Agri-food exports in the enlarged European Union

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Abstract: This paper explores the agri-food export dynamics in the New Member States and the Old Member States of the European Union during the enlargement process. The analysis relies on two different approaches based on the similarity and the sophistication indices of exported goods using a disaggregation at 95 items. The analysis shows that different and somehow divergent paths are in place. On the one side, the Czech Republic and Poland are involved in a quality catching up process and increase their competitiveness. On the other side, Bulgaria and Romania seem to be still trapped in the low-quality segment of the agri-food market with a decreasing competitiveness performance in the richest segment of the European market.

Key words: agri-food sector, EU enlargement, trade similarity, export sophistication

The economic integration of the Central and Eastern European countries into the European Union (EU) has been a great challenge for both the Old Member States (OMS) and the New Member States (NMS) from many points of view.

According to the standard comparative advantage setting of the Hecksher-Ohlin model, a potential outcome of the integration process could be a deeper specialization pattern in labour intensive, low value added sectors for the NMS and a simultaneous increase in imports of high value added goods from the OMS (Rollo 1995). Nonetheless, Baldwin et al. (1997) have emphasized that, under specific conditions, the enlargement process could lead to much greater economic net benefits for both New and Old Member States. In particular, they have pointed out some key elements that could give a positive impulse to a virtuous circle, such as an open, integrated capital market, the mutual recognition of health, safety, and environmental standards for production processes and consumer goods, the adoption of a common competition policy and a common state aid policy, and finally, the removal of border controls. If these conditions are complied with, the economic integration process may foster international relationships, increasing domestic productivity and economic growth.

In such a context, Crozet et al. (2009) have emphasized the role of quality in systematically affecting the direction of international trade with regard to both the capacity of domestic firms with a higher quality performance to break into foreign markets and the overall higher demand for high-quality products from richer countries.

To this purpose, in order to analyse the role of quality in export flows of the agri-food sector before and after the enlargement, in a time period from 1996–1997 to 2006–2007, we rely on two well-established empirical approaches, namely the trade similarity indices and the more recent sophistication indices, which provide a complementary information on different trade aspects. In order to synthesize such informative content and to obtain deeper insights, we also propose to merge the results coming from the two methodologies in a quite original way. In a nutshell, the combination of the similarity and sophistication analyses highlights in which specific market segments there is an effective trade similarity convergence and also whether for these agri-food items there is a higher degree of sophistication.

The agricultural sector provides a relevant case study since it is still important in the terms of value added and employment share in the NMS. Second, this sector faced relatively stronger and earlier reforms during the accession process in the 1990s (Hartell and Swinnen 1998). Third, the EU agri-food market has been much more protected from the international competition than other sectors. Finally, the combination of a strong financial support from the Common Agricultural Policy (CAP) and strict requirements in food safety standards is bringing about substantial and rapid changes in the whole sector (Swinnen 1994; Tangermann and Josling 1994; Tangermann and Banse 2000).

TRADE EFFECTS OF THE ENLARGEMENT PROCESS

Among the past empirical contributions on trade effects related to the enlargement process, Egger et al. (2007) find robust results in favour of a significant integration and convergence in behaviour in the East-West relationships, whereas the intra-East trade is far from converging to the Western standards. Generally speaking, there are two opposing forces affecting the production and export performances in the NMS: the first one relates to a competition effect dominated by relatively lower wage costs in the NMS; the second one consists of an overall increasing price level in the NMS markets due to a generalized demand effect (Forslid et al. 2002).

A specific emphasis on quality upgrading can be found in Dulleck et al. (2005), where the authors try to highlight the export dynamics not only by comparing different sectors, but also by examining what happened inside each single sector, with a focus on the market segment covered by the NMS in the terms of high or low quality products.

If the enlargement process fosters productivity gains for the NMS and these productivity gains are converted into a quality improvement process, the export performance will also be positively influenced since richer countries are more likely to have a greater demand for high-quality products (Hallak 2006). There may therefore be a double effect for the new EU countries: domestic productivity gains due to the enlargement of the final destination market may encourage export competitiveness at the general level (Mayer and Ottaviano 2008), while the demand for high quality products from the old EU members may move the export specialization patterns towards a quality improvement process (Shott 2004; Damijan et al. 2009).

To some extent, such a complexity of the driving forces influencing trade patterns in the EU countries explains, at least partially, the heterogeneity of empirical findings (Hertel et al. 1997; Jakab et al. 2001; Nahuis 2004), and suggests that a sector-based analysis could be a powerful tool to better investigate trade patterns. A sector-specific approach may reveal divergent trends within the agri-food sector, especially when the quality improvement process is relevant (De Benedictis and Tajoli 2007a, b). As emphasized by Damijan and Kostevc (2006), there is a mixed evidence on this point and each sector presents specific features depending on the domestic firms' behaviours and endowments and, more generally, on the market structures in the EU.

Focusing specifically on the agri-food sector, Božík (2011) emphasizes in a simulation approach the potential impacts of the CAP after 2013 on Slovak agriculture, where divergent behaviours of business units emerge according to the different support scheme and market conditions. When a specific trade analysis is carried (Gálik 2011), the Slovak Republic seems to be negatively affected by the enlargement process, since the negative trade balance of the agri-food trade has been permanently deepened after 2004.

In this paper we are interested in covering two main shortcomings of the existing literature on the agri-food trade patterns of the NMS during the enlargement process. First, empirical analyses on this topic only consider the trade dynamics and quality upgrading separately. Second, most empirical studies focus on single countries instead of providing a systematic cross-country comparison.

To this end, our specific contribution is to develop a methodological approach that combines the information on two distinct aspects: (i) the potential convergence in the agri-food sector of trade patterns between the NMS and OMS; (ii) the quality upgrading process of export flows of the former countries with respect to the latter ones.

This combination offers a key to highlight which specific segments feature the trade similarity convergence and also if they actually reveal a higher degree of sophistication. In particular, we are interested in two complementary issues. The first one regards to what extent the EU enlargement process has fostered a similarity of the NMS export flows compared with the OMS export structure up to now. The second issue regards to what extent the NMS exports are catching up with the quality upgrading process that characterizes the agri-food trade in richer countries.

We are aware that several country-specific features may influence the trade patterns of the NMS, but this is beyond the scope of this paper. In this work, we only provide a descriptive analysis of export patterns, with no investigation on the driving forces influencing it, which could be the objective of a further research.

DATASET AND METHODOLOGIES

The dataset

In order to calculate both sophistication and similarity indices, we collected trade volumes from the United Nations COMTRADE database that counts approximately 700 items for the agri-food sector in the Harmonized Standard 6 digit classification (chapters 01-24). The 6 digit items have been then aggregated into 95 export headings, in order to investigate the

agri-food exports in a sector-based approach rather than in a pure accounting approach.[1]

In order to compute sophistication indices, GDP per capita values from the *World Development Indicators* dataset of the World Bank, expressed at constant 2005 PPP international $, have been used.

Given our interest in the enlargement process, we have considered two reference periods (1996–1997 and 2006–2007), comparing the data before and after the EU access of the NMS. All values for both export flows and GDP per capita are calculated as a two-year average value in order to reduce the potential biases arising from statistical problems and/or conjectural features rather than the structural conditions.

For the sophistication measure, we have selected 76 countries according to the available data, representing about 90% of world agri-food trade.

As for the similarity indices, in order to catch a satisfactory heterogeneity in the countries' behaviour, as declaring countries we have focused on five NMS (Bulgaria, the Czech Republic, Hungary, Poland, Romania), as they differ in size, per capita GDP, the importance of the agri-food sector, time pattern of the integration in the EU. The bilateral trade similarity values have been calculated between each NMS as well as between each NMS and six OMS (France, Germany, Italy, the Netherlands, Spain, the United Kingdom), selected on the basis of their relative magnitude in the European agri-food market. We have considered as the final destination markets the aggregate of all NMS (EU12), the OMS as the EU pre-enlargement market (EU15), and the rest of the world (extra-EU). Such disaggregation is crucial in understanding the role played by the final demand in enhancing the quality content of the NMS export flows, assuming that the EU15 market represents the demand for high-quality products by richer countries.

The sophistication approach

Export sophistication is defined as the content of an exported good in terms of technology, design, quality, branding, economies of scale and any other factors of differentiation affecting its value. Other things being equal, the more a country is specialized in producing and exporting "sophisticated" products, the higher its GDP per capita. Hence, sophistication can be indirectly measured by the GDP per capita of exporting countries, through the so-called PRODY index (Lall et al. 2006; Hausmann et al. 2007). A PRODY index is associated to each exported item and it is defined as the weighted average of the GDP per capita of all countries exporting that product, where the weights reflect the revealed comparative advantage of each country in that specific product. The ranking of the exported products obtained by the PRODY index values shows the relative position of goods in terms of sophistication at the world level.

We calculate the PRODY index following Hausmann et al. (2007):

$$PRODY_i = \sum_j s_j GDP_j \quad (1)$$

where products are indexed by i ($\forall i = [1, N]$) and countries are indexed by j ($\forall j = [1, M]$); s_{ij} represents the weighting factor of the per capita GDP of each country j exporting the i-th product and is expressed as:

$$s_{ij} = \frac{RCA_{ij}}{\sum_j RCA_{ij}} \quad (2)$$

where the Revealed Comparative Advantage (RCA) is given by the Balassa index (Balassa 1965).

The underlying idea is that countries with a higher GDP per capita reached this goal because they were capable of producing goods with highly remunerative attributes that are progressively gaining advantage in the international markets thanks to their differentiation and distinctive quality. In other words, the sophistication level associated with an exported good gives an indirect information on the type of competition that each specific good has to deal with in international markets (Lall et al. 2006).[2]

In order to assess a country specific specialization pattern in terms of exports sophistication, Hausmann et al. (2007) propose an EXPY index associated to each exporting country. The EXPY is the weighted average of the PRODY of all the exported items of a country, where export specialization values are taken as weights. The value of the EXPY for each j-th country is given by the following equation:

$$EXPI_j = \sum_i \frac{X_j}{X_j} PRODY_i \quad (3)$$

where X_{ij} is the export flow in item i for country j and X_j represents the total export flows at the country level.

[1]United Nations Commodity Trade Statistics Database available at http://comtrade.un.org

[2]Clearly, this index does not cover all the possible factors influencing export performance of each good, since it also depends on the intrinsic nature of the good itself and on other localization factors. This is particularly true for the agri-food sector, in which localization factors linked to natural endowments are crucial to explain comparative advantages and export flows performance.

While in its original form, the EXPY is built upon the whole range of traded goods of a country, the recent contributions have emphasized the usefulness of such indices for the selected sectors as well (Minondo 2007; Carbone et al. 2009). Here, we have built a sector-based EXPY which we call $EXPY_{AF}$, that includes only *i-th* PRODY indices associated with the 95 items representing all the agri-food sector (Table A in the Appendix).

Temporal dynamics of these indices may give an additional information. The evolution of the PRODY index reflects changes in the sophistication level of each product. Given Eq. (1), its variation over time can be explained by two distinguished effects. First, it can change according to the variation in the GDP per capita of the exporting countries. Second, it may reflect the delocalization processes due to changes in specialization patterns. These changes reflect, in turn, a different geographical distribution of the export flows. These two effects can be disentangled by computing a PRODY where the GDP values for *j* countries are referred to their initial levels (constant GDP per capita) whereas the other components in Eq. (2) are allowed to vary. By comparing the variation of the PRODY index (full variation) with those obtained using a constant GDP, the residual variation reflects changes in the world specialization pattern (which we refer to as the GEO effect), disentangled from the variation related to the generalized GDP trend (which we refer to as the GDP effect).

Moreover, changes in the EXPY index are calculated according to Lebre de Frejtas and Salvado (2009) whereby the EXPY is related to both the current and the constant PRODY. This allows us to distinguish between changes in the level of the country export sophistication due to a change in the respective PRODY values and changes due to a modification in the country export specialization pattern (which we refer to as the country specialization effect).

The similarity analysis of export flows

Since the focus of this paper is on the dynamics of export flows in relation to the quality improvement process as well as to absolute levels, we also investigated to what extent the final destinations and the potential competitors act in the international markets.

To this purpose, we use trade indicators that measure the similarity between the export flows of two countries in the same reference market (Grubel and Lloyd 1975; Finger and Kreinin 1979; Kellman and Schroder 1983; Rolli and Zaghini 2002). The use of these indices as an analytical instrument for evaluating exports oriented towards a specific market is based on the idea that the more similar the bundle of goods exported by two countries on a common reference market are, the more likely they become potential competitors. The OMS are typically specialized in high-quality agri-food market segments and therefore, if the analysis shows that the NMS exports converge on the OMS ones taken as benchmark of quality standards, this may be interpreted as a shift towards a quality improvement pattern induced by the trade integration that followed the enlargement process (De Benedictis and Tajoli 2008).

At the general level, similarity increases with the value of the index, but there is no way to establish *a priori* a threshold level above which the export structure of two countries may be defined as similar. Hence, as a commonly adopted rule of thumb, we took the average value of 50% as a reference point for our analysis.

In this work, we use the product similarity index (PSI) that measure the similarity between the export flows of two countries in the same reference market. The PSI is expressed as:

$$PSI_{A,B} = \left\{1 - \left[\left(\sum_{i=1}^{N} |X_{iA} - X_{iB}|\right) \Big/ \left(\sum_{i=1}^{N} (X_{iA} + X_{iB})\right)\right]\right\} \times 100 \quad (4)$$

where X_{iA} and X_{iB} are the export flows of item *i* for countries *A* and *B*, respectively. The PSI varies between 0 and 100 and in the first case, the similarity is null, whereas in the second case, the export flows are identical.

How to combine quality with quantity changes in an export-oriented analysis

In order to provide a more synthetic picture, we developed an original framework to match the similarity and sophistication indices. This is done by ranking the 95 agri-food items here selected on the basis of the PSI values for each bilateral comparison (for each NMS, e.g.: Bulgaria vs. each benchmark country as France, Germany, Italy, the Netherlands, Spain, the UK, on the three distinguished markets, i.e., the EU12, the EU15 and the extra-EU) for the two reference periods. We then sum up all ranking values corresponding to the OMS competitors, resulting in one ranking for each NMS, disaggregated for the three reference markets (SIM_j^{Ω}, for Ω = EU12, EU15, extra-EU). This procedure corresponds to the application of the so-called Borda rule, a quite com-

mon analytical tool when ranking values that should be aggregated.[3]

In this way, we have a single similarity measure for each NMS related to all benchmark countries at the aggregated level disentangled for the 95 items. In order to synthetically compare countries without the item dimension, we have used a Spearman's rank correlation coefficient, calculated for the bilateral comparison of similarity trends in all 95 items (e.g., Bulgaria vs. the Czech Republic, Hungary, Poland, and Romania). The resulting Spearman's $\rho_{jz}^{SIM^{\Omega}}$ is given by:

$$\rho_{jz}^{SIM^{\Omega}} = 1 - \frac{6 \times \sum_{i=1}^{N} \left(r_i^{SIM_j^{\Omega}} - r_i^{SIM_z^{\Omega}} \right)^2}{N \times (N^2 - 1)} \quad (5)$$

where the correlation in similarity between country *j* and country *z* is given by the sum of *N* bilateral comparison of ranking values from the PSI applied to each *i*-th item. The index varies in the range (+1;–1) where higher values represent higher positive correlation.

By applying this aggregation rule, we are able to understand, in a synthetic view, not only the bilateral similarity trend but also the product specialization path for an increasing or decreasing trend of this type. For example, let us assume that two NMS (e.g., the Czech Republic and Poland) show an increasing export similarity on the EU12 market when compared with all OMS in the period analyzed. This result does not help us to understand the qualitative content of the export flows. Hence, we also compare the synthetic index based on the Borda rule in order to perform a bilateral comparison on the EU12 market. If we find significant differences between the two NMS in their $\rho_{jz}^{SIM^{\Omega}}$, the bilateral similarity between the two NMS has decreased during the time span, revealing that it may well be that product specialization of export flows has been differentiated between these two countries, even if they have increased their similarity with the OMS. In other words, this increase in similarity trend comes from different product specialization patterns.

In order to combine the information on similarity and quality, we need to synthesize ranking values for the 95 items calculated according to both similarity and sophistication at country level. In this case, we have computed a Spearman correlation index by working with the aggregated similarity ranking values for each NMS described by Eq. (4), and with the rankings based on the PRODY index that is unique for the world countries as a whole (Eq. (1)). In this way, we can also understand if a similar product specialization is converging or not with the product sophistication.

We obtain a Spearman's $\rho_j^{SS^{\Omega}}$ value aggregating similarity and sophistication for each *j*-th country as follows:

$$\rho_j^{SS^{\Omega}} = 1 - \frac{6 \times \sum_{i=1}^{N} \left(r_i^{SIM_j^{\Omega}} - r_i^{PRODYw} \right)^2}{N \times (N^2 - 1)} \quad (6)$$

where the correlation index for country *j* is given by the sum of *N* bilateral comparison of ranking values from SIM_j^{Ω} index for each market (EU12, EU15, extra-EU) and the global PRODY index at the world level applied to each *i*-th item. Also in this case the index varies in the range (+1; –1) where higher values represent higher positive correlation.

RESULTS

Before going into details on the sophistication and similarity analyses, some broad figures may help to sketch a picture of agri-food sector trade dynamics in these countries at the aggregate level. By comparing the normalized trade balances in the agri-food sector with respect to the total trade, two main issues emerge. First, the agri-food sector shows a quite different pattern with respect to the total trade, revealing that a sector-based approach is highly recommended. Second, within the agri-food sector, trade patterns are highly heterogeneous for the selected NMS, confirming that by comparing the export performance of distinguished countries, we can derive insightful information.

Very broadly, the NMS as a whole are net importers of agri-food products, especially from the extra-EU markets (Figure 1). Hungary, however, is a net exporter of agri-food products in both market areas whereas Poland is a net exporter towards the European market and a net importer from the rest of the world.

Let us now focus on results obtained by first applying the single sets of indicators and then by combining them into a synthetic information. Starting with the sophistication approach, the country specific EXPY values and their variation over time give an overall idea of the world trade competition engaged by each country in the agri-food sector (Tables 1 and 2). The pre-accession values of the country's exports sophistication index show that in a range of 76 countries, the selected NMS were well positioned, being comprised between the 20th and 30th positions, with the only

[3]Note that the top listed items correspond to the lowest values. This is because the smallest quotas correspond to the smallest figures (that are at the top of the ranking).

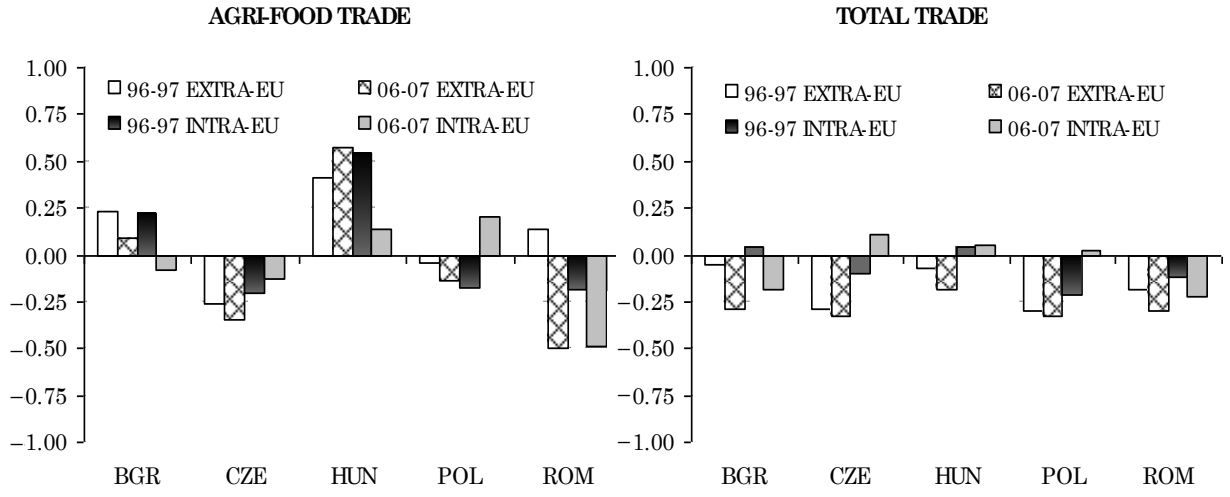

Figure 1. Trade balance for the selected NMS in the agri-food sector and the total trade

Source: own elaboration on the UNCTAD-COMTRADE data

exception of Bulgaria (42th). Looking at the changes over time, despite a general improvement of the index in absolute terms, it is clear at a first sight that a mixed evidence emerges. Hungary and Romania lost many positions and are now ranked 35th and 44th, respectively. Bulgaria is still at the bottom of the distribution, having lost three more positions (now ranked 45th). On the contrary, Poland and the Czech Republic have improved their relative position in the sophistication level of agri-food exports, gaining nine and four positions, respectively.

Regarding the different components of the EXPY, the GDP effect is always positive and similar in magnitude for all the five NMS; the so-called GEO effect is also homogeneous having a generally negative effect among the NMS, though it is less negative for Poland and the Czech Republic, while for Bulgaria, Hungary and Romania, this component had a stronger negative variation.

The country specialization effect is particularly interesting here because its dynamic is less clear. Hungary and Romania increased their export specialization in low sophisticated agri-food goods, as shown by the negative sign associated with this variation component. On the contrary, Poland experienced the largest improvement in terms of specializing in sophisticated agri-food exports, followed by Bulgaria and the Czech Republic.

It is clear from this preliminary picture that Romania and Hungary have lost a number of positions in the sophistication ranking because their agri-food exports are oriented towards goods whose sophistication is decreasing due to the re-localization of production and exports in favour of countries with a lower GDP per capita. Poland and the Czech Republic faced smaller negative GEO effects. In addition, they also succeeded in improving their export specialization towards more sophisticated goods.

Table 1. Trends in the $EXPY_{AF}$ for the agri-food sector (1996–2007)

	$EXPY_{AF}$ 96–97		$EXPY_{AF}$ 06–07		Ranking variation
	US $	ranking	US $	ranking	
Poland	15 005	25	20 067	16	9
Czech Republic	15 082	24	19 812	20	4
Bulgaria	13 628	42	17 427	45	−3
Hungary	15 272	21	18 613	35	−14
Romania	14 794	29	17 465	44	−15

Source: elaborations on the UNCTAD-COMTRADE data

Table 2. Change in the EXPY for the agri-food sector and its components (1996–2007)

	$EXPY_{AF}$ total variation	GDP effect	World GEO effect	Country specialization effect
Bulgaria	24.6	26.9	−6.0	3.7
Czech Republic	27.3	27.2	−3.6	3.7
Hungary	19.8	27.4	−5.9	−1.8
Poland	29.1	26.8	−3.6	5.9
Romania	16.6	27.7	−6.4	−4.7

Source: own elaboration on the UNCTAD-COMTRADE and the WDI (World Bank) data

Major changes in the export product composition of each single country need to be deeply investigated in order to understand which specific goods were mainly responsible for the observed trends. Focusing on the NMS, changes in the export quotas confirm the dynamics observed, with an evident shift from more sophisticated products – as is the case for wine in Bulgaria and livestock products in Hungary and Romania - to less processed and often residual products which are often used as by-products for other production processes such as minor cereals, oilseeds and oilseed panels. The only relevant exceptions are the Czech Republic and Poland that keep their share of sophisticated products in the period considered, such as beer, milk, feedstuff and processed fruits and vegetables, animal products and live animals.

In order to shed light on such divergences in the trade patterns of the NMS, we look at one specific aspect of the enlargement process, related to the greater or lower capacity of the NMS to compete with the OMS in the high-quality segment of the agri-food market.

The PSI values measuring similarity in exports between the selected NMS and OMS and changes over time are reported in Table 3. The PSI trends in the three markets analyzed show a generalized increase in the similarity pattern between the NMS and OMS, even if it mainly regards the EU12 market and, to a lesser extent, the EU15 market, whereas for the extra-EU market, we get a more heterogeneous evidence.

The PSI values reveal that during the enlargement process, there was a significant convergence between the NMS and OMS in the structure of agri-food exports directed towards the European Union market. Conversely, the trends in exports in the extra-EU market seem to be quite heterogeneous with the similarity of exports that decreases in many cases. To some extent, this specific result may be interpreted as a trade diversion from the extra-EU to the intra-EU.

More importantly, it seems that those countries with a higher dynamic performance on the EU15 market (which we have somehow indicated as the most high-quality oriented from the demand side) coincide with the best performers in the EXPY analysis, namely the Czech Republic and Poland. On the contrary, Bulgaria and Romania seem to converge to the export patterns of the OMS, especially in the EU-12 market.

Let us now synthesize the information related to the distinguished approach by applying the methodology proposed in par. 3.4. If we look at the correlation between similarity rankings among all OMS (Table 4), we can notice that, generally speaking, the correlation values are higher for the EU15 market, revealing that we can find the highest and most homogenous

Table 3. Similarity matrix for the PSI

		Germany		Italy		Netherlands		France		Spain		UK	
		1996–1997	2006–2007	1996–1997	2006–2007	1996–1997	2006–2007	1996–1997	2006–2007	1996–1997	2006–2007	1996–1997	2006–2007
Bulgaria	EU12	3.2	7.7	7.8	15.1	3.6	8.0	9.8	24.7	8.5	13.0	4.0	18.7
	EU15	1.9	2.3	2.8	3.9	0.9	1.9	1.3	2.6	2.4	3.2	2.6	4.8
	extra EU	8.4	7.2	11.3	6.3	0.4	3.8	0.2	5.2	15.3	8.5	6.7	6.0
Czech Republic	EU12	19.2	39.7	22.7	36.9	21.8	32.3	32.4	36.5	15.1	23.4	37.8	25.6
	EU15	2.1	8.5	1.5	7.7	1.4	6.3	1.3	7.8	2.0	7.7	3.5	17.9
	extra EU	4.7	8.1	3.6	4.4	3.6	5.2	2.5	4.5	5.3	6.8	4.1	8.1
Hungary	EU12	22.2	28.5	25.5	27.5	20.3	23.1	38.8	37.8	17.7	22.7	27.2	24.0
	EU15	8.0	9.7	9.5	10.5	6.2	6.4	6.8	11.7	9.7	9.5	11.1	14.5
	extra EU	16.6	15.1	15.4	7.6	13.8	8.5	12.2	11.3	17.9	13.3	12.5	8.5
Poland	EU12	17.7	43.0	27.6	34.9	17.7	31.2	29.3	28.7	18.8	19.9	33.0	21.2
	EU15	8.2	24.6	7.3	22.8	5.4	19.3	5.0	21.2	7.2	21.3	8.6	33.0
	extra EU	26.5	31.6	21.4	18.4	21.0	23.5	15.8	20.2	28.1	24.4	21.4	23.8
Romania	EU12	1.8	6.1	3.2	10.4	3.0	7.8	6.2	13.7	4.5	6.1	2.3	13.2
	EU15	0.9	2.3	1.1	3.1	0.5	2.0	0.6	2.7	1.1	2.9	1.2	4.0
	extra EU	2.8	4.0	2.2	2.1	2.4	1.7	2.6	3.2	3.8	3.3	2.0	2.3

Source: own elaboration on the UNCTAD-COMTRADE data

Table 4. Correlation of similarity rankings for the NMS based on the PSI index ($\rho_{jz}^{SIM^{\Omega}}$ Eq. [5])

	Bulgaria	Czech Rep	Hungary	Poland	Bulgaria	Czech Rep	Hungary	Poland
	1996–1997				2006–2007			
EU12								
Czech Rep.	0.199				0.204			
Hungary	0.382	0.438			0.219	0.449		
Poland	0.406	0.442	0.504		0.202	0.380	0.357	
Romania	0.316	0.080	0.269	0.236	0.576	0.184	0.189	0.183
EU15								
Czech Rep.	0.311				0.275			
Hungary	0.553	0.426			0.422	0.326		
Poland	0.560	0.488	0.513		0.346	0.452	0.390	
Romania	0.601	0.398	0.628	0.583	0.700	0.247	0.369	0.276
EXTRA-EU								
Czech Rep.	0.155				0.147			
Hungary	0.389	0.404			0.337	0.256		
Poland	0.169	0.370	0.159		0.098	0.215	0.283	
Romania	0.339	0.167	0.393	–0.111	0.417	0.279	0.255	0.167

Source: own elaboration on the UNCTAD-COMTRADE data

similarity among agri-food exports of the NMS in this specific market.

Second, two specific results seem to be particularly interesting since they allow us to distinguish between two opposite effects for different countries. On one side, we see that the correlation of similarity between Poland and all the other NMS decreased for all the three markets, revealing some heterogeneity at the country level (the only exception being the Czech Republic). On the other side, we can see that the strongest increase in trade similarity is measured for Bulgaria and Romania. Since these two countries appear to be far from closing the gap of similarity in high quality products with the OMS, a first clear pattern of falling down the quality ladder emerges.

This point may be reinforced from the evidence given by the correlation between similarity and sophistication (Table 5). Bulgaria and Romania have the highest negative values of the Spearman index revealing a lower correlation between similarity of the NMS with benchmark countries and a quality-oriented product specialization represented by PODY values. We should also underline that the lowest correlation value is found in the EU15 market, with a slight improvement for Bulgaria and deterioration for Romania. In other words, those items where the similarity between the NMS and OMS is higher do not correspond to the more sophisticated items at the world level.

Results for these two countries suggest that there has not been a substantial convergence at the high

Table 5. Correlation between similarity and sophistication for the NMS ($\rho_{j}^{SS^{\Omega}}$ Eq. [6])

	EU12		EU15		EXTRA–EU	
	1996–1997	2006–2007	1996–1997	2006–2007	1996–1997	2006–2007
Bulgaria	–0.255	–0.141	–0.344	–0.316	–0.211	–0.274
Czech Republic	–0.080	–0.098	0.009	0.011	–0.005	–0.011
Hungary	0.035	0.184	–0.036	–0.079	0.015	0.015
Poland	0.142	–0.022	–0.207	0.106	0.041	–0.039
Romania	–0.134	–0.247	–0.244	–0.341	–0.167	–0.221

Source: own elaboration on the UNCTAD-COMTRADE and the WDI (World Bank) data

quality level of agri-food exports during the enlargement process. Somehow, it appears that their less efficient productive systems, as well as their shorter integration history, weaken their competitive capability especially in the EU15 market ,where the greater demand for high-quality products offers a chance to increase the remuneration of inputs.

A different picture emerges for the Czech Republic and Poland, and to a lesser extent for Hungary. Here we can find positive values for $\rho_j^{SS^a}$, while some heterogeneity can be noted in the changes that occurred during the time period analyzed. The Czech Republic and Poland have a positive Spearman index values for the final period in the EU15 market which is the only market where the correlation has improved throughout the decade. On the contrary, for the other two markets, the correlation has decreased, revealing that the similarity rankings become more distant from the sophistication rankings. Hence, both the Czech Republic and Poland increased their competitiveness more than the OMS in the EU15 market for the high-quality segments of demand, while they diverge in the EU12 market.

If we go back to the item-specific similarity indices, it is worth noting that the Czech Republic mainly competes with Germany and the Netherlands, where high similarity indices are seen in quite a large number of agri-food products (processed rice, prepared or canned tomatoes, apples, kiwis and pears for Germany, eggs and sparkling wine for the Netherlands).

With regard to the item-specific similarity for Poland, it can be seen that this country represents the most evident case of convergence during the enlargement process, since the PSI shares sharply increased in the time period and the number of items with a significant trade similarity increased. This means that the export competitiveness in Poland is not concentrated in few sectors, but it involves a large number of items in the agri-food sector, where a quality upgrading process is also characterized by the product differentiation.

Finally, Hungary is an interesting case where the correlation between sophistication and similarity is higher for the EU12 and the extra-EU markets (with a substantial improvement for the former during the time period analysed) while a slight decrease in the correlation values can be observed for the EU15 market. If we consider the item-specific similarity values, even if the similarity is still far from the OMS for all markets, the enlargement process has led to an increased heterogeneity at item level. In other words, there is a product differentiation pattern and also a quality upgrading process mainly related to the EU12 reference market, partially revealing that Hungary is going to improve its export flows with respect to Bulgaria and Romania but in a less developed market with respect to the Czech Republic and Poland.

The general picture that clearly emerges is that similarity tends to be explained by two sets of products: livestock products, whose PRODY tends to be quite high and increased during the period considered, and the fruit and vegetable sector, whose PRODY was lower and increased at a slower pace, thus revealing that the country specialization deriving from the natural endowments and the past economic orientation is still playing an important role in the export competition.

CONCLUSION

This paper provides some new insights in the trade dynamics analysis of the agri-food sector for the enlarged European Union, applying a methodology for matching two (already existing) analytical tools which till now had only been used separately.

On the methodological side, the paper contributes in two ways to the economic literature on international trade. First, it applies the sophistication index to the agri-food sector while introducing a way to disentangle different effects within its dynamics. In more details, the overall sophistication variation of a country basket of exports is divided into three components: the variation of the per capita GDP; the world re-localization of exporting countries; the country specific effect which measures the changes in the export structure of one country compared with the sophistication level of the exported goods.

In our opinion, this way of decomposing variations in the sophistication indexes allows for a better understanding of which factors are really influencing the sophistication dynamics at the country as well as at the product level.

Looking at the empirical results, it seems quite evident that different behaviours are featured. Romania and Hungary have lost many positions in the sophistication ranking because their agri-food exports are oriented towards goods whose sophistication is decreasing due to the re-localization of production process and export flows towards countries with a lower GDP per capita. On the contrary, Poland and the Czech Republic seem to have succeeded in improving their export specialization towards more sophisticated goods.

The second methodological contribution of the paper is the combination of the similarity indexes with the sophistication ones. This is simply done by computing correlation measures among the similar-

ity rankings, on the one side, and the sophistication rankings, on the other. The advantage of the methodology lies in its capability to synthesize a huge quantity of trade data that refers to many countries (both reporters and partners) and products.

Our main results can be summarized in a quite complex general framework. A mixed blend of shadows and lights has emerged for the agri-food trade dynamics at this stage of the integration process that may now be considered quite mature especially when compared with the primary sector.

First of all, our results show an increase in agri-food trade between the NMS and OMS, revealing that their reciprocal role as consumers and suppliers is developing. This process is not perfectly symmetrical as shown by the trends in the normalized trade balances, which are improving for Poland and the Czech Republic, but worsening for Romania, Bulgaria and Hungary.

The same two subgroups of countries still hold when looking at the sophistication patterns: Poland and the Czech Republic are ranked in higher positions and have experienced an improvement in the relative sophistication level of their agri-food exports. On the contrary, Romania and Hungary have lost several points from an already low position in the ranking, while Bulgaria has remained almost stationary at its very low starting point.

APPENDIX

Table A – PRODY indices for the 95 agri-food sector (1996–1997 and 2006–2007)

No item	Item description	1996–1997		2006–2007		Ranking
		PRODY (USD)	ranking	PRODY (USD)	ranking	
88	Sparkling wine	16 584	29	32 095	1	28
25	Blue-veined cheese	25 052	1	30 874	2	–1
6	Swine carcasses (fresh or chilled)	24 919	2	30 483	3	–1
59	Animal fats	23 114	3	29 680	4	–1
1	Live animals (breeding)	22 224	8	29 614	5	3
13	Prepared bovine and swine meat	22 734	5	29 218	6	–1
23	Grated/powdered cheese	19 395	18	27 754	7	11
9	Edible offal	22 922	4	26 398	8	–4
7	Swine carcasses (frozen)	17 510	27	26 393	9	18
60	Virgin olive oil	14 907	53	26 327	10	43
21	Semi-processed milk	20 276	13	26 062	11	2
20	Yogurt and butter	17 879	24	25 957	12	12
62	Olive oil (excl. crude & virgin)	15 758	38	25 814	13	25
26	Other cheeses	22 537	6	25 797	14	–8
72	Processed cocoa	21 899	9	25 210	15	–6
73	Chocolate and choc. products	19 578	17	24 855	16	1
67	Meat sauces	16 077	32	24 336	17	15
48	Coffee roasted	19 305	19	24 037	18	1
4	Bovine carcasses (fresh or chilled)	19 659	16	24 028	19	–3
64	Meat cuts	16 047	34	23 945	20	14
56	Seeds	19 962	14	23 882	21	–7
84	Ice creams	17 594	26	23 585	22	4
16	Fresh and refrig. fish	19 714	15	23 553	23	–8
22	Fresh cheese	15 459	43	23 464	24	19
77	Confectionery	18 910	21	23 440	25	–4
19	Milk	17 011	28	23 143	26	2
78	Bakery products	20 404	12	23 071	27	–15
92	Vermouth	18 535	22	22 841	28	–6
15	Live fish	15 081	50	22 809	29	21
86	Non-alcoholic drinks	19 226	20	22 750	30	–10

Table A – continued

No item	Item description	1996–1997		2006–2007		Ranking
		PRODY (USD)	ranking	PRODY (USD)	ranking	
24	Soft cheese	22 410	7	22 736	31	–24
50	Durum wheat	20 994	10	22 677	32	–22
8	Sheep, goats, equines, fresh or frozen	18 472	23	22 321	33	–10
74	Uncooked pasta, cont. eggs	15 673	41	22 043	34	7
66	Edible meat	15 916	35	21 561	35	0
11	Chickens in pieces, fresh or frozen	15 744	40	21 559	36	4
87	Beer	17 599	25	21 268	37	–12
83	Sauces, soups, etc.	16 412	30	21 231	38	–8
89	Wines in conts. of 2 l/less	16 053	33	21 209	39	–6
30	Potatoes	13 151	69	21 117	40	29
51	Wheat	20 734	11	20 204	41	–30
12	Meats and offal, fresh or frozen	15 508	42	20 182	42	0
75	Pasta	12 976	71	20 174	43	28
93	Liquors and alcoholic drinks	13 764	64	19 917	44	20
85	Mineral waters	14 108	58	19 873	45	13
61	Non-virgin olive oil	14 017	60	19 839	46	14
44	Wild berries	15 371	44	19 529	47	–3
79	Tomatoes prepared or preserved	11 211	77	19 362	48	29
2	Live animals (no breeding)	15 906	36	19 329	49	–13
14	Prepared meats	14 947	52	19 303	50	2
17	Frozen fish	15 261	46	19 300	51	–5
82	Fruit juices	14 582	57	19 266	52	5
10	Whole chickens, fresh or frozen	14 953	51	19 099	53	–2
80	Preparations of veg. (excl. tomato)	15 128	49	18 893	54	–5
70	Candies and chewing gums	15 244	47	18 652	55	–8
42	Apples, kiwis and pears	14 891	54	18 626	56	–2
94	Feedstuffs	13 949	61	18 606	57	4
45	Frozen semi-processed fruit	12 967	72	17 806	58	14
31	Fresh tomatoes	14 719	56	17 727	59	–3
65	Low-fat meat preparations	14 815	55	17 574	60	–5
27	Eggs	15 229	48	17 499	61	–13
54	Flours, semolina etc.	11 970	75	17 449	62	13
3	Live animals (poultry, turkey, fowls)	15 754	39	17 221	63	–24
39	Citrus	16 221	31	17 208	64	–33
91	Ciders, alcohol, etc.	13 897	62	17 182	65	–3
76	Couscous etc.	15 873	37	16 919	66	–29
81	Preparations of fruit	13 606	66	16 677	67	–1
32	Fresh vegetables	13 085	70	16 290	68	2
18	Preparations of fish	13 425	68	16 265	69	–1
90	Wines in conts. of >2 l	10 909	78	15 569	70	8
40	Grapes	13 625	65	15 415	71	–6
57	Roots, rubbers, etc.	9 438	85	15 237	72	13
68	Other preparations of fish	12 923	73	15 224	73	0
5	Bovine carcasses (frozen)	15 335	45	15 167	74	–29
52	Other cereals	13 871	63	15 153	75	–12
28	Honey	10 477	82	15 006	76	6
55	Oil seeds and flours	10 057	83	14 836	77	6
46	Dried fruits	11 594	76	14 582	78	–2

Table A – continued

No item	Item description	1996–1997		2006–2007		Ranking
		PRODY (USD)	ranking	PRODY (USD)	ranking	
43	Berries	10 737	81	14 482	79	2
33	Frozen vegetables	14 033	59	14 099	80	–21
29	Plants, flowers, etc.	13 550	67	13 962	81	–14
71	Raw and semi-processed cocoa	10 892	80	13 418	82	–2
63	Vegetable oils from seeds	12 261	74	12 631	83	–9
36	Roots	7 394	90	12 310	84	6
37	Nut fruits	7 530	89	11 866	85	4
35	Preparations of vegetables in pieces	9 596	84	11 267	86	–2
41	Melons and watermelons	10 908	79	11 145	87	–8
34	Semi-processed vegetables	7 574	88	10 702	88	0
69	Sugars and sugar confectionery	7 604	87	10 668	89	–2
38	Tropical fruits	6 223	92	10 109	90	2
58	Rattan etc.	9 330	86	10 108	91	–5
53	Processed rice	7 269	91	9 671	92	–1
95	Unmanufactured tobacco	6 005	93	6 138	93	0
49	Spices	4 605	94	5 944	94	0
47	Coffee, not roasted	3 887	95	4 368	95	0

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