Essays on trade patterns across South Caucasus and Central Asia and the role of Kazakhstan, Russia and Ukraine in the global wheat market

Dissertation

zur Erlangung des Grades

Doktor der Wirtschaftswissenschaft (Dr. rer. pol.)

der Juristischen und Wirtschaftswissenschaftlichen Fakultät

der Martin-Luther-Universität Halle-Wittenberg

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Halle (Saale),

August 10, 2016

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Tag der mündlichen Prüfung:	24.04.2017
Erscheinungsjahr:	2017

Acknowledgement

I would like to gratefully and sincerely thank Prof. Dr. Thomas Glauben for his supervision, continued support and encouragement along my PhD studies at Leibniz Institute of Agricultural Development in Transition Economies (IAMO).

Moreover, I would like also to say special thanks to Dr. Sören Prehn for his day-to-day supervision, advices and critical comments. My completion of this project could not have been accomplished without his support and help for theoretical model as well as data collection.

My deepest gratitude is also to my third supervisor Prof. Dr. Ingo Pies who provided his remarkable support at the final stages of the dissertation and gave valuable comments during my presentation at Martin-Luther-University (MLU). I would like also to separately thank Dr. Oleksandr Perekhozhuk for his constructive and motivating discussions along my PhD studies.

Many thanks also go to Prof. Dr. Norbert Hirschauer and Dr. Miroslava Bavorova who gave me opportunity to finalize my dissertation, even though I was working on different project during my stay at MLU.

I am thankful also to my former officemates George from Georgia, Kerstin and Miranda for their support and chocolate gifts. Also I thank all my friends from IAMO, MLU and Halle for making my PhD life great and for all the fun we had during my stay in Halle.

I would like also to thank my parents, Prof. Nazim Imamverdiyev and Rafiga Imamverdiyeva, as well as my sister Ulviyya for their support, love, patience and encouragement throughout my professional life. Thanks also to my wife's parents and my relative, Parviz Amiraslanov, for their continued support and motivation.

Last but not the least, my deepest gratitude is to my loving, supportive and caring wife, Gulmira. Specially, she has been everyday with me through ups and downs of this journey and always providing strong believe that I would have done my dissertation someday.

This dissertation was supported by Volkswagen Foundation through MATRACC project "The Global Food Crisis – Impact on Wheat Markets and Trade in the Caucasus and Central Asia and the Role of Kazakhstan, Russia and Ukraine."

Abstract

Kazakhstan, Russia and Ukraine (KRU), collectively also referred to as the Black Sea region, have emerged as wheat exporters since the mid-1990s and have made contributions to world food security and the global agricultural trade. In particular, over the 2000-2010 period, the Black Sea region's share in the South Caucasus and Central Asia (SCCA) region's total imports was more than fifty percent. However, changes in input and wheat prices and several policy interventions have affected the competitiveness of KRU's wheat exports. Moreover, due to an increase in the Black Sea region's export shares, competition in the global wheat market has become more intense during the past decade. Therefore, the goals of this dissertation are to analyze KRU's competitiveness and market structure in the world wheat market and to identify its role in the SCCA region.

The empirical analyses of competitiveness are based on the annual wheat export data for KRU covering the period from 1996 to 2013. However, due to the lack of available data, the study was able to identify the factors that affect the comparative advantage of the Black Sea region's wheat exports only for the 2006-2013 period. The study of KRU's competitive structure covers annual wheat export data over the 2004-2010 period and investigates competition using data on wheat for human consumption.

The descriptive analyses show that the traditional wheat exporters' share of the world grain market has decreased since the emergence of the KRU countries. In addition, the Black Sea region's increasing share of wheat exports has affected the structure of the global wheat market. This share could be further enhanced if these three countries improved their internal transport infrastructures and expanded their relationships with trading partners.

One of the major sections of the thesis compares the competitiveness of KRU wheat exports in the world, the European market and the SCCA region using the Normalized Revealed Comparative Advantage (NRCA) trade index. The results of the NRCA index show that the KRU countries achieved comparative advantage in the world wheat export market primarily after 2001. Furthermore, the study reveals that, on average, Russia is more competitive than the other two post-Soviet countries. According to the NRCA index results, both Kazakhstan and Russia are competitive in the South Caucasus region. However, only Kazakhstan has comparative advantage in wheat exports in Central Asia. In the second part of the competitiveness study, we

analyze whether input prices and government interventions affect the comparative advantage of KRU's wheat exports in the global market. The study uses Box-Cox transformation method which can make the residuals more closely normal and less heteroskedastic. The results demonstrate that exchange rates, wheat prices and production do not have significant effects on the competitiveness of the wheat sector. However, input prices and numerous policy interventions have affected the comparative advantage of KRU wheat exports.

The next major section of the dissertation discusses the market structure of KRU wheat exports in the world market and the SCCA region using the gravity trade model. To control for heteroskedasticity and zero trade flows, the study uses the Poisson Pseudo Maximum Likelihood (PPML) estimation method. The estimation results indicate that transportation costs and high tariff rates are the main obstacles for KRU wheat exports in the world market. In addition, to increase wheat exports, the Black Sea countries should maintain good trade relationships with common border countries. Finally, the study did not find any evidence of market power in the global market or the SCCA region.

This dissertation contributes to the literature on the wheat export competitiveness of the Black Sea countries and, for the first time, investigates which factors affect the comparative advantage of KRU wheat exports in the international market. In addition, the findings of the market structure analysis contribute to the study of perfect competition in the international wheat market. The outcome of the analysis offers insight into food security concerns in the world and in the SCCA region in particular. Finally, another contribution of this study is that it produces several policy recommendations for exporting and importing countries with respect to the diversification of their wheat trades.

Key words: *Black Sea countries, competitiveness, gravity model, perfect competition, Poisson Pseudo Maximum Likelihood Estimation*

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Abbreviations

ARCA	Additive Revealed Comparative Advantage
A-vW	Anderson and van Wincoop
BA	Bilateral Agreement
BRCA	Balassa's Revealed Comparative Advantage
CANP	Comparative-Advantage-Neutral Point
CEPII	Centre d'Etudes Prospectives et d'Informations Internationales
CES	Constant Elasticity of Substitution
CIS	Commonwealth of Independent States
COFCO	China National Cereals, Oils and Foodstuffs Corporation
Comtrade	United Nations Commodity Trade Statistics Database
CPI	Consumer Price Index
EBRD	European Bank for Reconstruction and Development
EMS	Export Market Share
ER	Exchange Rate
EU	European Union
FAO	Food and Agriculture Organization
FAOSTAT	Food and Agriculture Organization of the United Nations, Statistics Division
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GIZ	German Agency for International Cooperation
GPML	Gamma Pseudo Maximum Likelihood
GSIM	Global Simulation Model
GTIS	Global Trade Information Services
HO	Heckscher-Ohlin
HOV	Heckscher-Ohlin-Vanek
HRS	Hard Red Spring
HRW	Hard Red Winter
HS	Harmonized System
IMF	International Monetary Fund
KRU	Kazakhstan, Russia and Ukraine
LRCA	Lafay's Revealed Comparative Advantage
MA	Multilateral Agreement
MFN	Most Favored Nation
MR	Multilateral Resistance
NAFTA	North American Free Trade Agreement
NBPML	Negative Binomial PML
NLS	Nonlinear Least Squares
NRCA	Normalized Revealed Comparative Advantage
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Square
PPML	Poisson Pseudo Maximum Likelihood
PPP	Purchasing Power Parity
PTM	Pricing-to-Market

RCA	Revealed Comparative Advantage
RDE	Residual Demand Elasticity
RER	Real Exchange Rate
RMA	Relative Import Advantage
RoW	Rest of the World
RTA	Regional Trade Agreements
SCCA	South Caucasus and Central Asia
SRCA	Symmetrical Revealed Comparative Advantage
SRS	Soft Red Spring
UK	United Kingdom
UN	United Nations
UNSC	United Nations Security Council
US	United States of America
USD	United States Dollar
USDA	United States Department of Agriculture
WCO	World Custom Organization
WGI	Worldwide Governance Indicators
WITS	World Integrated Trade Solutions
WRCA	Weighted Revealed Comparative Advantage
WTO	World Trade Organization
ZINBPML	Zero-inflated Negative Binomial Pseudo Maximum Likelihood
ZIPPML	Zero-inflated Poisson Pseudo Maximum Likelihood

1. Introduction

According to the United Nations (2011), the world's population will increase to 9 billion by 2050, and most of this growth is expected to take place in developing countries. This population trend, along with changes in diets, increasing use of bio-energy and income growth, means that market demand for agricultural products will continue to grow. In particular, the demand for cereals, for both food and feed use, will increase up to 3 billion MT, which means the production of cereal will need to increase 70 percent by 2050 (FAO 2009). Furthermore, the introduction of bio-energy could change some of the growth projections and may increase demand even more; such changes will depend on government policies and energy prices.

On the other hand, the global trade of agricultural products also continues to expand to ensure food security. It is expected that by 2050, the net cereal imports of developing countries will more than double, from 135 million MT in 2009 to nearly 300 million MT in 2050 (FAO 2009). It was forecasted by OECD/FAO (2010) that over the next ten years, grain prices would be 15-40% higher compare to its 1997-2006 level. However, the recorded grain prices in 2014 were lower than its 2007 level (OECD/FAO 2015). Competition in the global grain market adjusts based on internal and external prices. In particular, perfect competition could cause a decrease in grain prices. Therefore, a fair and competitive trading system in the global agricultural trade would ensure food security. In addition, balanced competition will allow farmers in developing countries to have greater access to and support for developing their grain markets. It is also worth mentioning that competition is based not only on price but also on quality. Consequently, it is crucial to consider quality effects in a competitive analysis of the wheat market.

Kazakhstan, Russia and Ukraine (KRU) entered the international wheat market after the collapse of the Soviet Union. Over the past seventeen years, KRU grain exports have increased sharply from an average of 9 million tons (MT) annually during the 1996-2000 period to 42 MT per year during the 2006-2012 period. The reasons for this include moving from a central planned to an open market economy, relative political stability, investments in grain production and supply chains, and reductions in livestock production. The emergence of the KRU countries (also collectively known as the Black Sea region) as large wheat

exporters has made a contribution to both world food security and the global agricultural trade. Moreover, despite the fact that the Black Sea countries already have a large share of global grain exports, this share could increase even more due to increases in production and yields. All these significant developments have raised questions about the competitiveness and market structure of KRU wheat exports in the international wheat market.

The wheat sector is the backbone of the Black Sea countries' agricultural economies. Since 2000, the KRU countries' share of the global wheat market has increased sharply and they have become the major supplier for several wheat importing countries. Moreover, during 2000-2010 period, KRU's share of the total wheat imports of the South Caucasus and Central Asia (SCCA) was more than 50 percent, and KRU become very competitive in wheat exports to these two regions. However, major changes in the prices of inputs and wheat and several government interventions have affected the competitiveness of KRU wheat exports. In addition, the KRU region is also one of the main exporters of wheat to North Africa, the Middle East and China, but the region competes primarily with traditional wheat exporters in these destinations. Furthermore, transport infrastructure, third-country effects and wheat quality are some of the main factors that contribute to the competitive structure of the Black Sea countries' wheat exports in the global market. Taking into account all these factors, this study analyzes the competitiveness of KRU wheat exports in comparison to the exports of its rivals and investigates the competitive structure of these three countries in the world wheat market.

Considering the huge export potential of the Black Sea region, analyses of the competitiveness and market structure of KRU wheat exports have received significant attention in agricultural literature. However, the majority of studies on competitiveness have used trade indices that do not assess comparative advantage over space and time (Yu et al. 2009). Moreover, literature on the competitiveness of KRU agricultural exports is based on the authors' judgements, and these studies do not empirically analyze which factors affect the competitiveness of KRU wheat exports (Khatibi 2008; Ishchukova and Smutka 2013; Yermakov and Kharchenko 2014). Finally, the market structure of KRU wheat exports has not yet been investigated comprehensively, and the few studies that have been conducted did

not consider third-country effects or the effect of wheat quality on bilateral trade (Li 2003; Jin et al. 2004; Mattoo et al. 2012)[1].

The purpose of the first empirical section is to analyze the competitive performance of and trends in KRU wheat exports in the European and SCCA markets using trade indices. I also identify factors that affect the comparative advantage of the Black Sea countries' wheat exports during the 2006-2013 period. The second empirical section aims to determine whether KRU countries had market power in the global wheat market and whether they faced competition in the SCCA region during the 2004-2010 period. For the analysis of the competitive structure, the study uses wheat for human consumption.

The study of competitive advantage is based on the trade theory of the Heckscher-Ohlin-Vanek (HOV) model, which suggests that a country's competitiveness in trade depends on its factor endowments. Moreover, Peterson and Valluru (2000) showed that different policy interventions can also affect comparative advantage among trading partners. Therefore, our study of competitiveness has three main goals: First, what is the competitive performance of KRU wheat exports in the international and EU markets? Which of the Black Sea countries is most specialized in wheat exports to the SCCA region? Do exchange rates, input prices and policy variables affect the comparative advantage of KRU wheat exports in the global market? Competitiveness is defined as the ability to be successful in competition. According to the trade theory, there will be perfect competition if there is free exit and entry to the international market. Thus, this dissertation investigates whether the emergence of the KRU countries created imperfect competition in the world wheat market. Finally, it explores whether the Black Sea countries have market power in wheat exports to the SCCA region.

The study of competitiveness is divided into two parts. In the first part, we compare the trends in the comparative advantage of KRU wheat exports in the international, EU-27 and SCCA wheat markets using the Normalized Revealed Comparative Advantage (NRCA) trade index. In the second part, the study uses three groups of variables to represent three factors (real exchange rate, cost of production and policy interventions) and empirically analyzes

[1] See sections 3.2 and 4.2

how these factors affect the competitiveness (NRCA values) of KRU wheat exports in the global market using the Ordinary Least Square (OLS) and Box-Cox estimation methods.

Another section of the thesis investigates the competitive structure of the Black Sea countries' wheat exports in the world market and in the SCCA region using the gravity trade model. In addition, the study analyzes how distance, tariff rates and trade agreements affect KRU wheat exports. To investigate these issues, we employ the Poisson Pseudo Maximum Likelihood (PPML) estimation method to control for heteroskedasticity and to solve the problem of zero trade flows (Santos Silva and Tenreyro 2006). The study also applies the OLS method as a benchmark and for comparison to the outcomes of the PPML method. Furthermore, in this analysis we consider the effects of third-country exchange rates and wheat quality with the help of time-country fixed effect, which is a proxy for multilateral resistance term.

This study reveals that there is perfect competition of KRU wheat exports in the world wheat market, which was not observed in previous studies. Furthermore, trade diversification among wheat importing countries will increase this competition even more. Policymakers in the KRU countries should also think about land reforms and decreasing input costs and livestock production to increase the competitiveness of KRU wheat exports in the global market.

In sum, this dissertation contributes to the literature on wheat export competitiveness and offers the first analysis of the factors that affect the comparative advantage of KRU wheat exports in the world market. In addition, the findings of the gravity trade model contribute to studies of perfect competition in the international wheat market. Although many researchers have investigated competition in the wheat market, this study also considers wheat quality effects in the analysis of competition by using multilateral resistance term in gravity model. The outcome of the analysis offers insight into food security concerns in the world and the SCCA region in particular. Finally, this study also provides several policy recommendations for exporting and importing countries with respect to the diversification of their wheat trade.

The rest of the thesis is structured as follows. Chapter 2 provides an overview of the wheat markets of the Black Sea countries and of traditional wheat exporters. The third chapter

investigates KRU's wheat export competitiveness in four markets and identifies the factors that contribute to the comparative advantage of KRU wheat exports in the world. The fourth chapter presents a study of the competitive structure of the Black Sea countries in the global wheat market and the SCCA region. Finally, the last chapter outlines the overall conclusions of the dissertation.

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2. Descriptive analysis of the world and KRU wheat markets

The export and production performance of world wheat traders has changed during the past two decades, in particular because new exporters appeared in the international wheat market in the early 1990s. Following the collapse of the former Soviet Union, the wheat export shares of the former Soviet Union countries, particularly Kazakhstan, Russia and Ukraine (KRU), has greatly increased. The aim of this chapter is to analyze the top global wheat exporters and producers and show the role of the KRU countries (also called Black Sea countries) in the global wheat market. This chapter is divided into 5 parts. The first part describes world wheat production and compares traditional wheat producers with the Black Sea countries. The second part discusses wheat quality in different countries. The third part investigates the price dynamics in international and KRU wheat markets. The fourth part analyses wheat consumption and imports as well as the role of the Black Sea region in supplying wheat to major importing countries. Finally, the last part investigates the competitive environment for world wheat exports and the role of the KRU countries in this market. The time period covered by the descriptive analysis is 1996-2012; however, this time period is shortened for some sections due to the lack of available data.

2.1. Wheat production

Wheat is the most important cereal crop produced in the world, and wheat production increases every year. Increasing wheat production in the world is important for developing and developed countries around the globe because the demand for food and feed wheat is also increasing every year. According to FAOSTAT (2015), the world's wheat production increased by 22% over the period 1996-2012, with the highest increase over the previous year occurring in 2004 (632 million tons). Improvements in breeding and modern technology have raised wheat production all over the world. The yield increased 26% after 1996, or approximately 1.5% per year, but the total harvested area decreased by 3% for the analyzed period (FAOSTAT 2015).

Table 2.1.1 lists the top 11 wheat producers in the world for the period 1996-2013. The top 10 of the 11 highest-producing countries countries accounted for more than 85 percent of total world wheat production and these countries controlled total world wheat production during this period.

China was the world's largest wheat producer and represented 17 percent of world wheat production from 1996-2013. Furthermore, China also had the highest average wheat yield for the same period. India has been the world's second largest wheat producer over the past decade and it had the largest average area harvested during the 1996-2013 period (27231 thousands hectares). However, most of the wheat is used for domestic consumption in China and India due to the huge local demand. On the other hand, the US was both the third largest wheat producer and one of the largest wheat exporters in the world during this period. On average, the US also had the second largest yield due to modernization and good management systems.

Table 2.1.1: Production, average yield and average harvested area of the world and top 11 wheat producing countries, 1996-2013

Country	Production mln,tons	Average Yield Hg/Ha	Average Area harvested thousands, ha
Argentina	243	25719	5313
Australia	389	17307	12478
Canada	456	25586	9925
China	1938	43176	25073
European Union	2401	51196	26039
India	1355	27559	27231
Kazakhstan	215	10038	11836
Pakistan	375	24518	8465
Russian Federation	804	19265	22934
Ukraine	305	27559	5985
USA	1066	28393	20902
World	11270	28720	217957

Source: Own compilation based on FAOSTAT.

After the mid-1990s, new wheat producers such as Kazakhstan, Russia and Ukraine entered the international wheat market. The role of the KRU countries in world wheat production increased primarily after the breakup of the post-Soviet Union. However, this increase was smaller in the 1990s than after 2000. This is because sown areas sharply declined, fertilizer use was low, grain seed quality was below average and production was poorly managed in the 1990s. After 2000, however, state support for the grain sector increased and governments introduced land reforms and decreased live-stock production. As a result, the KRU countries changed from wheat importers to primarily exporters of wheat. KRU's total wheat production was always higher than

that of the US from 2004-2012. A good explanation for this is that the US changed its policy and started to use wheat for bioenergy. In 2008, the total wheat production of the Black Sea countries accounted for 15 percent of the world's wheat production, which was 2 percent more than in 2007 (Prikhodko 2009). Such high production can be maintained in the future if wheat continues to be a highly profitable agricultural product for KRU farmers.

The wheat production potential of the KRU countries depends on land use and yields. Two of the main reasons for increases in KRU wheat production were the move to an open market economy and improvement in production. The KRU countries used less area for wheat production in 2012 than they used in the 1980s. Although unstable weather conditions in KRU increased production volatility for the KRU countries, major weather indicators showed that after 2000, these countries had favorable weather conditions, except in 2003 and 2010 (Liefert et al. 2013). Easy credit systems for farmers, investment, insurance for agricultural products, research, new technology and human capital development could improve production even further in the future.

When comparing wheat yields among the KRU countries, one can observe that the yield in Ukraine is 43% higher than Russia, even though it has a lower wheat production than Russia (Table 2.1.1). Plausible explanations for this include the replacement of old agricultural machines with new ones, an increase in fertilizer use and the use of zero-till technology in crop production by some agricultural companies. The size of the harvested areas in each country correspond to each country's total area: the largest harvested area is in Russia, followed by Kazakhstan and then Ukraine.

There are also other factors that increased wheat production in this region. For instance, following a government intervention, livestock, milk and sugar production were replaced by crop production in Russia. Between 1990 and 2000, KRU meat production, in particular pork and beef production, decreased by more than half while meat imports increased (Liefert et al. 2013). In addition, the Russian government stimulates wheat production with fixed domestic prices for fertilizers, low taxes, development of animal husbandry and subsidized credits (Svatos et al. 2014).

Land reform is also one of the policy issues that affected production. Of the three countries, only Russia has introduced reforms in the land market. In particular, in 2006, the Russian government

allowed the sale of farmland. However, the sale of farmland is still problematic in Ukraine and Kazakhstan (FAO-EBRD 2008). Such policies discourage farmers and investors from realizing their wheat production potential and decrease production.

Creation of agroholdings also affected the increase of wheat production in the Black Sea countries. These large corporations are vertically integrated and have more than 100,000 ha of agricultural land (FAO-EBRD 2008). These agro-holdings have the advantage of being able to attract more investment for agriculture and easier access to credits from banks.

2.2. Wheat quality

Differences in quality among classes and types of wheat can often affect the prices for and sales of wheat in the world. In this part, I will discuss the wheat quality of top exporters and describe the importance of wheat quality for exports. The US has six different wheat classes that each have a different protein content, but only three of them are primarily for export: Hard Red Winter (HRW), Hard Red Spring (HRS) and Soft Red Spring (SRS). In general, it is difficult to compare different classes of wheat across countries because each wheat class has a different quality (protein content). For instance, US Gulf HRW has an 11.5% protein content while both Australian Albany western hard wheat and Germany Rostock "A"-quality wheat have a 13% protein content.

In addition, among the Black Sea countries, Kazakhstan has high-quality wheat with a protein content between 12% and 14%, while Russia and Ukraine have relatively low-quality wheat with protein contents of 12% and 11%, respectively (Prikhodko 2009). In particular, 90% of Kazakhstan's total wheat production has a protein content between 12% and 14%, but 64% of Ukraine's total wheat production is feed wheat with a protein content of less than 11% (Prikhodko 2009). Russia primarily exports third and fourth class wheat, which has a protein content between 10.5% and 12.5% (APK-Inform 2013).

It is crucial to consider wheat quality when analyzing the trade patterns of wheat exports because countries with high-quality wheat can price discriminate in wheat exports. For instance, Lavoie (2005) found that the Canadian Wheat Board used price discrimination in exports of high protein wheat (a vertically differentiated product), especially in markets that valued the quality of the product. Djuric et al. (2015) mentioned that Serbia's competitiveness in wheat exports decreased

due to the low quality of the country's wheat in 2008. O'Brien and Olson (2014) looked at the competitive position of the KRU countries in global wheat exports by analyzing the quality of the exported wheat. The authors found that the competitiveness of KRU wheat exports is affected by differences in wheat quality characteristics and transport infrastructures. Moreover, according to O'Brien and Olson (2014), Kazakhstan's wheat export price is cointegrated with the Russian wheat export price, while the Russian wheat export price is associated with US soft red winter wheat and hard red winter export prices, and the Ukrainian wheat export price is related to German milling wheat export prices. Given the substantial influence of wheat quality on exports, I will consider this factor in my analyses.

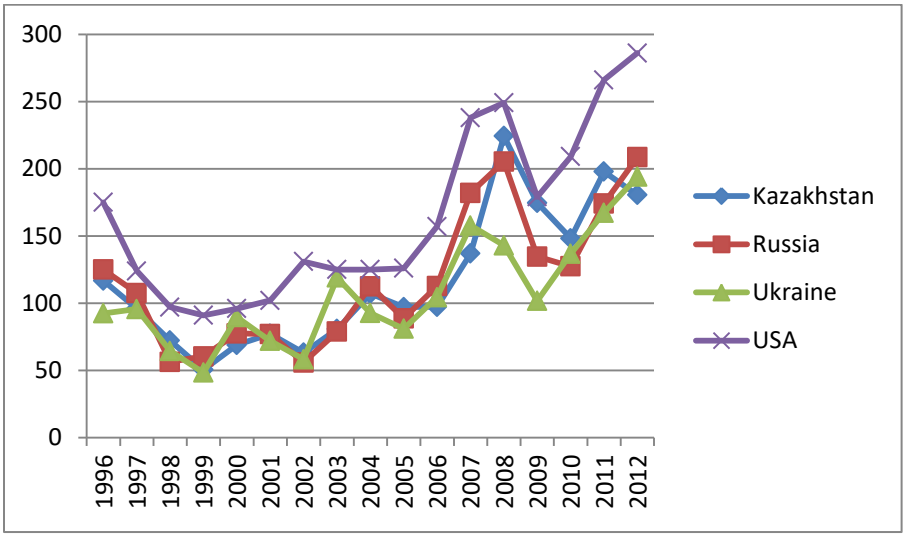
2.3. Wheat price

Price analyses of agricultural products have received a considerable amount of attention by researchers in the past two decades due to the growing trend towards market liberalization in the world. However, few studies have investigated the wheat price dynamics of the world for the past decade, particularly for KRU countries (Goychuk and Meyers 2011). High prices for wheat from the Black Sea region could not only increase production but also influence world price dynamics because the Black Sea region has a large market share of global wheat exports. Because the role of the Black Sea countries is increasing in the international wheat market and wheat prices are becoming more volatile, this study looks at the price volatility of traditional wheat exporters and compares the results with the price dynamics of the KRU countries.

Several studies have analyzed the factors that affect the price volatility of wheat. Kemeny et al. (2012) have found that KRU wheat export growth can positively influence international wheat price volatility. However, the volatility of crude oil and corn prices do not have any effect on global wheat price volatility. Other scholars have investigated short- and long-term wheat price dynamics among Russia and Ukraine and other traditional wheat exporters (Goychuk and Meyers 2011). The authors found that Russian price changes are cointegrated with EU (French) wheat prices, but Ukrainian wheat price volatility is not cointegrated with Canadian or US price series'.

Figure 2.3.1 illustrates the price volatility of KRU wheat for the period 1996-2012. As a benchmark, I also include the price volatility of US wheat, which shows the upper bound of the world market price. One can see that the KRU countries are primarily following the wheat price dynamics of the US, but they are always below the upper bound price. The reason for the price differences between KRU and US wheat might be due to differences in the quality of wheat produced by these countries.

Figure 2.3.1: Producer price for wheat in USD/ton, 1996-2012



Source: Own compilation based on FAOSTAT.

Table 2.3.1 presents descriptive statistics of wheat prices in USD per ton for the Black Sea countries and for the US over the period 1996-2012. The table shows that the mean price in the US is higher than in the other three countries. Furthermore, the most volatile price series is also observed in the US. A plausible explanation for this could be that the KRU countries have more control over wheat prices than the US, while the US has a free market and prices can therefore change quite a bit.

Price volatility affects the decisions of policymakers. A sudden price increase for wheat in 2007 affected consumers and producers, especially in transition countries. Therefore, many countries reacted with policies designed to limit increases in wheat prices and benefit their local consumers. These policies included introducing export duties, export quotas or export licensing

on grain exports; establishing price controls for selected products; and decreasing import tariffs. However, such policies did not benefit consumers and also had harmful effects on producers.

Table 2.3.1: Descriptive statistics of wheat prices in KRU and the US, 1996-2012 (USD/ton)

Countries	Observation	Mean	Std. Dev.	Min	Max
Kazakhstan	17	117.02	51.61	50.5	224.3
Russia	17	116.72	50.20	55.9	208.5
Ukraine	17	106.96	40.72	48.4	194
US	17	163.29	64.16	91	286

Source: Own compilation based on FAOSTAT.

Other reasons for the sudden increase in wheat prices were changes in the supply side as well as problems on the demand side. Subsidies for other agricultural products, reductions in stock levels for grain and high prices for fuel were the main reasons for the wheat price increase from the supply side. On the demand side, the main problems were the growth of interest in agricultural products, huge increases in demand for agricultural products in China and India, and the development of the biofuels market (FAO-EBRD 2008). All these changes represent the main drivers of increasing prices for agricultural products in emerging and transition countries.

To combat this price increase for agricultural products, the Black Sea countries applied several policies. For example, KRU introduced export restrictions on the wheat trade after 2006 to limit increases in the price of wheat. However, this policy did not benefit KRU consumers. In Ukraine, after the introduction of export quotas for selected grain types in 2006, wheat consumers gained very little: although the price of wheat was constant during that time, prices for flour and bread increased (Cramon and Raiser 2006). Moreover, because Ukraine is a net wheat exporter and many people work in this sector, this policy damaged the producers and decreased their income. Consequently, this policy actually increased poverty in the country and the primary beneficiaries of the policy were animal feed producers and flour millers (Cramon and Raiser 2006). In contrast, Russia applied different policies to control food prices. In 2007, the Russian government negotiated with the biggest suppliers and producers of food in the country to keep prices stable for several products (e.g., bread, milk, vegetables, eggs and cheese). However, consumers and producers did not gain much from this policy. Although prices were stable for some products, some producers decreased the quality of the products and, as a result, several producers were bankrupted due to this policy. Furthermore, the Russian government also

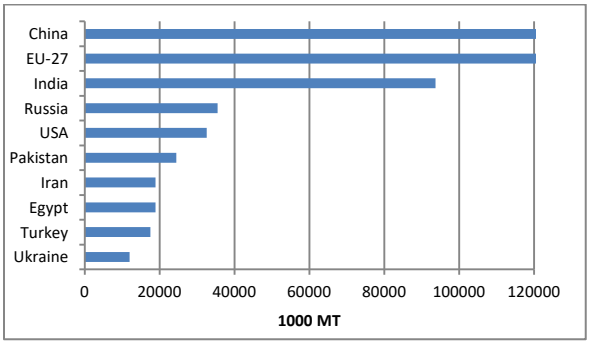
decreased the import tariff for milk and dairy products. While this type of policy can benefit the population if the country is a net importer of these products, local producers will suffer from this policy if the country is a net exporter (FAO-EBRD 2008).

Overall, if a country wants to control food prices, it has to calculate the costs and benefits of each policy before applying it. In addition, it would be more effective if the government gave subsidies to support the more profitable agricultural sector, developed the land market and infrastructure, and increased investment to the agricultural sector of the country.

2.4. Wheat consumption and importers

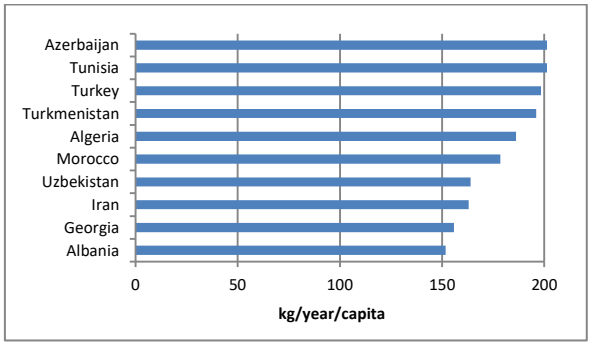
Wheat is the most important product among the cereals and has a higher caloric and protein content than any other food group. Because most wheat is consumed in the form of baked goods, it has to be milled to produce flour. Thus, the milling industry is the main consumer of wheat.

Figure 2.4.1: Top 10 wheat consumers of the world, 1000 MT, 2014



Source: Own compilation based on USDA.

Figure 2.4.2: Top 10 wheat consumers per capita, kg/year/capita, average 1996-2011



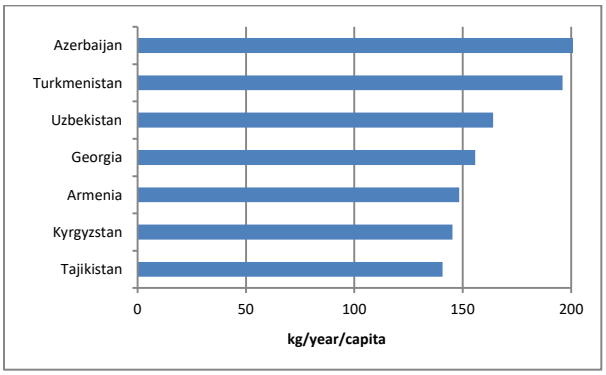
Source: Own compilation based on FAOSTAT.

Figure 2.4.1 shows the top wheat consumers of the world in 2014. China is the largest consumer of the wheat (124 million metric tons) followed by the EU-27, India, Russia, the USA and other countries. However, China's wheat consumption per capita could decrease in the future due to the shift in diet preferences from cereal to meat consumption. Wheat consumption in India will increase because of diet diversification (i.e., more wheat and less rice consumption). However, China and India are also the largest wheat producers and they import small shares of their wheat consumption.

The largest per capita consumers of wheat are Azerbaijan and Tunisia. A person in these countries consumes almost half a kilogram of wheat every day. If we look at the regional level, the highest consumption of wheat per capita is in North Africa. Wheat consumption in this region has increased by 20% over the past decade, but imports have increased by only 3% on average since 2001 (Weigand 2011). In contrast, in some South Asian countries, particularly in South Korea, Malaysia, Indonesia, Thailand, the Philippines and Vietnam, wheat consumption is low because consumers use rice as a substitute for wheat.

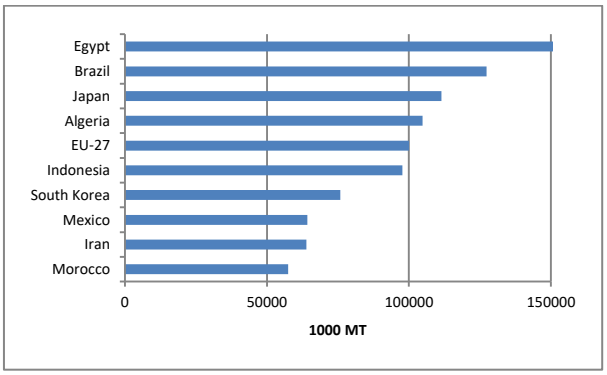
It is also interesting to look at per capita wheat consumption in the South Caucasus and Central Asian (SCCA) region because this region is one of the major importers of KRU wheat. Figure 2.4.3 presents the per capita wheat consumption of the SCCA region from 1996-2011. In the South Caucasus, the lowest consumption of wheat per capita was observed in Armenia, and the lowest consumption was in Tajikistan among the Central Asian countries.

Figure 2.4.3: Wheat consumption per capita in South Caucasus and Central Asian countries, kg/year/capita, average 1996-2011



Source: Own compilation based on FAOSTAT.

Figure 2.4.4: Top 10 wheat importing countries, 1000 MT, 1996-2014



Source: Own compilation based on USDA.

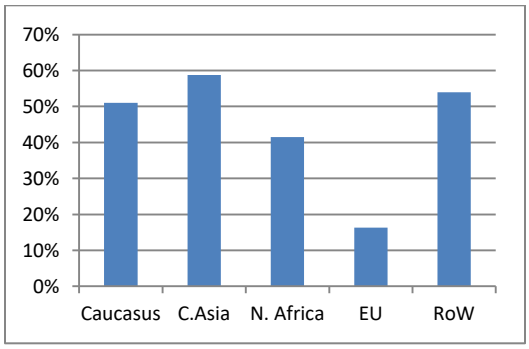
There are many wheat importers in the world, but Egypt and Brazil import the largest total combined share (5%) of wheat in the world (Figure 2.4.4). The other largest importers are Japan, followed by Algeria, Indonesia, South Korea and Mexico, but these countries import less than 5% of the international wheat.

If we look at the wheat imports of the SCCA countries, we can see that these countries import more than half of the wheat exported by the KRU countries (Figure 2.4.5). In general, due to

increasing populations and income growth, SCCA wheat imports are expected to rise in the future, and KRU will have great potential to export wheat to this region. In contrast, although North African countries are the main wheat importers in the world, they do not depend on KRU wheat exports.

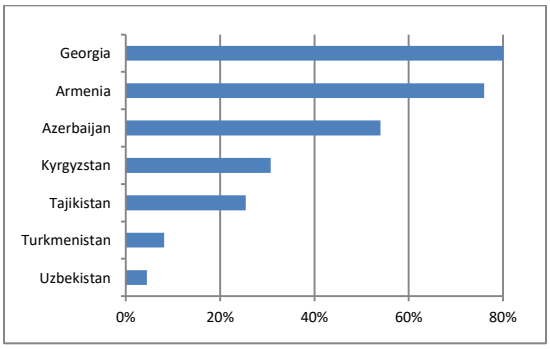
Now let us look at which SCCA countries depend primarily on wheat imports for consumption. Figure 2.4.6 demonstrates the wheat import to consumption ratio for the period 2000-2009. One can see that Georgia's and Armenia's wheat consumption depends primarily on wheat imports, as they import more than 75 percent of the wheat they consume from other countries. Although Uzbekistan has the highest wheat consumption in the region, it imports only 4 percent of the wheat it consumes, which means the country's local wheat production is almost sufficient for the country's population. However, because Uzbekistan has the highest population in the region, it imports quite a lot of wheat compared to other countries. It is worth to mention that Uzbekistan is also a major importer of wheat flour from Kazakhstan, which means this country meets its consumption with wheat flour as well. As mentioned previously, although Azerbaijan has the highest consumption of wheat per person, it imports nearly half (54%) of its wheat consumption primarily from Kazakhstan and Russia.

Figure 2.4.5: KRU countries' share of total regional imports, 2004-2010



Source: Own compilation based on GTIS and Eurostat (HS 8-digit code)

Figure 2.4.6: SCCA countries' wheat imports to consumption ratio, 2000-2009



Source: Own compilation based on FAOSTAT.

In general, the South Caucasian countries have different wheat import strategies. For example, Azerbaijan imports half of its wheat from the Russian Federation, but it is also one of the main importers of Kazakh wheat. Georgia has diversified its wheat importing strategy and imports wheat not only from Kazakhstan but also from the Russian Federation, Ukraine, the US and

other countries. Armenia buys wheat primarily from Russia, Ukraine and some European countries but imports only a small portion of its wheat from Kazakhstan.

The Central Asian countries (Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan) consume mostly Kazakh wheat. However, the railway capacity of the Central Asian countries limits wheat exports to the south. Moreover, Tajikistan and Uzbekistan rely mainly on wheat imports, but Kyrgyzstan and Turkmenistan import only small quantities of wheat and play minor roles in the regional wheat trade. Although these four countries import wheat mainly from Kazakhstan, Tajikistan and Uzbekistan also imported wheat from Russia during the 2000-2011 period. Hence, Kazakhstan faces some competition in the Central Asian region.

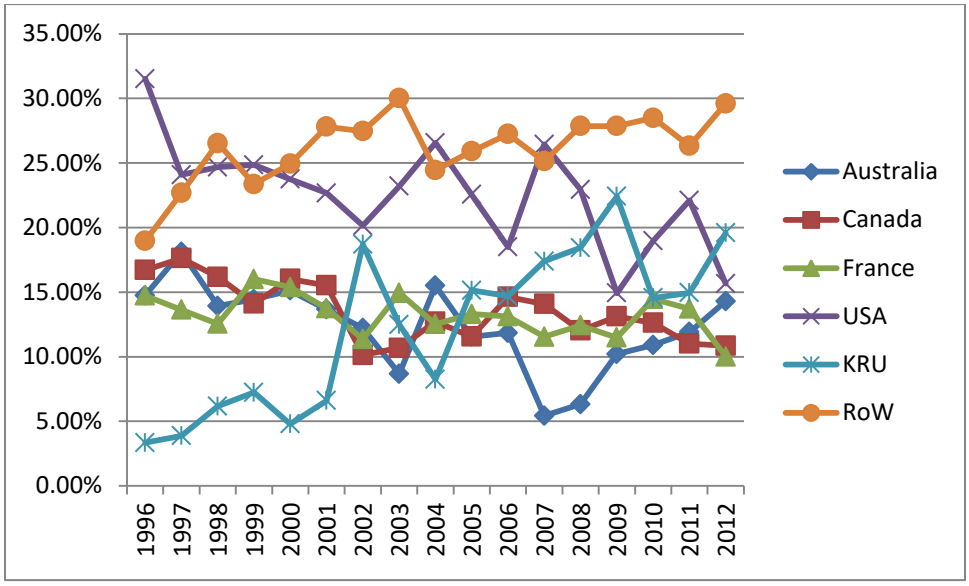
2.5. Wheat export

Wheat is the most exported agricultural product of the world in terms of quantity (UN Comtrade 2014). Global wheat exports have increased by 67% since 1996, with an average growth rate of 3.4% per annum (FAOSTAT 2015). The top five wheat exporters in the world are Australia, Canada, France, Russia and the USA. Figure 2.2.1 shows the wheat export shares of the top 5 countries and the rest of the world (RoW) from 1996-2012. As we see, the USA usually led in wheat exports with average share of 23% for the analyzed period and the highest share of 32% in 1996. However, the USA's share decreased by 8% from 2000 to 2012. One of the main reasons is that the USA started using wheat for biofuels and decreased its wheat exports to the world. The shares of Australia, Canada and France are similar and lower than the USA and the KRU countries.

The grain sector is the backbone of KRU's agricultural economy, and these countries are the main wheat exporters in the Commonwealth of Independent States (CIS). While still part of the Soviet Union, the KRU countries imported wheat from traditional wheat exporters such as the US, the EU, Canada, Australia and Argentina. These countries have increased their market share of wheat exports over the past 20 years, however. In Table 2.2.1, we see the role of the KRU countries in world wheat exports over the 2000-2011 period. The table shows that in 2009 and 2010, KRU was a leading wheat exporter in the world. International organizations estimate that the export market share of the Black Sea countries will continue to grow. For example, according

to the USDA, the KRU countries are expected to provide 22 percent of world wheat exports by 2021.

Figure 2.5.1: Wheat export shares of the top 5 exporting countries and rest of the world (RoW), 1996-2012



Source: Own compilation based on FAOSTAT

In general, the KRU countries became important players in international wheat exports after 2000. Several factors increased KRU wheat exports: the emergence of large wheat importers (the Islamic Republic of Iran, Pakistan and the Republic of Korea), a decline in US wheat exports, the growth in demand for feed wheat, decreases in freight cost and the devaluation of the national currencies of the KRU countries (Prikhodko 2009).

However, if we look at the graph of KRU wheat exports, we can see that there were many highs and lows in the total wheat exports of the Black Sea countries (Figure 2.2.1). This can be attributed to the KRU countries' proposing export taxes and export bans on wheat during the period from 2007-2011. In general, first export barrier was set by Ukraine in March 2007 for eight months. In April 2008, Kazakhstan introduced an export restriction on wheat that continued for five months. The next export ban was implemented by the Russian Federation in 2010. In addition, several countries including the Russian Federation and Kazakhstan implemented export

taxes to control wheat exports. All these policies affected wheat prices and trade relationships among the countries.

Table 2.5.1: Top 10 wheat exporting regions and countries, mln tons (HS 100190)

	2008	2009	2010	2011	2000-2011
KRU	16404	40950	43357	22064	335205
Australia	8098	20051	15634	19475	188027
EU	21229	15459	15516	13345	164931
Canada	17140	19455	21181	15377	158596
USA	7503	12881	4860	32036	104938
Argentina	8765	5114	4036	8373	102994
Turkey	29509	201	826	3	80282
Brazil	643	384	1320	2344	14516

Source: Own compilation based on UN-Comtrade.

The other reasons for KRU's volatile wheat exports were infrastructure problems and bad management systems (Pall et al. 2013). In particular, during the period from 2004-2010, Russia and Ukraine exported wheat to approximately 90 destinations, while Kazakhstan exported to only 61 countries. In contrast, because traditional wheat exporters have relatively better infrastructures and management systems they supplied wheat to even more destinations. For example, the US exported wheat to 134 countries and Canada exported to 111 countries from 2004-2010 (own calculations, WITS). As we see, a developed infrastructure and good management systems can increase the number of buyers.

The Black Sea countries' accession to the World Trade Organization (WTO) could bring other new opportunities in terms of the world wheat market due to the major differences in tariffs applied to WTO members and non-members[2]. After accession to the WTO, the Black Sea countries will be entitled to "most favored nation" (MFN) tariff rates and may therefore have better access to many wheat importing countries such as China, Turkey and the EU countries[3].

[2] Ukraine joined the WTO in 2008, and Russia joined in 2012. Kazakhstan began the negotiation process for accession to the WTO in 1996 but is still not a member of this organization.

[3] For example, in 2010, China had a tariff rate of 180 percent on wheat imports from non-WTO members and a rate of 65 percent for members.

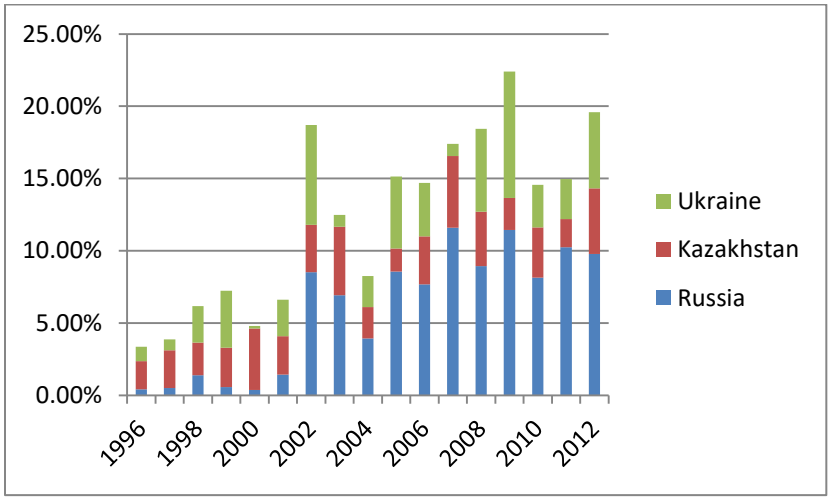
Such a situation could also affect the export shares of traditional wheat exporters. However, using a global simulation model (GSIM), Burkitbayeva and Kerr (2013) showed that KRU's accession to the WTO will not negatively affect wheat exports from Australia, Canada, the EU and the US because these traditional large wheat suppliers will diversify their exports while marginally increasing their exports to existing buyers at a lower price.

Outside Eurasia, the main competitors of the Black Sea countries are Argentina, Australia, Canada and the US. In the EU the main competitors are the United Kingdom (UK), France, Germany and Romania. The KRU countries compete primarily with EU suppliers in the European market and the North African region.

In spite of the fact that KRU supplies wheat in large amounts, several problems still exist for KRU wheat exports. First, the three countries have low economic efficiency and poor technical infrastructures that affect storage systems and wheat delivery. Moreover, old railway transportation systems cause delays in wheat transportation. An insufficient knowledge of new production practices and lack of experts in the agricultural sector also affect the development of the grain trade. Therefore, the governments of these countries need to take action to develop the grain sector in the future. These actions could include the following: investing in storage, handling equipment, and railway transportation; increasing support for human capital development as well as research; improving land markets; and strengthening credit systems for the agricultural sector (FAO-EBRD 2008). However, each of these three countries has its own export problems and export directions, which will be discussed in the next paragraphs.

Kazakhstan is the largest landlocked country in the world. The country's wheat is exported in three key directions: to Iran, Azerbaijan, Georgia and Turkey (35%); to Central Asian countries (24%); and to European countries (10%). Kazakhstan's wheat exports to China are very small relative to its exports to other countries. Wheat exported to western countries goes through the territory of the Russian Federation because Kazakhstan does not have cargo ships in the Caspian Sea. The smallest part of Kazakh wheat goes to Europe because the Russian Federation and Ukraine dominate the Black and Baltic Sea terminals and Russia has a high transportation tariff for wheat. Moreover, as Kazakhstan is very far from European countries and the railway capacities of the transporting countries are weak, it takes nearly a month for wheat to travel to European countries.

Figure 2.5.2: KRU share of world wheat exports, 1996-2012



Source: Own compilation based on FAOSTAT.

Poor transportation systems represent one of the main obstacles for Kazakhstan's wheat exports to the Central Asian market in recent years. For example, the absence of railway connections between Kazakhstan and Turkmenistan has been a major obstacle to the expansion of Kazakhstan's wheat exports to Iran (Zharmagambetova and Flake 2014). However, Kazakhstan's long-standing reputation as a net wheat exporter will likely allow the country to exploit its comparative advantage in the near future and eventually become a major contributor to food security across Central Asia and beyond (United Nations Security Council (UNSC), 2014a). According to the UNSC (2014b), Asia has the largest population of undernourished people (> 500 million) in the world. Kazakhstan could become a regional leader in the supply of wheat to the Middle East and Central Asia.

Several opportunities exist for Kazakhstan's government to increase its wheat exports, including to the Middle East, China and neighboring CIS countries. One of the goals of Kazakhstan's government has been to diversify wheat exports to the south via the Caspian Sea or overland through Turkmenistan to Iran and markets in the Middle East (Zharmagambetova and Flake 2014). While Iran has become one of the largest buyers of Kazakh wheat exports to the south, exports transported via the Caspian Sea are limited to 700,000 tons/year due to the existence of a single operational port terminal at Amirabad (Ziyadov 2012, p. 79). The Kazakh government has already begun to invest in a new rail infrastructure and routes to markets such as Iran. According to the Ministry of Agriculture of Kazakhstan, a new rail link has been completed between

southern Kazakhstan and the Turkmenistan-Iranian border, and plans to build a new grain terminal at the Iranian border are underway (Zharmagambetova and Flake 2014).

Another potential growth market for Kazakh wheat is China, where a growing middle class demand for animal protein (e.g., pork) and a steady decline in domestic wheat production are forecasted to increase wheat imports (Weigand 2011). Kazakhstan's wheat exports to China increased mainly after 2009, in the wake of signing the "Sino-Kazakh Cooperation Memorandum of Understanding Wheat Trade" between the Chinese National Cereals, Oils and Foodstuffs Corporation (COFCO)[4] and Kazakhstan's National Agricultural Holding AG. Under the agreement, Kazakhstan's wheat exports to China increased sharply from 24,000 tons in 2009 to 124 million tons in 2013 (UNComtrade 2014). The agreement was renewed in May of 2014, (COFCO 2014) and Kazakhstan recently finished building a new rail link from Eastern Kazakhstan to the Chinese border and is planning to construct a new grain terminal near the Chinese border (Zharmagambetova and Flake 2014).

Kazakhstan has also chance to export wheat to Europe. However, Kazakhstan faces high transportation costs due to railway capacity constraints and the dominance of the Russian Federation- and Ukrainian-owned sea terminals at the Black Sea and Baltic Sea ports that service Western wheat markets. Russia is Kazakhstan's main competitor in wheat exports and has a 40% export market share in the Black Sea region. Kazakhstan's wheat exports to the West go mainly through the Tuapse port, which opened in 2009. However, overland transport via rail of wheat to this port directly competes with the Russian wheat trade. Taman port, a relatively new port that began operating in September 2011, does not provide rail access (Flake and Zharmagambetova 2013). New port grain terminals require significant investment and will only partially mitigate the high transportation costs of reaching distant western European markets when competing with Russian and Ukrainian wheat.

Russia is the biggest wheat exporter in the Black Sea region, and Russia's wheat exports can also affect the world wheat price. Russia exports wheat primarily to North African countries (34%), although Russia also exports wheat to other important regions such as the Middle East (11%), Mediterranean countries (16%) and the South Caucasus (10%).

[4] COFCO, a major importer of grain into the Chinese market, procures, processes, and markets wheat, corn, and rice, (COFCO 2014).

The growth of wheat exports after 2000 is explained mainly by the increase in productivity of Russian agriculture. There was huge increase in Russian wheat exports in 2007 after Ukraine introduced export restrictions on wheat, and large importers began importing wheat primarily from Russia. However, Russia also placed export restrictions on wheat during 2010-2011 to prevent increases in staple food prices for local consumers. In general, farm level improvements and the development of agroholdings are expected to increase Russian wheat exports in the future (Liefert et al. 2013).

Ukraine is one of the most important suppliers of wheat to the international grain market. Ukraine wheat is exported mainly to African and the EU countries. More concretely, Ukraine's wheat was exported to four areas during the period from 2000-2011: Africa (36.8%); the EU (23.4%); the Middle East (14.8%); and Southeast Asia (9.5%). These shares changed for 2012/2013 marketing year, however, and wheat exports to the Middle East (31%) passed those to EU (27%) countries (WITS 2014). Furthermore, Ukraine has a relatively better port infrastructure and a better location in the Black Sea than Russia and Kazakhstan, which makes exporting wheat to other countries easier. However, the country exports wheat to the EU countries using the same railway transportation and tracks that are used to export wheat to CIS countries. It is also worth mentioning that most of the grain is exported by international companies in Ukraine and these companies sells wheat for prices that are higher than farm-gate prices (Acs et al. 2013).[5]

Although KRU wheat has a lower protein content than wheat from Canada and the US, it has the best quality-to-price ratio in the global wheat market. Lower production costs, the development of a port infrastructure and huge export potential will increase KRU's role in the world grain market. However, to develop KRU's image as a reliable wheat supplier to the world, the governments of the KRU countries must not ban wheat exports in the future and must improve institutional infrastructure.

[5] In 2010, the FOB price from the Black Sea for Ukrainian grain was 200 €/ton, but the farm-gate price was 105-109 €/ton (Acs et al. 2013)

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3. Wheat export competitiveness of Kazakhstan, Russia and Ukraine in the global market

3.1. Introduction

The features of wheat export competitiveness of Kazakhstan, Russia and Ukraine (KRU) have changed over the period from 1996-2013. Factors such as moving from central planned economies to open market economies, geographic location and high production potential have affected the degree of competitiveness of KRU countries' wheat exports (Liefert et al. 2013). To develop the KRU countries' agricultural strategy for the upcoming decades, it is necessary to have a clear idea of the competitiveness of KRU wheat exports in the global market.

Competitiveness can be defined as the ability to be successful in competition. When the farmer has comparative advantage over certain product, he/she can supply to the consumers better quality products at lower price and enjoy stable income. Furthermore, competition can be international (among countries) or domestic (among farmers or sectors). Although it is generally accepted that competitiveness is a relative measure, there is no single measure of competitiveness that is general accepted in the literature. Competitiveness can be viewed as a process that can be measured based on different cost factors, efficiency measures and productivity factors. In addition, competitiveness can be measured by comparative advantage or by using trade balance indices that are called trade-based measures of competitiveness. As the aim of this study is to measure competitiveness of KRU wheat exports in comparison to its rivals, this research will be based on trade-based measures of competitiveness.

According to the trade theory, a country's competitiveness is based on the concept of comparative advantage (Latruffe 2010). In international trade, comparative advantage is an important concept used to explain trade patterns. The idea of comparative advantage was developed by Ricardo, and Heckscher and Ohlin later developed this model based on differences in production costs. As it is impossible to observe relative prices under autarky, Balassa (1965) suggested using what is now known as Balassa's revealed comparative advantage (BRCA) index, which can be calculated from observed trade data. Although it a method used primarily to analyze competitiveness in the trade literature, using the BRCA index in comparative studies is

limited and problematic (Deardorff 1994; Yu et al. 2009). Several authors such as Vollrath (1991) and Proudman and Redding (1998) developed new indices to address the double-counting problem and the asymmetric value of the BRCA index, but none of these indices support comparisons of competitiveness over space and time. Yu et al. (2009) developed the Normalized Revealed Comparative Advantage (NRCA) index, which compares international competitiveness across countries and over time. Therefore, I am using the NRCA index to look at the patterns of competitiveness in KRU wheat exports, but I also compare the results with the BRCA index in the global market as a benchmark.

Previous studies investigated KRU agricultural exports over relatively short periods of time, but none of them looked specifically at the competitiveness of KRU wheat exports (Khatibi 2008; Ishchukova and Smutka 2013; Yermakov and Kharchenko 2014). Moreover, the studies that analyzed the competitiveness of KRU separately were more informal and based on the authors' judgements rather than on empirical research. However, the patterns of KRU competitiveness have changed during the past decade due to policy interventions and changes in input prices. In addition, wheat and energy prices have increased during the past decades. Although high wheat prices can increase farmers' incomes in the short term, they can affect competitive position in the long term. This study contributes to the body of knowledge of KRU wheat export competitiveness by using the BRCA and NRCA indices to accomplish three main goals: i) To investigate the competitive performance of KRU wheat exports in the global and the EU-27 markets over the 1996-2013 period, ii) To identify which of the KRU countries is most specialized in wheat exports to the South Caucasian and Central Asian markets given that the KRU countries represent the largest share of the total wheat imports to the South Caucasus and Central Asia, and iii) To identify the factors that affect the competitiveness of KRU wheat exports in the global market.

The rest of the study is organized as follows: the second section discusses the different trade competitiveness indices and presents a literature review on the competitiveness of KRU wheat exports. The third section presents the results of the trade indices. The fourth section discusses the factors that affect competitiveness and provides a description of the explanatory variables. The fifth section shows the estimation results and the last section concludes the study.

3.2. Comparison of different indices

According to the trade theory, the competitiveness of countries is based on the concept of comparative advantage. A combined Ricardian and Heckscher-Ohlin model of comparative advantage shows that international trade happens because of the differences in production costs and resource endowments. Thus, a country will specialize in exporting a product for which it has a cost advantage.

Several measures exist to quantify competitiveness, including the Real Exchange Rate (RER). The RER is defined as a price index of non-tradable products multiplied by the ratio of the price index of tradable products (Brinkman 1987). Although some studies have proposed using purchasing power parity (PPP) to compare the relative prices of different countries, changes in exchange rates and in PPP are sometimes due to government interventions and speculative attacks. A strong RER may indicate improvements in a country's competitiveness that can be attributed to fundamental causes such as productivity gains; on the other hand, the appreciation of a country's currency lowers competitiveness because the relative price of a product increases for the importing countries. Therefore, using RER to measure competiveness is tricky (Bureau and Butault 1992; Harrison and Kennedy 1997).

Another measure used to compare a country's or sector's competitiveness is Export Market Share (EMS). In the literature, this measure is also called the net export index, which is a country's or sector's net trade balance divided by its total trade. The value of this index lies between -1 and +1. According to Banterle and Carraresi (2007), the disadvantage of the net export index is that it does not consider a country's size. If the economy is self-sufficient and does not import a particular product, while exporting small amounts of the same product, it will have an EMS of 100 and high competitiveness, which is inconsistent (Pitts et al. 1995).

One of the most widely used methods for measuring competitiveness is revealed comparative advantage (RCA) index that was introduced by Liesner (1958) and later refined by Balassa (1965). Balassa's RCA (BRCA) index is the ratio of a country's export market share for a specific product relative to the country's total export market share in the world trade. The BRCA index is expressed as follows:

$$BRCA_{ij} = RXA_{ij} = (E_{ij}/E_{mj})/(E_{ni}/E_{mn}) \quad (3.1)$$

where E_{ij} represents the export of commodity *j* from country *i*, *n* is a set of countries and *m* is a set of commodities.

If BRCA>1, then country *i* has specialized in the export of commodity *j* and has comparative advantage in that particular sector. When BRCA<1, then country *i* has comparative disadvantage in the export of commodity *j* (Latruffe 2010).

Several problems exist with BRCA index. Vollrath (1991) claims that the BRCA index has two problems: "the double counting" of the commodity/country and no consideration of the import side. To solve the problem of double counting, country *i* is excluded from E_{mj} and E_{mn}, and commodity *j* is excluded from E_{ni} and E_{mn}. In addition, Vollrath (1991) defined the relative import advantage (RMA), which is calculated similarly to the RXA (RCA), and he suggested using relative trade advantage (RTA) to compare competitiveness.

$$RTA_{ij} = RXA_{ij} - RMA_{ij} \quad (3.2)$$

A positive value for the RTA indicates the presence of comparative advantage and a negative value indicates comparative disadvantage.

Additionally, the BRCA index ranges from 0 to infinity, which means that it has an asymmetry problem. Vollrath (1991) proposed using the revealed competitiveness (RC) index, which represents the difference between the logarithmic forms of RXA and RMA, thereby solving the asymmetric problem of the BRCA:

$$RC = lnRXA_{ij} - lnRMA_{ij} \quad (3.3)$$

This formula makes Balassa's index symmetrical, but when commodity *j* has zero exports, the RC index will be undefined.

Another disadvantage of Balassa's RCA index is that it ignores the influence of macroeconomic issues. Lafay (1992) solved this problem by including the GDP of country *i* in the formula. The Lafay RCA (LRCA) is the following:

$$LRCA_{ij} = \left(1000 \cdot \frac{EX_{ij} - IM_{ij}}{Y_i}\right) - \left(\frac{EX_{ij} + IM_{ij}}{\sum_j (EX_{ij} + IM_{ij})} \cdot \frac{1000 \sum_j (EX_{ij} - IM_{ij})}{Y_i}\right) \quad (3.4)$$

where EX_{ij} is the export of commodity j from country i, IM_{ij} is the import of commodity j to country i and Y_i is the GDP of country i. When $LRCA_{ij}$>0, country i has comparative advantage in exports from sector j. However, it is difficult to compare this index across time because the distribution of this index has an invariant mean over time (Sanidas and Shin 2010)

Dalum et al. (1998) suggested using a symmetrical RCA (SRCA) index, which is the approximation of the log-transformation of the Balassa index:

$$SRCA_{ij} = (RCA_{ij} - 1)/(RCA_{ij} + 1) \quad (3.5)$$

Although this index is symmetric, it does not have a stable mean over time and space, and the interpretation of SRCA results can change for more disaggregated data (De Benedictis and Tamberi 2001).

Proudman and Redding (1998) suggested using a weighted RCA (WRCA) index, which is obtained by the normalizing the numerator of the BRCA index:

$$WRCA_{ij} = RCA_{ij}/(1/N \sum_{j=1}^{N} RCA_{ij}) \quad (3.6)$$

where N indicates the number of sectors/commodities. However, the WRCA index also has asymmetric problem; it does not show changes in national exports relative to world trade and it is affected by the level of sectoral aggregation (De Benedictis and Tamberi 2001).

Because the BRCA index has a multiplicative specification problem, Hoen and Oosterhaven (2006) suggested using an additive RCA (ARCA) index, which is defined as:

$$ARCA_{ij} = (E_{ij}/E_{mj}) - (E_{ni}/E_{mn}) \quad (3.7)$$

This index ranges from -1 to +1 and is independent of the number of commodities and countries. However, according to Yu et al. (2009), the sum of all countries' ARCA values for a single product is not constant, and cross-country analyses are not as well established for use in the comparison of products.

One of the main goals of this study is to calculate the competitiveness of KRU wheat exports over time. Yu et al. (2009) introduced the normalized revealed comparative advantage (NRCA) index to measure the competitiveness of a particular sector. This index starts with the deviation of actual data from comparative-advantage-neutral point (CANP). Moreover, with the NRCA index, I can determine how country *i*'s export of product *j* deviates from its CANP. CANP is defined as:

$$\hat{E}_{ij} = \frac{E_i E_j}{E} \tag{3.8}$$

A country's export of a particular commodity is E_{ij}. If we find the difference between these two measures and then normalize this difference by total world exports, then the NRCA will be as follows:

$$\Delta E_{ij} = E_{ij} - \hat{E}_{ij} = E_{ij} - \frac{E_i E_j}{E} \tag{3.9}$$

$$NRCA_{ij} = \frac{\Delta E_{ij}}{E} = \frac{E_{ij}}{E} - \frac{E_i E_j}{EE} \tag{3.10}$$

The NRCA index calculates the degree to which a country's particular product deviates from the country's CANP in terms of its relative scale with respect to the world's total exports. When the value of the NRCA index is greater (smaller) than zero, it indicates that country *i* has comparative advantage (disadvantage) in the export of commodity *j*. According to Yu et al. (2009), the NRCA ranges from -0.25 to +0.25 and has a symmetric distribution. The symmetrical characteristics of the NRCA index help in comparing competiveness across products and countries and over time. Another advantage of the NRCA index is that it is affected by neither the reference group of countries nor by the commodity aggregation (Sanidas and Shin 2010). Because the NRCA index is normalized to the world's total exports, its values are very small. Thus, the authors suggested multiplying the values by 10,000, which will not affect interpretations of the results (Yu et al. 2009).

As we can see, all the previous indices have some disadvantages, but the NRCA index appears to be more effective than other indices due to its symmetrical characteristics and ability to easily compare across products and countries and over time. However, several trade index studies have used both the BRCA and NRCA indices to compare competitiveness (Yu et al. 2009; Sanidas

and Shin 2011; Sarker and Ratnasena 2014). Moreover, the results of the BRCA and NRCA indices are identical from a binary demarcation perspective when identifying the comparative advantage of a country in the export of a particular commodity (Yu et al. 2009; Bojnec and Ferto 2014). Therefore, in this study I will calculate the BRCA and the NRCA for KRU wheat exports and then compare the results.

3.2.1. Literature on the competitiveness of the wheat sector

A number of economic studies have analyzed the competitiveness of the agricultural sector for use in economic policy making and analysis. However, the wheat export market is one of the important sectors in agriculture because it is the most consumed cereal product in the world. Thus, some studies have analyzed the how policy measures, globalization, sector fragmentation and other factors affect the competitiveness of this specific agricultural product (Harling 2008; Wubben and Isakhanyan 2013). Ahearn et al. (1990) compared the competitiveness of wheat production in Canada and the USA by calculating cost of production. The authors found that cost per acre was high during 1986-1987, but the cost for both countries decreased during this period.

Carraresi and Banterle (2015) investigated the competitive performance of the EU-27 for several agricultural products as well as for cereals in the intra-EU market. In particular, the authors looked at how the EU enlargement and the global financial crisis affected competitiveness during the 1995-2011 period using EMS and the BRCA index. The authors revealed that after the enlargement, Germany and the Netherlands gained from competitiveness but France did not. However, the economic crisis softened the specialization path of the EU countries (Carraresi and Banterle 2015).

Sarker (2014) compared the competitiveness of Australia and Canada in the wheat sector from 1961 to 2012. The author found that international competitiveness in the wheat sector has been declining for both countries. Furthermore, even though the competitiveness of Canadian wheat is higher than that of Australian wheat, the rate of the decline has been faster for Canadian competitiveness than for Australian in the wheat sector.

In another study, Sarker and Ratnasena (2014) investigated the competitiveness of Canada's wheat, beef and pork sectors using the NRCA index. The study revealed that the competitiveness of the Canadian wheat sector was lower than that of the US in 1970, but that the gap narrowed

after the implementation of the North American Free Trade Agreement (NAFTA) in 1993. Moreover, the scholars analyzed how the cost of fertilizer, seed and energy, as well as exchange rates and government policies affected the competitiveness of the Canadian wheat sector. In my research, I will follow the study by Sarker and Ratnasena (2014) and will also analyze the factors that affect the competitiveness of KRU wheat exports.

3.2.2. Studies of the competitiveness of KRU wheat exports

The agricultural sector in the KRU countries has developed following the collapse of the Soviet Union. Therefore, several studies have analyzed the competitiveness of KRU's agricultural sector in the global market. However, very few studies have analyzed the competitiveness of the KRU countries' wheat exports. For instance, Ishchukova and Smutka (2013) looked at Russia's competitiveness in the export of several agricultural products using Balassa's index, Vollrath's index and Lafay's index. The authors revealed that Russia has comparative advantage in cereals, oilseeds, vegetable oils and chocolate. Moreover, although the revealed comparative advantage (RCA) index was very volatile over the 1998-2001 period, competitiveness has increased mainly since 2002. The results of Lafay's index show that Russia has significant comparative advantage in the export of several agricultural products to the Commonwealth of Independent States (CIS) and Asian countries. Furthermore, Ishchukova and Smutka (2013) indicated that Russia's accession to the World Trade Organization (WTO), improvements in credit for agriculture, and the development of infrastructure could increase the Russia's competitiveness in the world for many agricultural products. Moreover, Goretov et al. (2015) recently looked at the competitiveness of the agricultural sector in the Volga Federal Region of Russia. The authors conducted a cluster analysis of major agricultural production and concluded that to improve the competitiveness of the agrarian sector, the government should create a support system for investors by reducing investment risks. In addition, they suggested that it is also necessary to improve tax policy by introducing tax incentives for investments in agricultural projects (Goretov et al. 2015)[6].

[6] Saubanov et al. (2014) also found that wheat is Russia's most competitive agricultural product. Svatos et al. (2014) calculated the trade balance index and found that Russia is self-sufficient in grain exports but is dependent upon imports for other agricultural products (meat, vegetables and fruits).

Khatibi (2008) calculated Kazakhstan's RCA index for several sectors with respect to world exports to EU-27 countries and intra-exports among the EU-27 member countries for the 1990-2006 period. The study revealed that Kazakhstan's competitiveness lies primarily in the energy and manufactured products sectors. In terms of agricultural products, the results of Balassa's index show that Kazakhstan is competitive in the export of wheat, meslin and barley. Khatibi (2008) also showed that Kazakhstan's overall competitiveness significantly decreased during the 2001-2006 period, and the main reason was the country's dependence on the export of energy sector products. The author mentioned that the government's economic diversification is viewed as possible driver for developing competitiveness in global markets.

Yermakov and Kharchenko (2014) calculated Vollrath's (1991) RTA index for several Ukrainian agricultural products. The study found that among crop products, Ukraine has comparative advantage in the export of wheat, maize and barley. Over the 2000-2011 period, however, the country's competitiveness deteriorated and Ukraine lost competitiveness in meat products.

In summary, there have been no studies that analyzed the competitiveness of total KRU wheat exports for the 1996-2013 period. In addition, to the best of my knowledge, no study has compared the competitiveness of KRU wheat exports over time and across countries. Finally, none of these studies found the drivers of competitiveness for KRU wheat exports. Therefore, this is the first study that explores and compares the competitiveness of KRU wheat exports over distance for a longer period and investigates the factors that influence KRU's competitiveness.

3.3. Competitiveness of KRU wheat exports

I am using annual export value data at the 4-digit Harmonized System (HS) classification level, in which HS code 1001 represents wheat and meslin; the data are expressed in US dollars and were obtained from Comtrade for the 1996-2013 period. Wheat represents the largest share of the KRU countries' exports in the 4-digit HS code data. I collected wheat export data from KRU to the rest of the world (in US$) and also obtained the total value of wheat exports from all exporting countries (in US$). Finally, I collected the total export values from KRU and all exporting countries in US$.

I calculated the competitiveness of KRU wheat exports using the NRCA formula presented in the previous section[7]. I also measured KRU wheat export competitiveness using the BRCA index for comparative purposes, although this index has several serious weaknesses as mentioned in the previous section.

EU wheat exporters are some of KRU's main competitors in the global wheat market. Wheat from the KRU countries, however, represents the largest share of Central Asian and South Caucasian wheat imports. This study analyzes the KRU countries' wheat export competitiveness in two steps: first, by examining competitiveness in the global and the EU-27 markets and second, by investigating the relative competitiveness of each of the KRU countries in the South Caucasian and Central Asian markets.

Table 3.3.1: Descriptive statistics of Balassa's revealed comparative advantage (BRCA) index and the normalized revealed comparative advantage (NRCA) index for Kazakhstan, Russia and Ukraine wheat exports in the global market, 1996-2013

Index	Countries	Mean	Standard Deviation	Minimum	Maximum	Number of BRCA>1	Number of NRCA>0
BRCA	Kazakhstan	10.950	5.865	2.474	22.301	18	--
	Russia	1.879	1.275	0.174	4.388	12	--
	Ukraine	7.185	4.795	0.56	12.052	17	--
NRCA	Kazakhstan	0.555	0.196	0.174	0.83	--	18
	Russia	0.606	0.833	-0.651	2.148	--	12
	Ukraine	0.546	0.442	-0.025	1.435	--	17

Source: Own compilation based on UN-Comtrade.

Table 3.3.1 shows the descriptive statistics for the BRCA and NRCA indices for each KRU country in the global market. The NRCA index has a relatively smaller range than the BRCA index, which is also observed in the much smaller standard deviation of the NRCA index in comparison to the BRCA index. De Benedictis and Tamberi (2004) argue that a good measure of a comparative advantage index is low variation over time, which is the NRCA index in this study.

[7] Please see the Appendix for a detailed explanation of the NRCA formula for calculating the competitiveness of KRU wheat exports in the world, in the EU-27 and in the South Caucasian and Central Asian regions.

3.3.1. The BRCA and NRCA indices in the global market

Figures 3.3.1 and 3.3.2 compare the BRCA and NRCA indices for each KRU country. The NRCA index produces better results than the BRCA index, and the former is also better related to the wheat exports of the KRU countries than the latter[8]. One interesting finding is that both the BRCA and NRCA indices confirm that Russia experienced comparative advantage in wheat exports among the KRU countries after 2005. However, the competitiveness of Kazakhstan and Ukraine was very volatile for the analyzed period as they competed with each other. When we compare wheat export competitiveness over time, the volatility of competitiveness for Ukraine and Russia increased considerably after 2007. This increase in volatility may be due to the interventions introduced by the KRU countries' governments during the 2007-2012 years.

The NRCA index also allows me to assess comparative advantage patterns across countries. If we look at KRU wheat exports, we can see that Russia had higher wheat exports than Kazakhstan and Ukraine after 2005 (Table A1 in Appendix). This finding is consistent with the development patterns observed from the NRCA index. In particular, Russia became more competitive in wheat exports than Kazakhstan and Ukraine after 2005 (Figure 3.3.1). In contrast, the value of the BRCA index shows a completely opposite result: Russia had relatively less comparative advantage than did Kazakhstan and Ukraine (Figure 3.3.2). The Russian comparative advantage in wheat exports may have been due to natural factor endowments such as production potential, access to many foreign markets and relatively cheap transportation costs (Liefert et al. 2013). Kazakhstan was less competitive because of its location and transportation disadvantages as a landlocked country with limited access to rail cars and sea ports for wheat export, especially in terms of exports to the EU and North African countries. Imamverdiyev et al. (2015) analyzed the patterns of Kazakhstan's wheat exports and found that Russia is the main obstacle for Kazakh wheat exports in the Black Sea region. Although Ukraine has better access to sea ports, it has low railway capacity and few railway stations near major grain exporting ports as well as low wheat quality (Boersch 2013).

When we compare the results over time, we see that Kazakhstan enjoyed international wheat export competitiveness for the entire analyzed period. The value of the NRCA index increased four times between 2005 and 2008; however, the country's competitiveness decreased sharply

[8] Figure A1 in the Appendix shows KRU wheat exports to the world during the 1996-2013 period.

after 2008 (88% decrease in competitiveness between 2008 and 2009) because of the export restrictions applied by Kazakhstan's government in 2008. Russian wheat exports became competitive after 2002; from 1996 to 2001, Russia's results for the NRCA index were negative. Government interventions also weakened Russia's competitiveness, particularly in 2008 when the value of the NRCA index decreased by two times. However, Russia's competitiveness increased sharply between 2004 and 2007 due to favorable production developments and increases in yields. Ukrainian wheat exports were always competitive in the global wheat market, except in 2000. In particular, the results of the NRCA index show that Ukrainian wheat exports had comparative disadvantage in 2000. Moreover, although Ukrainian competitiveness in wheat exports was higher in years other than 2000, it was very volatile in comparison to Russia and Kazakhstan. The competitiveness results of Ukraine can also be attributed to government interventions, particularly to the export restrictions imposed in 2006 and 2010 that decreased wheat export competitiveness.

Figure 3.3.1: Comparison of the normalized revealed comparative advantage (NRCA) index for Kazakhstan, Russian and Ukrainian wheat exports in the global market, 1996-2013

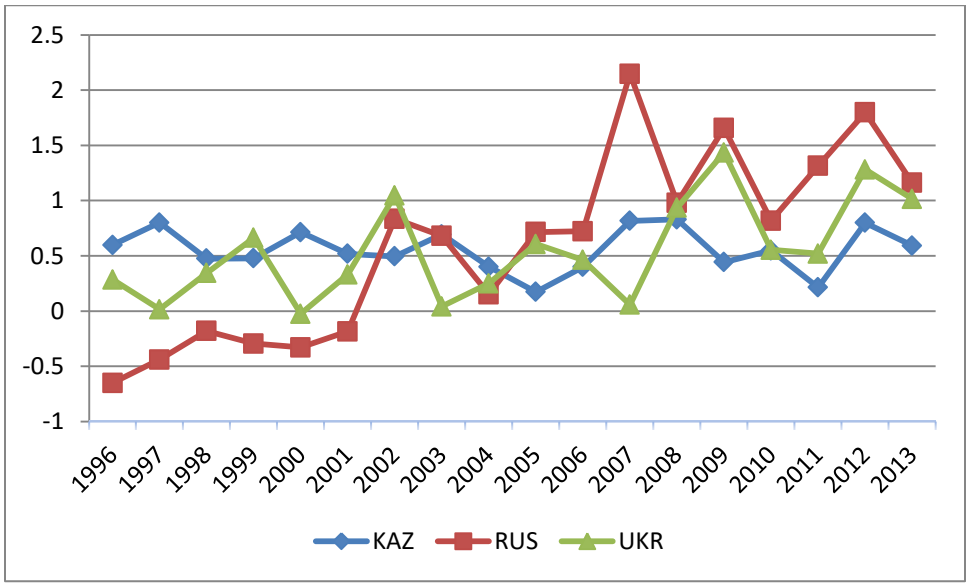
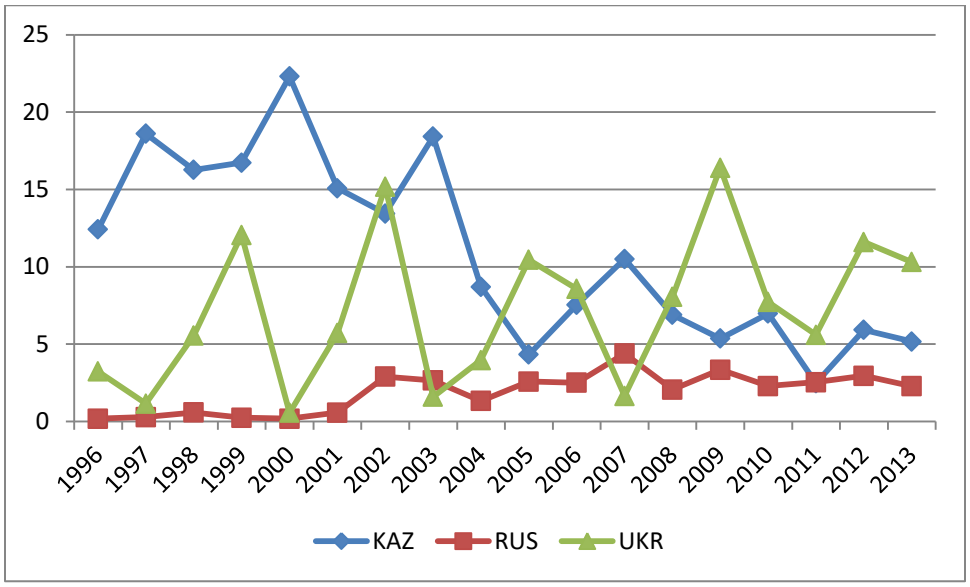


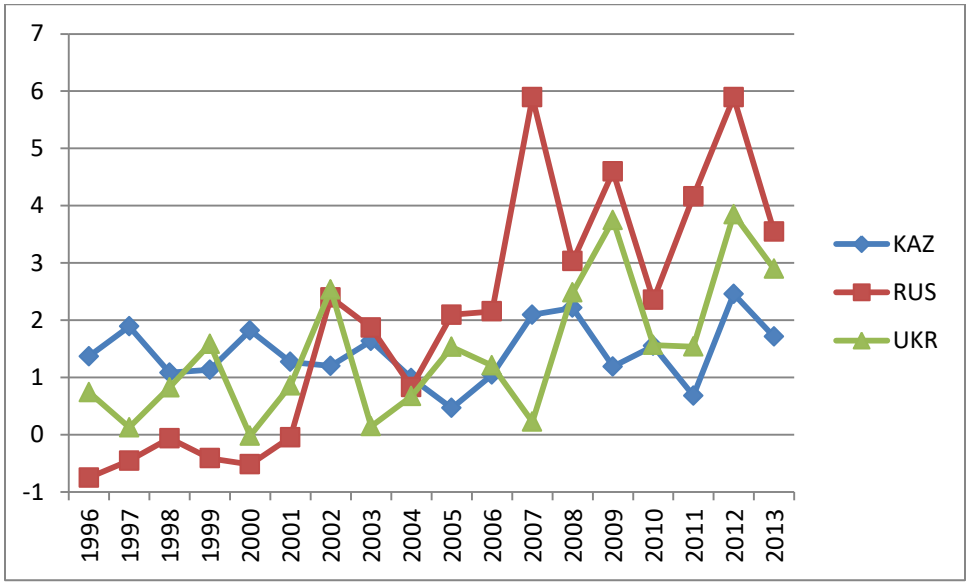
Figure 3.3.2: Comparison of Balassa's revealed comparative advantage (BRCA) index for Kazakhstan, Russian and Ukrainian wheat exports in the global market, 1996-2013



3.3.2. The BRCA and NRCA indices in the EU-27 market

The study also focuses on the competitiveness of KRU wheat exports in the EU-27 market (Figure 3.3.3). To answer this question, in equation 3.10 I replaced world wheat exports and total exports with EU-27 wheat exports and EU-27 total exports, respectively (see the Appendix). Before starting the discussion, it is worth mentioning that among the EU countries, the main exporters of wheat are France, Germany, Romania and the United Kingdom. The results for the EU-27 market are very similar to the results for the global market. When we compare the competitiveness of KRU wheat exports in the EU-27 market, we again see that Russia had relatively larger comparative advantage than Kazakhstan and Ukraine. The volatility of competitiveness for Kazakhstan's wheat exports was relatively less than that of Russia and Ukraine. In addition, in comparison to the other two countries, Russia became more competitive in the EU market after 2001. The only difference between the global market and the EU-27 market was that comparative advantage increased a slightly more in the EU-27 market than in the global market.

Figure 3.3.3: Comparison of the normalized revealed comparative advantage (NRCA) index for Kazakhstan, Russian and Ukrainian wheat exports in the EU-27 market, 1996-2013



3.3.3. BRCA and NRCA indices in the South Caucasus and Central Asian markets

Finally, I look at the competitiveness of KRU wheat exports in the South Caucasus and Central Asian markets using the global market as a benchmark for comparison. More specifically, in equation 3.10, wheat exports and total exports to the world market are replaced with exports to the South Caucasus and Central Asian regions (see the Appendix). As these two regions import wheat primarily from KRU countries, it is interesting to look at which KRU country is most competitive in these regions.

Figure 3.3.4 shows the results of the NRCA index for KRU wheat exports to the South Caucasian market. The results demonstrate that only Russia and Kazakhstan are competitive in this region and that they compete with each other. A plausible explanation for this is historical (Soviet Union) ties and low trade costs. In contrast, Ukraine has comparative disadvantage for the entire analyzed period, except for 2011. This comparative disadvantage may be due to the long distance between Ukraine and the South Caucasian region and the low quality of Ukraine's wheat. However, Ukraine's competitiveness increased in 2011 because Russia imposed export

restrictions on wheat that year. In addition, it is worth mentioning that even though Kazakhstan was also competitive in wheat exports to this region, Azerbaijan was the only country that imported a substantial amount of Kazakh wheat. However, Azerbaijan's demand for wheat is much higher than Armenia's or Georgia's because of Azerbaijan's large population and low wheat production. Therefore, one can conclude that Kazakhstan became competitive in the South Caucasian region due to the large amount of wheat it exported to Azerbaijan.

Figure 3.3.5 demonstrates the results of KRU wheat export competitiveness in the Central Asian market. The NRCA index shows that Kazakhstan specialized and had comparative advantage in wheat exports to Central Asian countries. However, the volatility of Kazakhstan's wheat export competitiveness was high. Although Kazakhstan's government interventions affected this volatility, changes in demand for imported wheat in Central Asia were another reason for the volatility. Furthermore, the value of the NRCA index is usually close to zero for Russia and Ukraine. This may be due to Kazakhstan's better quality of wheat, as well as its closer proximity to each of the Central Asian countries and better transport connections. On the other hand, Russia and Ukraine have not specialized in wheat exports to this region due to high trade costs and low quality of wheat. This finding is also supported by the descriptive statistics, which indicate that Kazakhstan had the largest share of wheat imports in Central Asian countries.

Figure 3.3.4: Comparison of the normalized revealed comparative advantage (NRCA) index for Kazakhstan, Russian and Ukrainian wheat exports to the South Caucasus, 1996-2013.

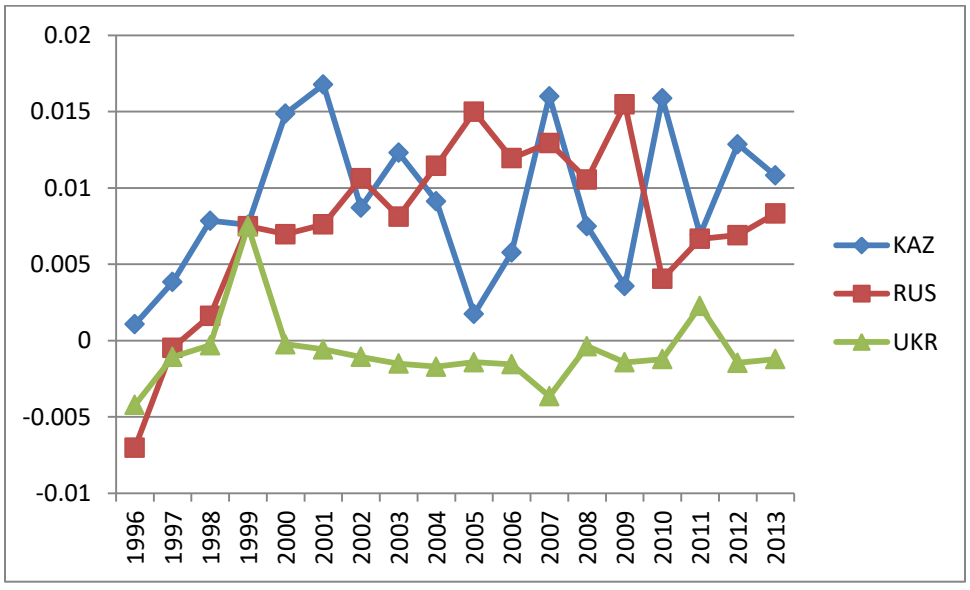
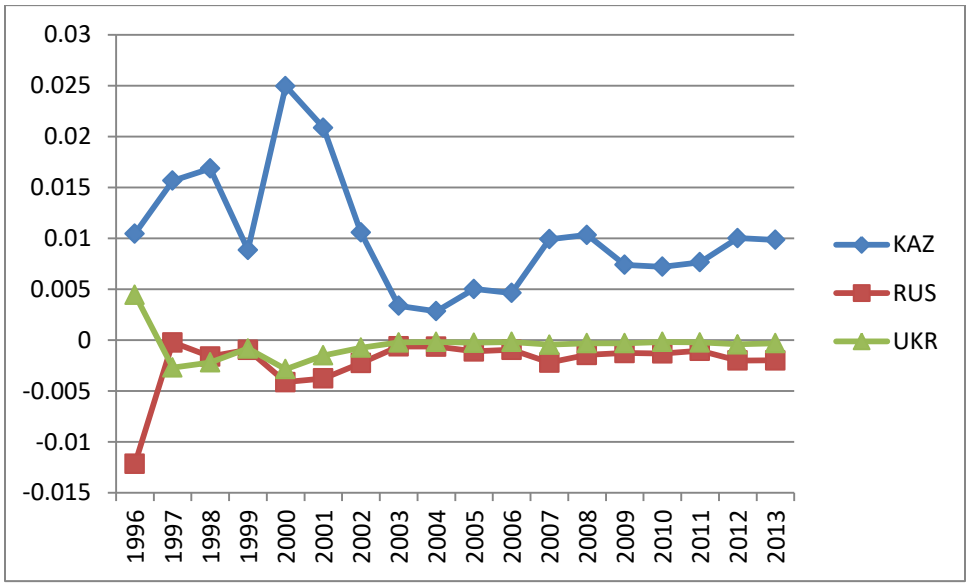


Figure 3.3.5: Comparison of the normalized revealed comparative advantage (NRCA) index for Kazakhstan, Russian and Ukrainian wheat exports to Central Asia, 1996-2013



3.4. Factors that affect competitiveness and data description

Another aim of this study is to analyze a group of variables that affect the competitiveness of KRU wheat exports in the world market. According to my research, several studies have used RCA indices in regression analysis (Sharma and Dietrich 2007; Frantzen 2008; Bojnec and Ferto 2014) but until now, only Sarker and Ratnasena (2014) have analyzed the competitiveness of a country's agri-food sector using the NRCA index. In their study, they investigated how the cost of production and policy variables affected the competitiveness of Canada's wheat, beef and pork exports.

To identify the variables that affect the competitiveness of KRU wheat exports, I use the Heckscher-Ohlin-Vanek (HOV) trade model. This model deals more with the factor content of trade than with the trade pattern of a single product. To produce a single product, a farmer uses capital, labor or land services, but to export the product, the farmer uses also exports of the services of production factors. Thus, the HOV theory states that countries will specialize in the export of the services of factors they have in abundance (Vanek 1968). This also means that in a

labor abundant country, the labor-capital ratio will be higher for production than for consumption. For example, a labor abundant country will specialize in the export of labor services and a capital abundant state will specialize in the export of capital services (Leamer 1980). Moreover, the HOV theory assumes that trading countries have identical technology. In this study, we can say that although the KRU countries do not have identical technology, they have very similar technology because technology did not change very much after the collapse of the Soviet Union. In general, although the HOV model has been criticized for having too little empirical power, it remains the trade model that is most widely used to explain comparative advantage[9]. Schluter and Lee (1978) and Lee et al. (1988) used the HOV model with US agricultural trade data. Peterson and Valluru (2000) analyzed how factor endowments and different government policy interventions affect agricultural comparative advantage using the HOV theory. Finally, Chor (2010) showed that international trade flows and comparative advantage can be affected by factor endowments, institutions, and industry as well as country characteristics. Taking into account the literature that analyzes competitiveness, in this study I look at three groups of variables that can affect the competitiveness (NRCA values) of KRU wheat exports in the global market: 1. Real Exchange Rate (RER); 2. Cost of production and 3. Policy variables.

Table 3.4.1: Explanation of independent variables

Variable	Description
RER	Real Exchange Rate (RER) was calculated using the nominal exchange rate multiplied by the ratio of US and each KRU's consumer price index (CPI).
Log_real_price	Logarithm of real producer price of wheat in US$ in each exporting country.
Log_production	Logarithm of wheat production in each exporting country in MT.
WTO	Binary variable equal=1 if the exporting country is WTO member, 0 otherwise.

[9] According to Treffler (1995), the HOV model performs badly in analyzing trade patterns and the author suggests using differences in technology and tastes instead. Harrigan (1997) also showed that relative technology is an important factor of specialization and trade in addition to factor endowments.

Diesel_price	Price of diesel in USD per liter
Corruption	Control of corruption: Percentile rank[a].
Log_fertilizer_price	Logarithm of fertilizer in USD per ton
Land-reform	Dummy variable=1, when the exporting country made reform in land selling, 0 otherwise.
Log_meat_production	Logarithm of meat production in each exporting country in MT[b].

[a] Control of Corruption captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests. Percentile rank indicates the country's rank among all countries covered by the aggregate indicator, with 0 corresponding to lowest rank, and 100 to highest rank. Percentile ranks have been adjusted to correct for changes over time in the composition of the countries covered by the Worldwide Governance Indicators (WGI).

[b] Production of Beef, Veal and Swine meat.

The KRU countries compete mainly with each other in terms of wheat exports and sell their wheat primarily in US dollars, although in some cases the countries sell their wheat in local currencies. Thus, it is interesting to look at how exchange rates between local currencies and the US dollar can affect competitiveness. Moreover, although several factor endowments can affect comparative advantage, in this study it was possible to collect data regarding wheat production costs, fertilizer prices and diesel prices.

Table 3.4.2: Summary statistics of the explanatory variables

Variable	Mean	St.Dev	Min	Max
RER	62.18	63.07	6.59	173.87
Log_real_price	8.56	1.28	6.76	10.35
Log_production	16.97	0.61	16.08	17.97
WTO	0.33	0.48	0	1
Diesel_price	0.81	0.21	0.45	1.25
Corruption	17.83	3.75	11.48	27.32
Log_fertilizer_price	5.45	0.59	3.98	6.30
Land-reform	0.33	0.48	0	1
Log_meat_production	14.07	0.73	13.24	15.15

Source: Own calculation

Fertilizer is one of several important inputs used for wheat production. Farmers use fertilizers to have better quality crops and to produce better crop yields. Fertilizers include nitrogen, phosphorus and potassium, and each of these ingredients has a different function. For instance, nitrogen supports chlorophyll and plant proteins in plant growth; phosphorus maintains energy in plants; and potassium helps in disease treatment and photosynthesis. The KRU countries have lower fertilizer use than many developed countries. However, among the Black Sea countries, Kazakhstan has the lowest per hectare fertilizer use. Moreover, almost fifty percent of the fertilizer used in the KRU countries is for cereal crops, in particular for wheat and maize production. The KRU countries' fertilizer use increased sharply from 30 to 154 million tons between 1960 and 2005. However, after the collapse of the Soviet Union in the first half of 1990s, there was a decline in fertilizer use (Schmitz and Moss 2015). Fertilizer use also decreased because of increases in the price of fertilizers. Sarker and Ratnasena (2014) found an insignificant effect of fertilizer prices on the competitiveness of Canadian wheat exports. However, it is interesting to investigate whether fertilizer prices influence the competitiveness of Black Sea wheat exports.

Diesel is another important factor to include in an analysis of comparative advantage in wheat exports. Although diesel represents a small share of the total cost of wheat production, changes in diesel prices can still affect competitiveness. In general, the price of diesel in Ukraine was thirty percent higher than in the other two countries for the 2006-2013 period because Ukraine is the only KRU country that does not produce oil. It mainly imports petrol from other countries, which makes diesel prices expensive. Several researchers have analyzed the effect of diesel prices on wheat production and competitiveness. For instance, Kishore et al. (2014) analyzed the effect of diesel prices on wheat production in India and found a negative and significant effect. On the other hand, Sarker and Ratnasena (2014) found an insignificant effect of diesel prices on the competitiveness of Canadian wheat exports. Based on the results of these studies, this study will examine the effect of diesel prices on the competitiveness of wheat exports.

Government interventions can change relative prices to benefit either consumers or producers. For example, in high-income countries, government raise food prices through policy interventions that advantage farmers. In poor countries, however, policy makers decrease food prices in an effort to ensure that consumers have access to cheap food. Policy interventions

derived from national differences in inputs, technologies, and tastes might change competitiveness. For instance, a good policy mechanism that was applied in the European Union (EU) shows that this region is a net exporter of several agricultural products. Government interventions can also influence the volume of trade in addition to he direction of trade. All these possibilities are explored in this chapter by including policy variables in the estimations.

This study used the explanatory variables that are most likely to affect competitiveness. For example, Burkitbayeva and Kerr (2013) argue that accession of the KRU countries to the WTO could boost their wheat exports. Ukraine joined the WTO in 2008 and Russia joined in 2012, but Kazakhstan is still in the negotiation process for accession to the WTO. Therefore, the study looks at the effect of WTO membership on competitiveness.

Corruption can act as an obstacle to bilateral trade, while good organizational structures in a country can reduce corrupt practices and foster trade. Usually states apply protectionist trade policies to control local production, but such policies force agents to engage in rent-seeking activities in the form of corruption. Restrictive trade policies promote corrupt activities and serve as a barrier to trade, thus indicating that there may be a possible negative relationship between corruption and trade (Horsewood and Voicu 2012). Corruption can also have indirect effect on trade. A firm can lose its reputation, for example, because of the poor reputation of a home country that has corruption problems. A second indirect effect can be lower levels of investment. In particular, high corruption in a country will discourage investors from developing the agricultural sector. According to Rodrik (1995), investment can also increase exports. Thus, corruption will discourage investment and reduce exports. Another indirect effect may be related to labor. A low level of output per worker is connected with the quality of government institutions (Doyle and Martinez-Zarzoso 2011). As we know, labor productivity is one of the factors of competitiveness. Low labor productivity will reduce exports, which will then lead to a low level of competitiveness. Taking into account these facts, it is also important to include a corruption index in our analysis. Several measures exist to compare the level of corruption in countries; for example, the Economic Freedom index, the International Country Risk Guide and the Cost-of-Doing-Business Index. However, this analysis uses the Control of Corruption Index provided by the World Bank.

Among the KRU countries, only Russia allows the sale of farmland and has done so since 2006. In Kazakhstan and Ukraine, it is possible only to rent land; one cannot buy farmland (FAO-EBRD 2008). However, reforms that allow the sale of farmland could encourage wheat production because investors will be interested in wheat production if they can buy farmland. Thus, this study also looks at how land reforms can affect competitiveness.

Finally, according to Liefert et al. (2013), one of the reasons for high wheat production in KRU was the decrease in meat production after the introduction of government interventions in the livestock sector. Therefore, in this study we include meat production to observe the effect it has on comparative advantage. Table 3.3.1 provides a detailed explanation of the independent variables used in the estimations, and Table 3.3.2 shows a summary description of the explanatory variables.

Sarker and Ratnasena (2014) also included seed price in their study, but due to the lack of data I was unable to include this variable. In addition, Trefler (1993) used labor costs to test the predictions of the HOV trade model, but the data available for the KRU countries do not clearly show the cost of labor in the wheat sector. Several studies have analyzed the implications of agricultural factor endowment use in former Soviet Union countries, but Russia was the main focus of these studies. For example, Liefert (2002) examined the comparative advantage of Russian agriculture using the social cost-benefit ratio. The author found that Russia has comparative disadvantage in the production of agricultural products. Unfortunately, as of this writing, there has not been a study analyzing the effect of input prices on the competitiveness of wheat exports in the KRU region. Thus, the aim of this study is to see how exchange rates, factor endowments and policy variables can affect the competitiveness of KRU wheat exports.

Due to the lack of data regarding fertilizer prices in KRU countries, the study analyzes competitiveness only for the 2006-2013 period. The data for wheat and meat production and for wheat prices were obtained from the United States Department of Agriculture (USDA). Exchange rate data were obtained from International Monetary Fund (IMF). Fertilizer price data were obtained in local currencies from the appropriate statistical office of each country and then converted into US dollars. Diesel prices in US dollars were obtained from the German Agency for International Cooperation (GIZ). Finally, corruption data were obtained from the Worldwide Governance Indicators database.

3.5. Estimation results

Although H-O-V trade model helps to identify set of independent variables, it does tell us whether these independent variables are correlated to NRCA index linearly or nonlinearly. Leamer (1984) mentioned that if we do not consider nonlinearity in the model, estimation results can be bias. Thus this study uses Box-Cox (1964) transformation to evade functional form misspecification. In addition, Box-Cox transformation can make the residuals less heteroskedastic and more closely normal. However, according to Spitzer (1982) while using Box-Cox transformation, the estimated variance-covariance matrix is conditional on the optimum number of Box-Cox parameter and can be bias. Therefore, in other study Spitzer (1984) suggests to use scaling of the data. This procedure makes the t-ratios of the explanatory variables scale invariant. However, while scaling the data, the results of estimations will be point elasticities and can be evaluated at the geometric means (Spitzer 1984). Furthermore, for comparison this study also uses the Ordinary Least Square (OLS) estimation method to identify factors that affect the competitiveness of KRU wheat exports. In addition, I use robust and cluster commands to control for serial correlation and heteroskedasticity. Due to the data limitations for the inputs, the study covers only the 2006-2013 period, and the number of observations is therefore 24 (=8*3). Table 3.4.1 shows the estimation results for the independent variables. In general, the results of OLS and Box-Cox estimations are similar, only fertilizer price is significant in case of OLS method. Moreover, the results show that several explanatory variables relating to the costs of production, such as fertilizer and diesel prices, have significant effects on the competitiveness of KRU wheat exports. In addition, all the policy variables except corruption have significant effects on the competitiveness of KRU wheat exports.

It is generally accepted in the trade literature that movements in exchange rates govern the patterns of and competitiveness in the international commodity trade. While the Black Sea countries tend to negotiate and sell exported wheat in US$, much of the country's wheat trade with former Soviet Union member states is conducted in local currency. Trade with European partners tends to be conducted in Euros. Consequently, using the Real Exchange Rate (RER) will likely capture the impact of the volatile inflation experienced by the KRU countries during the late 1990s (Glauben et al. 2014). Therefore, the study includes the RER between the local currency of each KRU country and the US dollar. For example, Kazakhstan's RER was calculated using the nominal exchange rate multiplied by the ratio of the US and Kazakhstan

Consumer Price Indexes (CPI). However, as we see from the results table, the real exchange rate (RER) is not significant for the competitiveness of KRU wheat exports in both cases. A plausible explanation for this result lies in the volatility of KRU's local currency during the period of analysis and the resulting complexity in contracting for wheat exports. Getting to the bottom of the potentially complex impacts of exchange rates movements on the competitiveness of KRU wheat exports is, however, beyond the scope of this study.

Table 3.5.1: Factors that affect the normalized comparative advantage index of KRU wheat exports using OLS estimation and Box-Cox transformation

	OLS	Box-Cox
RER	-0.005	-0.006
	(0.0030)	(0.436)
Log_real_price	-0.155	-0.257
	(0.2618)	(0.630)
Log_production	-0.179	-0.222
	(0.2169)	(0.524)
Log_fertilizer_price_USD	-0.113**	-0.193
	(0.0509)	(1.007)
Diesel_price_USD	1.689***	2.062*
	(0.5135)	(3.555)
WTO	0.280***	0.450*
	(0.0630)	(3.426)
Corruption	-0.022	-0.030
	(0.0177)	(1.638)
Land-reform	4.439***	6.006***
	(1.5519)	(10.062)
Log_meat_production	-2.717**	-3.795***
	(1.1253)	(8.676)
Constant	41.841***	57.275
	(14.0506)	(0.302)
Number of observations	24	24
R^2	0.42	-

Note: Numbers in parentheses are robust and clustered standard errors in case of OLS estimation; Numbers in parenthesis are standard errors in case of Box-Cox estimation

*, ** and *** shows statistical significance at 10, 5 and 1 percent level, respectively.

The factors associated with wheat production and pricing can be considered instrumental to a country's export competitiveness. Price increases can be expected to reduce the competitiveness of KRU wheat in the international grain market. However, although wheat production price has

the expected sign, it is not statistically significant. The production variable also does not have significant effect on competitiveness.

The analysis also considers the price of fertilizer in the analysis of competitiveness. As I discussed in the previous chapter, fertilizer use changed after 2000 in the KRU countries, which has affected prices. In the mid-1990s, the KRU countries were exporting fertilizer and most of the fertilizer produced in the region was not used for grain production. However, after 2000, the KRU countries began using mineral fertilizer mainly for domestic grain production. This situation affected the price of fertilizer and the production of wheat. Therefore, it is crucial to understand the effect of fertilizer prices on competitiveness. The results show that fertilizer price is statistically significant at the 5 percent significant level and has the expected sign only for OLS case. However, we can not really rely on the results of OLS, because this estimation method did not consider nonlinearity.

Another important factor in the analysis of comparative advantage for KRU wheat exports is the price of diesel fuel. Farmers rely mainly on diesel to fuel vehicles used in the production of wheat. The retail price of diesel was very volatile during the analyzed period. Changes in price can affect the production of wheat as well as the competitiveness of wheat exports. According to the results, the price of diesel fuel has a significant effect on competitiveness, although it has a positive sign for both estimation methods. Diesel is not significant part of the production cost of wheat. As I discussed earlier, Kazakhstan and Russia have significant oil and gas production, and the price of diesel in the KRU countries is not very high. Thus, an explanation for the positive sign is as follows: although the price of diesel increased over the 2006-2013 period, it did not negatively affect the price of wheat or competitiveness.

As was discussed in the previous section, it is also crucial to consider policy variables together with cost of production in the analysis of competitiveness. Several external and internal constraints have prevented the full integration of the Black Sea countries into the international wheat market. One of these constraints is WTO membership. Tariff rates for non-members are usually very high and non-members do not follow WTO rules (Kerr 2010). Thus, for many years the KRU countries were not able to benefit from the most favored nation (MFN) tariff rate available to WTO member countries. Two of the KRU countries, Russia and Ukraine, joined the WTO after 2008, but Kazakhstan's membership to the WTO is still under negotiation. As stated

earlier, WTO membership provides member countries with access to importing markets with low tariff rates. Reductions in tariff rates can increase a country's export volume and allow it to explore new export destinations (Burkitbayeva and Kerr 2014). Based on these facts, it is important to assess the effect of WTO membership on the competitiveness of KRU wheat exports. The results of both estimation methods show that the dummy variable for WTO membership has the expected sign and is statistically significant. This indicates that being a WTO member can increase a country's competitiveness in wheat exports.

The previous section discusses the importance of including corruption in the analysis of competitiveness because the level of corruption can hinder cross-border transactions and have a negative effect on exports. A large number of studies have analyzed the effect of corruption on economic activity and have found mixed results. For example, Wei (2000) and Rodrik et al. (2004) found a negative effect for poor institutional structures on the standard of living in a country. However, Meon and Weill (2008) and Horsewood and Voicu (2012) found that corruption had positive impacts on economic activity. Based on the literature and the facts discussed earlier in this paper, this study examines the effect of corruption on the competitiveness of KRU wheat exports. The outcome of the estimation shows that although corruption has a negative sign, it is statistically insignificant in both cases. A plausible explanation may be that wheat represents a small proportion of the total economy and variations in corruption over the 2006-2013 period were not very high. Thus, the level of corruption does not significantly affect competitiveness.

As previously discussed, the sale of farmland is not allowed in Kazakhstan and Ukraine. However, imperfections in the land market can create economic pressure for farmers. Land market policies could affect the cost of transactions in the land market and allow investors to have access to farmland. Moreover, in this case, the farmers in these two countries will suffer from competitive disadvantage. Carter and Mesbah (1993) investigated the effect of land reform on agro-exports in Chile. Using the model of economic competitiveness for different classes of producers, the authors found that land market reforms, particularly the introduction of land mortgage banks, could increase Chile's agricultural exports. Based on these facts, this analysis uses land reform as a dummy variable that is applied only to Russia in 2006. The results of both estimation methods show that land reform is statistically significant at the 1 percent significance

level and can positively increase the competitiveness of KRU wheat exports. Therefore, we can conclude that land reforms must be considered in the future policies of Kazakhstan and Ukraine to promote competitively stable wheat production.

According to Liefert and Liefert (2015), the reason that the Black Sea countries moved from grain importers to grain exporters was the decrease in livestock production. Because of this policy, local demand for animal feed has decreased substantially. After this reform, Kazakhstan and Ukraine became small net importers of meat, while Russia became a large net meat importer. The decrease in domestic feed consumption was substantial enough to turn the KRU region from a net importer into one of the world's top grain exporters. Taking into account this reform, it is crucial to analyze how policies regarding livestock production affected the competitiveness of KRU wheat exports. The outcomes show that meat production significantly affects competitiveness and has the expected sign in OLS and Box-Cox estimation methods. In particular, in Table 3.5.1 we see that the decrease in livestock production increased wheat exports as well as the competitiveness of KRU wheat exports over the 2006-2013 period.

Although governments have little control over exchange rates in an era of floating exchange rates, they can increase competitiveness for some goods through appropriate policy changes. However, this is not the case for KRU wheat exports. The results show that exchange rates cannot affect the competitiveness of KRU wheat exports. Moreover, when we look at cost competitiveness, we can see that input prices, particularly fertilizer and diesel prices, affect the comparative advantage of Black Sea wheat exports. The outcome of the estimation also shows that most of the policy variables have a substantial effect on competitiveness. In particular, WTO accession, improvements in land markets and reductions in meat production can enhance competitiveness. In summary, the governments of the KRU countries should consider input prices and several policy reforms as part of future efforts to increase KRU's competitiveness in wheat exports.

3.6. Conclusion

The results of this study can be divided into two parts. In the first part, the study analyzes the competitiveness of KRU wheat exports in the global and EU-27 markets and also identifies

which of the Black Sea countries was most competitive in the South Caucasian and Central Asian regions during the 1996-2013 period. To answer this question, this study uses the NRCA index, which allows comparisons of competitiveness across countries and over time. In addition, the study also uses the BRCA index as a benchmark, even though it has some disadvantages that are discussed in previous sections. The second part of the study identifies the inputs and policy factors that affected the competitiveness of KRU wheat exports from 2006 through 2013. In general, this is the first study that analyzes the competitiveness of the KRU countries' wheat exports using the NRCA index and identifies the factors that affect the competitiveness of KRU wheat exports in the global market.

This chapter also compares different trade indices used to measure competitiveness and shows the advantages of the NRCA index. As discussed in previous sections, other indices have some disadvantages, but the NRCA index appears to be more effective because of its symmetrical characteristics and because it allows easier comparisons across products and countries and over time. In addition, it is also possible to identify the competitiveness of a country's exports of a particular commodity because the results of the NRCA index are identical from a binary demarcation perspective (Yu et al. 2009). The descriptive statistics of the BRCA and NRCA indices show that the NRCA index has relatively low variation over time, which is the one of the advantages of this index. The results of the NRCA index indicate that the KRU countries had comparative advantage in wheat exports in the world market mainly after 2001. The competitiveness of KRU wheat exports decreased for several years because of government interventions (e.g., export restrictions), but then increased again because of favorable production developments and yield increases. Furthermore, the study also compares competitiveness across countries, and the results show that on average, Russia was more competitive than the other two countries during the analyzed period. An explanation for this result is that Russia had more production potential, good connections with many foreign markets and low transportation costs. When we look at KRU's comparative advantage in wheat exports in the EU-27 market, the results are almost identical to those for the global market; however, KRU's competitiveness was slightly higher in the EU-27 market than in the world market. The outcome of the NRCA index shows that Russia enjoyed a higher level of competitiveness in the wheat sector than Kazakhstan or Ukraine. The results also show that having access to many markets and better transportation links can increase competitiveness in wheat exports.

The study also looks at competitiveness of KRU wheat exports in two important regions: South Caucasus and Central Asia. In case of the first region, the NRCA index results show that only Russia and Kazakhstan had comparative advantage in wheat exports during analyzed period. Ukraine did not have comparative advantage in the South Caucasian region because of high transaction costs and low wheat quality. According to the NRCA index results, Kazakhstan was very competitive in wheat exports to the Central Asian region because of short distances and good wheat quality. Based on these results, one can conclude that transportation costs and wheat quality can play important roles in the competitiveness of wheat exports.

To identify the factors that affect the competitiveness of KRU wheat exports in the global market, the study uses the OLS and Box-Cox estimation methods. Because of data limitations for the independent variables, the study considers only the 2006-2013 period. The results show that exchange rates, wheat prices and production did not have significant effects on the competitiveness of the wheat sector. Moreover, regression results provide empirical support for the HOV theory of international trade. Fertilizer prices had a significant negative impact and diesel prices had a significant positive impact on the competitiveness of the wheat sector of Black Sea region. Although diesel price does not have expected the sign, the results demonstrate that high fertilizer prices were one of the obstacles to the competitiveness of Black Sea wheat exports to the world market. Among the policy variables considered in this analysis, WTO accession, land policies and meat production show substantial positive effects on competitiveness and have the expected sign. Therefore, Kazakhstan's WTO accession, land reforms in Kazakhstan and Ukraine and low meat production could increase KRU's comparative advantage in wheat exports to the international market. Although most of the policy variables affected competitiveness, institutional structure (corruption) did not matter to the international competitiveness of the wheat sector.

Because of data limitations, the study was not able to consider other input variables that are important for wheat production. There could be other important sector-specific factors that affect the wheat sector. Therefore, future studies could consider including, for example, seed prices and labor costs, both of which play an important role in wheat production. Furthermore, if data are available, studies could analyze competitiveness over a longer period and assess comparative advantage before and after 2000. Following the collapse of the former Soviet Union, some

structural changes have taken place in the wheat sector of the Black Sea countries. Therefore, one may also ask whether structural changes have had an impact on the competitiveness of KRU wheat exports in the global market. These interesting questions could be analyzed in future research.

Finally, the comparative advantage indices that were discussed in previous sections are not able to identify whether competitiveness is achieved because of market or non-market factors. It is an important issue because when a government wants to increase the competitiveness of a certain sector, it has to identify the relative contributions of market and non-market factors. Although this study used the NRCA index to measure competitiveness, and this index has more advantages than other trade indices, the NRCA index is not able to differentiate the effects of market and non-market factors on comparative advantage. Therefore, future studies should also focus on finding new trade indices that are able to differentiate market and non-market factors.

3.7. References

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3.8. Appendix

1. Competitiveness of KRU wheat exports in the world market:

$$NRCA_{ij} = \frac{E_{ij}}{E_n} - \frac{E_i E_{nj}}{E_n E_n} \quad (3.11)$$

where E_{ij} is the wheat exports of country *i* (e.g., Kazakhstan), E_i is the total exports of country *i*, E_{nj} is the world's wheat export to the world and E_n is the world's total exports to the world.

2. Competitiveness of KRU wheat exports in the EU-27 market:

$$NRCA_{ij} = \frac{E_{ij}}{E_n} - \frac{E_i E_{nj}}{E_n E_n} \quad (3.12)$$

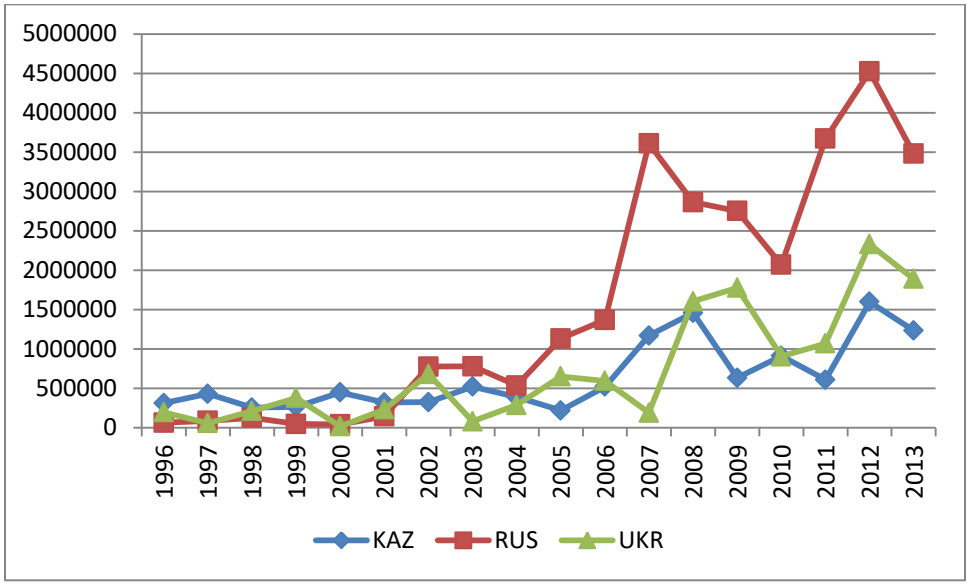
where E_{ij} is the wheat exports of country *i* (e.g., Kazakhstan), E_i is the total exports of country *i*, E_{nj} is the EU-27's wheat exports to the world and E_n is the EU-27's total exports to the world.

3. Competitiveness of KRU wheat exports in the world while exporting to Central Asia and South Caucasus:

$$NRCA_{ij} = \frac{E_{ij}}{E_n} - \frac{E_i E_{nj}}{E_n E_n} \quad (3.13)$$

where E_{ij} is the wheat exports of country *i* (e.g., Kazakhstan) to South Caucasus (or Central Asia), E_i is the total exports of country *i* to South Caucasus (or Central Asia), E_{nj} is the world's wheat exports to South Caucasus (or Central Asia) and E_n is the world's total exports to South Caucasus (or Central Asia).

Figure A1: Comparison of Kazakhstan, Russia and Ukraine wheat exports to the world (in current US$), HS1001 – wheat and meslin, 1996-2013



Source: Own compilation based on UN-Comtrade.

4. Competitive structure of Kazakhstan, Russia and Ukraine in the world wheat market: gravity model approach

4.1. Introduction

The international wheat trade has always been of interest to economists because wheat is the world's third most important crop if we measure it by the value of production (OECD-FAO, 2014). A large body of literature in agricultural economics has analyzed whether perfect competition or market power exists in the world wheat market. A number of studies found a competitive market for wheat exported from the US, Canada and Australia (Sekhar 2010; Carter et al. 2000), but some have argued that the market is imperfectly competitive (Jin and Miljkovic 2008; Cho et al. 2002). This discussion has continued since the Black Sea wheat exporters—Kazakhstan, Russia and Ukraine—emerged as large grain exporters to the international wheat market. The average annual growth of Black Sea region wheat exports has increased sharply from 9 million tons (MT) during 1996-2000 to 42 MT during the 2006-2012 period. Moreover, the KRU countries represent 21 percent of international wheat exports (Liefert and Liefert 2015). All these elements will increase competition, and KRU countries will become significant players in the world. Because KRU has high potential to export wheat to the world, it is interesting to focus on KRU's market structure in the global wheat market.

Several empirical papers on the grain trade have investigated the market structures of traditional wheat exporters in the global wheat market using the pricing-to-market (PTM) model (Jin and Miljkovic 2008; Jin 2008), and Pall et al. (2013a) used the same model to analyze Russian wheat exports. The authors concluded that the traditional wheat exporters and Russia have some monopoly power over several importing countries. However, no research has been conducted on KRU's market structure in the global wheat market. Consequently, no study has analyzed KRU's competitive structure for wheat for human consumption in the global grain market.

This study analyzes the question of whether there is any evidence of imperfect competition in the wheat trade, with a focus on the wheat exports of the Black Sea countries. The PTM model has some shortcomings, although previous empirical studies have used it to analyze the competitive structure of traditional wheat exporting countries. The key disadvantage of the PTM model is that it ignores third-country effects on bilateral trade. In particular, changes in a third country's

real exchange rate can have an impact on bilateral trade (Li 2003; Jin et al. 2004; Mattoo et al. 2012)[10]. Furthermore, the PTM model does not consider vertically differentiated wheat quality effects on bilateral trade (Lavoie 2005).

To investigate the market structure of the Black Sea countries, this study applies the gravity trade model, which takes into account third-country effects with a variable called "multilateral resistance" (MR) term (Anderson and van Wincoop 2003). In particular, we use the model by Anderson et al. (2014), which theoretically validates the use of exchange rates in the gravity trade model. In addition, this study also employs time-varying country fixed effects to control for MR (Baldwin and Taglioni 2007). To solve the problem of heteroskedasticity and zero trade, the Poisson Pseudo Maximum Likelihood (PPML) estimator is used in this study (Santos Silva and Tenreyro 2006). Furthermore, the gravity trade model is also estimated using the Ordinary Least Squares (OLS) estimator as a benchmark and for comparisons of the results.

The study aims to investigate the market structures of the Black Sea countries over the 2004-2010 period in two steps. In the first step, we examine whether the Black Sea countries, along with six other traditional exporters[11], exercise market power in 32 main importing countries. In the second step, we analyze whether KRU has competitive power in wheat exports in the South Caucasian and Central Asian regions. The findings of this study will contribute to the literature on perfect competition in the international wheat market.

The structure of the study is as follows. In second section we discuss the disadvantages of the pricing-to-market (PTM) model in an analysis of market structures and summarize the literature that has analyzed the wheat trade. The next section describes the gravity model as well as the reason for applying the Real Exchange Rate (RER). The fourth section discusses the literature on the gravity model estimation method. In section five, we discuss the estimation results and the last section concludes the paper.

[10] Several studies used the Residual Demand Elasticity (RDE) model to analyze the market structure of wheat exporters; this model also considers third-country effects (Carter 2000; Cho et al. 2002; Pall et al. 2013b).

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

4.2. Literature on the wheat trade and models for analyzing market structure

Most of the studies on the wheat trade have analyzed competition in the global wheat market among traditional wheat exporters. To our knowledge, no empirical research has been conducted on the market structure of KRU wheat exports, with the exception of Gafarova et al. (2014). Some studies have analyzed the competitive structure of traditional wheat exporters using the pricing-to-market (PTM) or residual demand elasticity (RDE) models[12]. For example, Pick and Carter (1994), Carew (2000), and Jin and Milijkovic (2008) found the market power of the US in wheat exports using the PTM approach and Carter et al. (2000), Yang and Lee (2001) and Cho et al. (2002) revealed the same results using the RDE model. On the other hand, Pick and Park (1991) found perfect competition for US wheat exports using the PTM model and Carter et al. (2000) and Sekhar (2010) found similar results using the RDE approach when they focused on several importing countries. Jin (2008) found PTM behavior for Canadian wheat exports, but Sekhar (2010) rejected this finding using the RDE approach. Dawson et al. (2014) applied the PTM model in an analysis of EU wheat exports and found that major EU wheat exporters applied price discrimination in Belarus and Iceland. Moreover, Pall et al. (2013a), recently analyzed the market structure of Russian wheat exports using the PTM approach and found market power for Russia in Azerbaijan, Lebanon and Mongolia. However, in another study, Pall et al. (2013b) examined the same market using the RDE model and found imperfect competition in different selected importing countries (Albania, Georgia, Greece). Using firm level data and the PTM model, Friebel et al. (2015) found price-discriminating behavior by Russian firms in 25 of 61 importing countries from 2002 to 2011. Gafarova et al. (2014) employed the PTM model to test for price discrimination by Black Sea region wheat exporters. The authors found evidence of discriminatory pricing in only 7 of 48 of Kazakhstan's export markets and concluded that even though Kazakhstan commands a high share of wheat exports to Central Asia, its ability to price discriminate is limited to Tajikistan and Uzbekistan. Furthermore, the scholars also found that Russia price discriminates when exporting wheat to Armenia and Azerbaijan, but Ukraine exhibits price-decimation behavior mainly in countries in the European market such as Lithuania, Portugal and Spain. As we can see, the PTM and RDE approaches contradict each

[12] The PTM model was introduced by Krugman (1986), and analyzes whether an exporting country can have price discrimination between its domestic market and an importing country, taking into account exchange rate volatility. The RDE model was introduced by Baker and Bresnahan (1988), and Goldberg and Knetter (1999) later applied this model in international trade to analyze competition.

other in some cases. Such contradictions have also been found for different products and markets, but Glauben and Loy (2003) concluded that these differences may be due to fixed contracts, and these authors prefer the results of the RDE approach because of its theoretical dominance.

As we have seen, several studies have used the PTM model to analyze the market structures of wheat exporters. However, some limitations exist for this model. One of the main shortcomings of these studies is that they do not consider the quality of wheat, which can affect the market structure. Countries with high-quality wheat can price discriminate in wheat exports. For instance, Lavoie (2005) found that the Canadian Wheat Board has used price discrimination in exports of high protein wheat (a vertically differentiated product), especially in markets that value the quality of the product. In our study, among the Black Sea countries, Kazakhstan has high-quality wheat with a protein content that is between 12 and 14 percent, but Russia and Ukraine have relatively low-quality wheat, with protein contents of 12 and 11 percent, respectively (Prikhodko 2009). Because of its high protein wheat, Kazakhstan could have market power in several destinations, and it is therefore very crucial to consider wheat quality in our research.

Another limitation of the PTM model is that it does not consider third-country effects on bilateral trade flows. In particular, third-country exchange rates can have strong impacts on bilateral trade. For instance, Li (2003) found that third-country exchange rates can affect the bilateral trade of developing and developed countries. In particular, the appreciation of third-country RERs can increase direct bilateral exports and decrease direct bilateral imports. Jin et al. (2004) showed third-country (Canada) exchange rate effects on the market shares of US wheat in ten Asian importing countries. Another study found China's exchange rate effect on competitor countries' exports to third markets, and it found that this spillover effect depends on product characteristics (Mattoo et al. 2012).

In comparison to previous studies that used vertically differentiated wheat quality and third-country exchange rate effects on bilateral trade, this study applies the gravity trade model to analyze the market structures of wheat exporters. Anderson and van Wincoop (2003) made a contribution to the gravity trade model with the inclusion of the multilateral resistance (MR) term. The authors showed that trade between two partner countries depends not only on a

bilateral trade relationship but also on the trade barriers experienced by each partner with respect to other countries. In particular, the MR term is able to consider the effects of third-country exchange rates and exporter wheat quality on bilateral trade. In addition, we use the exporter time-varying fixed effect, which is a proxy for the MR term (Baldwin and Taglioni 2007). Furthermore, to include zero trade flows in the gravity model and to solve the problem with heteroskedasticity, we apply the Poisson pseudo maximum likelihood (PPML) estimator (Santos Silva and Tenreyro 2006). In addition, this study uses the model by Anderson et al. (2014), in which the authors theoretically explain the use of the exchange rate variable in the gravity trade model.

A number of gravity studies have analyzed wheat trade patterns for major global wheat exporters (Koo and Karemera 1991; Sun et al. 2002). Koo and Karemera (1991) analyzed the factors that influence the international wheat trade using a gravity model approach. The authors found that production capacity, long-term trade agreements and credit sales significantly affected the volumes of trade flows. Sun et al. (2002) investigated the effects of volatility in real exchange rates on the world wheat trade and found that population, production, trade agreements and exchange rate factors matter, while ocean freight rates and income factors did not play major roles in explaining wheat exports. Finally, Grant and Lambert (2008) confirmed that the presence of regional trade agreements (RTAs) has a significant and positive effect on the wheat trade on the extensive margin, while trade diversion factors were found to negatively affect the wheat trade. To our knowledge, no studies have used the gravity model to analyze KRU wheat exports. Only one study by Renner et al. (2014) has used the gravity model to investigate Russian regional wheat flows. The authors found that regional infrastructure and transport costs were additional factors that need be considered when evaluating the interregional wheat trade (Renner et al. 2014).

To date, the literature on the Black Sea region's wheat trade is limited to issues relating to competitive structure. To the best of our knowledge, no study has used the gravity model to investigate the competitive structure of the KRU countries. Moreover, studies that have used the gravity model to analyze the wheat exports of traditional exporters were unable to comment on competition in the wheat market. Most of the studies used the PTM model to analyze the market structure, but we have already discussed the disadvantages of this model. In the next chapters, we

show that the gravity trade model can give a better picture of the market structures of wheat exporters.

4.3. Gravity model and real exchange rate

In this section, we attempt to give more information about the gravity trade model and explain how this approach can be used to better understand market structures. The gravity trade model has been the workhorse of international trade studies for over 50 years. This model is used to explain capital flows, migrations and trade volumes between states. The idea for the gravity trade model comes from Newton's Law of Universal Gravitation, which says that the gravitational force between two objects depends on the masses of the objects and the distance between them. In economics, the gravity trade model explains that bilateral trade between any two countries depends on their economic "weights", so-called Gross Domestic Product (GDP), and the costs of trade between them, which is generally proxied by the distance between the capitals of the two countries. The gravity trade model was later augmented by adding policy variables to show the effect of policies on trade flows.

Several economic researchers have tried to formulate a gravity model to explain international trade, but the real contributions to this effort came in the early 1960s. In particular, the first empirical application and mathematical formulation came from Tinbergen (1962) and Pöyhönen (1963), and their work made the gravity trade model the workhorse of applied international trade studies. The model is mainly used in the analysis of bilateral trade flows, although it can be used in many areas. The basic formula for the gravity trade model is as follows:

$$E_{ij} = \frac{Y_i^a Y_j^b}{D_{ij}^c} \tag{4.1}$$

where E_{ij} represents bilateral trade between countries *i* and *j*, Y_i and Y_j indicate the economic "weights" (GDPs) of country *i* and *j*, respectively, and D_{ij} is the bilateral distance between the two countries. The terms *a*, *b*, and *c* are often estimated in terms of natural logarithms, denoted by "ln". This formula shows that bilateral trade between two countries is directly proportional to the economic sizes (GDPs) of the importing and exporting countries, and inversely proportional to the distance between them. In other words, larger countries will have more trade flows and

more distant countries will trade less. The model has been used to analyze trade for a wide variety of regions, time periods and products.

Despite its popularity, the model has several difficulties. In particular, the microeconomic foundation (especially the role of prices) has not been well-developed in the gravity trade model. In Tinbergen's (1962) gravity model, the role of prices is not specified. The author says that trade flows between two countries depends on both the demand and supply sides and on the cost of trade between the countries. Because of its weak theoretical foundations, the gravity model was losing its reputation among researchers who were unable to use it to conduct comparative statics exercises. In addition, the model's estimation results are biased because some important variables are omitted. Finally, "old" gravity models did not consider third-country effects on bilateral trade. For instance, bilateral trade between countries A and B can change as a result of changes in the cost of trade between countries A and C. It may be that countries A and C have signed a trade agreement that removes trade barriers and lowers tariff rates between them. According to basic economic theory, a situation such as this will decrease trade flows between countries A and B. In particular, this situation will cause trade diversion and trade creation. However, the "old" gravity trade model does not consider such effects at all. Decreases in trade costs between countries A and C do not affect trade between A and B, which is at odds with standard economic theory. All these shortcomings were decreasing the credibility of the model and creating problems in the interpretation of explanatory variables.

Although Anderson (1979) presented a microeconomic foundation for the gravity trade model, his work was not highly valued initially. He developed the model based on constant elasticity of substitution (CES) preferences and assumed that goods are differentiated by place of origin. The author found that the more trade barriers a country has with other countries, the more it will be pushed to trade with its bilateral partner. Anderson and van Wincoop (2003) later showed this barrier as multilateral resistance term, which was not explicitly shown in Anderson's (1979) theory.

Later, Bergstrand (1985) extended the gravity trade model by adding price terms to measure price effects. The advantage of this contribution is that this price term can capture exporters' and importers' locations relative to other potential suppliers. In another studies, Bergstrand (1989, 1990) contributed to the model by explicitly adding the supply and demand sides of the

economy. The author kept CES preferences and added factor endowments (per capita income and capital-labor ratio) based on the Heckscher-Ohlin (H-O) model to explain specialization. Here, per capita income represents the supply capacity of the exporting country and the demand capacity of the importing country[13]. Deardoff (1998) also used the H-O structure under perfect competition by using identical preferences and unequal factor prices.

Anderson and van Wincoop (2003) (hereafter A-vW) made significant contributions to the development of the gravity trade model. In particular, the authors simplified the complicated price index, which is shown in the appendices of the Anderson (1979) and Bergstrand (1985, 1989, 1990) studies. Furthermore, the scholars manipulated and simplified the CES expenditure functions. The most important assumptions of the A-vW model are the following: products are differentiated by place of origin; each supplier produces unique products; trade costs between partners are symmetric; and the supply curve of each exporter is vertical. The main contribution of A-vW model was including multilateral resistance (MR) for exporters and importers and providing a computational solution for the MR terms. The authors argue that when an exporter and an importer do not have many alternatives for trade with others, the MR term will be high and trade between these two partners will increase.

To understand the content of the A-vW gravity trade model, let us first derive it. First, multilateral trade resistance can be divided into three components: *i)* Trade barriers exist between country *i* and *j*; *ii)* Country *i* has trade barriers with all trade partners except *j*; and *iii)* Country *j* has trade barriers with all trade partners except *i.* A second assumption that we should consider is that the world consists of *n* number of countries and *n* number of products, and each country is specialized in the production of one product. Third, consumption in each country j has CES preferences:

$$C_j = \left[\sum_{i=1}^{n} s_i^{(1-\varphi)/\varphi} c_{ij}^{(\varphi-1)/\varphi}\right]^{\varphi/(\varphi-1)} \qquad j = 1, \ldots, n \tag{4.2}$$

where C_j is the consumers' utility function in country *j*, s_i is the share parameter, c_{ij} is the consumption of region *i's* product by region *j* consumers and φ is the elasticity of substitution

[13] For the first time, Bergstrand (1989, 1990) also showed the role of price indexes in the gravity trade model; however, in the estimation he used existing price indices.

among all products ($\varphi > 1$). Consumers in country *j* maximize their utility function subject to the budget constraint:

$$Y_j = \sum_{i=1}^{n} p_i c_{ij} \tau_{ij} \tag{4.3}$$

where p_i denotes the supplier's price for country *i's* product and τ_{ij} is the trade cost between countries *i* and *j*. The first order condition for export from country *i* to *j* will be equal to (E_{ij}):

$$E_{ij} = \left(\frac{p_i \tau_{ij}}{\Pi_{jt}}\right)^{1-\varphi} Y_j \tag{4.4}$$

where P_j is the CES price index and $E_{ij} = p_i \tau_{ij} c_{ij}$. Here $\Pi_{jt}$is equal to:

$$\Pi_{jt} = \left[\sum_{i=1}^{n} \left(p_i \tau_{ij}\right)^{1-\varphi}\right]^{\varphi/(\varphi-1)} \tag{4.5}$$

The total income of country *i* is therefore:

$$Y_i = \sum_{i=1}^{n} E_{ij} \tag{4.6}$$

Following the equation of the A-vW model, we substitute equation (4.4) and (4.5) into (4.6) and after some mathematical calculations we obtain this formula:

$$E_{ij} = \frac{Y_i Y_j}{Y^w} \left(\frac{\tau_{ij}}{P_{it} \Pi_{jt}}\right)^{1-\varphi} \tag{4.7}$$

$$P_{it} = \left[\sum_{i=1}^{n} \left(\frac{\theta_j}{\Pi_{jt}^{1-\varphi}}\right) t_{ij}^{1-\varphi}\right]^{1/(1-\varphi)} \tag{4.8}$$

$$\Pi_{jt} = \left[\sum_{i=1}^{n} \left(\frac{\theta_i}{\mathrm{P}_{it}^{1-\varphi}}\right) t_{ij}^{1-\varphi}\right]^{1/(1-\varphi)} \tag{4.9}$$

The fourth assumption that A-vW made is that bilateral trade barriers, τ_{ij} and τ_{ji}, are equal for all pairs. In equation (4.7), E_{ij} is total exports from country i to j; Y_i and Y_j show the GDP of each country; Y^w shows the total income of all countries; P_{it} and Π_{jt} represent price indexes, also called "multilateral resistance" (MR) terms; τ_{ij} indicates trade cost, which for our purposes can be distance, RER or tariffs; and finally, φ is the elasticity of substitution between the units.

As we explained, bilateral trade between two nations depends on not only the bilateral relationship of the countries but also the bilateral relationship of each country with respect to other countries. For instance, consider the wheat trade between Russia and Georgia and between Kazakhstan and Uzbekistan. Both of the countries in the Central Asian region are landlocked and their railway system connections with other countries have not been well-developed. On the other hand, Russia and Georgia have sea access and they have good transport connections with other countries. Therefore, ceteris paribus, wheat exports from Russia to Georgia will be less than wheat exports from Kazakhstan to Uzbekistan. This is because Georgia will have more opportunities to buy wheat from other countries, which it actually does in reality, but Uzbekistan will buy wheat primarily from Kazakhstan. Equation (4.7) has become a widely used method for analyzing bilateral trade with the gravity trade model.

Although the formula for multilateral resistance (MR) term (4.8 and 4.9) looks simple, it is difficult to apply this formula in the estimation. For example, as we see from the formula, the MR term for an exporting country depends on trade costs and the MR of the importing region, which are part of the regression. Moreover, it is difficult to calculate the exact transport cost for each bilateral trade relationship. Such difficulties are one of the drawbacks of the A-vW formula. Several researchers have applied different methods for calculating multilateral resistance terms (Feenstra 2002; Straathof 2008; Baier and Bergstrand 2009). For instance, Anderson and van Wincoop (2003) made additional assumptions such as equalizing trade costs and using a non-linear programming approach. One of the most widely used methods is fixed effects, developed by Feenstra (2002), in which exporter and importer fixed effects are used to calculate price indexes. Basically, for the exporter it uses a dummy variable equal to one when *i* is the supplier and zero otherwise, and another dummy for the importer equal that is equal to one when *j* is the importer and zero otherwise. Feenstra (2002) showed that these fixed effects give consistent estimates of the average effects, and the method is easy to implement in the regression. However, the disadvantage of this method is that we cannot see the effect of changes in trade costs, which is the primary purpose of the gravity trade model.

However, as MR terms can change over time, then A-vW's gravity trade model can be used only with cross-section data (Baldwin and Taglioni 2007). As we can see, several authors have tried to calculate MR term and apply it in empirical studies because it is a very crucial part of the

gravity trade model. In this study, we apply importer- and exporter-time dummies to help remove the cross-section correlation between the unobservable MR terms and independent variables and to avoid a time series correlation. Moreover, these fixed effects capture all country-specific factors that vary over time (Baldwin and Taglioni 2007).

Another issue that is analyzed in the gravity trade model is the calculation of the trade cost between the trade partners. Trade cost can change depending on products, trading partners and means of the transport. Researchers have used variables representing the distance between the capitals of the two trading partners and many dummies to consider the effects of common borders, language, colonial ties and trade agreements (e.g., Bergstrand 1985; Rose and van Wincoop 2001; Grant and Lambert 2008). Limao and Venables (2001) as well as Combes and Lafourcade (2005) calculated real shipping costs, from which we can conclude that using a distance variable as a proxy produces results that are very far from reality[14]. In our case, it is difficult to calculate real transport costs because the KRU countries export wheat using different methods for transport, and there are some corruption issues that greatly affect the cost of transportation. Therefore, in this study it is safer to use a distance variable as a proxy for trade costs. In this study, this variable represents the geographic distance between the capitals, but in some cases it chooses large cities. For example, in the case of Turkey, the data selects Istanbul instead of Ankara.

In general, the gravity model also allows us to evaluate the impact of trade agreements, institutional quality, infrastructure and diplomatic relations on bilateral trade (Afman and Maurel 2010; Baier and Bergstrand 2007; Francois and Machin 2013). Furthermore, a large number of studies have developed the gravity specification using dummy variables to represent language, common borders and colonial ties (e.g., Bergstrand 1985; Rose and van Wincoop 2001; Grant and Lambert 2008).

Changes in exchange rates can alter the home and foreign prices of agricultural products. An increase in RER reflects the depreciation of an exporting country's currency[15]. The appreciation

[14] For further discussion of the calculation of trade costs, please see Disdier and Head (2008) and Bertholen and Freund (2008).

[15] In our research, RER is calculated as the nominal exchange rate multiplied by the ratio of the importer's and exporter's consumer price indexes (CPIs), which means that an increase in RER will depreciate the exporting country's currency.

of an exporting country's currency will cause an increase in the price set by the exporting country and a decrease in its exports. However, restricted trade volumes can create monopolies or perfect competition in international trade. For example, Yanikkaya et al. (2013) analyzed the effect of RER on Turkey agricultural exports using the gravity model and found that the exporting country faced strong competition in several agricultural products, but that it had market power in the export of hazelnuts and dried figs.

Several gravity-related studies have focused on the impact of the exchange rate (ER) on exports, and this concept was introduced in the gravity model for the first time by Bergstrand (1985, 1989). Later, Soloaga and Wintersb (2001) also included this variable in the gravity model using a two-stage estimation method and a dummy coefficient in a fixed effects model. However, local production and international trade data help in showing the effect of the real exchange rate (RER), which is not absorbed by fixed effects. For instance, some recent studies have extended the model using real exchange rate, and these studies found different results (Yannikaya 2001; Philippidis et al. 2013; Yanikkaya et al. 2013). However, all these studies do not have a theoretical explanation for using exchange rates in the gravity model. Therefore, this research will be based on the method that has been developed by Anderson et al. (2014), which found a positive effect of exchange rate on the export of aggregated agricultural products.

4.4. Estimation methods

The next step is to discuss estimation methods for the gravity trade model. Many estimation methods have been applied to the gravity model, but some of them give biased results (Santos Silva and Tenreyro 2006). Although combining the OLS estimation method with the log-linear specification in the gravity trade model is an approach that has been used extensively in empirical research, this method is inappropriate for several reasons. First, trade between any two partners is frequently zero, and the log-linearization of zero values is problematic because the logarithm of zero is undefined. Second, according to Jensen's inequality, the log-linearization of the gravity function can lead to inconsistent estimations in the presence of heteroskedasticity because it changes the feature of the error term (Santos Silva and Tenreyro 2006). In the next paragraphs, I will discuss all these problems in detail and describe an appropriate estimation

method that was introduced by Santos Silva and Tenreyro (2006) for analysis using the gravity model.

Zero trade flows can occur frequently in the analysis of bilateral trade flows. Several scholars have argued that 50 percent of the observations from their empirical studies are zero trade values (Santos Silva and Tenreyro 2006; Helpman et al. 2008; Burger et al. 2009). This percentage can increase by 30 percent if we apply the gravity model to analyze foreign direct investment (FDI) flows. According to our panel data, 51 percent of wheat exports are zero and these zero trade values come mainly from exports from Canada, the EU and the US. Zero trade values usually occur because of missing values, rounding errors or real no-trade flows. However, if the dependent variable has many zeros, it will cause problem when using the log-linear specification. Several methods have been used to address zero trade problems (e.g., Frankel et al. 1997). A standard method that has been applied in empirical studies is dropping zero trade flows from the sample (Linnerman 1966; Afman and Maurel 2010). However, excluding zero trade flows from the estimation could mean losing important information and causing biased results. Hence, empirical studies should avoid this method (Westerlund and Wilhelmson 2011). Other empirical studies have suggested adding a small constant (e.g., either 1 or 0.1) to zero trade flows and then applying the log-linear specification. These methods can be correct if zero trade flows are distributed randomly. However, in the analysis of real trade flows this is not the case. Moreover, none of these methods have a theoretical background (Burger et al. 2009), and the estimation results usually depend on selected values (Santos Silva and Tenreyro 2006). Therefore, it is not advisable to apply this method for the analysis of bilateral trade using the gravity model.

Santos Silva and Tenreyro (2006) suggested using the Poisson pseudo maximum likelihood (PPML) estimator, which solves the problem of zero trade flows. The authors argued that a natural way to solve this issue is to estimate the gravity trade model directly from its multiplicative form. With this method, the problem of zero trade flows disappears because we do not need to apply the log-linear specification. In particular, the multiplicative gravity relationship can be written as the exponential function. Later, Santos Silva and Tenreyro (2011) used simulation evidence to demonstrate that the PPML works even with excess zeroes and overdispersion.

The second problem with using OLS estimation, even when all bilateral trade relationships do not have zero trade flows because of Jensen's inequality[16], is that the log-linearization of the gravity function can lead to inconsistent estimations in the presence of heteroskedasticity because it changes the feature of the error term. Because the trade data are heteroskedastic, the mean of the error term is a function of the explanatory variables. In particular, after log-linearization, the error term will be dependent on the independent variables, which violates the condition for consistency of OLS. Moreover, heteroskedasticity can affect the variance of the estimated parameters, which means that we cannot trust the t-values. To solve this problem, Santos Silva and Tenreyro (2006) suggest using the PPML when the gravity equation is estimated in levels. In sum, the PPML is consistent when there are heteroskedasticity and zero trade flows.

In the PPML model, the conditional mean is proportional (not necessary equal) to the conditional variance. When this assumption holds, the coefficient estimates of maximum likelihood are consistent and efficient (Krizistin and Fischer 2015). However, Santos Silva and Tenreyro (2006) showed that the PPML is also consistent even when conditional variance is not proportional to the conditional mean. The Poisson gravity model also works with over-under-dispersion because the estimator does not make any assumption about it.

Based on the information in the previous paragraphs, to address the problem of heteroskedasticity and excess zeroes, I use the PPML estimation method, and our model is the following:

$$T_{ijt} = \exp\big(\alpha_0 + \alpha_1 ln.dist_{ij} + \alpha_2 contig_{ij} + \alpha_3 tariff_{ijt} + \alpha_4 BA_{ij} + \alpha_5 MA_{ij} + (\sum_{n=1}^{9} \alpha_n ex.c.rer_{nt}) + \gamma_{it} + \delta_{jt}\big) + \varepsilon_{ijt} \quad (4.10)$$

where T_{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 the distance between i and j; contig_{ij} is equal to 1 if the countries have a 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 the RER of the

[16] Jensen's inequality implies that the expected value of a logarithm of a random variable does not equal the logarithm of its expected value: (*E(ln(y))≠ln(E(y)*).

exporting country; γ_{it} and δ_{jt} are exporter and importer time-varying fixed effects, respectively; and ε_{ijt} is the normally distributed error term.

We need to apply the Poisson model to the fixed effects specification of the gravity trade model (Wooldridge 2002):

$$P(T_{ij} = T|x_{ij}) = \frac{(\mu(x_i\beta))^{T_{ij}} e^{-\mu(x_i\beta)}}{T_{ij}!}, \qquad T_{ij} = 0,1,2, ..., \text{ where } T_{ij}! \text{ is T factorial} \tag{4.11}$$

As we mentioned before, in the Poisson model, the conditional variance is equal to the mean:

$$\sigma(T_{ij}|x_{ij}) = E(T_{ij}|x_{ij}) = \mu(x_{ij}\beta) \tag{4.12}$$

We can estimate β coefficient with maximum likelihood. First we need to find the log-likelihood function of the Poisson model, which is the sum of the logarithms as a function of β.

$$log\ K(\beta) = \sum_{i=1}^{n}\sum_{j=1}^{n}(T_{ij}(x_{ij}\beta) - \exp(x_{ij}\beta) - logT_{ij}!) \tag{4.13}$$

Then, we have to maximize this function with respect to β:

$$\sum_{i=1}^{n}\sum_{j=1}^{n}(T_{ij} - exp(x_{ij}\beta))x_{ij} = \sum_{i=1}^{n}\sum_{j=1}^{n}\varepsilon_{ij}x_{ij} = 0 \tag{4.14}$$

where $\varepsilon_{ij} = T_{ij} - exp(x_{ij}\beta)$.

In addition, in the PPML estimation, dependent variables do not have to be integers, and the data are not required to follow the Poisson distribution because the model has the Poisson pseudo-maximum likelihood estimator and gives equal weight to all observations (Gourieroux et al. 1984 a, b). If we need a consistent estimator, the conditional mean should have the correct specification;

$E(T_{ij}|x_{ij})=\exp(x_{ij}\beta)$, where T_{ij} is the trade flows between country *i* and *j*. (4.15)

Krizistin and Fischer (2015) also mention that the "… PPML estimator is like the Poisson maximum likelihood estimator in that the Poisson model is taken to motivate the first order condition defining the estimator, but is unlike so far that the data generating process used to obtain the distribution of the estimator does not need to be the Poisson."

Several other methods have been developed to solve the problems with the gravity model, and one of them is the nonlinear least squares (NLS) estimator. However, Santos Silva and Tenreyro (2006) argue that this estimator is inappropriate because it gives more weight to high variance observations and it is not robust to heteroskedasticity. Manning and Mullahy (2001) suggest using the gamma pseudo-maximum likelihood (GPML) estimator, where the variance is proportional to the square of the conditional mean. However, this can create biased results when we have countries with strong economies and better trade data because more weight will be given to noisier observations (Santos Silva and Tenreyro 2006).

Another method is the negative binomial PML (NBPML); this distribution assumes that the conditional variance is equal to the conditional mean plus the product of its square and a scalar to be estimated. However, one of the disadvantages of this estimation method is that it depends on the unit of measurement of the dependent variable (Head et al. 2009). Therefore, if we measure trade in millions of dollars or in thousands of dollars, the results of the estimation will be different. Burger et al. (2009) developed the zero-inflated Poisson/negative binomial pseudo-maximum likelihood (ZIPPML/ZINBPML) methods to address the problem of excess zeros and overdispersion, but Staub and Winkelman (2010) later argued that these methods are inconsistent under model misspecification and the PPML is still consistent even with large number of zeros.

In sum, the PPML model does not face any of the problems that were mentioned above. Therefore, this study focuses primarily on the PPML, but as a benchmark we are also using the OLS method to compare the results between these two estimation methods and show the advantages of the PPML method.

4.5. Data and descriptive statistics

Because we have already examined the models and estimation methods, in this section we discuss the data and estimation results. We are estimating equation 4.10 using the panel data for the 2004-2010 years to see the structure of the global wheat market. The number of years is limited because of the availability of the Harmonized System (HS) 8-digit level data for exporting countries. The HS data have been used for traded products by more than 170 countries since 1988 and were developed by the World Custom Organization (WCO). In the UN-Comtrade

data, one can find HS 4-digit level data for an even longer period, but these data include food wheat and feed wheat as well as meslin. To analyze wheat for human consumption, we should use HS 8-digit level data, which is more concrete.

Table 4.5.1: Summary statistics

Definition	Mean	Std.Dev	Min	Max
Export	2.76e+07	7.97e+07	0	9.65e+08
Logarithm of the distance (ln_dist)	8.335	0.694	6.426	9.703
Contingency (contig)	0.024	0.154	0	1
Import tariff	0.136	0.268	0	1.3
Bilateral Agreement (BA)	0.139	0.350	0	1
Multilateral Agreement (MA)	0.333	0.472	0	1
RER of Canada with respect to importing country (CAN_RER)	0.432	0.598	0.00007	2.058
RER of Germany with respect to importing country (DEU_RER)	0.288	0.398	0.00005	1.421
RER of France with respect to importing country (FRA_RER)	0.289	0.399	0.00005	1.425
RER of Great Britain with respect to importing country (GBR_RER)	0.214	0.299	0.00003	1.152
RER of Kazakhstan with respect to importing country (KAZ_RER)	42.659	59.135	0.007	199.445
RER of Romania with respect to importing country (ROU_RER)	1.011	1.402	0.0002	4.848
RER of Russia with respect to importing country (RUS_RER)	9.137	12.657	0.002	4.848
RER of Ukraine with respect to importing country (UKR_RER)	1.770	2.452	0.0003	8.399
RER of USA with respect to importing country (USA_RER)	0.377	0.522	0.00006	1.825

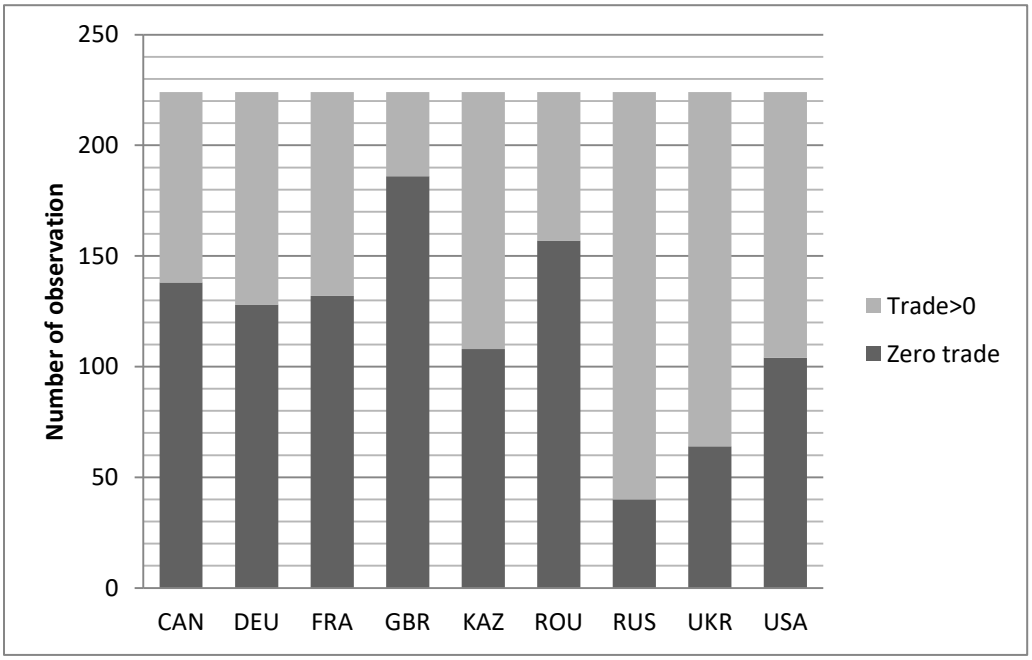
Source: Own compilation

We use export value data for nine large wheat exporters and thirty-two main importing countries (Appendix: Table B.1). In total, 32 countries take more than 70 percent of the total KRU wheat exports. Export value data for the KRU countries as well as for Canada were taken from Global Trade Information Services (GTIS), data for the US exports came from the US Census Bureau Foreign Trade Division and the source of the EU countries' wheat export data was Eurostat. Tariff data were mainly obtained from the World Trade Organization (WTO) website, but for non-members of the WTO, the data were available from the United Nations TRANIS data, the World Integrated Trade System (WITS) Database and the OECD tariff database. Bilateral and

multilateral agreement data were available from UN-ESCAP; DG-Trade; the Office of United States Trade Representative; and Foreign Affairs, Trade and Development of Canada. For the trade cost data, we obtained the distance between the most populated cities for each country pair from CEPII (*Centre d'Etudes Prospectives et d'Informations Internationales*, *2013*). Another geographic variable, contiguity, was also provided by CEPII. Finally, exchange rate data were available from the International Monetary Fund (IMF) website. Summary statistics for all variables are reported in Table 4.5.1.

In total, almost half of the observations in the dataset are zero trade flows, which may be due to rounding errors caused by the reporting countries or high trade costs between the trade partners. As we see from Figure 4.5.1, zero trades represent more than half of the total observations for all countries, except for KRU and the US. Several issues could explain the many zeros for wheat export data. For instance, 61 percent of Canadian wheat exports are zero. This could be due to weak trade relationships with analyzed countries, or because Canada exports mainly durum wheat to a small number of countries. However, the US has relatively fewer zero wheat exports than Canada because it has much better trade relationships with trade partners, and it exports primarily hard red winter wheat, which is consumed by many countries. In terms of the EU's exporting countries, the data show a relatively high number of zero trade values because the main importers of wheat from Great Britain, France, Germany and Romania are the other members of the EU. However, only three importing countries (Greece, Italy and Spain) belong to the EU zone in our data. If we were to take the logarithm of the dependent variable, we would drop 52 percent of the observations in the data. Moreover, if these zero trade values appear randomly, dropping them would not pose any problems. However, zero trade flows occur because of a selection process rather than a random process. Therefore, calculating the estimation without the zero values could create biased results. Despite the fact there are many zeros in the data, we are keeping them in the estimation with the help of the Poisson estimation.

Figure 4.5.1: Number of observations with zero trades and positive trades



The KRU countries show more positive trades relative to other observed countries. For instance, if we look at KRU wheat exports to Caucasian countries (Armenia, Azerbaijan and Georgia), we can see that only 17 percent of the observations are zero trade flows, which proves that there is a relatively strong wheat trade relationship between these two regions. Furthermore, GTIS data show that the wheat importing countries of the Central Asian region (Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan) depend mainly on Kazakhstan wheat exports. However because Russia and Ukraine also play important roles in this region, this study looks at the market structures when KRU countries export wheat to Central Asian countries.

4.6. Estimation results and discussions

The results of the regression are displayed in Table 4.6.1. The table is divided into three panels, and each panel has two parts. First, we look at the wheat exports of six traditional exporting countries and KRU to thirty-two importing countries; second, at KRU exports to the South Caucasus; and third, at KRU exports to the Central Asian countries.

In all panels we regress the data using two estimation methods: the PPML estimation with time-varying fixed effects and ordinary least squares (OLS). However, as the OLS estimate is the

logarithm of the exports, this regression drops zero trade values. For instance, in the first column, the OLS estimation keeps 48% of the sample and demonstrates only positive export flows. In contrast, the PPML estimation uses all observations without dropping zero trade values. All standard errors are robust and clustered. Due to space limitations, we did not report the results of the time-varying country fixed effects.

One can see that the OLS results are significantly different from those generated by the PPML (see columns 1 and 2). This difference demonstrates that heteroskedasticity played an important role in the results of these two estimation techniques. For instance, in all countries, case elasticities for geographic distance, which is the substitute for trade cost, demonstrate different results for the OLS (-1.956) and the PPML (-1.837)[17]. The outcome of the second estimation method shows in absolute terms the lesser role of transport cost in wheat exports. However, the outcomes of both estimation methods show the expected sign, indicating that long distances decrease the wheat flow between two partners. Moreover, after controlling for distance, the contiguity dummy is about four times less in the PPML estimation than in the OLS, but it is significant in both cases. The estimation results demonstrate that neighbor countries can trade more, which is consistent with previous empirical gravity trade studies. According to the results of both estimation methods, low tariff rates appear to be important for wheat exports. Therefore, importing countries should consider this in future policy decisions if they want to more and cheaper wheat from traditional wheat exporters.

However, bilateral and multilateral trade agreements do not have any effect on the observed countries' wheat exports. A plausible explanation can be that these agreements are too general and they do not specifically affect the wheat trade. Finally, all the coefficients of the RERs, except for that of Kazakhstan, demonstrate negative signs and insignificant results in the OLS estimation. However, the RER coefficients change from negative to positive for six countries under the PPML. Although a positive sign for RER demonstrates perfect competition in the international wheat market, the results are significantly different from zero only for Kazakhstan. The outcomes for all countries do not show any evidence of the market power of the traditional wheat exporters.

[17] For information about the elasticities, please see the note under Table 4.6.1.

The estimation results listed in columns 3 and 4 show wheat exports from KRU to the South Caucasian countries. In this panel, the outcomes of the PPML estimation are again lower than those from the OLS. However, the trade cost variables do not have the expected sign. In particular, high transportation costs increase trade in both the OLS and PPML regressions, and this result is significant for both estimation methods[18]. Moreover, sharing a border negatively influences trade between KRU and the South Caucasus. The reason could be that KRU countries do not prefer to export to neighboring South Caucasian countries. The OLS estimation excludes the tariff result because it drops the zero trade flows, and as a result, tariff does not change according to the importing country. In contrast, the PPML shows that tariffs play an insignificant role in KRU wheat exports to South Caucasian countries. The results for bilateral and multilateral agreements are excluded from the estimation because, as all these countries were members of the former Soviet Union, their agreements do not change by country. Focusing on the main variables of interest, the RER coefficients indicate that Kazakhstan's RER had a positive and significant impact on wheat exports under the PPML, although it had a relatively lower effect under the Poisson regression. The exchange rates of Russia and Ukraine did not have a significant impact on wheat exports to the South Caucasian region, but the estimation result shows a relatively smaller effect for RER under the PPML estimation method than under the OLS. Moreover, in the second case, the results show that there is no evidence of KRU market power in the South Caucasian region and that Kazakhstan faced competition while exporting to this region.

[18] Although in most gravity studies distance has a negative sign, in our case it is positive. This may be due to wheat quality and different levels of demand in each Caucasian country. For instance, the closest country to the Russian Federation is Georgia, but Russia exports more wheat to Azerbaijan than to the other two South Caucasian countries because Azerbaijan has the largest population (demand) of the three countries. Moreover, wheat exported to Georgia goes through Azerbaijan or through the sea. Therefore, there is no exact transportation cost for Georgian imports. On the other hand, the distance variable measures the distance between the capitals, and the geographic distance between Kiev and Tbilisi is shorter than the distance between Moscow and Tbilisi. However, Georgia imports more wheat from Russia than from Ukraine. There are several papers that show that distance is not a good proxy for transport cost, but as it is very difficult to measure the exact transport cost, using distance as a proxy for transport cost is generally accepted in the gravity trade literature (Combes and Lafourcade 2005; Martinez-Zarzoso and Nowak-Lehmann 2007).

Table 4.6.1: Estimation results

	All countries		KRU to Caucasus		KRU to Central Asia	
	OLS	PPML	OLS	PPML	OLS	PPML
ln_Dist	-1.956***	-1.837***	6.326*	4.384***	-15.062**	-2.001
	(0.565)	(0.394)	(3.289)	(1.219)	(6.572)	(1.372)
Contig	415.856**	89.405*	21.854	-76.82***	-99.99**	4.535***
	(0.682)	(0.391)	(0.559)	(0.241)	(9.377)	(1.562)
Tariff	-0.625***	-0.333**	--	0.261	--	--
	(1.257)	(1.081)		(22.621)		
BA	-54.484	-16.81	--	--	1.28e+24*	165.626
	(0.491)	(0.382)			(24.821)	(1.484)
MA	-30.195	-5.109	--	--	--	--
	(0.407)	(0.322)				
CAN_RER	-0.464	-0.086	--	--	--	--
	(1.622)	(1.23)				
DEU_RER	-1.073	0.077	--	--	--	--
	(2.251)	(1.87)				
FRA_RER	-1.592	-0.406	--	--	--	--
	(2.614)	(1.745)				
GBR_RER	-1.419	0.661	--	--	--	--
	(3.043)	(2.528)				
KAZ_RER	0.332	0.880*	14.195	5.016*	-13.074	6.215**
	(0.016)	(0.012)	(0.088)	(0.04)	(0.364)	(0.075)
ROU_RER	-1.639	0.295	--	--	--	--
	(0.688)	(0.554)				
RUS_RER	-0.35	0.288	8.321	2.849	1.917	2.081*
	(0.069)	(0.055)	(0.439)	(0.195)	(1.563)	(0.159)
UKR_RER	-0.253	0.37	5.639	2.197	0.485	0.897
	(0.365)	(0.282)	(2.141)	(1.017)	(8.689)	(0.954)
USA_RER	-0.585	0.267	--	--	--	--
	(1.804)	(1.371)				
Constant	28.304***	34.914***	-36.233	-18.196**	110.918*	26.042**
	(5.239)	(3.634)	(26.334)	(7.976)	(56.452)	(10.602)
N	959	2016	52	63	46	84

Note: Results for time-varying country fixed effects are not reported due to space limit. Prob. values based on robust standard errors adjusted for clustering by country-pair appear in parentheses. Variables in log are interpreted as elasticities; variables in level are interpreted as semi-elasticities which are transformed to the true elasticity by multiplying by the mean of the corresponding exogenous variable (Tenreyro 2007); binary variables interpreted as semi-elasticities, which are corrected by following formula: *(exp(b_i)-1) x 100%*, where b_i is the estimated coefficient (Wooldridge 2010). The results of binary variables give again semi-elasticity, but they are corrected for an approximation error (Santos Silva and Tenreyro 2006).

*, ** and *** shows statistical significance at 10, 5 and 1 percent level, respectively.

In the last panel, columns 5 and 6 present the outcomes for KRU wheat exports to Central Asian countries[19]. Although geographic distance has the expected sign for both estimation methods, it is insignificant under the PPML. The reason could be that transportation costs are a small percentage of the total trade costs for this region because the main trading partner (Kazakhstan) is very close to the Central Asian countries. The coefficient for contiguity in the PPML method confirms the previous idea because it shows that Kazakhstan exports more wheat to common border countries. We omitted the tariff and multilateral agreement variables from the regression because all these countries belong to the CIS countries, have zero tariff rates among them and have signed the same multilateral agreements. In contrast, not all the Central Asian countries have bilateral trade agreements with the Black Sea countries. Although this variable demonstrates a positive sign for both estimation methods, it is significant only under the OLS. The insignificant value for bilateral trade agreements in the PPML estimation shows that bilateral trade relationships did not play an important role in KRU wheat exports to the Central Asian region. RER had significant positive effects on Kazakh and Russian wheat exports under the PPML estimation. However, the OLS results demonstrate insignificant results for RER for all countries and an opposite sign for Kazakhstan. Moreover, we see that Ukraine's exchange rate did not have a significant effect on wheat exports. A plausible explanation for this could be that Ukraine is located a long distance from the Central Asian countries and is therefore not an important exporter to this region. Overall, the PPML results show that KRU countries prefer to export wheat to neighbor countries and KRU countries face strong competition in the Central Asian region.

In summary, the study found that the PPML method did not produce the puzzling results that were found when using the OLS method. Furthermore, we observed negative effects of transportation costs on wheat export for all countries except in the case of trade between KRU and the South Caucasus. Therefore, to increase wheat exports, KRU countries should invest in rail transport, sea ports and grain terminals, which play a crucial role in the wheat trade. However, we cannot generalize this policy recommendation to all three KRU countries. For instance, because Kazakhstan does not have direct access to sea ports, it would be better for Kazakhstan to develop its railway infrastructure and build grain terminals to the east and south

[19] As we discussed before the main importers of KRU wheat in Central Asia are Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan.

(i.e., near China and Iran). Russia and Ukraine should improve railway connections inside their countries to transport wheat from remote areas to the sea ports and build new rail links to all sea ports that do not have rail access (e.g., Tamam port). In addition, the Russian and Ukrainian governments should invest in building new sea ports, which could stimulate wheat exports in the direction of North Africa and the Middle East.

The estimation results also revealed that sharing a border had a substantial effect on wheat exports for all countries, except for trade between the Black Sea countries and the South Caucasus region. Therefore, to increase wheat exports, the KRU countries should maintain good trade relationships with common border countries. Furthermore, the results suggest that high tariff rates decrease wheat exports to all observed countries. The estimation results also prove that the KRU countries did not have market power in wheat exports to the South Caucasian and Central Asian countries and that Kazakhstan faced competition in all cases. In summary, our results represent an improvement on previous wheat market structure studies (Jin et al. 2008; Jin 2008; Pall et al. 2013), and the findings indicate perfect competition in the global wheat market; a result that was also observed by Carter (2000) and Sekhar (2010).

4.7. Conclusions

Several international trade studies have analyzed the competitive structure of wheat exporters in the world grain market. This debate became particularly relevant after the emergence of the KRU countries in the international grain market. Empirical papers were finding diverse results for the analyses of the market power of traditional wheat exporters. Taking into account the huge wheat export potential of the Black Sea countries, this study has aimed to analyze whether these countries have market power in the international wheat market and whether the KRU countries face competition in wheat exports to the Central Asian and South Caucasian regions.

To date, the literature on wheat competition has used the PTM model to analyze the market structure of the global wheat market. However, this model has some shortcomings: it does not consider the effects of third-country exchange rates and wheat quality on exports. To address these issues, this study therefore investigates the potential role of KRU in the global wheat market using the gravity trade model. In particular, with the help of country-time fixed effects,

the gravity model is able to consider the effects of third-country exchange rates and wheat quality on bilateral trade. The study also uses the Poisson pseudo maximum likelihood (PPML) estimator, which helps address the problems of heteroskedasticity and zero trade (Santos Silva and Tenreyro 2006). In addition, we estimated the gravity model using the OLS method as a benchmark and found that the PPML is superior to OLS.

This study makes several contributions to the international grain trade literature. First, the study investigates KRU wheat competition using the gravity trade model, which takes into account third-country effects and wheat quality. Second, to the best of our knowledge, this is the first study that looks at the effect of RER on wheat exports using the theoretical approach developed by Anderson et al. (2014). Third, for the analysis of competitive structure, we use wheat for human consumption (HS-8 digit code), which is very crucial in the context of food security. Finally, the study conducts a market power analysis of the Black Sea countries in two important regions (Central Asia and the South Caucasus), which have not been done in previous trade literature.

Results of this study show the negative effects of geographic distance on wheat exports for all countries and for KRU exports to Central Asia. Thus, KRU governments should invest in transportation (e.g., invest in railway and sea ports) to decrease transport costs. Furthermore, the estimation of KRU wheat exports to Central Asia demonstrates the significant role of common borders. In addition, tariff rate has a substantial negative effect on wheat exports from all countries.

The emergence of KRU increased competition in the international wheat market, and, for the first time, our study confirms this idea using the gravity trade model. In addition, the study clearly reveals the significant role of RER in wheat exports, which indicates perfect competition in the global wheat market. Finally, we also found no evidence of KRU's market power over wheat exports to South Caucasian and Central Asian countries.

Due to constraints in obtaining data that include more specific wheat types, we could not analyze the market structure of wheat "giants" for a long time period. A larger sample size could help in conducting a more accurate analysis and provide results for more years. Future research could also conduct this analysis on other grain products as well as for wheat flour in this region.

4.8. References

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4.9. Appendix

Table B.1: List of the countries

Cases	Exporting country	Importing country
All countries	Canada, France, Germany, Kazakhstan, Romania, Russian Federation, Ukraine, United Kingdom, USA	Afghanistan, Albania, Armenia, Azerbaijan, Bangladesh, Algeria, Egypt Arab Republic, Georgia, Greece, Indonesia, India, Iran Islamic Republic, Israel, Italy, Jordan, Kenya, Kyrgyz Republic, Korea Republic, Lebanon, Libya, Morocco, Pakistan, Philippines, Syrian Arab Republic, Spain, Tajikistan, Turkmenistan, Tunisia, Turkey, Uzbekistan, Vietnam, Yemen Republic
KRU to South Caucasus	Kazakhstan, Russian Federation, Ukraine	Armenia, Azerbaijan, Georgia
KRU to Central Asia	Kazakhstan, Russian Federation, Ukraine	Kyrgyz Republic, Tajikistan, Turkmenistan, Uzbekistan,

5. Summary, conclusion and recommendation

The market shares of traditional wheat exporters have changed during the past two decades following the emergence of the Black Sea countries in the international wheat market. These changes have affected the competitiveness of wheat exporters as well as the competitive structure of the global grain market. Previous articles on the competitiveness of KRU agricultural product exports have been primarily informational and have shown results for short periods of time. However, the changes in the patterns of competitiveness during the past decade have been caused by changes in input prices and by policy interventions. Several empirical studies have found imperfect competition for traditional wheat exporters in the global grain market. However, after the emergence of Kazakhstan, Russia and Ukraine (KRU), the competitive structure has changed in the international wheat market. This dissertation first gives a review of the world wheat market and the role of KRU in the wheat imported by the South Caucasus and Central Asia (SCCA) region. Second, it empirically investigates the competitiveness of KRU wheat exports, and third, the study looks at the competitive structure of the Black Sea countries' wheat exports in the global wheat market.

A descriptive analysis of traditional and non-traditional wheat exporters shows that the KRU countries' share of the world wheat market has increased during the past two decades. Since the collapse of the former Soviet Union, wheat production has increased in KRU countries due to structural changes, yield increases and land reforms. Moreover, the huge wheat export potential of new "giants" has changed the market structure of the international grain market. The wheat exports of the Black Sea countries can be increased in the future if these countries become WTO members, avoid government interventions and improve transport infrastructures inside their countries and with trading partners. Furthermore, the study reveals that the KRU countries have a significant market share in the wheat imports of South Caucasian and Central Asian countries. In total, the SCCA region imports more than half of its wheat from KRU countries. Because of increasing populations and growth in incomes, wheat imports in this region are expected rise in the future, and the Black Sea countries will have great potential to export wheat to the SCCA. However, some countries in the SCCA region have diversified import strategies, while others are highly dependent on wheat from the Black Sea countries. For example, Azerbaijan buys half of its wheat from the Russian Federation and the other half from Kazakhstan. In contrast, Georgia

has a very diversified strategy, and Georgia is not highly dependent on KRU wheat exports. The second chapter also discusses quality of wheat quality from different countries. In general, although wheat quality in the Black Sea countries is lower than that of traditional wheat exporters, Kazakhstan has higher quality wheat than Russia and Ukraine. The study reveals that it is very crucial to consider wheat quality in an analysis of the competitive structure of wheat exporters.

This study about KRU wheat export competitiveness uses the Normalized Revealed Comparative Advantage (NRCA) index, but for comparison I use also Balassa's revealed comparative advantage (BRCA) index. However, this study argues that the NRCA index is a more appropriate method to compare competitiveness because it allows assessments of comparative advantage across countries and over time. The results for the 1996-2013 period indicate that Russia became more competitive than Kazakhstan and Ukraine in international wheat exports after 2005. This is mainly because of Russia's huge production potential and easy access to many foreign markets. When we compare the competitiveness of KRU in the European wheat market, we see that the comparative advantage for the Black Sea countries has increased slightly in the EU-27 market. In contrast, when we look at competitiveness in the SCCA region, we can see that not all the Black Sea countries are competitive. In particular, the results of the NRCA index show that only Kazakhstan and Russia are competitive in the South Caucasian region, while Kazakhstan has comparative advantage in wheat exports to Central Asia. Furthermore, for the first time in the literature, this study has identified which factors affect the competitiveness of KRU wheat exports in the international market. The OLS and Box-Cox estimation results for the 2006-2013 period show that input prices, particularly diesel price, have a significant effect on competitiveness. Moreover, several policy variables such as WTO accession, land reforms and meat production substantially affect the comparative advantage of KRU wheat exports in the world market. In contrast, the study did not find any crucial effects of exchange rates, production costs, price and corruption on the competitiveness of KRU wheat exports.

The fourth chapter estimates the gravity trade model to investigate the competitive structure of the Black Sea countries' wheat exports. Following the literature of gravity trade model studies, this thesis uses the Poisson Pseudo Maximum Likelihood (PPML) estimation method to address the problems of heteroskedasticity and zero trade flows. However, the model is also estimated

using Ordinary Least Squares (OLS) as a benchmark and to provide a comparison with the PPML results. The outcomes of both estimation methods demonstrate that heteroskedasticity and excess zeros played a significant role in the differences in the results observed between these two estimation techniques. The estimation outcomes are divided into three parts. In the first part we look at wheat exports from KRU and other traditional exporters to 32 major importing countries. In the second and third parts, we analyze KRU wheat competition in the South Caucasus and Central Asian countries, respectively. The results indicate that distance, which is a proxy for transportation cost, is one of the main obstacles for KRU wheat exports to all countries. Furthermore, the estimation outcomes show that the presence of a common border has a significant positive effect on KRU wheat exports to Central Asian countries. This may be explained by the Black Sea countries having better trade relationships and transport connections with neighboring countries. High tariff rates set by destination countries can decrease the import of wheat from KRU as well as from traditional exporters. The results for Real Exchange Rate (RER) indicate that there is no evidence of market power of the KRU countries for wheat exports to all destinations and to the SCCA region. In the South Caucasian region, only Kazakhstan faces competition in wheat exports, but the exchange rates of Russia and Ukraine are not significant. This result shows that the Black Sea countries do not have market power in wheat exports to South Caucasian countries. In the case of KRU exports to Central Asia, the empirical analysis shows that Kazakhstan and Russia faces strong competition in wheat exports to this region, but Ukraine's RER does not have important role in exports to this region. A plausible explanation for this could be that Ukraine has high transportation costs for wheat exports to Central Asian countries.

This dissertation has made several important contributions to the agricultural trade literature. The first input is that we are employing the normalized revealed comparative advantage (NRCA) index, which has not been used before in an analysis of a single agricultural product. As discussed in the third chapter, other trade indices have some disadvantages, but the NRCA index is more effective because of its symmetrical characteristics and because it allows for easy comparisons across products and countries and over time. Second, to the best of our knowledge, none of the previous studies have empirically analyzed the factors that affect the competitiveness of the Black sea countries' wheat exports. Previous studies that separately investigated the

competitiveness of the Black Sea countries' agricultural exports were more informational and based on author's judgments rather than on empirical analyses.

Third, we use the gravity trade model to analyze KRU wheat competition in the global wheat market. As discussed in the fourth chapter, several approaches have been used to analyze the competitive structure of the international wheat market, but these models have some shortages. Therefore, in this dissertation, we use the gravity trade model with time-country fixed effects, which considers third-country effects and wheat quality. In addition, previous empirical papers that looked at the impact of the exchange rate on commodity exports do not have a theoretical background. Thus, the final contribution of this study is that it investigates the effect of RER on wheat exports based on the theoretical approach of the Anderson et al. (2014) model.

Taking into account the descriptive analysis and empirical results, this study makes the following suggestions. Because wheat production and the export potential of the Black Sea countries are increasing, the KRU countries will be able to meet a large proportion of the demand for wheat from the CIS countries, China and Iran. However, to accomplish this, the KRU countries should invest in building new railways, sea ports and grain terminals. In addition, the governments of the countries should avoid implementing export restriction policies to build long-term and reliable relationships with trade partners. The descriptive analysis shows that the SCCA countries (e.g., Armenia and Azerbaijan) are highly dependent on wheat exports from the Black Sea region. Therefore, importing countries should diversify their import sources, which could increase competition and reduce prices in the international wheat market. Moreover, importing countries should also cooperate with the KRU countries in building new transport infrastructure, which could decrease the costs of trade as well as prices.

If policymakers want to be competitive in wheat exports, they should consider setting appropriate input prices. Furthermore, after WTO accession and the implementation of land reforms, the competitive advantage of KRU wheat exports will increase even more. As their livestock production decreases, the Black Sea countries can specialize in wheat exports and become very competitive in the global wheat market.

The empirical analysis of the gravity model suggests that the expansion of KRU wheat exports is not creating any market imperfections in the world wheat market. Instead, KRU expansion has

made competition more intense and reduced the market power of traditional wheat exporters. The study also did not find any market power among the Black Sea countries in wheat exports to the SCCA region.

Future research could consider other input prices, such as labor cost and seed price, and new policy interventions over a longer period to see whether these factors affect competitiveness. The inclusion of these variables would provide a better explanation about the comparative advantage of KRU wheat exports. In addition, new studies could also include the latest changes in exchange rates in the Black Sea countries in 2014/2015. Moreover, after the Ukrainian conflict, there was a huge reduction in world oil prices that affected the economies of the Black Sea countries. All these recent changes could affect the competitiveness as well as the market structure of KRU wheat exports.