The correlation between the agricultural productivity and the export performance of the agro-food foreign trade in the Visegrád Group countries following accession to the European Union

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Abstract

In this paper we have sought to answer three research questions: what was the difference between the agricultural export growth rates of the Visegrád Group countries following the EU accession; how did the multifactor productivity in the countries under study evolve; and could a correlation be observed between the growth rates of the multifactor productivity and of the agricultural exports. The average annual growth rate of the multifactor productivity was highest in Poland, followed by the growth rate in Slovakia, in Hungary and in the Czech Republic. The average annual growth rates of the exports of agricultural raw materials and of the total food economy had identical rankings except for Hungary. The results of the analysis allow the presumption that the different annual average growth rates of the multifactor productivity of agriculture have also influenced the development of the agricultural export performance of the countries under study.

Keywords

agro-food foreign trade, agricultural productivity, Visegrád Group countries

1. Introduction

It is recognised that the Hungarian agro-food foreign trade has undergone remarkable changes following the accession to the European Union (EU): "With Hungary's accession to the EU, the system of conditions of the agro-food foreign trade has considerably altered. The changes concerned both directions of turnover, but their effects could be sensed far more strongly in the imports than in the exports." (KSH, 2007:2).

Several authors have analysed the changes which have occurred in the Hungarian agro-food foreign trade. By way of establishing a starting point for further analyses, we begin by providing a short overview of the main processes which occurred after the accession in the foreign trade of the Hungarian food economy products on the basis of the findings of previous studies. Thereafter, we have examined the development of the agro-food exports of the Visegrád Group countries. Following this, we have inspected the development of the multifactor productivity of agriculture, comparing thereafter the correlation between the growth rates of the multifactor productivity and of the agro-food exports.

Examination of the productivity is considered as important also due to the fact that productivity may be deemed as one factor (of major importance, in the opinion of some authors) of competitiveness. In connection with this, Botos (2009) commented that "certain components of competitiveness – especially in the macro-economic aspect – may not be quantified or quantified only in a quite unreliable manner". Furthermore, cites from Porter (1991) that "… only the productivity may be used as basis of comparison at the level of the national economy". Even so, relatively little information is available on the trends of the productivity of Hungarian agriculture and on their comparison with other countries in recent years. Here we should mention that intensive research

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activities were performed in the mid- 1980s into the competitiveness of agriculture at the Research Institute of Agricultural Economics (AKI) in Budapest (see for example Borszéki et al., 1986).

The three main calculation methods of the multifactor productivity are: the Stochastic Frontier Analysis (SFA), the Data Envelopment Analysis (DEA), and the index calculation method. Based on the character of the objectives and on the available database, we have selected the index calculation method for our analysis. Different index formulae may be used for the measurement of productivity with the index calculation method. Owing to their consistency with the productivity theories, the Fisher and Törnquist indices have come into general use. There is only a minimal difference between the values resulting from these two index formulae but as the Törnquist index is often preferred in empirical analyses (Coelli et al., 2005), we have used the Törnquist-Theil index for the calculation of the multifactor productivity index.

In summary, therefore, the research topics of our paper may be defined as follows:

1. What trends can be observed in the evolution of the agro-food export turnover of the Visegrád Group countries following the EU accession in 2004?
2. How has the multifactor productivity in the agriculture of the Visegrád Group countries developed following their EU accession in 2004?
3. What correlation may be detected or presumed between the growth rates of the agro-food export performance and of the multifactor productivity?

2. Trade literature overview

The development of the Hungarian food economy's foreign trade following the accession has been examined by several authors from several aspects. Here we present the most important findings of some studies.

Studies connected to the trade theories have assessed what products on what markets might be competitive. These studies include the works of Bojnec-Fertő (2006) and of Fertő (2004, 2006 and 2008), using the four different indices of the revealed comparative advantages elaborated by Balassa (1965). According to their findings, the structure of the comparative advantages revealed in agriculture is more stable than the price or quality competitiveness. They established that Hungary had comparative advantages against the EU-15 countries in respect of live animals, meat and meat preparations, oilseeds, timber and corkwood, but not in cereals.

Kiss (2005, 2007) studied the Hungarian food economy's foreign trade, with special regard to the trade with the old and new Member States. She concluded that the reasons for the trade balance deterioration which occurred during recent years were to be sought not in the insufficient export performance but rather in the more powerful import penetration. In her opinion, a change in the export structure (processed products with higher added value, animal products, fruit and vegetable sector) and its geographical diversification (developing and emerging countries) would be necessary.

Some of the research studies have assessed the competitiveness of the different food economy sectors, among others: Bozsik (2004) – wine products; Fogarasi (2003) and Jámbor (2008) – cereals; Medina (2005) – fruit and vegetables; Csillag (2005) – sugar; Módos (2004) and Tóth (2005) – meat product chain.

Several researchers in AKI are studying the foreign trade performance of the Hungarian food economy and the evolution of its competitiveness. Potori et al. (2004) assessed the viability and competitiveness of the main agricultural sectors, basing their analyses on the comparison of the alternative costs of the resources used for the production through application of DRC indices. Kartali et al. (2004a and 2004b) performed detailed analyses prior to EU accession of the competitive advantages and disadvantages of the main product chains (cereals, oilseeds, fruit and vegetables, wine, pork, poultry and milk) deriving from the demand and offer, marketing, logistics and distribution. They showed that the fruit and vegetable sector had the highest competitive advantages among plant products, while the oilseeds and cereals sectors were also judged as competitive. As regards animal products, the competitiveness indices among the product groups under study presented remarkable differences. Product groups of live animals, meat and meat preparations gained favourable competitiveness rankings but the milk and dairy products did not. Kürthy et al. (2007) sought to answer the question: what were the reasons for the dynamic growth of the food economy's imports following the accession. The dynamic growth was attributed to the following factors: methodological difficulties (the problematic of the country of consignment and country of origin), production transfer of the multinational companies, high cost-intensity of the domestic production (higher tax burdens), assortment widening (the quantity of imported live animals, meat and meat preparations, dairy products as well as of beverages and tobacco products increased in a spectacular manner), poor infrastructure, and low level of community marketing. A focused investigation of the imports from the Visegrad states shows an increase from 12% to 24% over the period 2000-2006, with the highest increase in Poland.

Kartali (ed.) (2008) and co-authors, on the other hand, examined the issue of the growth of the Hungarian food economy's exports. They assessed the top 30 target markets between 2000 and 2006. Their main conclusions included: the top ten target markets – including Austria, Italy, Russia, Romania, the Netherlands and Poland – absorbed 63%, and the top 30 target markets 94%, of Hungary's agro-food exports. The average market expansion growth rates presented remarkable differences; the largest markets were the most stable ones; the range of operation of the Hungarian food economy's exports was relatively small, with a radius of 2,500 km, in practice covering only Europe (simultaneously implying competitive advantages and disadvantages); the "driving markets" of the Far East were distant from Hungary; the poor transport infrastructure constituted the main difficulty within the logistics of the sector.

At the request of the Hungarian Chamber of Agriculture, collaborators at AKI prepared a wide-scope study entitled "Opportunities for improving competitive chances in the Hungarian food economy". Popp et al., (eds, 2008) stressed that no single factor could be mentioned as the reason for the weaker competitiveness of Hungary compared to other Central European countries. At the same time they pointed out: "… by today, our decline is slightly higher in almost all areas compared to the other countries, while we have no competitive advantages worthy of mention in any area, counterbalancing for example the attraction of the Slovakian tax system, the overall development level of the Czech infrastructure … or even the more dynamic enterprising culture and better management training in Poland".

The special value of the study consists in the fact that the competitive disadvantages of the Hungarian food economy are discovered in strict co-operation with the participants of everyday life (agricultural, food economy and commercial enterprises) and simultaneously proposals are made for their elimination. The practical utility of the findings is increased by the fact that, beyond *horizontal* diagnosis of the agricultural players, diagnosis of the participants of the *different product chains* is also provided. For the purposes of our study, a short overview of the horizontal competitive disadvantages may be summed up as follows.

The authors have ranked the competitive disadvantages in *three main* groups:

- **Economic environment:** Above all, participants of the economy have evaluated the taxation system as extremely bad, with special regard to its effects increasing the labour costs and thus encouraging illegal or "semi-legal" employment. In Hungary, the administrative burdens of the enterprises are extremely high and the economic and legal changes are often incalculable. Serious problems derive from the remarkable share of the black economy, inconsistencies of the monetary policies, and from the fact that "the agricultural development programme principally focused on production, while the targeted development of the agricultural production's value adding logistic systems (transport, freighting, storage and distribution) was not included among the priorities" (Popp et al., eds., 2008:45).
- **Agricultural policy:** The authors have expounded already that "Development of a coherent agricultural (food economy) policy concept, palpably improving the competitiveness of the domestic farmers and food industrial enterprises and spanning over governmental cycles, has remained unsuccessful during the recent period …" (Popp et al., ed., 2008: 11). In the exposition of the topic they have stated that agricultural policy in Hungary in fact meant "support policy", having the principal aim of drawing as much as possible of the available EU resources; at the same time, this system often generated unnecessary investments. Among issues requiring solutions, the authors mentioned the problems deriving from the land purchase ban of the co-operatives and companies, the rationalisation of the different standards, and the abuses of dominant position by the food chains, as well as the urgent necessity of progress in the fields of information flow, innovation, special training and marketing activities.
- **Social problems:** beyond general lack of trust and business, in some cases also the lack of co-operation within the product chains, of skilled labour and property security, as well as the unilateral, production technology-oriented attitude of the Hungarian managers constitute the most important competition barriers.

Wagner et al. (2009, 2010) surveyed in an international comparison the effects of the explosion of food prices which occurred in recent years on the foreign trade of the Hungarian food economy. They calculated that the high agricultural trade surplus is due to the product divisions of cereals and oilseeds, while the share of the other product divisions (meat, vegetables, fruit and vegetable preparations) decreased and the division of milk and dairy products, for example, realised a negative balance.

3. Data sources and methodology

We have used data classified according to the SITC nomenclature for presenting the foreign trade processes. Analyses of the foreign trade processes have been made for the total agro-food trade as well as for the agricultural raw materials and for processed products. Items of product section "0", as well as product divisions 21, 22, 24, 27, 29, 41, 42 and 43 were included among agricultural raw materials, while the processed products included items of product section "1" and product divisions 56 and 63. The total agro-food exports are constituted of the sum of these two product groups. Data were drawn from the COMEXT database maintained by Eurostat (Eurostat 2010a).

For calculating the productivity indices, data of the Economic Accounts for Agriculture (EAA) have been used in all cases; the source of all data used was the internet database of Eurostat (Eurostat 2010b)

When calculating productivity, the outputs may be compared with one, several or all inputs. If comparing to one input, we get a partial productivity (PP) index; multifactor productivity (MFP) index is drawn from comparison to several inputs and total factor productivity (TFP) index from comparison with all inputs.

The productivity indices are categorised by the domestic agricultural economists in different ways (see, among others: Baráth et al.,2009; Mészáros, 1990, 1991; Szabó, P. 2003; Nábrádi, 2007; Nemessályi, Zs. and Nemessályi, Á., 2003; Pfau and Széles, 2001; Szűcs and Fekete Farkas, 2008).

For the calculation of the total factor (and multifactor) productivity three methods are commonly used: Stochastic Frontier Analysis (SFA), Data Envelopment Analysis (DEA), and the index number methods. For further details on productivity and efficiency calculations and their mathematical modelling see Coelli et al, 2005; Kumbhakar-Lovell, 2003; Fried et al., 2008; Mundlak, 2001 In: Gardner - Rausser eds., 2001.

Mészáros (1990, 1991) Hughes (2000) and Davidova et al. (2002) carried out investigations of the total factor productivity of Hungarian agriculture in the 1990s and at the Millennium, but little is known about its changes in recent years (Baráth et al., 2009). Several analyses of the technical efficiency – one of the elements of the TFP – have been published in recent years (see for example: Bakucs et al., 2010; Fogarasi, 2006, 2008; Latruffe-Fogarasi, 2009; Varga, 2006).

Due to lack of data concerning land rental rates, analysis of the total factor productivity was not possible in this paper (as in other studies, see: EC, 2002), therefore multifactor productivity index (MFP) was used for comparison. The multifactor productivity has been calculated on the basis of the Törnquist-Theil index. The Törnquist-Theil multifactor productivity index, in its general form, can be described by the following formula:

$$\ln MFP_{t_0,t} = \ln \frac{outputIndex_{t_0,t}}{inputIndex_{t_0,t}} = \frac{1}{2}\sum_{m=1}^{M}(r_{it_0} + r_{it})(\ln y_{mt} - \ln y_{mt_0}) - \frac{1}{2}\sum_{n=1}^{N}(s_{it_0} + s_{it})(\ln x_{mt} - \ln x_{mt_0}) \qquad (1)$$

where:

y: output quantity
x: input quantity
r: output shares
s: input shares
t_0: base time period
t: actual time period

The transitivity requirement is not satisfied by the Törnquist-Theil index in its original form, therefore it may only be used for bilateral comparisons. For complying with our aims, however, also comparison of the productivity indices' levels and their changes in time is necessary; thus we had to select an index allowing multilateral comparison (among countries and time periods). Based on the EKS[2] method, the Törnquist-Theil index may be transformed (Caves et al., 1982) for allowing multilateral comparisons:

$$\ln MFP^{T}_{t_0,t} = \left[\frac{1}{2}\sum_{m=1}^{M}(r_{mt} + \overline{r_m})(\ln y_{mt} - \overline{\ln y_m}) - \frac{1}{2}\sum(r_{mt_0} + \overline{r_m})(\ln y_{mt_0} - \overline{\ln y_m})\right] -$$

$$\left[\frac{1}{2}\sum_{n=1}^{N}(s_{nt} + \overline{s_n})(\ln X_{nt} - \overline{\ln X_n}) - \frac{1}{2}\sum_{n=1}^{N}(s_{nt_0} + \overline{s_n})(\ln X_{nt_0} - \overline{\ln X_n})\right] \qquad (2)$$

where:

[2] The EKS abbreviation derives from the initials of *Éltető, Köves* and *Szulc*, researchers that have investigated the index calculation problems emerging during international comparisons (*Éltető–Köves* [1964]; *Szulc* [1964]).

$\overline{\overline{r_m}}$: arithmetic mean of the output shares
$\overline{s_n}$: arithmetic mean of the input shares
$\overline{\ln X_n}$: arithmetic mean of inputs
$\overline{\ln y_m}$: arithmetic mean of outputs

Gross output of agricultural industry at constant producer prices in EUR constituted the category of outputs (Y) at the calculation of the multifactor productivity. Labour (x_1) in annual work units, the utilised agricultural area (x_2) in hectares and total intermediate consumption (x_3) at constant prices were used as inputs. When determining the input shares required for aggregation, in order to approach as much as possible the real conditions, we have also taken into account the costs of unpaid labour calculating with unit costs of the paid AWU. For determining the input shares of capital and intermediate consumption (IC), we have used the EAA's data in current prices concerning fixed capital consumption and intermediate consumption.

4. Results

The results are expounded below in the order of the objectives: firstly, the statements concerning the development of the food economy's foreign trade, then the results of the multifactor productivity calculations; and finally the correlation between the development of the multifactor productivity and of the export performance are examined.

4.1. Trends of the food economy exports in the Visegrád Group countries

During the assessment of the food economy's foreign trade, we have sought to answer the question: what differences existed among the growth rates of the Visegrád Group countries' food economy exports. We have examined the changes occurring in the agricultural exports separately for agricultural and processed products. Exports of both agricultural raw materials and of processed products have accelerated following the EU accession in each country (Figure 1); however the rates of growth were different in each country and in the different stages of the product chains. It is remarkable that exports of the processed products have increased more slowly than those of unprocessed products (agricultural raw materials) in each of the four countries. *The exports of the agricultural raw materials* have increased most in Poland and Slovakia (with a minimal difference); followed by the Czech Republic, while the rate of growth is much smaller in Hungary.

Growth rate of the exports of *processed products* was clearly the highest in Poland. The Czech Republic ranked second, while – as with the export growth of agricultural raw materials – Slovakia was third and, again far behind, Hungary was in fourth place. Consequently, the growth of the *total food economy exports* was highest in Poland and in Slovakia, followed by the Czech Republic, while Hungary presented by far the smallest growth rate.

Upon analysis of the foreign trade processes, it is evident that the growth rates of the agricultural exports presented remarkable differences in the four countries, simultaneously indicating differences in competitiveness of these countries. The changes of competitiveness are determined by several different factors; in the case of the food economy, the tendencies of the agriculture's productivity may be considered as one of the important explanatory variables. Therefore, for the purposes of our paper, the following questions emerge: what changes occurred within the same period in respect of the productivity of agriculture in the four countries, and whether any correlation can be detected between the productivity of agriculture and the export performance of the different sectors of the food economy. These issues will be dealt with later.

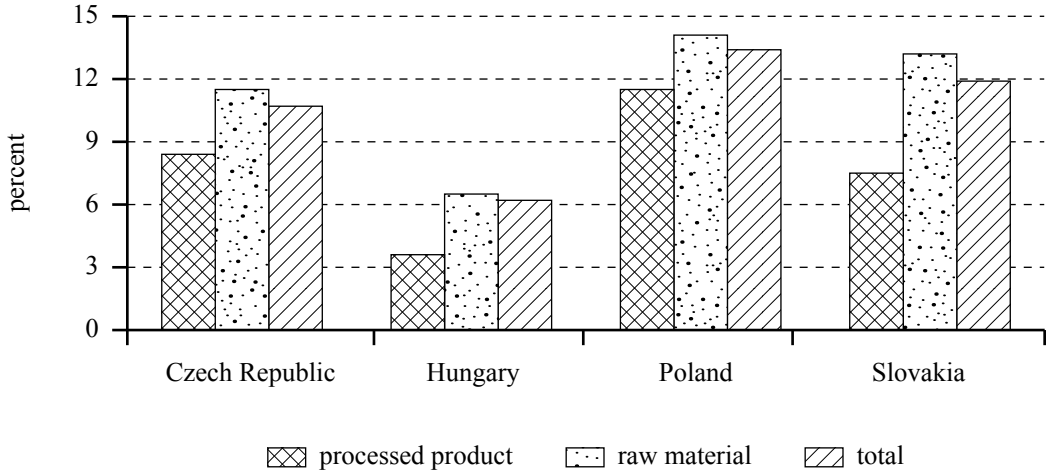

Figure 1: Average annual growth rates of the food economy's exports in the Visegrád Group countries (2001-2009)

Source: Own calculation based on Eurostat data

4.2. Evolution of the multifactor productivity index

The starting point for calculating a multifactor productivity index consists in defining the outputs and inputs as well as in establishing the shares of the single inputs. Table 1 shows the averages of the input shares in the countries under study.

Table 1

Average input shares used for the calculation of the multifactor productivity index (2001-2009)

Country	Capital	Labour	IC*
Czech Republic	0.11	0.26	0.64
Hungary	0.10	0.39	0.51
Poland	0.05	0.55	0.39
Slovakia	0.10	0.29	0.61

* Intermediate consumption (IC)

Source: Own calculation based on Eurostat data

Examining the shares of the single inputs, it can be established that there was no considerable difference as regards the share of capital in the input costs between Hungary, the Czech Republic and Slovakia. We consider it an interesting result that the share of capital is remarkably lower in Poland than in the other countries. At the same time, the share of the labour factor is by far the highest in the Polish agriculture, implying that the Polish agriculture is more labour-intensive than in the other countries. Hungary occupies the second place considering the share of the labour factor, allowing the presumption that labour has a more important role in the agricultural production in Hungary than in the Czech Republic and Slovakia. It is worthy of mention that share of paid AWU within the total AWU was higher in the countries with large average farm size: in the Czech Republic (135 ha) and Slovakia (120 ha) 74.4% and 58.1% respectively, while lower in Hungary (29 ha) 22.6% and

in Poland (12 ha) merely 6.0%![3] (Bergua et al., 2008; Martins, 2008, 2009a, 2009b). Upon inspecting the share of the FTF (purchases of goods and services), it is apparent that Poland constitutes an exception also in this respect; the share of the FTF within the costs is namely remarkably smaller than in the other three countries.

After having determined the input shares, the development of the multifactor productivity can be defined (Figure 2).

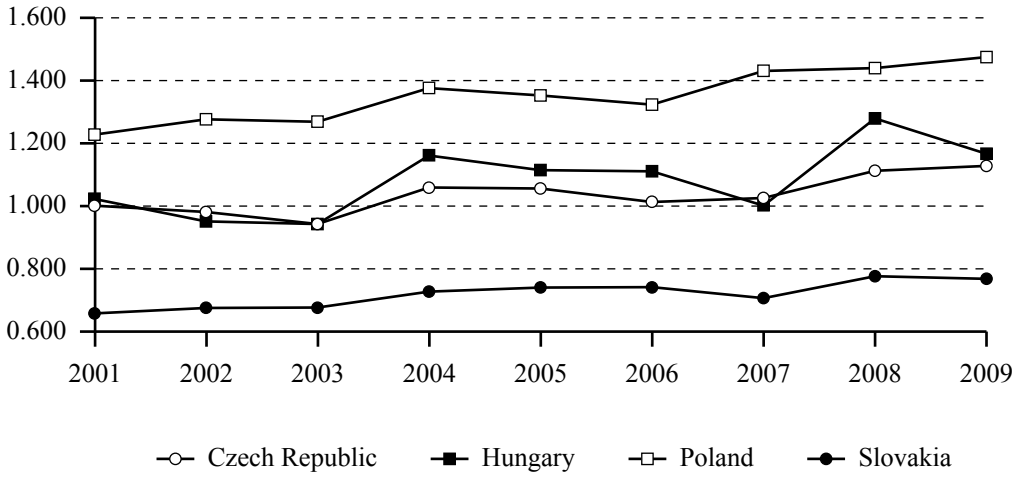

Figure 2: Development of the multifactor productivity of agriculture in the Visegrád Group countries (2001-2009)

Source: Own calculation based on Eurostat data

Thanks to the use of the multilaterally consistent index, the results can be compared among countries and also their changes in time can be followed. Based on the comparison among countries, it can be established that the multifactor productivity was unequivocally the highest in Poland and the lowest in Slovakia. The MFP level values of Hungarian and Czech agriculture were similar, even though in most years the Hungarian data exceeded the equivalent Czech values. Regarding the changes over time, the data show growth in each country. The growth rate was the highest in Poland, with an annual value of 2.3%; the same value, that is, the MFP growth rate, was 1.9% in Slovakia, 1.5% in the Czech Republic and 1.6% in Hungary. The growth is higher even in Slovakia and Poland, while larger fluctuations can be observed in Hungary and in the Czech Republic.

4.3. The correlation between the growth rates of the agro-food exports and of the multifactor productivity of the agricultural sector

With the help of Table 2 we have examined the correlation between the annual growth rate of the multifactor productivity of the agricultural sector and the growth rate of the exports of agricultural raw materials and of the processed products and of the total agricultural export. It is important to stress that several other factors not examined here may have a role in influencing the growth rate of the agro-food exports. In this paper we have tried to establish whether a correlation might be observed (or more precisely: presumed) between the growth rates of the multifactor productivity of agriculture and of the agro-food exports.

[3] In all countries under study, the data refer to farms exceeding 1 ESU.

Table 2

Annual average growth rates of the multifactor productivity of the agriculture and of the export performance in the Visegrád Group countries (2001 and 2009)

	MFP	Agricultural raw materials	Processed agricultural products	Total agro-food export
Czech Republic	1.50%	11.5%	8.4%	10.7%
Hungary	1.60%	6.5%	3.6%	6.2%
Poland	2.30%	14.1%	11.5%	13.4%
Slovakia	1.90%	13.2%	7.5%	11.9%

Source: Own calculation based on Eurostat data

Based on the data included in Table 2, the following statements can be made. The annual average growth rate of the multifactor productivity was the highest in Poland, followed by Slovakia. The same sequence is observed as regards the average annual growth rates of the agricultural raw materials and of the entire agricultural exports. The fact that while there was little difference between the annual average growth rates of the MFP of the Hungarian and Czech agriculture, the exports of the Czech food economy products (in both product chain stages) remarkably exceeded the Hungarian values is of note. Notwithstanding the Hungarian contradictory data, it may be presumed that the different annual growth rates of the productivity of agriculture influenced the agricultural export performance of the countries under study. Hungarian and Czech data, at the same time, call attention to the fact that several factors may contribute to the change of the growth rate of agricultural exports and also to the necessity to apply measures and economic incentives taking into account the most likely factors.

5. Summary

The Hungarian foreign trade balance in the period 2004-2006 declined by nearly 50% on average compared to the period 2001-2003, and has exceeded the base time period level by only 15% in the past three years.

Amongst the Visegrád countries Hungary was the least successful in adjusting itself to the newly emerging conditions of the EU accession in terms of agro-food exports. Its total trade balance with these countries was in almost all of the post accession years unfavourable.

Hungarian farmers proved to be unprepared for the conditions of the CAP both in terms of their technical-technological backgrounds and in their market competences. Animal husbandry organisations and, in particular, individual farms that were earlier kept going by state subsidies and protective tariffs that were high in Central European terms, were to suffer many sad experiences in the early years of accession.

An explanation for this can be that the dual type farm structure created by the compensation and privatisation practice in Hungary provided much less favourable conditions for the agricultural exports than the structures established in the Czech Republic and in Slovakia. Poland, on the other hand, with the primacy given to its individual farms, practically escaped from those difficulties that hit the rest of the Visegrád countries due to their history of large scale systems so heavily in their agricultural transition processes.

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