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THE ROLE OF FOOD CRISIS AND TRADE COSTS IN THE HUNGARIAN MAIZE EXPORTS*

Abstract

Maize is one of the most important agricultural export products in Hungary. The paper investigates the role of economic crisis and trade costs on the pattern of Hungarian maize exports over the period from 1996 to 2015. The authors employ standard gravity model to explain the drivers of Hungarian maize exports at the world market. The results suggest that on the demand side both importers' market size and the importers' income have positive and significant impacts on Hungarian maize exports. The distance and crisis have negative impacts, whilst the EU membership positively influenced Hungarian maize exports.

Keywords: agriculture, grain trading, agribusiness, maize, Hungary, gravity model.

JEL codes: Q11, Q13, Q17.

Introduction

There is more and more literature on the impacts of global food crisis on the commodity markets (e.g. Akhter, 2017; Gutierrez, 2012; Tadassee, Algieri, Kalkuhl and von Braun, 2016). While majority of papers concentrate on the various impacts of price spikes on commodity markets and poverty in developing countries, there is less attention on the effects of crisis on agri-food trade (e.g. Heady,

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2011; Giordani, Rocha and Ruta, 2016). Although the importance of trade events in rice and wheat markets is widely analysed, there has virtually been no discussion of trade events being an important factor in world maize markets. This neglect is partly understandable in the light of some important features at the global maize market (Heady, 2011). First, the United States strongly dominate the global maize trade, accounting for around 60 per cent of world exports, consequently trade restrictions elsewhere have less weight to influence international price. Second, maize is also used as livestock feed in much of the world (comparing to rice and wheat which are typically staple foods), thus the demand for maize is relatively elastic; which in turn implies less sensitivity to trade shocks. Third, earlier studies confirm that rising oil prices added considerably to maize production and transportation costs (Headey and Fan, 2008; Mitchell, 2008). Finally, the growing use of maize in biofuel production indicates large impact on the global maize market, making trade-based explanations of rising maize prices less attractive.

However, despite the characteristics of global maize market, there are some grounds to justify the importance of trade analysis in this market. The world maize trade is traditionally subject to trade intervention. The number of major players on the global market is restricted. On the export side, the exporter countries apply different promotion programmes, while importer countries use wide range of trade barriers in order to protect their domestic markets. These trading policies are playing an important role in determining flows of maize (Koo and Karemera, 1991). Despite of the importance of maize in the global agriculture, the research on maize trade is fairly limited. There are some studies focusing on the international grain trade with special emphasis on the global players (e.g. Jayasinghe Beghin and Moschini, 2010; Haq, Meilke and Cranfield, 2013), but papers on the export of small maize exporting countries is basically non-existent. This paper tries to fill in this gap. Although Hungary is a small-scale maize exporter country, it was ranked 8th top maize exporter country in 2016. Thus, we can argue that Hungary is a good case study to investigate the role of trade costs for a small-scale, but still an important player in the global maize exports. In addition, recent food crisis provides an additional motivation for our research. The aim of the paper is to analyse the impacts of trade costs and food crises in Hungarian maize export in the last two decades. The structure of the paper is the following. First, we provide a brief overview of Hungarian maize sectors. Next section, describes empirical methodology which is followed by presentation of results. The final section provides conclusions.

The Hungarian maize sector

The crop sector is predominant in Hungary, 80 per cent of agricultural land is used by the crop sector. The share of maize land is around 40 per cent within total cropland with 1.1 million hectares. The Hungarian maize production highly fluctuates due to climatic conditions, ranging between 4 and 9.5 million tonnes

(Fig. 1). Hungary is one of the major producers within the European Union with 10-12 per cent of the EU annual production. After France (13-16 million tonnes), Romania (7-12 million tonnes) and Italy (8-10 million tonnes), Hungary is usually ranked between fourth and sixth, depending on the harvest of the year (KSH, 2016). The maize is one of the most important agricultural export products in Hungary. The export orientation of maize production has increased especially after the EU accession due to structural changes in Hungarian agriculture. The share of crop sector has increased at the expense of livestock sectors, thus the domestic demand for maize has also declined.

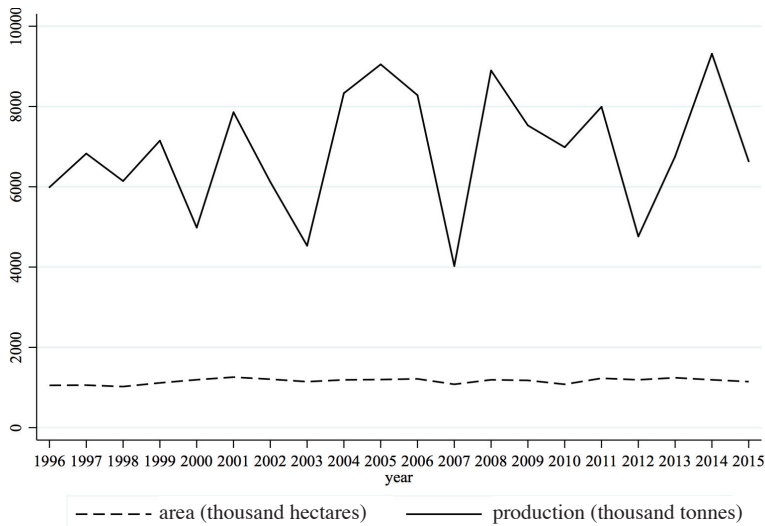


Fig. 1. Hungarian maize production, 1996-2015.

Source: own calculations of the authors based on KSH (2017).

The Hungarian maize export fluctuated considerably between 1996 and 2015. The level of the Hungarian maize export has been rather low in the first decade of the analysed period (Fig. 2). However, in the second decade, the maize export more than doubled on average. At the same time, there were no significant changes in the sown area and the average harvested volume of maize. The impact of food crisis is visible, despite of poor harvest the value of export dramatically increased. The value of export has declined in 2008 and 2009, and its level has recovered only in 2011. The value of exports for the last three years has fallen to the level of the crisis years.

The most important destinations for Hungarian maize exports are Italy, Romania, the Netherlands, Germany and Austria (Fig. 3). Italy is traditionally one of the most important markets for the Hungarian grain products including maize. Romania is also playing an important role, as it is mostly functioning as a transit country

and an exit point to the Black Sea market for the Hungarian maize, because of the Danube river running across both countries. The value of the average export of the next three countries in Figure 3 shows the importance of their processing sector for the Hungarian maize export and also the importance of the Rhine-Main-Danube Canal, which is the only waterway passing the continent and making inland navigation and water transportation possible. Two large non-EU markets are still playing relatively important role: the Russian and the Ukrainian market.

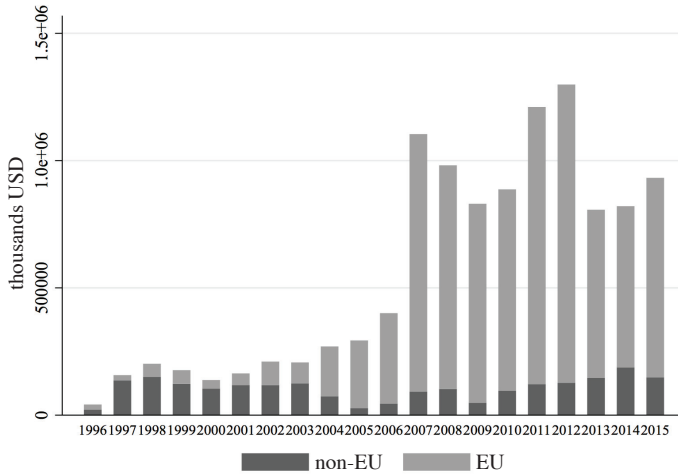


Fig. 2. Hungarian maize exports by main market segments, 1996-2015.

Source: own calculations of the authors based on World Bank (2017a).

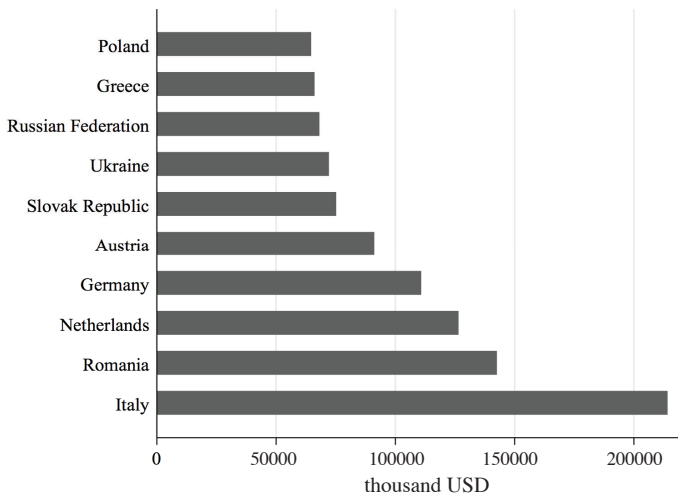


Fig. 3. The average exports of the top 10 Hungarian destinations between 1996 and 2015.

Source: own calculations of the authors based on World Bank (2017a).

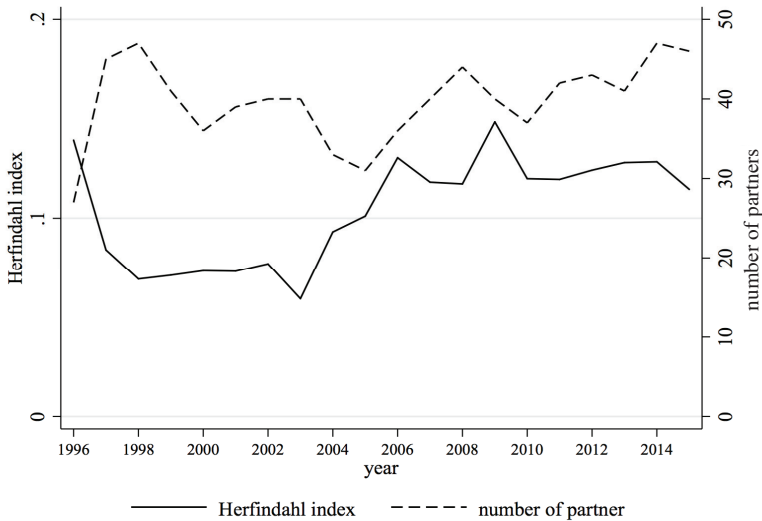


Fig. 4. Market concentration and number of export relationships in Hungarian maize exports
Source: own calculations of the authors based on World Bank (2017a).

Hungary has exported maize to 83 countries during the analysed period. However, the number of destinations gets much lower per year. The number of trading partners is varying between 27 and 47 (Fig. 4). Interestingly, in the first decade the geographical concentration of maize export has been much lower with smaller export value. The geographical concentration has increased with higher number of trading partners and higher export value in the second half of the period. However, the instability in numbers of market partners partly indicates that the sources of maize export growth are mainly based on the increase in exports on traditional markets and less on finding new destinations for Hungarian maize.

Material and methods

Following the international trade literature the gravity model has become a standard toolkit in empirical agricultural trade analysis highlighting some special features of agricultural trade. The baseline econometric model explanation starts from traditional gravity theory, which points out that bilateral trade between countries is positively associated with their national economic sizes (incomes) and negatively associated with their geographical distance (e.g. Anderson, 1979; Frankel and Rose, 2002; Anderson and van Wincoop, 2003; Bojnec and Fertő, 2010). The increases in national incomes generate greater demands, and the location of the closest partner country lowers transportation costs.

Although there is no paper dealing exclusively with the maize trade, some studies have investigated, at least partly, the cereals trade employing the gravity approach. Koo and Karemera (1991) use gravity model to investigate the in-

ternatioanl wheat market showing that production capacities, income and trade policy measure play an important role in determining trade flows of wheat. There is an increasing research to evaluate the impact of RTAs on the agricultural trade. Koo, Kennedy and Skripnitchenko (2006) highlight that RTAs induce an increase in traded volume generally among the members, but do not necessarily cause trade diversion. Ghazalian, Larue and Gervais (2011) find that the tariff preferences have more significant effect on the EU's intraregional trade creation than on the non-tariff preferences. Serrano and Pinilla (2012) emphasise that the role of RTAs in the EU is to exert much bigger effect on the agricultural products than in case of others. Ghazalian (2015) finds that the effect of distance on trade reveals significant differences in countries belonging to different economic and geoeconomic groups.

In this paper we investigate determinants of the Hungarian maize exports between 1996 and 2015 using standard gravity trade model. The export data come from the UN Comtrade database (UNSD, 2017), with the World Integrated Trade Solution (WITS) database and software (denominated in US dollars) (World Bank, 2017a). The empirical analysis is based on bilateral trade of maize at the Harmonised System 4-digit level (code of HS1005).

The standard formula of gravity equation can be described for the value of X_{ijt} , which is the value of exports from export country i to import country j over a particular time t (Anderson and van Wincoop, 2003):

$$X_{ijt} = G_t M_{it}^x M_{jt}^m \varphi_{ijt} \quad (1)$$

where: M_{it}^x and M_{jt}^m denote exporting and importing country's attributes, G_t is a common year-specific vector determining trade. Variation in trade intensity enters via φ_{ijt} . Following Head, Mayer and Ries (2010) we refer to M_{it}^x and M_{jt}^m as monadic effects, and to φ_{ijt} as the dyadic effect.

After Eaton and Kortum (2002) we estimate the log of the dyadic term φ_{ijt} as a linear combination of factors affecting trade costs between partner countries:

$$\ln \varphi_{ijt} = \delta D_{ijt} + u_{ijt} \quad (2)$$

The D_{ijt} and u_{ijt} describe the observed and unobserved component of bilateral trade costs. The standard approach to estimate gravity model is to take the log of equation (1) and substitute in equation (2) to obtain the following formula:

$$\ln X_{ijt} = \ln G_t + \ln M_{it}^x + \ln M_{jt}^m + \delta D_{ijt} + u_{ijt} \quad (3)$$

The authors employ dummy variables to capture G_t . In empirical literature, exporter and importer characteristics are usually approaching GDP and GDP per capita. Following Head, Mayer and Ries (2010) we separate the size and devel-

opment effects, thus we express the monadic terms with number of Population (Pop) and GDP per capita (GDPCAP). Putting these monadic effects we can rearrange equation (3) as follows:

$$\ln X_{ijt} = \ln G_t + \alpha_1 \ln POP_{it}^x + \alpha_2 \ln GDPCAP_{it}^x + \alpha_3 \ln POP_{it}^m + \alpha_4 \ln GDPCAP_{it}^m + \delta D_{ijt} + u_{ijt} \quad (4)$$

This theoretical framework also provides an approach to identify the home market or reverse home market effect for different industries (Feenstra, 2004). Home market effects imply that for differentiated products exports are more sensitive to changes in the income of the exporting than of the importing country. Contrary, trade in homogenous goods is more sensitive to the income of the importing country than to the domestic income of the exporter, and shows a reverse market effect.

The most recent literature addressed issues concerning the correct specification and interpretation of the gravity trade equation in empirical estimation (see overview by Bachetta, Beverelli, Cadot, Fugazza, Grether, Helble, Nicita and Piermartini, 2012; Head and Mayer, 2013). Variants of equation (4) are applied to many empirical studies. However, this equation suffers a serious shortcoming that has become well known after seminal paper by Anderson and van Wincoop (2003). Several researches have argued that standard cross-sectional methods yield biased results because they do not control for heterogeneous trading relationships (e.g. Feenstra, 2004; Helpman, Melitz and Rubinstein, 2008). In other words, equation (4) omits multilateral resistance terms that are of functions to the whole set ϕ_{ijt} . There are several approaches to estimate the multilateral resistance terms. The preferred method for most papers uses fixed effects for each exporter-year and importer-year to “absorb” the monadic effects in equation (3). Considering our case with a single origin (Hungary), the inclusion of solely fixed destination effects can control for the multilateral resistance. However, we should emphasise that the inclusion of these fixed pair effects already controls, in turn, for multilateral resistance. Thus, the inclusion of fixed effects is unnecessary in the extended gravity model of time invariant trade costs variables, which are usually included when estimation is made by ordinary least squares (OLS), such as a distance, a common border, etc. Having a single origin implies that the number of pairs coincides with the number of destinations. Therefore, in our case, the inclusion of a variable with a different value for each pair and constant over time can control for both multilateral resistance and unobservable heterogeneity (Serrano, García-Casarejos, Gil-Pareja, Llorca-Vivero and Pinilla, 2015).

We divide the set of dyadic variables, D_{ijt} , into two groups: a set of control variables typically used in gravity regressions and a set of indicators that represent trade agreements. The time-invariant controls are distance and common

border. In case of Hungary, other usual proxies as common language, shared legal system and colonial ties are not applicable for our case. Time-invariant variables are also serving to control for both multilateral resistance and unobservable heterogeneity. Time variants controls include belonging to a common regional trade arrangement (RTA), belonging jointly to GATT/WTO and joint membership in the European Union. Finally, we add a time-invariant dummy (Crisis) to control the impacts of food crisis. The description and sources of variables are in Table 1.

Table 1

<i>Description of variables</i>		
Variable	Definition	Source
X	Export in current US dollars	World Bank, Comtrade
POP	Population figure	World Bank, WDI
GDP CAP	GDP per capita in current US dollars	World Bank, WDI
Distance	The physical distance between national capitals for country pairs	CEPII
Border	Dummy variable equal to unity for exporting and importing countries with a common land border	CEPII
RTA	Dummy variable equal to unity for country pairs that are covered by the same regional trade agreement	WTO
WTO	Dummy variable equal to unity for country pairs that are covered by the WTO agreement	WTO
EU	Dummy variable equal to unity for country pairs that belong to the European Union	CEPII
Crisis	Dummy variable equal to unity for the period after 2007	

Source: own compilation.

The second econometric issue is how to deal with the zero-valued bilateral trade flows. It is known that standard gravity models cannot easily deal with zero trade flows. In literature, this has resulted in a widespread practice to ignore zero flows in the analysis of bilateral trade. However, zero-valued observations contain important information for better understanding the patterns of bilateral trade flows. Therefore, they should not be discarded *a priori*. Several methodological approaches have been applied or suggested to address the problem of zero trade flows. The first most common solution confines the sample to non-zero observations in order to avoid the estimation problems related to zero trade flows. The second solution is that (part of the) zero values may be substituted by a small constant. In this way, the double-log model can be estimated without throwing these zero country trade flow pairs out of the sample. The third type of studies has employed the standard Tobit model to estimate the gravity equation with zero trade flows (e.g. Rose, 2004; Anderson and Marcouiller, 2002). The fourth type of studies applies the Heckman (1979) sample selection model to

deal with zero trade values (Francois and Manchin, 2013; Linders and de Groot, 2006), arguing that this model is preferred both theoretically and econometrically. Finally, Santos Silva and Tenreyro (2006) propose the PPML estimator to solve heteroscedasticity problem. Martin and Pham (2015) argue that, in the case of the small fraction of the zero values, the PPML estimator model is the preferred method to be used in estimation. However, Santos Silva and Tenreyro (2011) show that the PPML estimator is generally well behaved, even when the proportion of zeros in the sample is very large. Thus, to deal with heteroscedasticity issues we apply the PPML estimation technique. In addition, we calculate clustered standard errors at the country-pair level.

Results and discussion

We present three different specifications starting with monadic and time-invariant dyadic variables, and adding sequentially the time-varying dyadic and crisis variables (Table 2). Regarding to monadic variables we find that origin based attributes are not significant. The insignificant effects of exporter GDP per capita variable indicate the lack of home market effects confirming theoretical hypotheses and empirical findings (Feenstra, 2004; Serrano and Pinilla, 2014). Our estimations show that increases in importer-country per capita income and population promote bilateral trade with elasticities that vary between 0.821 and 0.342. Notice that the elasticities of per capita income double the elasticities of population. In line with theoretical expectation, the significant importer per capita income confirm the reverse home market effect for the maize market. The Distance between partners reduces trade and the estimated elasticities ranging between 1.357 and 1.583, which are higher than the typical findings in literature (one). Surprisingly, the impact of common border is insignificant in all specifications, which is not in line with findings of earlier papers (e.g. Haq, Meilke and Cranfield, 2013; Ghazalian, 2015). Turning to time-varying dyadic variables we observe that WTO membership and joint RTA membership have no significant impact on Hungarian maize exports. These findings contradict the typical results of agricultural trade literature (e.g. Haq, Meilke and Cranfield, 2013; Ghazalian, 2015; Koo, Kennedy and Skripnitchenko, 2006; Serrano and Pinilla, 2012; Serrano, García-Casarejos, Gil-Pareja, Llorca-Vivero and Pinilla, 2015). The positive and significant effects of the EU membership on Hungarian maize exports are in line with other studies emphasising the positive impacts of the EU integration (e.g. Serrano and Pinilla, 2012). The strong EU effects can explain partly the insignificant RTA and WTO impacts. Figure 2 confirms that the EU market has an important role in Hungarian maize exports and 8 of the top 10 destinations are the EU Member States (Fig. 3). Last column presents augmented model with Crisis variable. Our calculations suggest that crisis has strong and negative impacts on Hungarian maize exports.

Table 2

<i>Estimation results</i>			
	1	2	3
<i>Monadic variables</i>			
ln POP origin	-9.654	-9.047	4.849
ln POP destination	0.821***	0.786***	0.789***
ln GDPCAP origin	1.164***	0.476	-0.190
ln GDPCAP destination	0.494***	0.371*	0.342*
<i>Time-fixed dyadic variables</i>			
ln Dist	-1.583***	-1.388***	-1.357***
BORDER	-0.260	-0.098	-0.058
<i>Time-varying dyadic variables</i>			
WTO		0.079	0.087
RTA		-0.511	-0.505
EU		1.102***	1.240***
<i>Additional variable</i>			
Crisis			-0.886***
constant	24.308	28.970**	3.383
N	1581	1581	1581
R ²	0.451	0.454	0.481

Note: ***, **, * denote significance at 1%, 5% and 10% level.

Source: own compilation.

Conclusions

The paper investigates the role of economic crisis and trade costs in the pattern of Hungarian maize exports over the period from 1996 to 2015. The authors employ standard gravity model to explain the drivers of Hungarian maize exports at the world market. Hungarian maize exports has increased considerably after 2004 with strong fluctuations. The geographical concentration of Hungarian maize exports has also grown after the EU enlargement with considerable yearly variations in terms of trading partners. Our results imply that on demand side both importers' market size and the importers' income has positive and significant impacts on Hungarian maize exports. The home market effects are not existent, while reverse home market effects are important drivers for Hungarian maize exports. Within trade costs, the distance has strong negative impact on maize exports. While the EU membership considerably and positively influenced Hungarian maize exports, the impacts of other trade agreements are not relevant for Hungary. This partly can be explained by large trade costs of

Hungary. The coefficients of distance are consistently higher than for the coefficients of the EU membership. The maize as a homogenous product subjecting to volatile domestic and market conditions is not necessarily appropriate product for a long-term and sustainable agricultural export strategy. Despite the good climatic and favourable agricultural policy conditions, the scope of Hungarian maize exports is rather limited. The further research is needed to better understand the chances of European maize exports.

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ROLA KRYZYSU ŻYWNOŚCIOWEGO I KOSZTÓW HANDLOWYCH W EKSPORCIE WĘGIERSKIEJ KUKURYDZY

Abstrakt

Kukurydza jest jednym z najważniejszych produktów eksportu rolnego na Węgrzech. W artykule omówiono rolę kryzysu gospodarczego i kosztów handlowych w kształtowaniu się wzoru węgierskiego eksportu kukurydzy w latach 1996-2015. Autorzy zastosowali standardowy model grawitacyjny, aby wyjaśnić czynniki wzrostu węgierskiego eksportu kukurydzy na rynku światowym. Uzyskane wyniki sugerują, że po stronie popytu zarówno wielkość rynku importerów, jak i ich przychody mają pozytywny i znaczący wpływ na eksport węgierskiej kukurydzy. Odległość i kryzys mają negatywny wpływ, natomiast członkostwo w UE ma pozytywny wpływ na eksport węgierskiej kukurydzy.

Słowa kluczowe: rolnictwo, handel zbożem, przemysł rolny, kukurydza, Węgry, model grawitacyjny.

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