlation between prices and income is much lower for farms producing pig livestock. There are higher differences among countries. High level of correlation is observed in countries where there are a lot of farms specializing in pig livestock production like Germany (0,87), Denmark (0,84), and Poland (0,80). On the other hand there are few countries where this correlation is close to zero (Latvia – 0,01; Finland – -0,03) or negative (Italy – -0,18; Portugal – -0,43; Spain – -0,55).

The income of farms producing beef and veal is in many cases negatively correlated with beef prices (11 out of 18 analyzed countries). The negative correlation is higher than 0,25 in Greece, Spain, Latvia, Austria, and Slovakia. Only in 7 countries income of these farms rises with the increase of cattle meat prices. This is the case of Bulgaria, Denmark, Hungary, Ireland, Poland, Finland, and Sweden.

One of the reason for the fact that correlation between key commodity prices and income is far from being fully positive is that farms produce many different products. Diversification of production diminish the strength of this relation. However we can observe that even when we take into account – as it is presented in table 2 – the correlation between commodity price and the value of the production its value although significantly larger still in some cases is far from being close to 1. The correlation coefficient between cereal prices and cereals production value of fieldcrops is larger than 0,75 in 22 out of 24 analyzed countries. It is low only for Cyprus . One of the factor diminishing this correlation is production risk. For instance in the year 2008, when cereal prices

in Cyprus were at their maximum there was a severe drought and there was substantial drop in domestic production. Still in general the analyzed correlation is very high in most countries.

The same high correlation is observed when milk prices and milk production in farms specializing in this type of production is taken into account. In 14 out of 22 analyzed EU member states the correlation coefficient is larger than 0,75, and only in two countries (Czechia and Slovakia) is lower than 0,25. Results for cattle producing farms as well as pig producing farms show similar relation although in these two cases the correlation coefficients are lower in general and there are more exceptions (for instance negative correlation for Italian and Slovakian farms producing beef and veal).

It is interesting to analyze correlation coefficients between key commodity prices and selected elements creating final income. Coefficient of correlation between cereal prices and costs borne by fieldcrops farms are presented in the table 3. It is easily seen that at least in the case of fieldcrops farms the value of costs is highly correlated with cereal prices. In 16 out of 24 analyzed countries this correlation is higher than 0,7. This situation is advantageous for farmers. High correlation between prices determining receipts and costs let diminish the price risk. Costs are diminished in years when unfavorable prices occur.

Similar situation appears when milk farms are analyzed. In 16 out of 21 analyzed EU member states correlation coefficient is higher than 0,5 (the highest value in United Kingdom – 0,96, Finland – 0,91, and Poland – 0,88). However there are few countries where correlation between milk prices and costs incurred by milk producing farms is close to 0 (Greece, Czechia, Lithuania) or negative (Slovakia – -0,24). When it comes to two other group of production – farms producing beef and veal and farms producing pig livestock – there are also high level of correlation between key commodity prices and cost borne by farmers for most of the analyzed countries with few exceptions like, for instance, Czechia and Spain in the case of pig livestock producers.

Very interesting results concern relation of subsidies received by farmers to prices of key commodity. Correlation coefficient between cereal prices and subsidies gained by farmers that specialize in cereal production are presented in table 4. The most desirable situation is when there are negative correlation between the level of prices that constitute income level and subsidies. It helps to reduce income risk, since subsidies act as counter cyclical instrument. However, as it can be seen in table 3. Under the Common Agricultural Policy subsidies for fieldcrops farms are very often positively correlated with cereal prices. In 13 out of 24 analyzed countries correlation coefficient is higher than 0,5. The negative correlation occurs only in United Kingdom, Austria and France.

In the case of farms that specializes in milk production correlation between milk prices and subsidies gained by farmers is significantly lower. Only in 7 EU member states out of 21 analyzed this coefficient is higher than 0,5, and in most countries it is close to 0 or even highly negative like in Ireland (-0,48) or Slovakia (-0,49). When it comes to pig livestock producing or beef and veal producing farms there are significant differences among countries, although the average is closer to 0 than in group of farms specializing in milk or cereals production.

Since correlation between prices and income is far from being complete it is interesting to examine if the method of averaging monthly prices to one mean price for consecutive years influence the level of correlation. It is especially important for prices where there is a strong seasonality. X-12-ARIMA method applied for time series of all analyzed prices proved that seasonal coefficient is significant for cereal prices. Further research showed that mean yearly cereal prices are suitable for the analysis that was carried through. Nevertheless estimation of correlation coefficients between income of fieldcrops farms and wheat prices from successive months show some interesting results. The level of these coefficients for six selected EU member states are presented in figure 2. As it can be

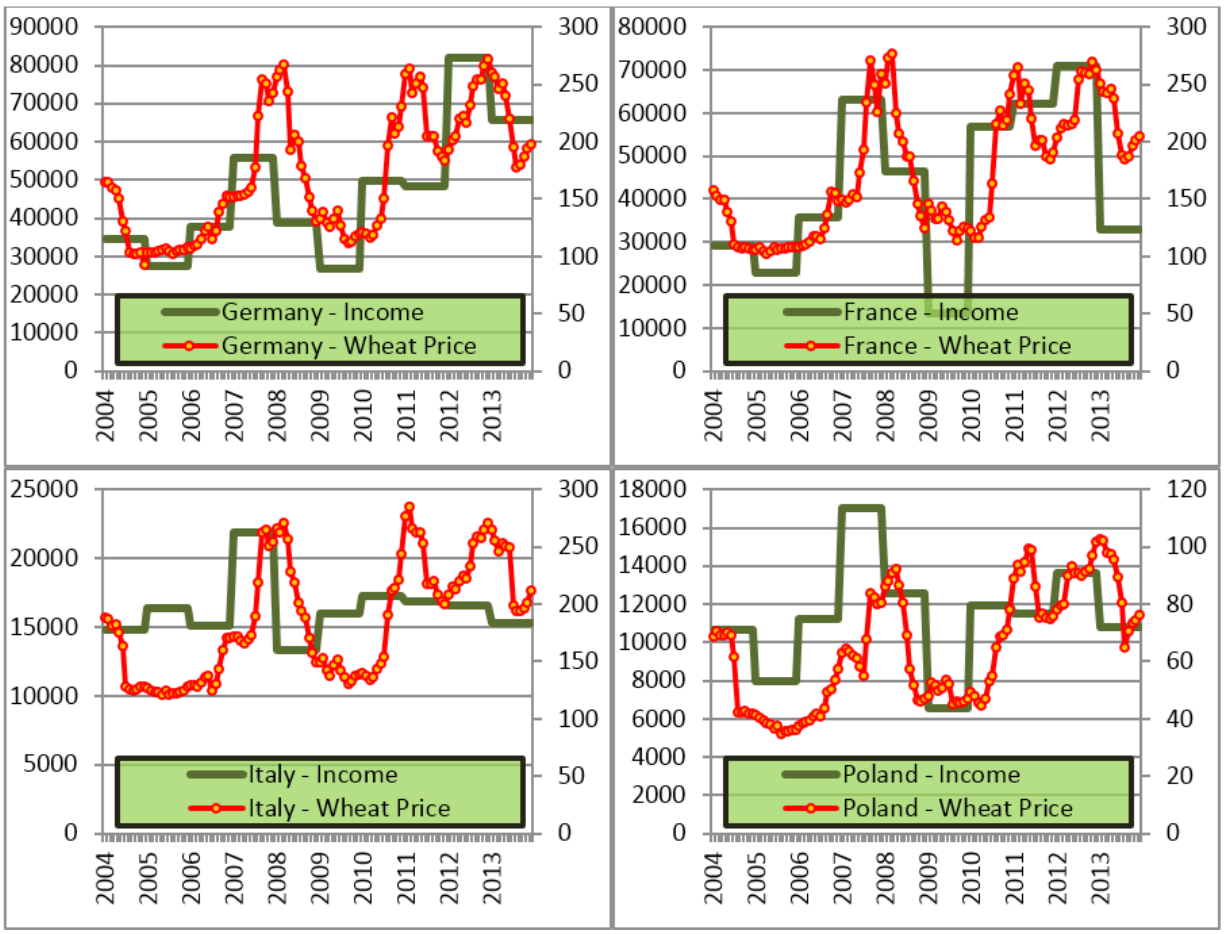

Figure 1. Yearly income of fieldcrops farms (left axis) and monthly cereal prices (right axis) in Germany, France, Italy and Poland in 2004-2013 [in euro]
Source: own elaboration on the Eurostat and FADN data basis.

Table 1. Correlation between cereal prices and income of fieldcrops farms for EU member states in 2004-2013

Country	HUN	SWE	FRA	EST	SVK	CZE	BEL	POR
Correlation coefficient	0,91	0,91	0,89	0,89	0,86	0,85	0,85	0,82
Country	DEU	LTU	OST	IRE	UKI	LVA	NED	POL
Correlation coefficient	0,82	0,77	0,76	0,76	0,71	0,71	0,66	0,6
Country	DAN	BGR	ESP	ELL	CYP	SUO	ITA	SVN
Correlation coefficient	0,59	0,57	0,43	0,33	0,32	0,15	0,02	-0,01

Source: own elaboration on the Eurostat and FADN data basis.

Table 2. Correlation between cereal prices and cereals production value of fieldcrops farms for EU member states in 2004-2013

Country	FRA	SWE	POR	BEL	DEU	LTU	LVA	ELL
Correlation coefficient	0,97	0,96	0,94	0,92	0,92	0,92	0,91	0,89
Country	DAN	CZE	NED	HUN	BGR	SVK	IRE	UKI
Correlation coefficient	0,89	0,88	0,88	0,87	0,87	0,86	0,86	0,85
Country	ITA	EST	OST	SVN	ESP	SUO	POL	CYP
Correlation coefficient	0,84	0,82	0,82	0,81	0,79	0,77	0,69	0,17

Source: own elaboration on the Eurostat and FADN data basis.

Table 3. Correlation between cereal prices and production costs incurred by fieldcrops farms for EU member states in 2004-2013

Country	UKI	DEU	BEL	LVA	POR	HUN	LTU	SWE
Correlation coefficient	0,85	0,85	0,84	0,83	0,82	0,81	0,8	0,78
Country	DAN	CZE	ITA	NED	SUO	IRE	ESP	BGR
Correlation coefficient	0,76	0,76	0,76	0,74	0,74	0,74	0,73	0,72
Country	SVN	OST	FRA	EST	ELL	SVK	POL	CYP
Correlation coefficient	0,67	0,64	0,63	0,63	0,63	0,59	0,24	0,22

Source: own elaboration on the Eurostat and FADN data basis.

Table 4. Correlation between cereal prices and subsidies received by fieldcrops farms for EU member states in 2004-2013

Country	HUN	NED	DAN	SWE	IRE	BEL	CYP	LTU
Correlation coefficient	0,9	0,77	0,76	0,73	0,68	0,67	0,66	0,65
Country	EST	DEU	POL	CZE	ELL	SVK	LVA	ESP
Correlation coefficient	0,65	0,59	0,57	0,54	0,54	0,41	0,28	0,27
Country	ITA	SVN	POR	BGR	SUO	UKI	OST	FRA
Correlation coefficient	0,25	0,16	0,12	0,09	-0,11	-0,28	-0,36	-0,48

Source: own elaboration on the Eurostat and FADN data basis.

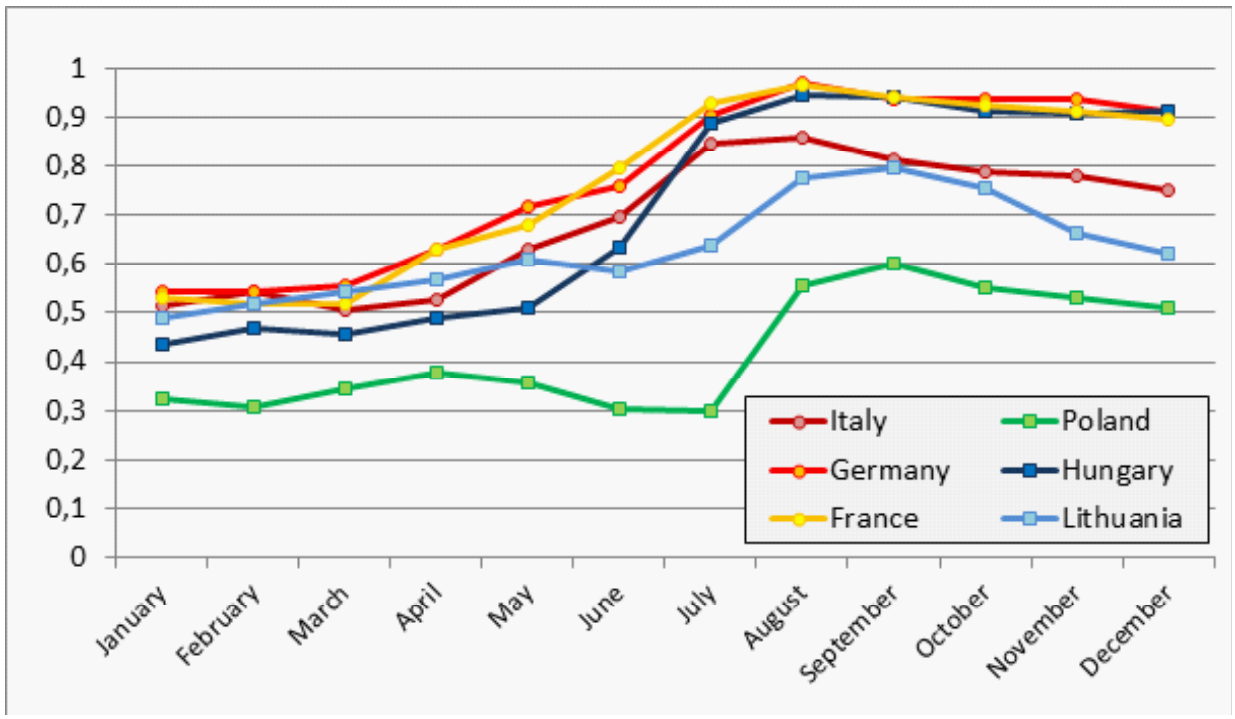

Figure 2. Correlation coefficient between income of fieldcrops farms and wheat prices in separate months in selected UE member states in 2004-2013
Source: own elaboration on the Eurostat and FADN data basis.

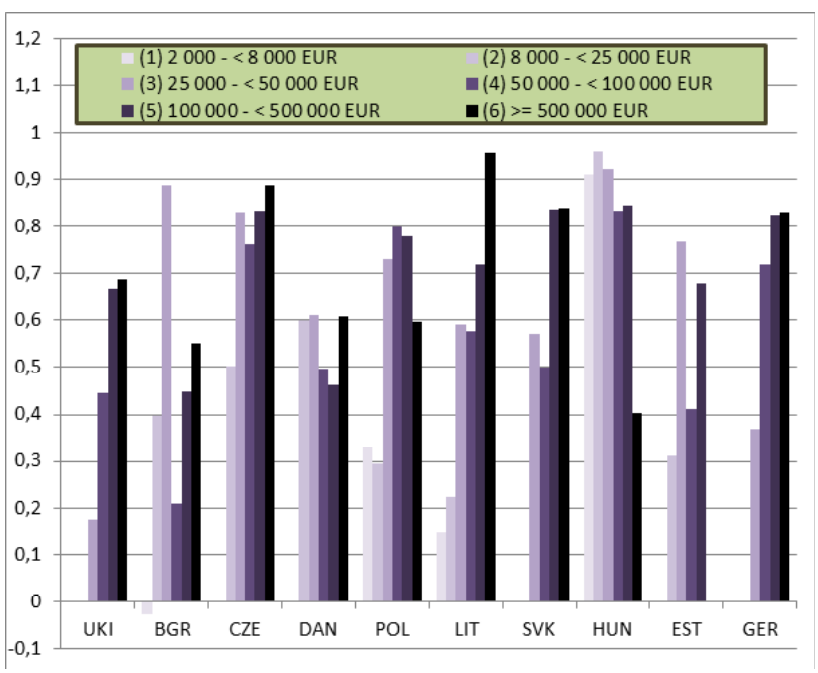

Figure 3. Correlation between cereal prices and income of fieldcrops farms according to economic size in selected UE countries
Source: own elaboration on the Eurostat and FADN data basis.

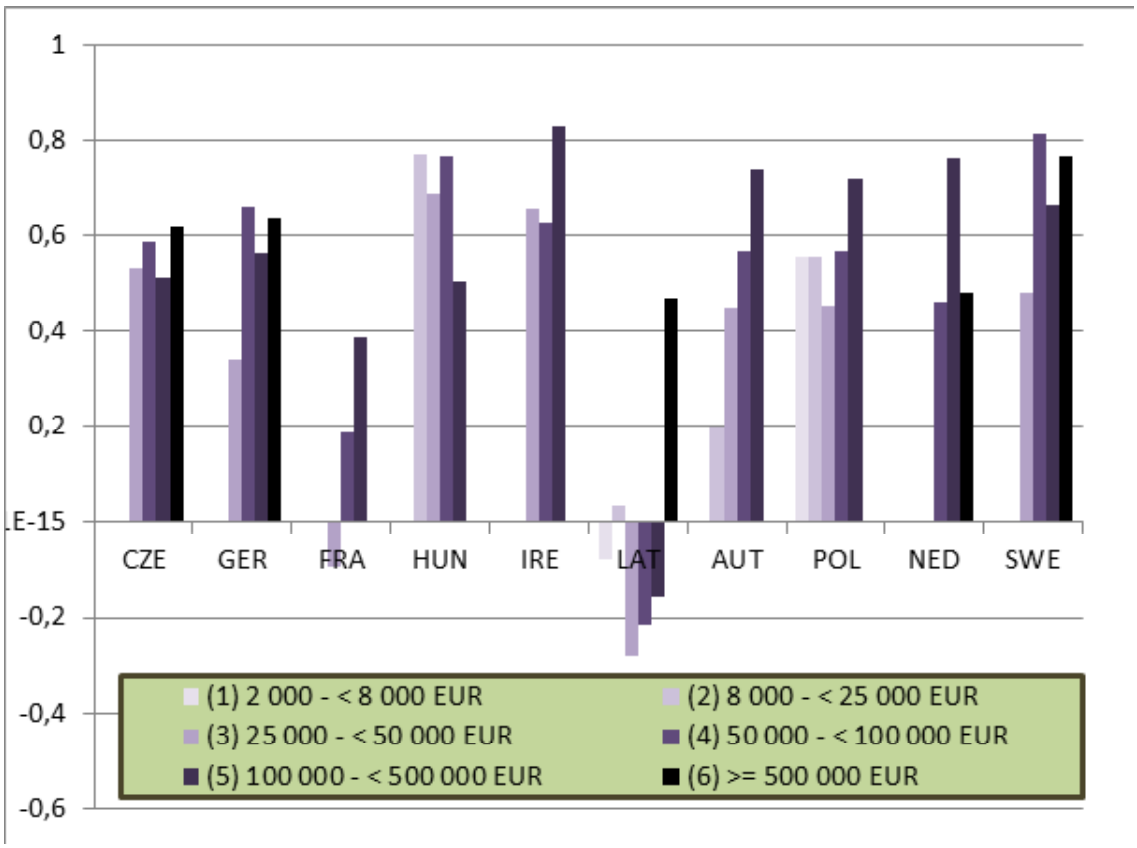

Figure 4. Correlation between milk prices and income of milk farms according to economic size in selected UE countries
Source: own elaboration on the Eurostat and FADN data basis.

expected, the correlation is the highest for August and September prices. During post-harvest period farmers sell most of their production and their yearly income is related to prices that occurred during these months. However some differences among countries can be observed. Changes in the level of correlation between income and prices preceding and following harvest time are higher for East European countries than for old member states. The line representing the latter group of countries is smoother. One of the explanation of this phenomena is that store capabilities are bigger in this countries and farmers do not have to rely only on post-harvest period prices.

The last part of the analysis is dedicated to differences in correlation between key commodity prices and farm income among farms of various economic size. As it was mentioned in the methodology part due to insufficient number of groups representing various economic size farms, results for pig livestock producing farms are not presented.

Fieldcrops farms income-price correlation by economic size of farms for selected EU member states is presented in figure 3. The lighter color of the bar the smaller economic size of analyzed farms. Although there are significant differences among analyzed countries one can observe positive relation between the economic size of farm and income-price correlation in most cases. It is especially true for United Kingdom, Czechia, Lithuania, and Germany. On the other hand Hungary is the most distinct exception. On average correlation coefficient between cereal prices and farm income for the smallest economic size farms is only 0,26. This coefficient for second smallest group equals 0,44 and 0,54 for the consecutive group. The highest level of income-price cor-

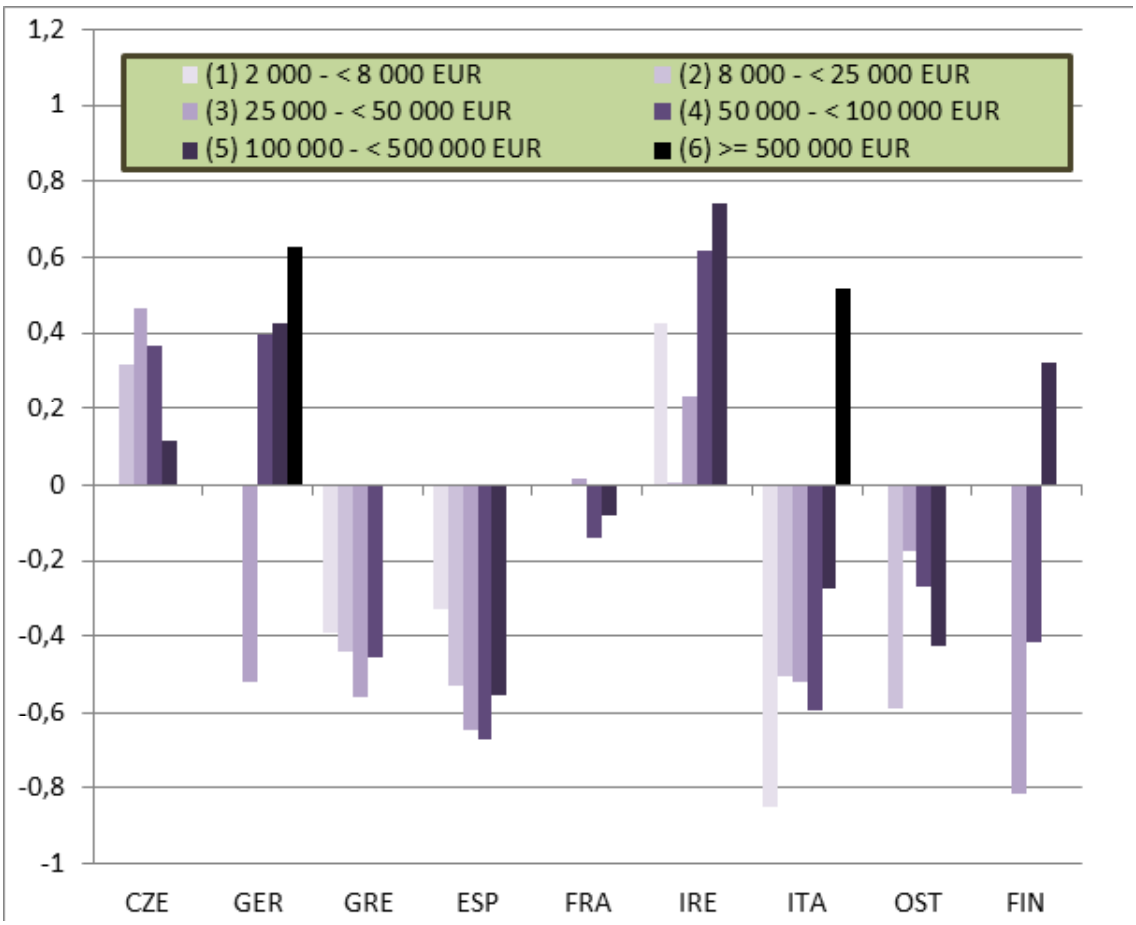

Figure 5. Correlation between cattle meat prices and income of cattle specialist farms according to economic size in selected UE countries
Source: own elaboration on the Eurostat and FADN data basis.

relation occurs for the farms which economic size exceed 500000 euro and equals 0,63. It can be stated that there is positive relation between economic size of farms and their income-price correlation.

In the case of milk producing farms there are 10 countries that have representatives in three or more groups of economic size. Income-price correlation coefficients for this ten EU member states are presented in figure 4. There are no representatives of the smallest economic size group of milk farms in any country. Like in the case of fieldcrops farms Hungarian farms that specialize in milk production show relation opposite to the one that can be observed in other countries. Regardless if correlation coefficients are negative or positive it can be noted that the bigger economic size the higher level of income-price correlation. The average correlation between milk price and milk farms income for the specified groups of economic size starting from the smallest to largest is respectively: 0,28; 0,34; 0,36; 0,56; 0,54. The same as in the case of fieldcrops farms there is a positive relation between economic size and income-price correlation for farms specializing in milk production.

The last analyzed type of production is cattle specialist farms. Here only 9 countries have satisfactory number of representatives in various economic size groups. As it was mentioned the

general level of income-price correlation in beef and veal producing farms is low. Nevertheless when average income-price correlation is analyzed we can conclude that this coefficient is higher for farms of larger economic sizes. These coefficients for consecutive group of economic size starting from the smallest one are respectively: -0,29; -0,29; -0,28; -0,13; 0,03; 0,57. Conclusions are the same as in two other types of production. Income-price correlation is higher for economically larger farms.

CONCLUSIONS

The analysis indicate that there is in general significant correlation between agricultural prices and farmers' incomes. However there are considerable differences among particular EU member states. No geographical pattern has been found. It cannot by stated that for instance income-price correlation is higher in new member states over old EU countries or that there is differences between northern and southern countries.

The level of correlation strongly depends on the production type of farms. Cereals and milk producing farms are strongly dependent on price changes. This relation is weak for specialist pig or cattle farms. It should also be emphasized that in countries specializing in particular type of production, price-income correlation is higher.

Desirably, subsidies are less correlated with key prices than value of production or specific costs. This is especially true for milk, cattle and pig producing farms.

Economic size of farms significantly influence the level of price-income correlation. The larger farm the higher level of income-price correlation coefficient. This relation is in force for all 3 different types of productions that were analyzed. Price risk is more important for bigger farms.

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