Competitive Structure of Kazakhstan, Russia and Ukraine in World Wheat Market: Gravity Model Approach

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Abstract

Due to an increase in export shares of Kazakhstan, Russia and Ukraine (KRU) the competition in global wheat market has become more intense during the last decade. Hence, this study aims to analyze the market structure of KRU over the period 2004-2010. By using the gravity trade model and Poisson Pseudo Maximum Likelihood (PPML) estimation method, this study confirms that the emergence of KRU increases the competition in international wheat market. The other main finding is that there is no evidence of market power of KRU wheat exporters over the South Caucasian and Central Asian countries.

Keywords: *gravity model, exchange rate, perfect competition, Poisson Pseudo Maximum Likelihood estimation*

Introduction

It has been a long-lasting discussion whether perfect competition or market power exists in the world wheat market. Several studies found competitive market for the wheat export of the US, Canada and Australia (Sekhar, 2010), but some detected market power (Cho et al., 2002). This discussion continues with the emergence of Black Sea wheat exporters - Kazakhstan, Russia and Ukraine, in the international wheat market. It is estimated that because of high production potentials and geographical locations, wheat export shares of the Black Sea countries will steadily increase in the future. Those factors will make the competition more intense and KRU countries will become important players in the region. Since KRU has high wheat export potentials in the world, it would be interesting to focus on the market structure of KRU in global wheat market.

Some studies have been carried out on the market structure of the traditional wheat exporters in the world wheat market with pricing-to market (PTM) model (Jin, 2008) and Pall et al. (2013) used the same model to analyze Russian wheat export for the firs time. The authors conclude that traditional wheat exporters as well as Russia have some monopoly power over several importing countries. However, the disadvantage of PTM model is ignoring the third-country effects, in particular real exchange rate (RER) impact, on bilateral trade. Li (2003) found that appreciation of third-country RER can increase direct bilateral exports and decrease the direct bilateral imports. Therefore, to see the market structure of wheat exporters we are going to use the gravity trade model which considers also third-country effect with the "multilateral resistance" (MR) term (Anderson and van Wincoop, 2003). In addition, this study also uses time-varying country fixed effects which controls for MR term (Baldwin and Taglioni, 2007). To solve the problem with heteroskedasticity and zero trade, Poisson Pseudo Maximum Likelihood (PPML) estimator is used in this study (Santos Silva and Tenreyro, 2006).

The study aims to investigate the market structure of Black Sea countries over the period 2004-2010 in two steps. In the first step, we examine whether Black Sea countries along with other six traditional exporters[1] exercise market power in 32 main importing countries. In the second step, we analyze whether KRU have competitive power in wheat export in South Caucasian as well as in Central Asian region, respectively. The findings of this study will contribute to the literature of perfect competition on the international wheat market.

[1] For the correct identification of perfect competition, we include also wheat export data of the US, Canada, France, Germany, United Kingdom and Romania for the same period.

Methodological approach

To investigate the market structure of Black Sea countries we use the gravity trade model. The gravity model is based on Newton's Law of Universal Gravitation Model and is the workhorse of the applied international trade studies. Anderson and van Wincoop (2003) have made a contribution for subsequent extension of gravity trade model, where they show that trade between two partner countries depends not only on bilateral trade relationships of those two units, but also on trade cost of each country with respect to other countries, which the authors called "multilateral resistance" (MR) term:

$$E_{ij} = \frac{Y_i Y_j}{Y^w}\left(\frac{\tau_{ij}}{P_{it}\Pi_{jt}}\right)^{1-\varphi} \qquad (1)$$

E_{ij} is total export from country i to j; Y_i and Y_j show GDP of each country, respectively; P_{it} and Π_{jt} represent price index, also called "multilateral resistance" (MR) terms; τ_{ij} indicates trade cost, that in our case it might be distance, RER or tariff; φ is the elasticity of substitution between the units and, finally μ_{ij} is an error term.

Although Anderson and van Wincoop (2003) used non-linear programming approach to calculate multilateral resistance terms, this study apply importer- and exporter-time dummies, since it helps to remove cross-section correlation between the unobservable MR terms and independent variables, and to avoid time series correlation. Moreover, these fixed effects capture all country specific factors that vary over time (Baldwin and Taglioni, 2006).

Changes in exchange rate can alter the local and foreign prices of agricultural products. An increase in RER indicates depreciation of exporting country's currency[2]. Appreciation of exporting countrie's currency will cause an increase in price set by exporting country and decrease its exports.. Although some researchers used exchange rate in gravity related studies, they do not have theoretical explanation for using this variable in gravity trade model. Therefore this research will be based on the method that has been developed by Anderson et al. (2014), where they found positive effect of exchange rate on aggregated agricultural products export.

Although several estimation methods have been applied in gravity model, some of them give bias results (Santos Silva and Tenreyro, 2006). Investigation of trade patterns in international wheat market show that most countries do not export wheat sequentially. According to our panel data 51 percent of wheat exports is zero and this zero trade values mainly come from the export samples of Canada, the EU and the U.S. In our research we also include zero trade values. In order to use zero values, we apply Poisson Pseudo Maximum Likelihood (PPML) estimator which is developed by Santos Silva and Tenreyro (2006). Moreover, in the presence of heteroskedasticity, the log-linearization of the gravity function can lead to inconsistent estimations, because it changes the feature of the error term. Since the trade data is hetereoskedastic, the mean of the error term is a function of the explanatory variables. Moreover, heteroskedasticity can affect the variance of the estimated parameters, which means we can not trust the t-values. To solve this problem Santos Silva and Tenreyro (2006) suggest using PPML where gravity equation is estimated in levels. In sum, PPML is consistent when there are heteroskedasticity and zero trade flows.

[2] In our research RER is calculated with the nominal exchange rate multiplied by the ratio of importer and exporter's consumer price index (CPI), which means an increase in RER will cause depreciation of the exporting country's currency.

Another advantage of PPML estimator is that the dependent variable does not have to be an integer and it does not require that the data have to follow Poisson distribution, because the model has Poisson pseudo-maximum likelihood estimator and it gives equal weight to all observations. Later Santos Silva and Tenreyro (2011) with simulation evidence demonstrate that PPML works even with excess zeroes and overdispersion.

To deal with the problem of heteroskedasticity and with excess zeroes we are going to use PPML estimation method and our model will look like this:

$$E_{ijt} = \exp\left(\alpha_0 + \alpha_1 ln.dist_{ij} + \alpha_2 contig_{ij} + \alpha_3 tariff_{ijt} + \alpha_4 BA_{ij} + \alpha_5 MA_{ij} + (\sum_{n=1}^{9} \alpha_n ex.c.rer_{nt}) + \gamma_{it} + \delta_{jt}\right) + \varepsilon_{ijt} \qquad (2)$$

where E_{ijt} is the wheat export value from exporting country i to importing country j at time t, $\ln.\mathrm{dist}_{ij}$ is the log of distance between i and j; contig_{ij} equal to 1 if countries have common border; tariff_{ijt} is the import tariff for wheat; BA_{ij} and MA_{ij} are bilateral and multilateral trade agreements between countries, respectively; $\mathrm{ex.c.rer}_{nt}$ is a RER of the exporting country; γ_{it} and δ_{jt} are exporter and importer time-varying fixed effects, respectively; ε_{ijt} is the normally distributed error term.

In general, this study focuses mainly on PPML, but as a benchmark we are also taking the OLS method to compare the results between these two estimation methods and show the advantages of PPML.

We estimate equation 2 using the panel data over the period 2004-2010 to see the market structure of global wheat market. The number of years is limited because of availability of HS 8-digit level data for selected exporting countries. We use export value data of nine big wheat exporters to thirty-two main importing countries. Wheat export value data for KRU countries as well as for Canada are taken from Global Trade Information Services (GTIS), data for the U.S exports comes from the US Census Bureau Foreign Trade Division, while for the EU countries, it is from Eurostat. Tariff data is mainly taken from WTO website, but for non WTO members, the data is available on World Integrated Trade System (WITS) and OECD tariff data base. Bilateral and multilateral agreement data is available on UN-ESCAP, DG-Trade, Office of United States Trade Representative and Foreign Affairs Trade and Development of Canada. Geographical variables (distance and contiguity) are provided by CEPII, and exchange rate data is taken from the IMF.

Discussion of results

As stated earlier, we mainly focus on PPML estimation with time-varying fixed effects, but as a benchmark we also apply OLS estimation. Moreover, as this study is interested in market structure of world wheat exporters and KRU countries, we divide our samples into three cases: first, the wheat exports of six traditional exporting countries and KRU to all importing countries; second, the KRU export to the South Caucasus, and third, the KRU export to the Central Asian countries.

In the first case we investigate the wheat trade between nine exporting countries and 32 importing countries. The results of OLS estimation do not coincide with the ones generated by PPML. It might be argued that heteroskedasticity plays an important role for the differences between these two estimation techniques. For instance, the elasticities for geographical distance, which is the substitute for the trade cost, demonstrate different results for OLS (-1.956) and PPML (-1.837). The outcome of the second estimation method shows in absolute terms lower role of transport cost in wheat exports. Moreover, after controlling for distance, contiguity dummy is about four times less in PPML estimation than OLS, but it is significant in both cases. According to the results of both estimation methods, low tariff rate appears to be important for wheat exports. However, bilateral and multilateral trade agreements do not have any effects on those countries' wheat exports. In addition, all the coefficients of RERs, except Kazakhstan, demonstrate negative sign and insignificant results in OLS estimation. However, RER coefficients changes from negative to positive for six countries under PPML. Although a positive sign of RER demonstrates perfect competition in international wheat market, it is significantly different from zero only for Kazakhstan.

In the second case we analyze the wheat export from KRU to South Caucasian countries. High transportation costs increases trade both under OLS and PPML regressions and it is significant for both estimation methods[3]. Sharing a border influences the trade negatively between these two regions. The reason might be that KRU countries do not prefer to trade with neighboring South Caucasian countries. OLS estimation excludes the tariff result, because it drops out the zero trade and as a result tariff does not change according to importing countries. In contrast, PPML results show insignificant role of tariff in KRU wheat exports to South Caucasian countries. The results for bilateral and multilateral agreements are excluded from the estimation, because they are not changing according to countries. Focusing on main variables of interest, RER coefficients, show that RER of Kazakhstan has positive and significant impact on wheat exports under PPML, while it shows relatively lower effect under Poisson regression. The RERs of Russia and Ukraine demonstrate insignificant results for both estimation methods, but it shows relatively smaller effect of RER under PPML. These results show that there is no evidence of market power of KRU in South Caucasian region and Kazakhstan faces competition while exporting to this region.

Finally, in the third case we analyze KRU wheat exports to Central Asian countries. Although geographical distance has negative effects under both estimation methods, it is insignificant in the case of PPML. The reason might be that for this region transportation cost is small share of total trade costs, since main trading partner (Kazakhstan) is located a short distance from Central Asian countries. The coefficient for contiguity in the case of PPML confirms the previous idea of transportation cost, since it demonstrates expected sign and significant result. We omitted tariff and multilateral agreement variables from the regression, since all these countries belong to the CIS countries, have zero tariff rate among them and signed up to the same multilateral agreements. In contrast, the coefficient of bilateral agreement has positive sign in both cases, but it is only significant under OLS. Insignificant value of bilateral agreement in PPML estimation shows that, bilateral trade relationships do

[3] Although in most gravity papers distance has negative sign, in our case it is positive. The reason can be the quality of wheat and different demand in each South Caucasian country. For instance, the closest country to Russian Federation is Georgia, but it exports more to Azerbaijan than other two countries, because the population (demand) of Azerbaijan is more than others. Moreover, wheat to Georgia either comes through Azerbaijan or through the sea. So, there is no exact transportation cost for Georgian import. On the other hand, distance variable measures a distance between the capitals and geographically the distance between Kiev and Tbilisi is shorter than the distance between Moscow and Tbilisi. However, Georgia imports wheat more from Russia than Ukraine. In general there are several papers which show that distance is not a good proxy for transport cost, but since it is very difficult to measure the exact transport cost, it is generally accepted to take the distance as a proxy for transport cost in gravity trade literature.

not play important role in KRU wheat exports to Central Asian countries. The RER has significantly positive effects on Kazakh and Russian wheat exports under PPML estimation. However, OLS results demonstrate insignificant results of RER for all cases and opposite sign for Kazakhstan. Moreover, as Ukraine is located a long distance from Central Asian countries it is not an important exporter to this region and our results confirm this idea. Overall, PPML results show that KRU countries face strong competition in Central Asian region.

To sum up, we find out that PPML results do not produce the puzzling results as it observed under OLS. Furthermore, we observed negative effects of transportation costs on the wheat exports in all cases except the trade between KRU and South Caucasus. Sharing a border has substantial effect with expected sign in all cases except the trade between Black Sea countries and South Caucasian region. Moreover, low tariff rates increase wheat exports to all observed countries. The final conclusion of this study is that KRU countries do not have market power in wheat markets of South Caucasian and Central Asian countries. In sum, our results represent an improvement on previous wheat market structure studies (Jin, 2008; Pall et al., 2013) and find out perfect competition in the global wheat market which has been also observed by Sekhar (2010) and others.

References

Anderson, J. and van Wincoop, E. (2003). Gravity with Gravitas: A Solution to the Border Puzzle. *American Economic Review*. American Economic Association, vol. 93(1): 170-192.

Anderson, J., Vesselovsky, M., and Yotov, Y. (2014). Gravity with Scale Economies (No. 2014-4). LeBow College of Business, Drexel University.

Baldwin, R., and Taglioni, D. (2007). Trade effects of the euro: A comparison of estimators. *Journal of Economic Integration* 22(4): 780-818.

Cho G., Jin H.J. and Koo W.W. (2002). Measuring the Market Power of the US Wheat Exporters in Asian countries: An Issue about Adjustment of Nominal Exchange Rate When Using as a Cost Shifter. American Agricultural Economics Association Annual Meeting, 28-31

Jin H. (2008). Competitive structure of Canadian wheat exports in the world market. *Applied Economics Letters*, 15:13: 1059-1064.

Li, Y. (2003). Does third-country exchange rate affect bilateral trade?. Master Thesis, Oregon State University

Pall Z., Perekhozhuk O., Teuber R. and Glauben T. (2013). Are Russian wheat exporters able to price discriminate? Empirical evidence from the last decade. *Journal of Agricultural Economics :* 177-196.

Santos Silva, J. and Tenreyro, S. (2006). The Log of Gravity. *The Review of Economics and Statistics* 88 (4): 641-658.

Santos Silva, J. and Tenreyro, S. (2011). Further simulation evidence on the performance of the Poisson pseudo-maximum likelihood estimator. *Economics Letters* 112(2): 220-222.

Sekhar, C. S. C. (2010). Structure of the World Wheat Market: Some Implications for Strategic Trade Policy?. *Journal of Quantitative Economics* 8(2): 142-158.