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# **Determinants of competition in agro-food trade between Central European Countries and the European Union**

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## ABSTRACT

This paper investigates determinants of competition in agro-food trade between five transition Central European Countries (CEC-5) (Czech Republic, Hungary, Poland, Slovakia, and Slovenia) and the European Union (EU-15) countries during the pre-enlargement years 1995-2003. We distinguish between one-way exports and imports, and two-way successful and unsuccessful price and quality competition in agro-food trade between the CEC-5 and the EU-15. The effect of trade balance on trade competition is found more significant than the effect of export-import unit values difference. Natural and human factor endowments increase price competition and reduce unsuccessful quality competition. Higher level of economic development reduces quality competition, whereas the size of the economy reduces price competition and increases quality competition. Agricultural labor productivity improves price and quality competition. Less quality differentiated products increase price competition. Research and development (R&D) expenditures improve quality competition.

**Keywords:** competition categories, determinants, agro-food trade, Central and Eastern Europe, European Union.

## 1 INTRODUCTION

The globalization of the economies has encouraged interests on investigation the relationship between a country's trade competitiveness and the role of different factors in strengthening and maintaining competitive advantages, for patterns of trade specialization, catching up and their impacts on economic development. This holds for different economy sectors, including for agro-food products. RAYNOLDS (2004) argued on increasing world trade in certified organic fresh and processed agro-food products employing commodity chains network governance approach shaping product specification and trade globalization.

This paper is motivated to investigate determinants of competition in agro-food trade between the CEC-5 and the EU-15 member countries during the pre-enlargement years 1995-2003. So far there is no any such a study for the countries involved and for agro-food trade. Besides this, this paper contributes to literature in three significant directions. First, this is one of the first study to explain possible determinants of catching up processes in the price and quality trade competition in the matched two-way trade or for the decomposed intra-industry-trade on price and quality competition thus employing the knowledge from intra-industry trade literature (e.g. GRUBEL AND LLOYD, 1975; GREENAWAY et al., 1994; ATURUPANE et al., 1999; FERTÓ, 2005) and from price and quality trade competition literature (e.g. AINGINGER, 1997 and 1998; ULFF AND NIELSEN, 2000). Second, the decomposed intra-industry trade on the price and quality competition categories is explained by supply side (e.g. factor endowments) and demand side factors (e.g. level of incomes or economic development) as well as country specific factors.

Finally, the study has broader relevance also due to the countries coverage during their trade liberalization and agro-food sector restructuring with policy and development implications.

Therefore, in this paper we investigate determinants of price and quality competition in agro-food trade between the CEC-5 and the EU-15 applying combined unit values and trade balance approach to discriminate between price and quality competition in trade, and applying econometrics techniques to identify determinants of trade competition. We first present methodology and data used. After then are presented empirical results on price and quality competition categories for the individual CEC-5 and the econometric results on catching up in agro-food trade competition of the CEC-5 with the EU-15. Finally, the paper derives policy implications of relevance for agro-food sector development, agro-food trade business and for policy makers with open question for future research.

## 2 METHODOLOGY AND DATA USED

We distinguish between one-way exports and imports, and two-way successful and unsuccessful price and quality competition in agro-food trade between the CEC-5 and the EU-15. The focus is on trade competition categories and the determinants in catching up process in price and quality competition in two-way trade. We combine intra-industry trade literature (GREENAWAY et al., 1994) with price and quality competition literature (e.g. AIGINGER, 1997; ULFF AND NIELSEN, 2000). Unit values of exports and imports by products have been used for assessing product quality. The unit export-import value difference and the trade balance by product have been used to categorize matched two-way trade flows in four competition categories (e.g. GEHLHAR AND PICK, 2002; BOJNEC AND FERTŐ, 2007a and 2007b):

Category 1.  $TB_{(i,j)} > 0$  (or  $V_{(i,j)}^x > V_{(i,j)}^m$ ) and  $UVD_{(i,j)} < 0$  (or  $UV_{(i,j)}^x < UV_{(i,j)}^m$ )

Category 2.  $TB_{(i,j)} < 0$  (or  $V_{(i,j)}^x < V_{(i,j)}^m$ ) and  $UVD_{(i,j)} > 0$  (or  $UV_{(i,j)}^x > UV_{(i,j)}^m$ )

Category 3.  $TB_{(i,j)} > 0$  (or  $V_{(i,j)}^x > V_{(i,j)}^m$ ) and  $UVD_{(i,j)} > 0$  (or  $UV_{(i,j)}^x > UV_{(i,j)}^m$ )

Category 4.  $TB_{(i,j)} < 0$  (or  $V_{(i,j)}^x < V_{(i,j)}^m$ ) and  $UVD_{(i,j)} < 0$  (or  $UV_{(i,j)}^x < UV_{(i,j)}^m$ )

where the trade balance ( $TB_{(i,j)}$ ) is calculated as  $TB_{(i,j)} = V_{(i,j)}^x - V_{(i,j)}^m$ , where  $V_{(i,j)}^x$  is the value of the  $i$ -th product exports from a home (domestic) country (in our case individual CEE-5) to the  $j$ -th partner country (in our case EU-15) and  $V_{(i,j)}^m$  is the value of the  $i$ -th product imports to the home country from the  $j$ -th partner country. The unit value difference ( $UVD_{(i,j)}$ ) is calculated as  $UVD_{(i,j)} = UV_{(i,j)}^x - UV_{(i,j)}^m$  where  $UV_{(i,j)}^x$  is the export unit value, which is calculated as  $UV_{(i,j)}^x = V_{(i,j)}^x / Q_{(i,j)}^x$  and  $UV_{(i,j)}^m$  is the import unit value, which is calculated as  $UV_{(i,j)}^m = V_{(i,j)}^m / Q_{(i,j)}^m$ . In these calculations,  $Q_{(i,j)}^x$  and  $Q_{(i,j)}^m$  are quantities of exports and imports, respectively, between the home country  $i$  and the partner country  $j$ . Trade balances indicate successful or unsuccessful competition in trade, and export-import unit values determine price or quality competition. The four competition categories (Categories from 1 to 4) are applied only on the *two-way* trade flows satisfying the simultaneous conditions of the unit value difference and the trade balance by product. In

the two-way trade flows, in the first and third categories the home country  $i$  is successful in price competition (trade surplus at lower export than import unit value) and in quality competition (trade surplus at higher export than import unit value), respectively, and vice versa in the second and fourth categories, where the home country is unsuccessful in price competition (trade deficit at higher export than import unit value) and in quality competition (trade deficit at lower export than import unit value).

We employ econometric analysis to investigate determinants of trade competition behind of different catching up processes in agro-food trade. First, we focus on the causality between the competition category and the basic elements of competition category classification, thus we specify the following estimating equation:

$$\text{Category}_{it} = \alpha_0 + \alpha_1 \text{UVD}_{it} + \alpha_2 \text{TB}_{it} + \varepsilon_{it}, \quad i=1, \dots, 4, t=1995, \dots, 2003 \quad (1),$$

where  $\text{Category}_{it}$  is the share of category  $i$  in total matched two-way agro-food trade,  $\text{UVD}_{it}$  the average difference between export unit values and import unit values and  $\text{TB}_{it}$  is the sum of trade balance in category  $i$  and  $t$  is time.

The differences between values of exports and imports and export and import unit values respectively, may hide some information in the dynamics of trade flows and trade competition categories. Thus in the second stage, we divide both previous explanatory variables into further two elements. Consequently, we estimate the following model of the four competition categories:

$$\text{Category}_{it} = \alpha_0 + \alpha_1 \text{UV}_{it}^x + \alpha_2 \text{UV}_{it}^m + \alpha_3 \text{V}_{it}^x + \alpha_4 \text{V}_{it}^m + \varepsilon_{it}, \quad i=1, \dots, 4, t=1995, \dots, 2003 \quad (2),$$

where  $\text{UV}_{it}^x$  is the average export unit values,  $\text{UV}_{it}^m$  is the average import unit values,  $\text{V}_{it}^x$  is the value of exports and  $\text{V}_{it}^m$  is the value of imports in category  $i$  and  $t$  is time.

In the third step we focus on economic drivers of catching up process in agro-food trade competition. We employ insights from international trade theory to identify the economic factors to explain the different paths of catching up process in agro-food trade competition. We estimate the following model of the four competition categories:

$$\text{Category}_{it} = \alpha_0 + \alpha_1 \text{LANDCAP}_{it} + \alpha_2 \text{GDPCAP}_{it} + \alpha_3 \text{EDUC}_{it} + \alpha_4 \text{GDP}_{it} + \alpha_5 \text{AGLABPROD}_{it} + \alpha_6 \text{HIIT}_{it} + \alpha_7 \text{RD}_{it} + \alpha_8 \text{COUNTRY}_i + \varepsilon_{it}, \quad i=1, \dots, 4, t=1995, \dots, 2003 \quad (3),$$

where  $\text{LANCDAP}$  is the arable land per capita which is a proxy for natural factor endowment and  $\text{EDUC}$  is a proxy for human capital endowment. Gross domestic product (GDP) is a proxy for the market size.  $\text{GDPCAP}$  is the per capita GDP which is also a general proxy for the factor endowment. But it is also possible to use as a proxy for economic development. We expect that the variables of factor endowments ( $\text{LANDCAP}$ ,  $\text{GDPCAP}$ , and  $\text{EDUC}$ ) are positively associated with successful price competition (category 1) and unsuccessful quality competition (category 4), whereas negatively associated with unsuccessful price competition (category 2) and successful quality competition (category 3). On the other hand, we expect opposite associations between the market sizes (GDP) and the shares of competition trade categories.  $\text{AGLABPROD}$  is the labor productivity in agriculture, which causes production efficiency in agriculture, but might have mixed impacts on price and quality competition in agro-food trade.  $\text{HIIT}$  is a proxy for quality differentiated trade, which might also influence trade competition in both

directions. RD is the total intramural research and development (R&D) expenditure in agricultural sciences. Similarly as in the case of the market size, we expect that the increase of expenditures for R&D leads to technological advancement (e.g. DULLECK et al., 2005) and thus has negative impacts on successful price competition (category 1) and unsuccessful quality competition (category 4), but has positive impacts on unsuccessful price competition (category 2) and particularly on successful quality competition (category 3). Finally, in order to control the country specific effects we use country dummies (COUNTRY), which are due to differences in the size of the agricultural sector, differences in the size of the countries, and differences in factor endowments. The country dummies control other variables in our model.

We undertake a panel data analysis using fixed effects (FE) and random effects (RA) regressions employing generalized least squares, maximum-likelihood and generalized estimating equation approaches. The Hausman test is used to check the general specification of the model (e.g. BALTAGI, 1995).

The agro-food trade competition categories are analyzed using detailed trade data from OECD for the years 1995-2003. The agro-food trade is defined by EU-COMMISSION (1999). This trade data sample consists of 255 items at four-digit level in the Standard International Trade Classification (SITC) system. From this dataset are calculated trade competition categories as the dependent variable  $Category_{it}$ , which measures the share of a category  $i$  in total matched two-way agro-food trade. Moreover, from this trade dataset are taken or calculated the explanatory variables, which are specified in equations (1) and (2): the value of exports ( $V_{it}^x$ ) and the value of imports in category  $i$  ( $V_{it}^m$ ), the average export unit values ( $UV_{it}^x$ ) and the average import unit values ( $UV_{it}^m$ ), the average difference between export unit values and import unit values ( $UVD_{it}$ ), and the sum of trade balance in category  $i$  ( $TB_{it}$ ). Yet, from this trade database are also calculated the weighted price/quality gap indicator (PGAP) and the horizontal intra-industry trade (HIIT) variable, which are used in equation (3). The PGAP is defined as:

$$PGAP = \sum \left( \frac{p_{j,i}}{p_{EU,i}} \right) sx_{j,i} ,$$

where  $j$  is country and  $i$  is the product belonging to agriculture.  $p_{j,i}$  is the price at which country  $j$  sells exports of the product  $i$  on EU markets;  $p_{EU,i}$  is the average price of product  $i$  in total EU imports;  $sx_{j,i}$  is the share of product  $i$  in country  $j$ 's exports to the EU. The HIIT variable is a proxy for quality differentiated trade and is defined as a dummy variable, which takes value one if holds  $0.75 \leq PGAP \leq 1.25$  and zero otherwise (FERRAGINA AND PASTORE, 2005).

The data for the other explanatory variables specified in equation (3) are collected from various data sources. The LANCDAP variable is the arable land per capita which is a proxy for natural factor endowment. It is defined as arable land per capita in 1000 hectare. The data source is the Food and Agricultural Organization of the United Nations (FAO) at its website FAOSTAT <http://www.fao.org>. The EDUC variable is a proxy for human capital endowment. It is defined as the share of student of tertiary education in the total students by ISCED level. The data source is Eurostat at its website

<http://epp.eurostat.ec.europa.eu>. The gross domestic product (GDP) measures the size of the economy and is defined as total GDP in billions of 1990 US\$ (converted at Geary Khamis PPPs). The data source is the Groningen Growth and Development Centre and the Conference Board in its Total Economy Database at the website <http://www.ggdc.net>. The GDP per capita (GDPCAP) is also a general proxy for the factor endowment. But it is also possible to use as a proxy for economic development. The GDPCAP is expressed in 1990 thousands US\$ (converted at Geary Khamis PPPs). The data source is the Groningen Growth and Development Centre and the Conference Board in its Total Economy Database at the website <http://www.ggdc.net>. The labor productivity in agriculture (AGLABPROD) is defined as labor productivity per person engaged in agriculture as volume indices (1995 = 100). The source of data is the Groningen Growth and Development Centre's the 60-Industry Database at the website <http://www.ggdc.net> and O'MAHONY AND VAN ARK (2003). The total intramural R&D expenditure in agricultural sciences (RD) variable is expressed in millions of Euro, which is deflated by consumer price index. The source of data is Eurostat on its website <http://epp.eurostat.ec.europa.eu>. Finally, in order to control the country specific effects we use four country dummy variables (COUNTRY) for the Czech Republic, Hungary, Poland and Slovakia.

### 3 EMPIRICAL RESULTS

The descriptive analysis suggests different patterns in the catching up processes in agro-food trade competition of CEC-5 with the EU-15 (Table 1). The one-way agro-food trade between CEC-5 and the EU-15 is less important than two-way trade. Almost all one-way agro-food trade in the case of the Czech Republic and Slovenia are imports. Close to this development patterns is also Hungary. On the other hand, Poland and Slovakia significantly increased one-way exports to the EU-15 countries, but more than 83 percent of the one-way agro-food trade remains imports.

The majority of agro-food trade between the CEC-5 and the EU-15 are two-way trade flows. These flows are increasing further for the Czech Republic, Poland, Slovakia and Slovenia. This development pattern is consistent with trade theory suggesting that trade liberalization and growth of real incomes lead to the increase in matched two-way intra-industry trade. The share of the two-way trade is the highest for Hungary, but it deteriorated slightly over the analyzed period.

**Table 1: Trade competition categories for Central European countries on the EU-15 markets (in %)**

	Czech Republic				Hungary				Poland				Slovakia				Slovenia			
	1995	2003	mean	SDV	1995	2003	Mean	SDV	1995	2003	Mean	SDV	1995	2003	Mean	SDV	1995	2003	mean	SDV
One-way	11.2	3.4	7.2	2.9	1.5	3.1	2.6	0.7	4.6	3.2	5.5	2.9	20.9	15.5	17.6	3.3	19.8	13.2	15.3	3.5
Exports	0.0	1.0	1.0	0.8	4.4	0.3	7.3	7.9	9.5	16.3	18.2	7.1	8.7	16.6	16.7	10.8	0.4	0.5	0.2	0.1
Imports	100.0	99.0	99.0	0.8	95.6	99.7	92.7	7.9	90.5	83.7	81.8	7.1	91.3	83.4	83.3	10.8	99.6	99.5	99.8	0.1
Two-way	88.8	96.6	92.8	2.9	98.5	96.9	97.4	0.7	95.4	96.8	94.5	2.9	79.1	84.5	82.4	3.3	80.2	86.8	84.7	3.5
Category1	39.3	23.0	28.6	5.1	28.6	30.6	32.9	3.9	30.1	31.2	27.9	3.1	38.4	39.7	38.4	3.9	14.1	17.6	17.6	2.8
Category2	15.7	34.7	25.9	6.0	9.4	10.0	10.1	1.4	18.8	20.4	22.4	3.0	26.8	33.6	25.8	6.6	37.3	34.6	36.3	4.8
Category3	6.3	16.5	13.6	3.5	42.5	44.2	41.0	2.8	21.2	27.4	21.2	5.4	3.0	6.7	4.8	6.0	9.1	8.2	6.3	2.4

Note: “Mean” means the mean value for the analyzed years 1995-2003. SDV means standard deviation.  
 Source: Own calculations based on data of OECD.

In the structure of two-way trade by the competition categories, for the Czech Republic there is seen a shift from successful price competition (category 1) to unsuccessful price competition (category 2) and from unsuccessful quality competition (category 4) to successful quality competition (category 3). The initial relatively high proportion of successful price competition has not been sustainable with trade liberalization and increases of some input prices, whereas the increase in successful quality competition can be explained by improvements in agro-food quality competitiveness.

Hungary has experienced greater stability in the shares of individual four competition categories. The successful quality competition (category 3) is the most significant single competition category and increased further over time. The successful price competition (category 1) is the second most significant single competition category and also increased slightly. The successful quality and successful price competition account for three-fourth of the matched two-way Hungarian agro-food trade with the EU-15. The unsuccessful price competition (category 2) remains at similar levels, whereas the unsuccessful quality competition (category 4) has declined. Therefore, Hungary has been made some catching up in agro-food trade competition with the EU-15, particularly in successful quality competition.

Poland experienced a slight increase in successful price competition (category 1) and more substantial improvements in successful quality competition (category 3) and reductions in unsuccessful quality competition (category 4). There has been found a slight increase in unsuccessful price competition (category 2).

Slovak agro-food trade with the EU-15 has been concentrated on price competition with a slight increase in the successful price competition (category 1), which is the most important single competition category in the two-way matched agro-food trade flows with the EU-15. The importance of the unsuccessful price competition (category 2) has increased, but has been reduced the importance of the unsuccessful quality competition (category 4). In spite of the relatively low proportion of the successful quality competition (category 3), its increases indicates some quality improvements in the Slovakian agro-food trade with the EU-15.

The evidence for Slovenia suggests relatively a high degree of both the unsuccessful quality competition (category 4), which remains at a similar level, and the unsuccessful price competition (category 2), where some improvements have been found as it has declined, but takes still important proportion. There has been found a slight improvement in the successful price competition (category 1), but deterioration is in already low proportion of the successful quality competition (category 3). This evidence indicates that Slovenian agro-food trade has had both difficulties in price and quality competition in the EU-15 markets, but it seems that these difficulties in the catching up processes have been even more substantial in the case of quality competition than in the case of price competition.



Moreover, we present our econometric results in three steps. First, we focus on the basic elements of competition category share in two-way matched agro-food trade estimating equation (1) of the competition category share  $i$  ( $\text{Category}_{it}$ ) in total two-way agro-food trade as a function of the average difference between export unit values and import unit values ( $\text{UVD}_{it}$ ) and the sum of trade balance in the each competition category  $i$  and time  $t$  ( $\text{TB}_{it}$ ) over the analyzed years. The Hausman test is used to check the general specification of the model, which rejects the fixed effects (FE) model specification. Due to this, we employ random effects (RE) panel models (Table 2).

**Table 2: Trade competition catching up in Central European agriculture (dependent variable  $\text{Category}_{it}$ , tested equation 1)**

	Category 1	Category 2	Category 3	Category 4
Unit value difference (UVD)	-0.004	-0.002	-0.003	0.016**
Trade balance (TB)	0.217***	-0.381***	0.368***	-0.025
Constant	0.201***	0.140***	0.090***	0.322***
$R^2$	0.0584	0.0083	0.8735	0.1131
Number of observations	45	45	45	45

Note: \* stands for significance at the 10% level ( $p\text{-value} < 0.1$ ); \*\* significance at the 5% level ( $p\text{-value} \leq 0.05$ ); \*\*\* significance at the 1% level ( $p\text{-value} \leq 0.01$ ).

Our econometric results suggest that the net trade flows play an important role in the growth of the share in price and quality competition, but the changes in export and import unit values have, except of unsuccessful quality competition, no significant effect on them. The growing trade balance leads to a decreasing share of unsuccessful price competition. The increasing unit value difference yields a larger share of unsuccessful quality competition.

Second, we focus on the differences between exports and imports in trade balance and export and import unit values, respectively, to identify determinants of the dynamics of trade competition. We estimate the model of trade competition categories with four explanatory variables: the average export unit values ( $\text{UV}^x_{it}$ ), the average import unit values ( $\text{UV}^m_{it}$ ), the export values ( $\text{V}^x_{it}$ ) and the import values ( $\text{V}^m_{it}$ ) in competition category  $i$  and  $t$  is time. The Hausman test is used to check the general specification of the model, which again rejects the fixed effects (FE) model specification. Thus we employ random effects (RE) panel models (Table 3).

**Table 3: Trade competition catching up in Central European agriculture (dependent variable  $\text{Category}_{it}$ , tested equation 2)**

	Category 1	Category 2	Category 3	Category 4
Export unit value ( $\text{UV}^x$ )	0.006	-0.007	-0.002	0.021

Import unit value ( $UV^m$ )	0.001	0.040*	-0.002	-0.017*
Export values ( $V^x$ )	0.270***	-0.174	0.585***	-3.059***
Import values ( $V^m$ )	-1.790***	0.024	-0.904***	0.534***
Constant	0.259***	0.192***	0.060***	0.339***
$R^2$	0.2069	0.0625	0.8873	0.4846
Number of observations	45	45	45	45

Note: \* stands for significance at the 10% level (p-value < 0.1); \*\* significance at the 5% level (p-value  $\leq$  0.05); \*\*\* significance at the 1% level (p-value  $\leq$  0.01).

The estimations reinforce some aspects of previous results for tested equation (1). The export and import values have significant effects on the share of successful price and successful quality competition. The high import values negatively influenced the share of successful price and successful quality competition. The positive effects of export values are greater than negative effects of import values, thus trade balance have a positive effects on both categories. Interestingly, the trade balance has a significant effect for unsuccessful price competition, but the coefficients of export and import values are not significant. The unsuccessful quality competition is the opposite case, both export and import values are highly significant: the increase of exports leads to a lower share of unsuccessful quality competition, and the growing imports contribute the higher share of unsuccessful quality competition. Surprisingly, increasing import unit values have positive effect on the share of unsuccessful price competition, whilst it influences negatively the share of unsuccessful quality competition. In sum, the price effects (unit values) are less important than trade flow effects indicating a less successful price or quality competition catching up development.

Third, we focus on economic drivers of trade competition catching up processes to explain the different paths of price and quality trade competition catching up processes. We estimate the model as specified in equation (3) using variables of natural, human and other factor endowments, economic development, labor productivity in agriculture, quality differentiated trade, and country specific effects. The Hausman test is used to check the general specification of the model, which again rejects the fixed effects (FE) model specification. Thus we employ random effects (RE) panel models that have been estimated employing generalized least squares, maximum-likelihood and generalized estimating equation approaches. We found the more robust results with the last generalized estimating equation approaches method, which results are reported in Table 4.

**Table 4: Drivers of trade competition catching-up process in Central European agriculture (dependent variable  $Category_{it}$ , tested equation 3).**

	Category 1	Category 2	Category 3	Category 4
Arable land per capita (LANDCAP)	8.958**	12.014	-7.163**	-14.577
GDP per capita (GDPCAP)	-0.006	0.007	-0.020*	0.001

Education (EDUC)	1.066***	0.029	-0.349	-0.893**
Size of GDP (GDP)	-1.044***	-0.319	1.71***	-0.001
Agricultural productivity (AGLABPROD)	0.179**	-0.014	0.204*	-0.040
Quality differentiated trade (HIIT)	0.001	0.045***	-0.039	0.027
R&D expenditure (RD)	-0.002	0.001	0.001**	0.001
Czech Republic	0.237***	-0.204***	0.307***	-0.183***
Hungary	0.218***	-0.053*	-0.281***	-0.097
Poland	0.449***	-0.007	0.011	-0.069***
Slovakia	0.250***	0.096***	-0.074***	0.081***
Constant	0.092*	0.164*	0.166**	0.465***
Wald chi2(3)	646.91	16.73	38.65	5.59
Number of observations	45	45	45	45

Note: \* stands for significance at the 10% level (p-value < 0.1); \*\* significance at the 5% level (p-value ≤ 0.05); \*\*\* significance at the 1% level (p-value ≤ 0.01).

We found that arable land per capita significantly increases the share of successful price competition and decreases the share of successful quality competition. The successful quality competition is also reduced by GDP per capita. Level of education increases successful price competition and reduces unsuccessful quality competition. The size of the economy reduces successful price competition and increases successful quality competition. Agricultural labour productivity increases successful price and successful quality competition. Less quality differentiated trade increases unsuccessful price competition. R&D expenditures increase successful quality competition. Variations are found also across countries. Finally, the paper derives policy implications of relevance for agro-food trade business and for policy makers with some open questions for future research.

#### 4 CONCLUSIONS

The determinants of price and quality competition in agro-food trade between the CEC-5 and the EU-15 have been investigated during the pre-enlargement years. The unit values and trade balances have been used to differentiate between price and quality trade competition and the determinants of trade competition have been tested. We have found mixed results by individual CEC-5, which indicates differences in agro-food trade competitiveness. The Czech Republic and Slovakia have made catching up in successful quality competition, but not in successful price competition. The quality competition improvements, where trade surplus have been achieved at high prices, indicates an improvements in quality advantages arising from investments in R&D, new technology improvements and food industry restructuring and improvements. Hungary and Poland have also made catching up in successful quality competition, but in a lesser extent also in successful price competition, where trade surplus have been achieved at low price related to natural factor endowments such as arable land per capita. Only Slovenia has not made

any significant catching up in successful quality competition, but only to a lesser extent in successful price competition. This implies a need for agro-food sector restructuring to improve price and quality trade competition.

We have found that the net trade balance play an important role for the significance in price and quality competition. The separate export and import values have found to have significant effects on the significance of price and quality trade competition as well. The significance of the effects of the export-import unit values difference on price and quality trade competition is less than the trade balance effect indicating a modest price and/or quality trade competition catching up development of the CEE-5 agro-food trade with the EU-15 markets. It has been identified that natural (arable land per capita) and human (education) factor endowments increase the share of successful price competition. The endowed natural factor endowments are important for crop production, which is reducing the importance of successful quality competition with trade surplus at high price. The availability of human capital is important for production and economic efficiency thus enabling potentials for quality advantages reducing unsuccessful quality competition and increasing trade surpluses at low price. The importance of successful quality competition is also reduced by the level of economic development measured by GDP per capita indicating CEC-5 agro-food supply side adjustments from exports towards increasing domestic consumers' demands for higher-quality products caused by increasing domestic incomes. The larger size of the economy reduces trade surplus at low price (successful price competition) and increases trade surplus at high price (successful quality competition). According to the size of GDP, the biggest CEC-5 in our sample is Poland, followed by the Czech Republic and Hungary. The smallest is Slovenia, which is also the most developed according to the GDP per capita. Agricultural labor productivity improves trade surplus at low price (successful price competition) and trade surplus at high price (successful quality competition). Therefore, an important trade business competition and development objective in the CEC-5 agro-food sector should be improvements of agricultural labor productivity pertained to fewer, but more educated, innovative and productive labor. Trade in similar, less quality differentiated products increases trade deficit at high price (unsuccessful price competition), which arises due to consumers' demands for diversified products and thus causes market segmentation in similar products. It has been expected that R&D expenditures lead to innovation improvements and quality advantages and thus to agro-food trade surplus at high price (successful quality competition). Although the CEC-5 agro-food sectors are geographically situated in a similar region, there are significant differences and variations across CEC-5 in determinants of agro-food trade competition with the EU-15 markets. Finally, it is worth mentioning that we have not found significant role of foreign direct investments (FDIs) on price and quality competition in agro-food trade of CEC-5 with the EU-15. This suggests that FDIs, which have been important in agro-food sectors in the CEC-5, particularly in Hungary, Poland and the Czech Republic, have not been targeting the EU-15 markets, but during the CEC-5 adjustments to the EU membership, they seem to be focused on domestic CEC-5 markets or other non EU-15 markets (see also HELPMAN et al., 2004). This is an issue for future research, including the possible shifts and changes in trade competition that might have occurred after the CEC-5 accession into the EU.

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