

Drivers of the Duration of Grain Competitiveness in European Union Countries

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ABSTRACT

This paper describes an evaluation of the drivers of the duration of grain competitiveness in the European Union (EU-27) member states on global markets from 2000 to 2011. Results indicate that most of the EU-27 member states were competitive with at least one segment of grain chain products. The long-term competitiveness of grain products differs between the EU-27 member states and across grain chain product groups. Trade costs reduce, while agricultural endowments, the level of economic development, export differentiation for final consumer grain products, EU enlargement and recent EU membership increase the duration of grain competitiveness. Competitiveness may be increased through sustainable grain trade specialization with a focus either on entering the market for diversified niche products, or on developing a competitive, global, integrated supply chain management system.

Keywords: Grain competitiveness, Global trade, Duration analysis, Discrete time models, European Union.

INTRODUCTION

The increasing integration of agri-food products into global markets that has occurred over the last few decades has threatened the competitiveness of European Union (EU) agriculture (Latruffe, 2010). Using different approaches, studies have highlighted the decreasing competitiveness of the EU grain sector on global markets (EC, 2007, 2011; LMC International, 2012). Maintaining grain competitiveness on global markets is crucial to the grain sector's economic sustainability, which is also being challenged by anthropogenic climate change that increases yield variability and causes other agro-ecological and economic changes. The competitiveness of various subsectors of EU agriculture, such as the

markets for dairy, meat, fruit and vegetable products (Bojnec and Ferto, 2014a, 2014b, 2015), has been relatively deeply analysed (FoodDrinkEurope, 2012, 2014). However, research into the competitiveness of grain on global markets is still limited (EC, 2007). Thus, the aim of the present paper is to fill this gap in the literature by investigating the competitiveness of the grain products of EU-27 member states on global markets in the period between 2000 and 2011. More specifically, the paper focuses on analysing the economic features of grain competitiveness and seeks to provide a better understanding of the levels and composition of competitiveness (and their duration) for grain chain products for the EU-27 member states on the global market.

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MATERIALS AND METHODS

Theoretical framework of competitiveness

Different theoretical frameworks and empirical approaches have been developed to investigate competitiveness, and are described in the literature (Latruffe, 2010; Bojnec and Fertó, 2012a). Because a single definition of the concept of competitiveness does not exist, the different approaches which are taken to competitiveness analysis depend on the aim of the analysis (typically, analysis of performance, potential or competitive process), on the level of the survey (micro, meso or macroeconomic), and on the analytical space-time structure. The two widely used approaches to evaluating competitiveness are computing different trade indices (Sarker and Ratnasena, 2014), and using Porter's (1990) diamond model to investigate performance indicators such as domestic resource costs and social cost-benefit ratios (Bojnec, 2002; Havrila and Gunawardana, 2003; Carraresi and Banterle, 2015).

This analysis applies the first approach: trade competitiveness indices. Numerous authors have analysed different features of EU agri-food competitiveness (Wijnands *et al.*, 2008) and a growing body of studies describes the trade competitiveness of EU countries in the agri-food sector. For example, Drescher and Maurer (1999) investigated the competitiveness of European dairy industries, while Bojnec and Fertó (2014a, 2014b, 2015) analysed the competitiveness of the EU member states for dairy, meat, fruit and vegetable products on global markets. Ascito *et al.* (2008) analysed the competitiveness of the Italian flower and ornamental plant sector. Crescimanno and Galati (2012 and 2014) analysed the competitiveness of Italian fishing and wines in terms of international trade, while Crescimanno, Galati and Bal (2014) researched the competitiveness of the

agri-food sector in the dominant Mediterranean countries.

The purpose of this article is thus to evaluate the drivers of the competitive performance of the grain sector in the EU-27 member states using a global comparison. [The EU-27 member states are considered to be comprised of the old EU-15 (OMS-15) member states (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Ireland, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom) and new EU-12 member states (NMS-12). The NMS-12 group was created through two EU enlargements: 1st May 2004 (NMS-10: Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia) and 1st January 2007 (NMS-2: Bulgaria and Romania). On the 1st July 2013, Croatia entered as the EU member state number 28.] Among the drivers of the competitiveness of the grain sector are natural agricultural endowments, the level of economic development, trade costs, grain product diversification and differentiation, EU enlargement and the new EU member states (NMS-12).

Hypotheses

We hypothesize that countries that are better endowed with an agriculture that supports grain production will tend to have competitiveness of longer duration (Bojnec and Fertó, 2009, 2010c). More specifically, we expect that countries with more arable land and with higher crop yields will remain competitive for longer (Hypothesis 1).

Agri-food exports are shaped by interregional trading costs and intraregional commuting costs (Bojnec and Fertó, 2010a, 2011). Accordingly, we expect that the duration of competitiveness will increase with relative declines in the costs of trade. Such a finding will indicate that higher trading costs decrease the probability of the survival of competitiveness (Hypothesis 2).

Agri-food competitiveness can be sensitive to levels of economic development

(Crescimanno *et al.*, 2014). We predict that the duration of competitiveness will be positively correlated to the level of economic development of the exporting countries. While relative employment in agriculture is related to agricultural endowments, it is used as an additional proxy for the level of economic development within Hypothesis 3.

The duration of competitiveness is expected to be longer for diversified agri-food export structures in a given product group (Hess and Persson, 2011). Therefore, trade diversification (a greater number of products) is estimated to have a positive impact on the duration of competitiveness in a given product group. However, within Hypothesis 4 we also assume that greater product heterogeneity will appear in the grain value chain according to the degree of processing of grains (from primary grains through to final consumer goods). Accordingly, we predict that the greater the differentiation of final consumer goods, the longer the duration of competitiveness.

There is some debate in the literature about the impact of EU enlargement on competitiveness, and on the difference in performance between old and new EU member states (NMSs) in terms of the duration of competitiveness (Bojnec and Fertő, 2012b). The current authors predict that the variables EU enlargement and NMSs will both have a positive impact on the duration of competitiveness (Hypothesis 5).

Methods

Trade Competitiveness Indices

The export competitiveness of grain products is investigated through use of the revealed comparative advantage (RCA) index, which is widely used in the empirical literature (Amirteimoori and Chizari, 2008; Amirteymouri *et al.*, 2012; Bojnec and Fertő, 2012b, 2014a, 2014b; Khaksar Astaneh *et al.*, 2014). The RCA index is defined as the following (Balassa, 1965):

$$RCA = (X_{ij} / X_{im}) / (X_{wj} / X_{wm}), \quad (1)$$

Where X_{ij} describes individual EU-27 member states' i grain product exports for a particular grain product group j to the global market, while X_{im} represents the total merchandise exports of individual EU-27 member states i to global markets. X_{wj} denotes the global exports of a given grain product j , and X_{wm} denotes total global merchandise exports, which are used as the benchmark for comparison. $RCA > 1$ indicates that a country has a comparative advantage in grain products on the global market.

Vollrath (1991) proposed an alternative equation for describing comparative advantage called the relative trade advantage (RTA). This accounts for exports as well as imports and is calculated as the difference between RCA and its counterpart, relative import penetration advantage (RMA), namely:

$$RTA = RXA - RMA \quad (2)$$

where,

$$RMA = (M_{ij} / M_{im}) / (M_{wj} / M_{wm}) \quad (3)$$

where M represents imports. Thus,

$$RTA = [(X_{ij} / X_{im}) / (X_{wj} / X_{wm})] - [(M_{ij} / M_{im}) / (M_{wj} / M_{wm})]. \quad (4)$$

If $RTA > 0$, this indicates a relative trade advantage; i.e. a sector in which a country is relatively more competitive in terms of trade. Similarly to the RCA index, the RTA index is based on observed trade patterns. It compares a country's exports and imports of a commodity relative to its total exports and imports of merchandise to the corresponding export and import performance of a set of countries (world), which is used as the benchmark for comparison.

Duration of competitiveness indices

The next step in the analysis concerns evaluation of the duration of $RCA > 1$ and $RTA > 0$ indices. Calculating duration appears to be straightforward: it is simply the time (measured in years) that a product has maintained an uninterrupted comparative advantage. The duration of



RCA>1 and RTA>0 indices for each of the EU-27 member states is estimated by applying the Kaplan-Meier product limit estimator (Bojnec and Ferto, 2012b).

Drivers of the duration of competitiveness

The literature about the determinants of the duration of RCA>1 and RTA>0 indices employs Cox proportional hazards models (Besedeš and Prusa, 2006; Bojnec and Ferto, 2008, 2012b). However, some studies have highlighted the fact that three problems are inherent to the Cox model which act to reduce the efficiency of estimators (Hess and Persson, 2011). First, the use of continuous-time models (such as the Cox model) may result in biased coefficients when the database refers to discrete-time intervals (years, in our case), especially in samples with a high number of ties (numerous short spell lengths). Second, Cox models do not control for unobserved heterogeneity (or frailty). Thus, results may not only be biased, but also spurious. Finally, the third issue of concern relates to the proportional hazards assumption implying that similar effects occur at different chronological intervals. Following Hess and Persson (2011), we estimate different discrete-time regression models including probit, logit and complementary log-log (Cloglog) specifications in which product-exporter country random effects are incorporated to control for unobservable heterogeneity.

Data

We used trade data from the six-digit World Customs Organization's Harmonized System (HS-6) level in the period 2000-2011 to calculate RCA and RTA indices. The United Nations International Trade Statistics UN Comtrade database (UNSD, 2013), [from the World Customs Organization's International Standard

Industrial Classification (ISIC-3116)] and the Broad Economic Classification (BEC) categories product description are used to define grain chain categories containing 48 HS-6 code grain products. To obtain more information and to facilitate comparison of different stages of the grain supply chain, data from the HS-6 code grain products was transposed to the BEC classification system. Table A1 in the Appendix presents the concordance between the 48 HS-6 code grain products and the four main BEC system categories (BEC 21 – primary grain products (three HS-6 code grain products), BEC 111 – primary grain products mainly for industry (eleven HS-6 code grain products), BEC 121 – processed grain products mainly for industry (twenty one HS-6 code grain products), and BEC 122 – processed grain products mainly for household consumption (thirteen HS-6 code grain products)). The UN Comtrade database was used for calculating RCA and RTA indices with the World Integrated Trade Solution (WITS) software.

In the econometric analysis we used two proxies for factor endowment in grain production. The first variable is the crop yield in terms of tonnes per hectare. The second is the area of arable land in hectares. All data are based on FAO (2014) statistics.

The EU countries' average costs of trading and their global trading partners for agricultural products were identified using World Bank data (2014a).

The variable for economic development is the natural logarithm (\ln) of GDP per capita at purchasing power parity (PPP) denominated in international US dollars (data from 2005 based on World Bank [2014b]). The proxy for the level of economic development that was employed is the share of agricultural employment in total employment based on FAO (2014) statistics.

Agri-food export diversification is measured by the \ln of the number of agri-food products exported per year.

The primary source of data for export diversification and consumer (differentiated)

agri-food product related data is UNSD (2013).

We introduced two dummy variables: a dummy variable for EU enlargement, which is equal to one when the NMS-12 member states join the EU, and zero otherwise, and second, a dummy variable for the NMSs, which is awarded a value of one for the NMSs, and zero in all other cases.

We applied binary dependent variables, taking the value equal to one if the letter i (i.e. $RCA > 1$, or $RTA > 0$) is observed to cease during the analysed time interval, and zero otherwise.

RESULTS

Evolution of the World Grain Market

During the last decade, the size of the global grain market increased rapidly. As can be seen from Figure 1, global grain exports more than tripled during the period 2000-2011. During the same period, grain exports from the EU-27 member states also increased, but much more slowly than global grain exports. As a result, the share of EU-

27 member states' global grain exports declined from more than 27% to less than 23% in the aforementioned period. This deterioration in the relative importance of the EU-27 member states in the global grain market can be explained by the faster growth in grain exports from some other non-EU-27 member states. The decline in the relative importance of the grain sector of the EU-27 member states clearly justifies the investigation into the drivers of the duration of competitiveness.

The relative decline in the global grain exports of the EU-27 member states was primarily caused by the decline in global grain exports of the major OMS-15 countries, namely: France, Germany, the United Kingdom (UK), Italy, Belgium, the Netherlands, Spain, Sweden and Denmark (Figure 2). On the other hand, a slight increase in the global share of grain exports occurred with the major grain exporters of the NMS-12: Hungary, Romania, Bulgaria, the Czech Republic, Poland, Slovakia and Lithuania. This suggests that EU enlargement has generally caused exports from the NMS to increase.

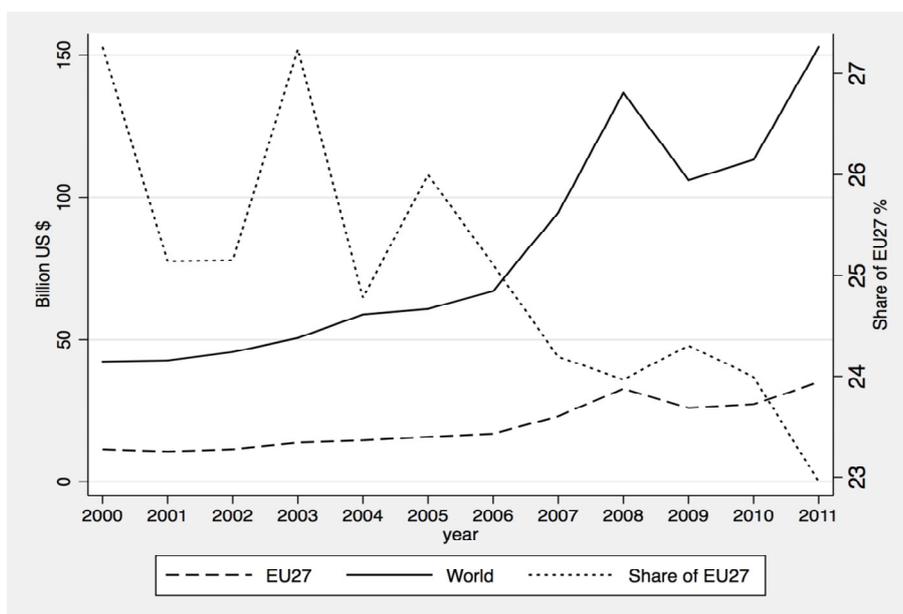


Figure 1. Evolution of global grain exports (2000-2011). **Source:** Authors' own calculations based on Comtrade database using WITS software.

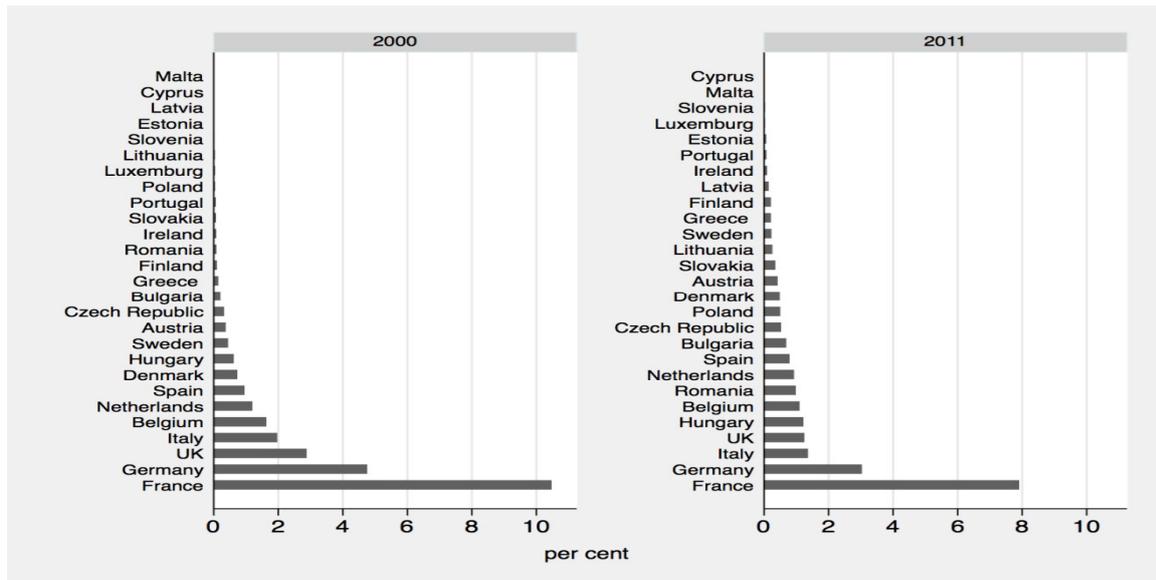


Figure 2. Share of global grain exports of EU-27 member states, by country. Source: Authors' own calculations based on Comtrade database using WITS software.

RCA and RTA indices

Most of the EU-27 member states have been competitive ($RCA > 1$ and/or $RTA > 0$ indices) on global grain markets (Figure 3). However, some variability exists between the EU-27 member states according to the $RCA > 1$ and $RTA > 0$ indices.

RCA and RTA indices by BEC grain product group

Figures 4-7 present the RCA and RTA indices for the EU-27 member states on the global market according to BEC grain product groups.

The most competitive EU-27 member

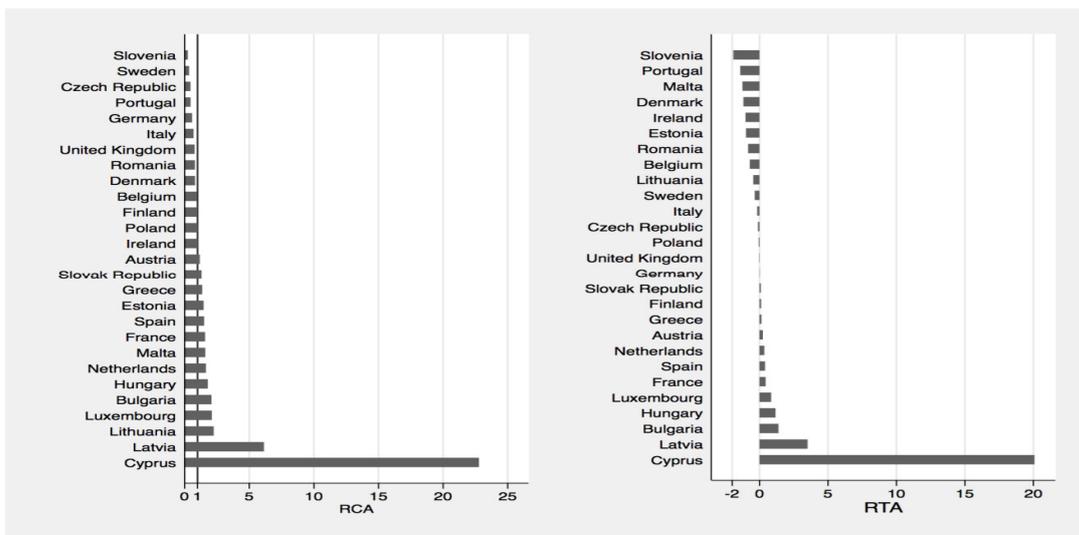


Figure 3. Mean of EU-27 member states' RCA and RTA indices for grain products (2000-2011). Source: Authors' own calculations based on Comtrade database using WITS software.

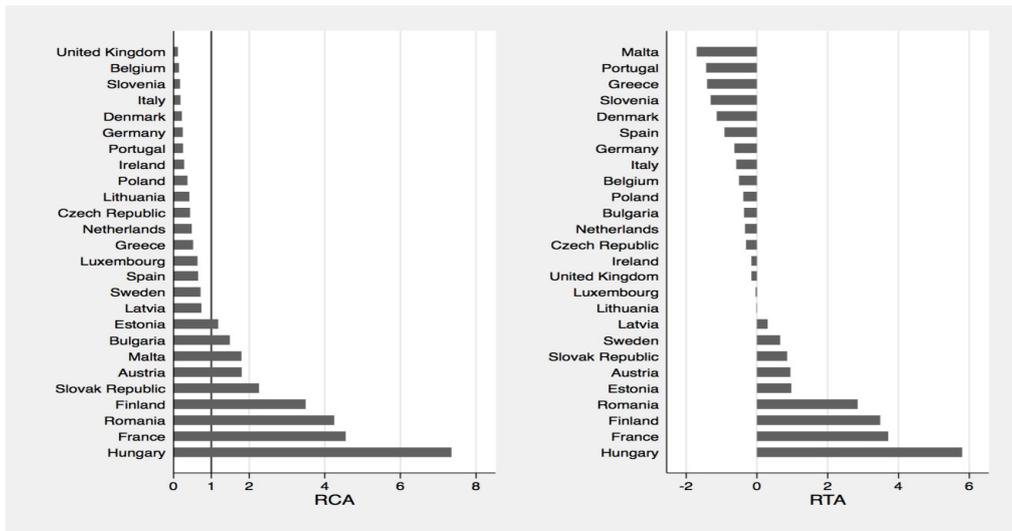


Figure 4. Mean of RCA and RTA indices for EU-27 member states for BEC-21 Primary Grain Products (2000-2011). Source: Authors' own calculations based on Comtrade database using WITS software.

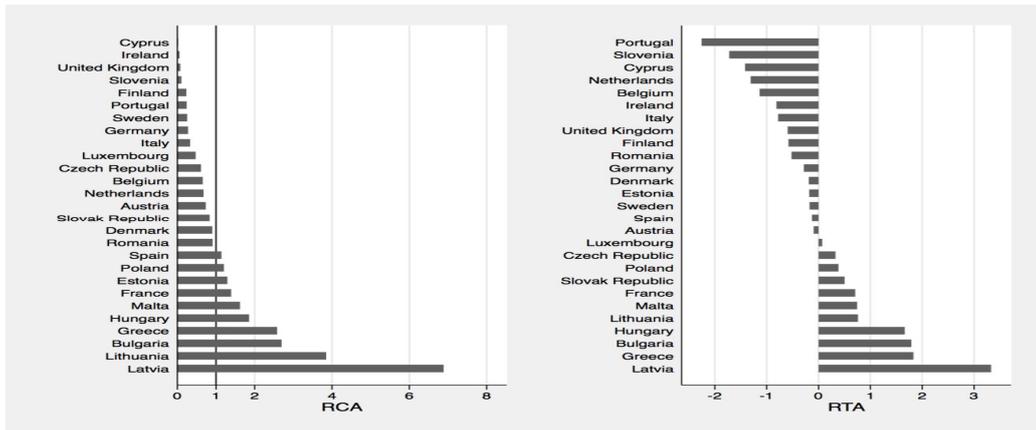


Figure 5. Mean of RCA and RTA indices for the EU-27 member states for BEC-111 Primary Grain Products mainly for Industry (2000-2011). Source: Authors' own calculations based on Comtrade database using WITS software.

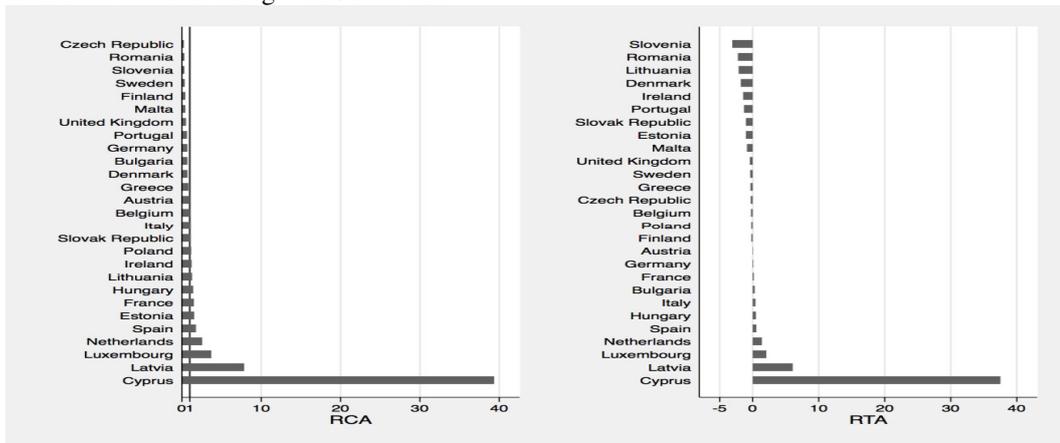


Figure 6. Mean of RCA and RTA indices for the EU-27 member states for BEC 121-Processed Grain Products mainly for Industry (2000-2011). Source: Authors' own calculations based on Comtrade database using WITS software.

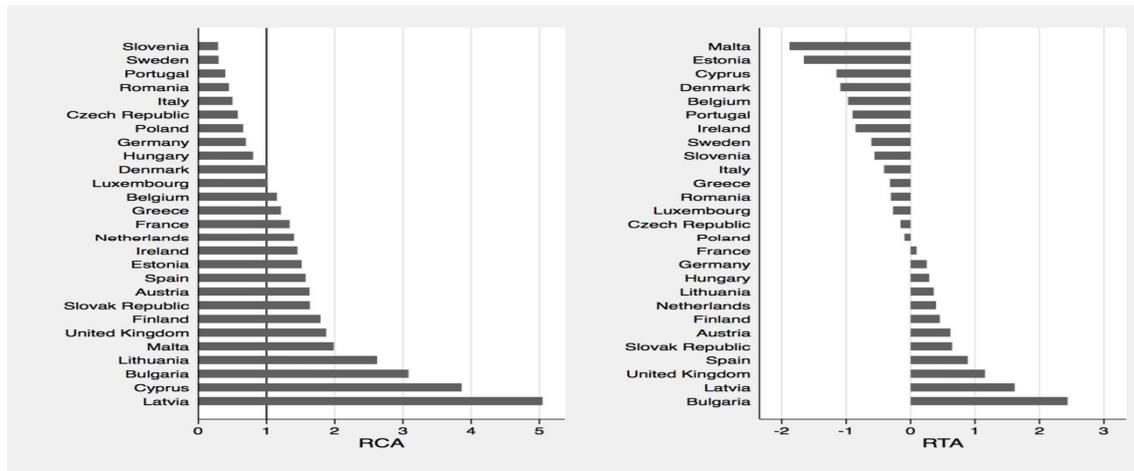


Figure 7. RCA and RTA indices for the EU-27 member states for BEC 122–Processed Grain Food and Grain Products intended for Final Consumption in Households (2000-2011). Source: Authors’ own calculations based on Comtrade database using WITS software.

states for ‘BEC 21 primary grain products’ (RCA>1 and RTA>0 indices) on the global market are Austria, Finland, France, Hungary, Romania and Slovakia (Figure 4).

The most competitive EU-27 member states for ‘BEC 111 primary grain products mainly for industry’ (RCA>1 and RTA>0 indices) on the global market are Bulgaria, France, Greece, Hungary, Latvia, Lithuania, Malta, and Poland (Figure 5).

The results of the RCA and RTA indices for the EU-27 member states for ‘BEC 121 – processed grain products are mixed mainly for industry’ (Figure 6). They are at least partly determined by the development of the milling industry and other grain processing industries. The most competitive EU-27 member states on the global market for the BEC 121 (RCA>1 and RTA>0 indices) are Cyprus, France, Hungary, Latvia, Luxembourg, the Netherlands and Spain.

The most competitive EU-27 member states on the global market for ‘BEC 122 – processed grain food and grain products intended for final consumption in households (RCA>1 and RTA>0 indices) are Austria, Bulgaria, Finland, France, Latvia, Lithuania, the Netherlands, Slovakia, Spain, and the UK (Figure 7).

Drivers of the duration of competitiveness

Table 1 presents discrete-time models (probit, logit, and cloglog specifications) which include random effects for every exporter-product combination. The robustness of the regression results is investigated on the basis of the regressions for two different dependent variables: the duration of the RCA>1 indices and the duration of the RTA>0 indices. While in general, the regression coefficients are slightly higher for the logit model, according to sign and statistical significance they are similar across the various estimation procedures. The signs and statistical significance of the regression coefficients for the duration of the RCA>1 indices and the duration of the RTA>0 indices are largely similar.

Significantly negative coefficients are found for the variable ‘greater area of arable land’, which decreases the likelihood of failure in duration according to the RCA>1 and RTA>0 indices. This outcome is consistent with Hypothesis 1, but the same does not hold for the regression coefficients of crop yield, which are not found to be significant.

Table 1. Results of regression of determinants of duration of revealed comparative advantage (RCA>1 indices) and relative trade advantage (RTA>0) indices (2000-2011).

	RCA			RTA		
	(1) Probit	(2) Logit	(3) Cloglog	(4) Probit	(5) Logit	(6) Cloglog
In Crop yield	-0.201	-0.393	-0.219	-0.060	-0.119	-0.081
In Agricultural employment rate	-0.062**	-0.109**	-0.057**	-0.054***	-0.101***	-0.057***
In Arable land	-0.135*	-0.271**	-0.143**	-0.364***	-0.662***	-0.383***
In Trade cost	1.135***	2.053***	1.197***	0.461**	0.860**	0.511**
In GDP per capita	-0.585***	-1.086***	-0.438**	-0.510***	-0.966***	-0.475**
In Number of products	-0.226	-0.401	-0.306	0.496*	0.882*	0.459
Consumer goods	-0.293	-0.612*	-0.360**	-0.204	-0.369	-0.199
EU enlargement	-0.279***	-0.522***	-0.257***	-0.067	-0.144	-0.001
NMS	-1.315***	-2.314***	-0.956***	-1.245***	-2.276***	-1.372***
Constant	7.676**	14.340**	6.222**	4.587	8.806*	4.252
N	9157	9157	9157	9157	9157	9157
Rho	0.921	0.916	0.899	0.835	0.831	0.800
Log likelihood	-2531.8	-2526.3	-2538.9	-3385.341	-3383.723	-3417.795
Likelihood-ratio test of rho=0	0.000	0.000	0.000	-0.060	-0.119	-0.081

Source: Authors' own calculations. * Significant at the 0.1 level, ** Significant at the 0.05 level, *** Significant at the 0.01 level.

In line with Hypothesis 2, higher trading costs increase the likelihood of failure in the duration of the RCA>1 and RTA>0 indices.

GDP per capita and a higher share of agricultural employment have significantly positive coefficients, suggesting that the likelihood of failure in the duration of RCA>1 and RTA>0 indices for economically developed economies is more likely. This conclusion is consistent with Hypothesis 3.

The regression coefficients for product diversification and product differentiation are mixed. The duration of RTA>0 indices (probit and logit models) are found to be inconsistent with the number of products (product diversification) and thus with Hypothesis 4, while the hypothesis is confirmed (logit and cloglog models) for differentiated consumer grain products, with a negative correlation between likelihood of failure in duration of RCA>1 indices and the existence of differentiated consumer grain products.

EU enlargement reduces the probability of failure in the duration of grain RCA>1 indices in the EU-27 member states, consistent with Hypothesis 5, but not for RTA>0 indices. Finally, the duration of competitiveness (the RCA>1 and RTA>0 indices) for grain products in the NMSs is more likely to be sustainable, as consistent with Hypothesis 5

DISCUSSION

These findings about the competitiveness of the EU-27 member states' grain value chains and their sustainability are of some practical value. Factors determined to be critical to competitiveness in primary grain production pertaining to a country's natural endowments, and to innovation related to product diversification and also the differentiation of existing and new product varieties. Better integrating the grain industry across the whole value chain is



important, as are on-site farm practices, grain storage, milling and grain processing, and the marketing of diversified and differentiated grain products to consumers. The long-term sustainable development of the grain sector is likely to also require investment into public infrastructure such as private-public grain storage facilities and more research, development and innovation in grain value chain activities.

The heterogeneous nature of the competitiveness of the grain value chains in the EU-27 member states shows the advantages and disadvantages that are common and/or specific to different countries and grain value chain products. Groups of EU-27 member states were distinguished on the basis of the competitiveness indices. The first group, including France, Bulgaria, Hungary and Latvia, benefitted from relatively strong grain competitiveness, confirming the findings of previous studies (Saboniene, 2009; Hubbard and Jámbor, 2013; Juhász and Wagner, 2013).

The second group of EU-27 member states had relatively weak grain value chain competitiveness. Among these countries are Sweden and Portugal from the old EU-15 member states and the new EU-12 member state Slovenia. Identification of the weak competitiveness of some of the EU-27 member states on global grain markets vis-à-vis some other global grain players is consistent with previous findings (EC, 2007). Their lack of competitiveness on global markets may be related to structural problems in the respective grain value chains (FoodDrinkEurope, 2012, 2014). The third group includes EU-27 member states which were competitive with some niche grain products (Romania and Finland for the BEC 21; Greece, Lithuania, and Poland for the BEC 111; and Austria, the Netherlands, Spain, Slovakia, and the UK for the BEC 122). Finally, annual fluctuations in national competitiveness indices can be explained by the fluctuations in the traded value of grain, which may be related to adverse weather conditions and instabilities in primary grain

production, or to other changes in global market conditions such as changes in end-year grain chain storage from primary to processed products, and/or changes in demand.

CONCLUSIONS

This paper contributes to understanding the competitiveness of the grain sector in the EU-27 member states, firstly by describing the outcome of calculating RCA and RTA indices over space and time. Secondly, the duration of RCA and RTA indices is identified (over time). Third, a regression analysis is applied to the drivers of the duration of $RCA > 1$ and $RTA > 0$ indices for grain products on global markets. Finally, on the basis of the empirical results, managerial and policy implications are derived and the main limitations of the study and opportunities for further research are described.

Our estimations imply that the duration of competitiveness differs between the EU-27 member states, and across the BEC grain chain groups of products. The heterogeneity in the results confirms that most of the EU-27 member states were not competitive at every stage of the global grain supply chain. EU-27 member states have faced strong competition on global grain chain markets from other competitors who offer specialized, diversified and differentiated niche grain chain products. The long-term duration of the RCA and RTA indices was not only different between EU-27 member states, but also among the BEC grain chain groups of products.

Among the main drivers of the duration of grain competitiveness in the EU-27 member states are agricultural factor endowments (Hypothesis 1), the level of economic development (Hypothesis 3), export differentiation of final consumer grain products (Hypothesis 4), and EU enlargement along with new EU membership (Hypothesis 5). Trading costs

were found to reduce the duration of grain competitiveness (Hypothesis 2).

The main managerial implications are that gains from grain chain economies of scale can be made and organizational advantages can be obtained through product specialization and by increasing the role of long-term, sustainable grain chain management.

In terms of the main policy implications, it is clear that the role of agricultural policy (more specifically, the role of Common Agricultural Policy (CAP), which has historically played a crucial role in grain markets) has changed dramatically. From once being the primary driving force in grain markets, it is now acting to create an indirect, enabling environment in the EU in support of global grain market competition.

The main limitations of the study include the concept of competitiveness that is employed which is based on the RCA and RTA indices for global grain markets of the EU-27 member states. In addition, the role of agricultural policy, particularly the role of the CAP, is included in the analysis only indirectly through proxy variables for EU enlargement and NMS.

Accordingly, because intra-EU trade preferences and non-tariff measures may act to maintain intra-EU trade preferences, further research can provide more insight by distinguishing between grain trade on intra-EU markets and non-EU markets. Among the drivers of competitiveness which can be investigated with a single or multi-country focus are the role of public policies such as the CAP, the role played by biofuels mandates, grain trade restrictions, changes in global supply and demand and relative logistics-based advantages/disadvantages.

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گردانندگان زمان رقابت پذیری بازار غلات در کشورهای اتحادیه اروپا

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چکیده

این مقاله به توصیف ارزیابی گردانندگان زمان رقابت پذیری غلات در بین اعضای اتحادیه ی اروپا در بازار جهانی بین سالهای ۲۰۰۰ تا ۲۰۱۱ می پردازد. نتایج نشان می دهد اغلب اعضای اتحادیه ی اروپا حداقل در یک بخش از زنجیره ی تولیدات غلات در رقابت با هم بوده اند. رقابت بلند مدت تولیدات غلات بین اعضای اتحادیه اروپا متفاوت از رقابت بین زنجیره ی گروه های تولید غلات است. هزینه های تجاری کم شده است در حالی که اموال کشاورزی، توسعه ی اقتصادی، تفاوت صادرات برای مصرف کنندگان نهایی غلات، گسترش اتحادیه ی اروپا و اعضای جدید اتحادیه مدت زمان رقابت را افزایش داده است. رقابت ممکن است از طریق تجارت ویژه ی پایدار غلات با تمرکز بر ورود به بازار محصولات متنوع و یا ایجاد سیستم مدیریت زنجیره ی ادغام شده ی عرضه ی جهانی و رقابت افزایش یابد.