EFFECT OF VOLUNTARY EXPORT RESTRICTIONS ON THE GRAIN MARKET IN UKRAINE AND POLICY IMPLICATIONS

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A thesis submitted in partial
fulfillment of the requirements for the
degree of

MA in Economic Analysis

Kyiv School of Economics

2020

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Head of the KSE Defense Committee

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Date _____

Kyiv School of Economics

Abstract

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The agricultural sector of Ukraine is an important sector for the development of the country. Consequently, we need to be sure that the market operates in the most efficient way. The goal of this research is to study the effect of the export restriction namely "Memorandum of Understanding" under which Ukraine operates since 2011. In our analysis, we got an understanding of the price transmission mechanism of the memorandum and discovered that in recent years memorandum did not affect price formation. As the positive side of the memorandum, it was revealed that in the absence of the supply or demand shocks the policy does not intervene in the export price formation and provides an opportunity for market players to maximize their export revenues. We came to the conclusion that memorandum can be considered as an optimal solution for having export restrictions in place in order to protect interests of both domestic consumer and market players.

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To my parents

ACKNOWLEDGMENTS

The author wishes to express the deepest gratitude to Thesis Advisor Oleg Nivievskyi for useful critique, suggestions, and valuable ideas. I am very grateful for comments and help from all KSE professors and their contribution which helped to improve the content and my knowledge. I also appreciate the help of Rico Ihle and his ideas on how to get more insights from data. Finally, I am thankful to Ilya Polovnikov for inspiring me for this journey.

GLOSSARY

MoU Memorandum of Understanding

WTO World Trade Organization

MSVECM Markov-Switching Vector Error Correction Model

STC Smooth Transition Cointegration Model

ARIMAX Autoregressive Integrated Moving Average with Exogenous Variables

TVECM Threshold Vector Error Correction Model

FOB Free On Board

EXW Ex-Works

MY Marketing Year

Chapter 1

INTRODUCTION

The agricultural sector in Ukraine is an important sector for the development of the country as according to the State Statistics Service of Ukraine (Ukrstat) approximately 13% of the total country's GDP was generated within the sector in 2018. Moreover, the export of agricultural products made up 44.3% of total export and made up 22.1[1] bln USD in 2019 making the sector strategic in stabilizing the trade balance of the country. Among the major agricultural exports are the grains, making up approximately 50% of total agricultural exports.

At the same time prices for agri-food products are important for the wellbeing of Ukrainian households. According to the Ukrstat, in 2018 typical Ukrainian household expenditures on food products made up 47.7%[2] of total expenditures. Analyzing the breakdown of expenditures on food products we can notice that 14% of total food expenditures were made in the category Bread – the second largest category by total expenditures after meat products 21%. Such consumption patterns indicate the vulnerability of typical Ukrainian to the price increases for grains even though the effect of price increase will not be directly transmitted into the price of bread.

So, at the beginning of 2006 when the first commodity price shock had happened pushing the prices for oilseeds and grains to record highs Ukraine as a net exporter faced an opportunity to benefit from the situation on the market by attracting investments and promoting the growth of the sector. Thus in order to realize the potential of the grain sector, it is essential to ensure that transmission of the world market price into domestic happens freely. But with the start of the crisis the largest exporting countries with the

[1] Ukrstat: http://www.ukrstat.gov.ua/operativ/operativ2019/zd/tsztt/tsztt_u/tsztt1219_u.htm
[2] Ukrstat: http://www.ukrstat.gov.ua/operativ/operativ2007/gdvdg_rik/dvdg_u/str_vut2010_u.htm

reaction to the price shock begun to implement export restrictions of various forms aiming to protect domestic consumers from food shortage and to dampen the transmission effect of world prices into the domestic price (Sharma, 2011). As a result of the growing price pressure on low-income households, Ukraine went to the path of implementing export restrictions.

On September 28, 2006 the government implemented the first measure which is export licensing for grains. The goal of imposing licensing on grain export was to protect domestic consumer by stabilizing domestic supply of grains and preventing prices from growth. But the licencing was not last long due to concerns of market players by the design of the system of how an who gets the license from government.

On October 11, 2006 licenses were replaced by export quotas. Estimated results by von Cramon-Taubadel end Raiser (2006) indicate that already by the end of the year domestic producers incurred losses of 300 mln USD.

On February 28, 2007 the export quota was abolished and reintroduced again on June 20, 2007 with newly specified volumes available to be exported.

In the marketing year 2007/2008 total foregone revenue of producers due to the effect of restrictions on grains together with introduced tax on oilseed export totalled 2 bln USD (Worldbank, 2008)

From June 2011 until October 2011 the government implemented export taxes which almost eliminated export as the price offered by Ukrainian producers was not competitive anymore on the world market. But starting from October 2011 Ministry of Agricultural Policy in Ukraine and grain traders signed a "Memorandum of Understanding" (MoU). Under the memorandum grain exporters are obliged to report export statistics and information about stocks of grain available to trade and amount exported. If the grain export exceeds the amount specified by the government which is specified at the beginning of the marketing year amounting to approximately 80% of domestically produced grains, then export becomes restricted.

Theoretically, interventions may lead to the market inefficiency. The export restrictions create the situation when volumes that could be exported in a free trade regime accumulate within the country and the world prices appear to be separated from the domestic market. According to Kulyk, Herzfeld, Nivievskyi (2014) interventions such as voluntary export restrictions, which limit exports push domestic prices below the world price by accumulating excess supply of grains within the country. As a result, farmers and grain traders who have enough inland storage capacities to store grains lose their opportunity to benefit from the highest possible prices and causes revenue losses. According to the specific of the market, the highest price for grains may appear by the end of the marketing year in May - June, when the supply of grains is much weaker than after the harvesting in July - September. The foregone revenue could be reinvested in production expansion and efficiency increase and stimulate expansion of the industry.

This leads us to the question what the effect of MoU on a grain market in Ukraine is. Having analyzed policy papers and current state of export restrictions in Ukraine now it was revealed that there were studies devoted to the effect of quotas, taxes, export bans, and indirect restrictions, but there are no studies that explain effects of voluntary export restrictions in Ukraine.

In this work, we are going to analyze the price transmission effect of the memorandum and to answer the following questions. Whether the memorandum is an effective tool for stabilization of the domestic price? However, we are going provide an empirical evidence of the effect and say whether a particular policy is successful in separating the domestic prices from the world market price.

Here the price transmission effect is the following. When there is no effect of the memorandum on the price transmission the world market price dictates the dynamics of the domestic price and the price difference between two prices can be explained by the transaction costs between markets. But once there is a price dampening effect meaning that traders cannot export and

should sell grain at the domestic market of limited capacity. The producer will be asked by the trader to lower the price, which is definitely not a good news for producer. So, in terms of the price transmission framework we expect that the world market price stays the same or increases, while domestic market price declines.

We expect that at the beginning when MoU was implemented for the first time the pricing behavior of traders might be affected by the expectation channel as the memorandum specifies quantity, which can be exported in the particular season resulting in domestic price dampening. When traders realize that they are about to reach the export limits, which are specified as a maximum cumulative export volume for the whole country, then there might be changes in pricing strategy for the grain trade. By the end of the year when traders are willing to sell more and comply to memorandum limits they will have even higher pricing competition not only for the best price, but also for export volumes. So, such mechanism pushes them to lower price by the end of the year. Moreover, we believe that MoU overall is less distortive once compared to previous export measures under which the grain market was operating. We expect that the policy dialog between government and market players regarding domestic production of grains and the amount of grains which can be exported in particular year helps to protect interests of both grain traders and domestic consumers.

Additionally, as the price dampening effect occurs then it might have a negative effect on farmers' willingness to expand production. On the other hand, it might be true that the MoU does not influence price transmission mechanism, because the situation when export becomes restricted might happen closer to the end of the marketing year. So, traders can hold grains until the beginning of the new marketing season and continue export.

Chapter 2

LITERATURE REVIEW

During the price boom of 2007/08 prices for commodities have risen significantly and the governments all over the world have had to decide whether to intervene to the market or not. As a result, many countries across the world in order to protect themselves from this event decided to implement various policies and export restrictions in order to address the issue of the growing prices. These policy measures became a popular topic for research. Some of them investigate which drivers contributed the most to the growing prices while others analyze more specifically which measures were implemented over the world in order to mitigate the effect of the growing prices.

In the analysis by Jones and Kwiecinski (2010) authors developed a classification of counties by their reaction with policies to the commodity crisis and investigated how their decisions affected trade flows between countries as well as the effectiveness of the policy. For the case of Ukraine, authors identified that having implemented export restrictions the government limited gains from export revenues on cereals market to traders, while consumers faced the environment of the growing prices on the domestic market. Thus, confirming that export policy failed to deliver food security at the same time negatively affecting the welfare of the country.

Dollive (2008) assessed how policy which was aimed to protect domestic consumption of commodities through export restriction may affect the world commodity market price. By performing a case study of China, Argentina and Ukraine author arrives at the conclusion that once major exporting countries impose export restrictions it significantly decreases world supply of the commodity under restriction and threatens its trading partners by pushing them to compete with the rest of the world for available amounts of grains.

As a result, such a mechanism of reduction in supply pushes prices to increase even at a faster rate than it was.

According to Mitra and Josling (2009), export restrictions may have various motives for implementation such as political reasons, financing government expenditures, food security, and protection of domestic consumer interests. However, neither of export restrictions forms demonstrated positive effect for the exporting country as all of the forms showed some welfare losses and the less distortive measure was export quota (diminishing losses when tending to zero).

The comprehensive theoretical analysis of export restrictions was developed by Kulyk, Herzfeld, Nivievskyi (2014). The analysis covers the period of both commodity price spikes 2006/07 and 2010/11. The authors identified that the most restrictive measure appeared to be export quotas of 2006/08 and 2010/11, while export tax in 2011 was considered the less distortive. Theoretical analysis suggests that despite benefits which domestic consumer has when export restrictions are in place, the overall economy experienced huge losses in welfare. Moreover, price history shows that export restrictions were not able to prevent the domestic market from price increase due to government interventions policy of buying out grains from the domestic market, the decision of traders to hold the grains in storages until more favorable price conditions. The MoU was considered distortive to the economy as well due to the uncertainty of the trading volumes to traders and the image of Ukraine as a reliable trading partner. Export restrictions overall did not reach the desired result by protecting the domestic consumer from growing prices, while generating losses for the agricultural sector and economic welfare of the country.

Baffes and Haniotis (2010) analyzed what was the nature of such fast growth in prices during the crisis. Among the key influencers authors identify accelerated demand for biofuels, excess demand for investment funds for the commodities, growing demand from emerging economies and excess

liquidity. It was highlighted that there is definitely a strong relationship between oil prices agricultural commodities as the peak of agricultural commodities corresponds to the price peak of crude oil USD 133/barrel which is 94% increase from the previous year, while prices for rice increased from USD 375/ton till USD 757/ton in just 6 months. However, the authors concluded that commodity prices follow non-stationary behavior pointing out that the prices are too volatile and there is no trend relationship.

Martin and Anderson (2012) analyzed the policy measures that net importer and net exporter during commodity shocks did and the effectiveness of such decisions. It was shown that collectively imposed policy interventions with respect to commodity price shocks do not lead to positive changes, but only contribute to the growing price environment and contribute to the acceleration of price growth. Estimated results showed that collective measures of countries to deal with the price shock contributed to the further 45% increase in prices for rice and a 30% increase in the price of wheat on the world market. Thus, it was suggested that the best option during the price shock on the world market was to have a collective agreement of WTO members to intervene less with trade policies in order to limit further price development.

Djuric, Götz, Glauben (2010) analyzed the effect of the export ban which was implemented as a result of the commodity price peak in 2007 – 2008 in Serbia. The result indicates that the export ban was ineffective in protecting domestic market prices from price spikes on the world market. The reason why export ban failed in separating domestic wheat price from shocks on the world market was driven by the government approach to implementing other policies which had offset the dampening effect on the domestic price of the export ban. In particular, having introduced export ban they had import tariffs on the local market which generated additional obstacles to fulfill domestic consumption. Moreover, the government implemented a program according to which the government purchased wheat from the domestic

producer in order to build up the volumes of wheat in stock creating additional demand during the periods of harvest shortage and making pressure on the domestic price. The transmission effect was estimated by the vector error-correction model (MSVECM) which allows different regimes to be included in the model.

Diao et al. (2013) in their research tries to investigate what effect the implementation of the export ban has on economy in Tanzania. The authors identify that although maize is one of the key foods of low-income households under the free-trade regime maize price growth on the world market will not cause acceleration of the overall food prices. However, ad hoc policy decisions discourage investments.

Garcia-Lembergman, Rossi, Stucchi (2018) analyzed quantitative export restrictions on beef cattle in Bolivia. They show that quantitative export restrictions not only negatively affect production by discouraging investment into the sector, but also might increase domestic prices. Authors apply synthetic control approach to FAO dataset which covers the period 1961 – 2013. The obtained results support the idea that quantitative export restrictions cannot be considered as an effective tool for price stabilization and as a stimulus to increase production.

In the work by Götz, Glauben, Brümmer (2010) was an estimated price transmission effect on the wheat market in Russia and Ukraine due to export restrictions during the commodity crisis in 2007/08. Applying Markov-Switching Vector Error Correction Model (MSVECM) authors identified that both export taxes in Russia and export quotas in Ukraine had a dampening effect on the domestic wheat price followed by significant reductions in exports from countries under analysis. Despite export restrictions effectiveness in separating domestic prices from world market price export restrictions making worse off growers by decreasing their revenues and incentives to expand production due to ad hoc decisions of the government.

In the work by Götz, Djuric, Glauben (2014) the domestic price effects of export controls were analyzed for Kazakhstan, Russia, and Ukraine. In order to perform analysis authors developed two indicators which are price dampening and price insulating effects. Where the price insulating effect indicates the percentage change in long-run price transmission elasticity between free-trade and restricted trade regimes. The dampening effect helps to identify whether the price was insulated by export restrictions and was represented as the difference in average changes in the world and domestic markets in grain prices. The authors found that export restrictions in Russia and Kazakhstan in 2007/08 was ineffective in dampening domestic prices. In the case of Ukraine, the most effective restrictions were quotas of 2006/07 and 2007/08, while taxes of 2011 had a smaller effect on domestic prices. Moreover, the authors pointed out that overall export restrictions can be considered ineffective in dampening domestic prices while generating losses for the economy.

Götz, Djuric and Nivievskyi (2016) analyzed the effect of export restrictions in Russia and Ukraine and assess the transmission effect of the world market price into the domestic market price of wheat. The period under analysis covers the effect of quotas (2006/07, 2007/08) and tax regimes (2011) for Ukraine and the export ban (2010/11) for Russia. In this work authors highlight to effects that help to explain the transmission mechanism of the world market price into a domestic price which is the domestic supply effect and price insulation effect.

In order to estimate effects, authors applied regime-switching long-run price transmission model. According to the model price dampening effect can be explained by higher intercept parameter and lower slope coefficient in restricted trade regime, as intercept parameter associated with higher supply on a domestic market and represent domestic supply effect, while the difference in slope coefficients is an effect of price insulation where the lower value indicates the higher barriers to price transmission.

Moreover, the authors examined how export restrictions affect interregional trade flows of grains across different regions within the country. The regional analysis revealed that domestically produced crops will be redistributed within the country from regions that experience good weather conditions and harvest to the regions which had their products below their original level. Thus, in the analysis of price transmission effects, it is essential to account for the domestic supply effect for Russia as price dampening and insulating effect varied significantly between the regions over time. In the case of Ukraine, the difference in price effects was relatively small as the distances between regions where grains are produced affected by mainly the same weather conditions and the distance between those regions is much smaller than in Russia. To conclude authors mentioned that taking into account regional price effects for Ukraine price dampening effect is weak. Hence, export controls have a negative effect on the grain sector by decreasing incentives to expand production of producers for the upcoming years and increasing production costs along with decreasing wheat price.

The work by Götz et al. (2016) cover the period of commodity price shocks of 2007/08 and 2010/11 and provides a comprehensive assessment of how effects of export restrictions on price transmission effect. The authors applied a smooth transition cointegration model (STC) and Markov-Switching vector error correction model (MSVECM) and regime switch model (RS) and revealed that the STC model demonstrates better goodness of fit. Moreover, it was emphasized that MSVECM has disadvantages that it assumes that regime switches from free trade to restricted trade happens unexpectedly for grain traders, while STC incorporates expectations of traders about future changes in trade policies by allowing prices to adjust gradually. By incorporating expectations to the model authors accounted that when the trader expects the policy change to come in the near future it will affect his pricing decisions today. Technically, in STC model price decisions made according to logistic transition function which allows for prices to be adjusted

smoothly, but not abruptly as it is in MSVECM assuming that pricing decisions of traders change only due to regime switch.

Estimations show that export restrictions have a dampening effect on domestic prices. However, the short-run effect of the export restrictions is revenues which were foregone to exporters, but as a long-term consequence is decreased the incentive to expand production.

Chapter 3

DATA DESCRIPTION

3.1 Preparation of the data

The data set contains two parts. The first part contains ex-works (EXW) prices in UAH/ton and free on board (FOB) prices USD/ton (reported by Ukragroconsult). The EXW prices was converted to USD/ton applying exchange rates of the European Central Bank (ECB). However, we also should take into account that EXW prices are reported including VAT. So, we deduct VAT (20%) from EXW prices in order to have the same comparison base with FOB prices.

The second part of the data contains:

1) Monthly exported volumes in thousand tons (reported by Ukragroconsult)

2) Volumes which are allowed to be exported by MoU in marketing year MY (reported by USDA)

We transform monthly export volumes to the cumulative export volumes. The transformation was done in order to track changes in order to control the amounts which was exported cumulatively for every month in the MY. The cumulative export volumes provide us with better insights once they are compared to the limits specified in memorandum. Also, in the research we decided to focus our analysis on the wheat market. The main reason is the availability of MoU limits on other grains such as barley and corn. It makes little sense to run the analysis when having little evidence of the development of the memorandum.

3.2 Composition of the sample

In order to assess how the MoU may affect the price transmission, we merged price data with the data about exported volumes. Information about prices is a country level weekly data for Ukraine which covers the period Jan 2010 – Sep 2019 for wheat, maize and barley.

Table 1. Summary statistics of prices

Variable	Obs	Mean	Min	Max	Std.
Milling Wheat EXW	507	202.81	144	291	34.63
Milling Wheat FOB	507	234.03	159	361	49.53

Notes: all prices are given in USD/ton

Export volumes data set contains monthly exports of grains from Ukraine during the period from Jul 2011 till Jun 2019.

Table 2. Summary statistics of export volumes

Variable	Obs	Mean	Min	Max	Std.Dev
Wheat	96	1 025.71	65	3047	700.76

Notes: volumes provided in thousand tones

We obtained the volume for grains which are specified in the MoU notes using the USDA reports[3] about the policy for the 2014 – 2019 marketing years (MY). For the MY 2011/12 and MY 2012/13 we use the volumes as it was specified in Kulyk, Herzfeld, Nivievskyi (2014). The only issue that we have with the data is that in MY 2013/14 there was not specified exact limits of wheat to be exported. So, further this data issue turned into missing observations.

[3] USDA fas.usda.gov/search/memorandum%20of%20understanding%20grain%20Ukraine

Table 3. Wheat export limits as specified in MoU

	MY 11/12	MY 12/13	MY 13/14	MY 14/15	MY 15/16	MY 16/17	MY 17/18	MY 18/19
Volume	10500	6600		12800	16600	16500	16500	16000

Notes: volumes provided in thousand tones

3.3 Exploratory data analysis

After having all the data in place we can perform exploratory data analysis to get more insights. In order to catch the effect of MoU we need to introduce the "spread" variable. The spread represents the difference between the prices on the world market the proxy of which is FOB price and the domestic market (EXW) (see Figure 1).

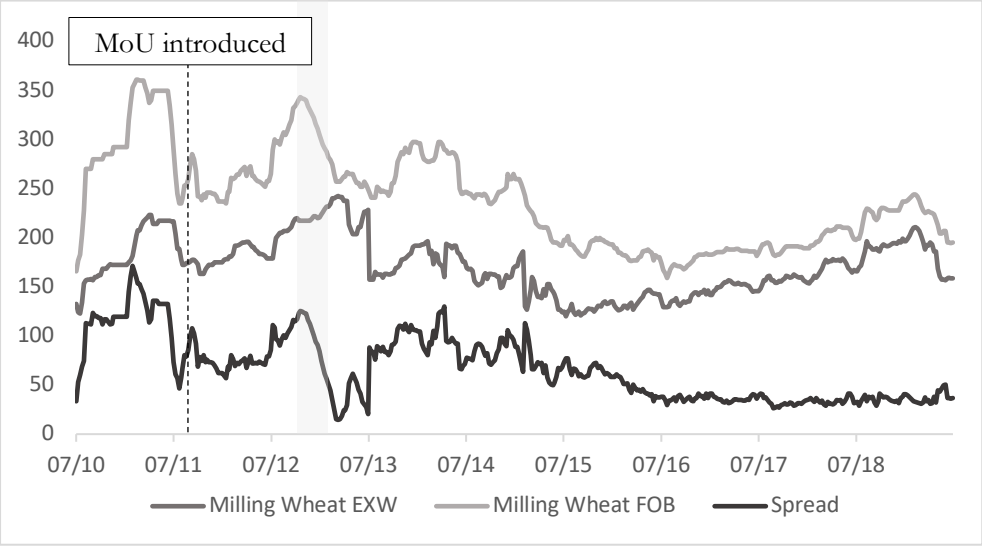

Figure 1. Prices and spread dynamics for wheat 2010 – 2019, USD/ton.

Analyzing the price dynamics we can observe that there was a declining trend in FOB and EXW prices from March 2011 till September 2016. Moreover, we can observe significant reduction in price volatility over the same period

(see Figure 2). Starting from October 2016 till April 2019 there was an upward trend in both EXW and FOB prices.

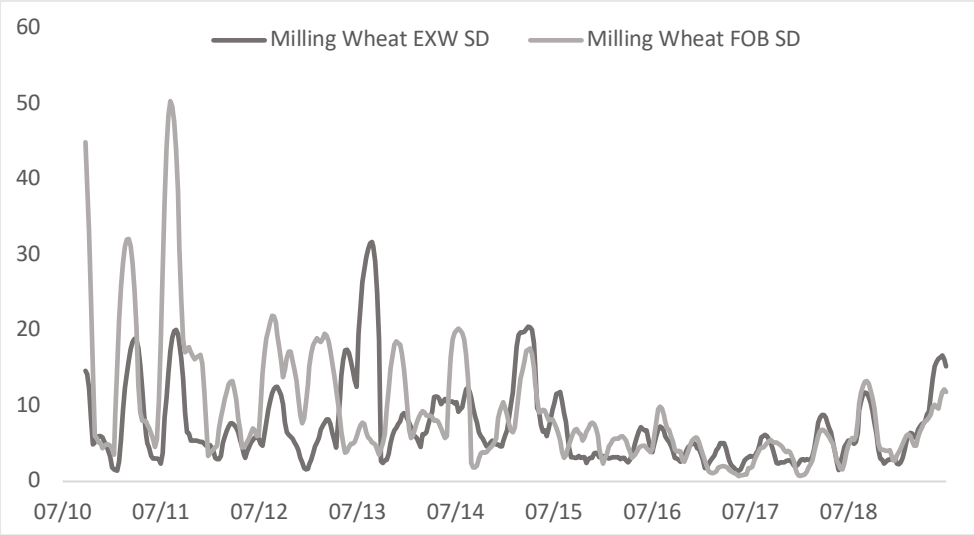

Figure 2. 13-weeks rolling window standard deviation of FOB and EXW

Now let's take a closer look at price spread. The spread is consistent with the dynamics of prices in terms of volatility demonstrating the smaller variance starting from 2016. At the same time, the spread demonstrates a declining trend from 50-150 USD/ton in 2010-2015 till its stabilization at the level of 30 USD/ton in 2016-2019.

Analyzing export dynamics we can observe upward sloping trend in export volumes which indicates that over the last 10 years Ukraine has significantly increased production volumes of wheat. Moreover, there is a clear seasonality pattern with the peaks of export volumes in September - October. Also, we can observe that the magnitude of the peaks also increased significantly over the period with the record high in 2016. Those peaks are linked to the harvest periods of wheat. The nature of significant increase in exports can be explained by significant increase in the volumes of wheat produced in the

Ukraine. Thus, taking this into account we should include control variables for months where increase in fluctuations take place (see Figure 3)

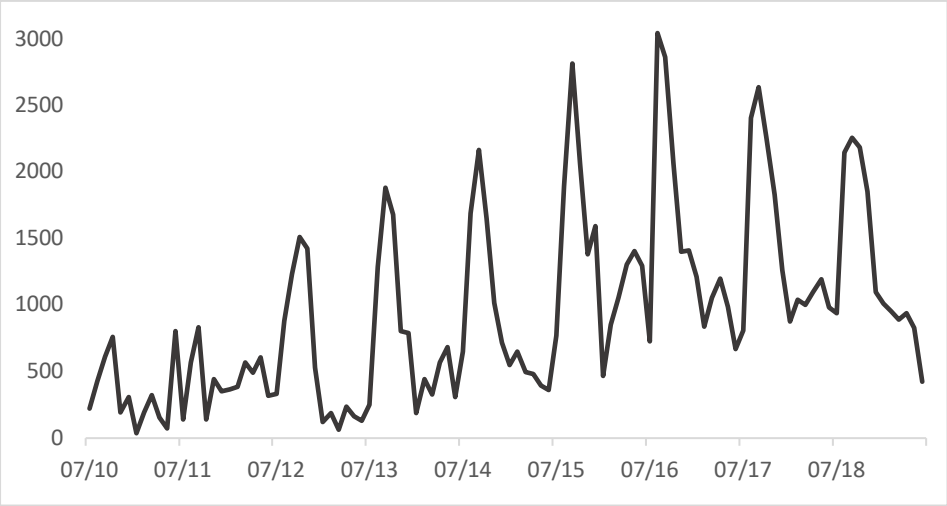

Figure 3. Wheat export volumes dynamics 2010 – 2019.

In order to have even better understanding of the MoU we analyze cumulative export dynamics along with the limits specified by the MoU for the particular marketing year (MY) (see Figure 4). As we can see from the graph, for the first time MoU was implemented in 2011 with the limits of 10.5 million tons to be exported. But the specified volumes for the particular year was set on the level which exceeded the export potential significantly, which was a signal for the export volumes to be reconsidered for the next year. As a result in the MY 2012/13 limits were revised and set to the level of 6600 thousand tons of wheat available to export. For the MY 2012/13 we should expect the binding effect of the MoU, because by November 2012 Ukraine exported 5390 thousand tons of grains which is approximately 80% of available export for the MY. Such a fast pace in wheat export volumes in the first half of the year was followed by the slowdown in export volumes for the rest of the marketing season. Hence, the decline in export pace might result in more sales in the domestic market which potentially can be the driver of price decline on EXW basis driving the price spread up.

According to the USDA, in MY 2014/15 we also should expect binding effect of the MoU as the export totaled about 15% less than it was allowed for this year. Such low export volumes could be explained by concerns of the traders which resulted in the stop of the wheat shipment process.

Finally, for the period 2015-2019 the wheat export limits was locked at the level of 16.5 million tons. As we can see during that period amounts exported exceeded the MoU limits, which is also might be the case when during the negotiation process between the government and grain traders they arrive to the conclusion that domestic supply of wheat is satisfied. Therefore, traders continue exporting if there was not specified new limits to them.

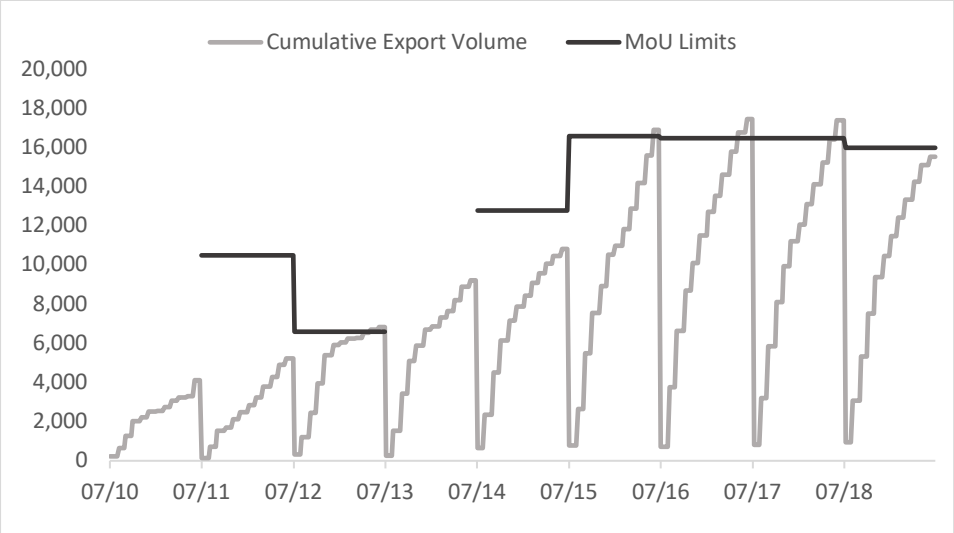

Figure 4. Cumulative export dynamics and MoU limits 2010 – 2019.

Unfortunately, it was not possible to find precise information on the limits which was set for the MY 2013/14. Hence, we can observe the gap for MoU limits in the data. Hence, when we model the effect of the memorandum on spread variable we decided that the best solution is to drop that marketing year from the analysis, because modelling this gap using dummies or as an average between nearest marketing seasons might lead to measurement error and somewhat biased results.

To obtain even more insights about the memorandum effect we decided to run a moving window correlation between FOB and EXW prices and plot it together with MoU fulfillment rate. The correlation window of 13 weeks was chosen in order to get an understanding of the medium run trends in the data. However, it will provide us with understanding of the memorandum effect on pricing strategies of trader in different periods of the season (see Figure 5).

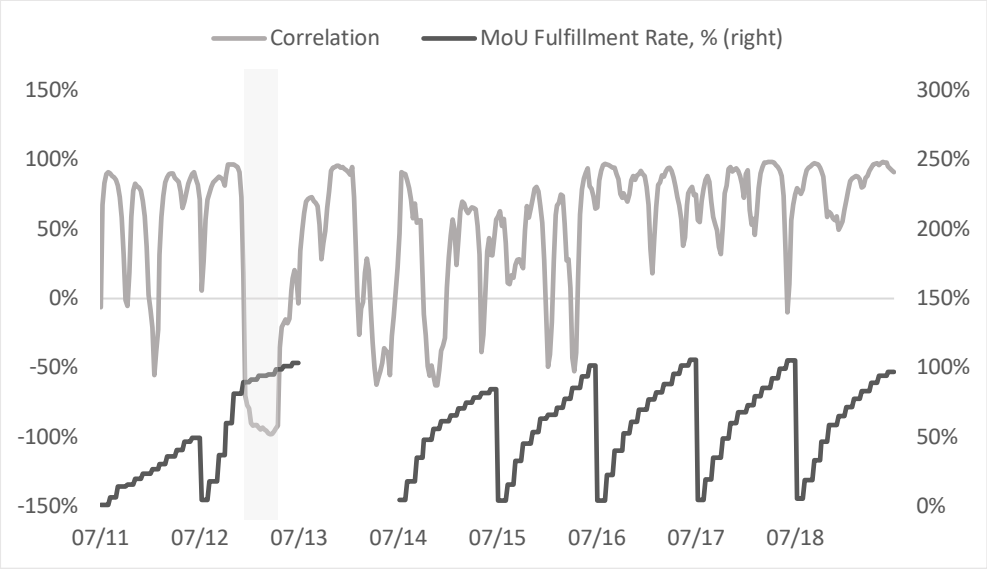

Figure 5. 13-weeks rolling window correlation of FOB and EXW price and MoU fulfillment rate.

Looking at the graph we can observe that in the MY 2012/13 in the place of the fulfillment flattening we can observe change in the correlation sign between FOB and EXW prices. We can see that the effect did not vanish immediately. The negative correlation among prices was along the period from the beginning of January till the end of the March. However, at this point we already can describe the transmission effect. Looking at the Figure 1, on the MY 2012/13 and combining it with obtained results from the Figure

5 we can conclude that the memorandum has dampening effect on the FOB price.

Having analyzed the medium run relationship between prices, which helped us to identify structural break in MY 2012/13. We decided to extend our analysis to behavior of the price spread for exploratory purposes. In order to do this we run a simple linear regression of price spread on trend. For the regression we also set up a rolling window of 13 weeks and perform it for all sample. We store betas and p-values and plot them on the graph together with fulfilment rates of the memorandum (see Figure 6).

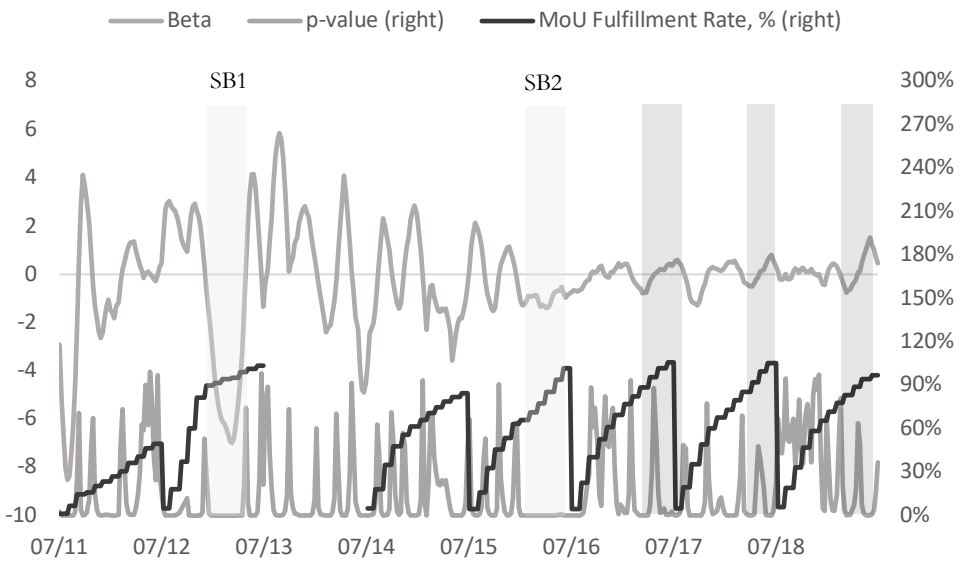

Figure 6. 13-weeks rolling window regression of price spread on trend and the memorandum fulfilment rates.

From the graph we can observe that there are two possible structural breaks that are represented on the graph as SB1 and SB2, where the first structural break can be explained by the effect of the memorandum while. The second structural break corresponds to the period when grain exporters were not compensated with VAT. After the moment when such a policy was eliminated in 2016 we can observe a reduction in the volatility of price spread.

Starting from July 2016 we do not have any policy events which are present at the same as the memorandum. So, this period becomes a reference period in our analysis. At the same time by looking at the periods after July 2016 and focusing our attention on the year ends we can observe some patterns which are consistent with our hypothesis of the memorandum effect. These patterns are presented on Figure 6 as the grey shaded area. The patterns indicate that when export fulfillment rate is about 70% - 80% of export volumes as specified in the memorandum the price spread shrinks. As we pointed out earlier the price spread shrinking happens due to the significant decrease in FOB price which is an indication of a decrease in export revenue.

To conclude the exploratory data analysis we emphasize core ideas which we are going to test in the part with empirical findings:

1. Based on rolling window regression we think that the memorandum fulfilment rate of 70% - 80% of export limits is a reasonable place to start looking for the effect of the memorandum by controlling for the effect with a dummy variable.

2. We are going to analyze the memorandum on three major periods. The first part of the analysis will be conducted for the whole sample. In the second part, we are going to analyze MY 2011/12 - 2012/13, where the first structural break of the memorandum has happened. The third part will be devoted to the most recent years of the memorandum MY 2016/17 - 2018/19, where we explore the effect of the second structural break.

Chapter 4

METHODOLOGY

Following our main goal which is to identify the effect of the MoU on the domestic prices in Ukraine, we decided to construct the Autoregressive Integrated Moving Average model with exogenous regressors (ARIMAX). We decided to follow the particular approach as the MoU is an explicit measure of export restriction, while the previous literature considered only implicit ones where changes to different regimes can be easily cached by MSVECM and TVECM models. The difficulties with estimation by MSVECM and TVECM arise, because the price changes under the MoU are not that strong as the ones under export ban, quotas and taxes.

The advantage of using the ARIMAX model is that by including the exogenous regressor which represents the MoU we can explicitly identify whether it has an effect on price behavior or not.

Firstly, we construct the variable "Spread" which represents the difference between free on board price (FOB) which is the price of the good including the transportation costs to the nearest port and ex-works price (EXW) which represents the price of the good at the farm gate level. We expect that under MoU the price transmission from the world market to the domestic market might exhibit somewhat different behavior.

$$P_t = P_{FOB,t} - P_{EXW,t} \quad (1)$$

Then in order to estimate an ARIMAX model we have to ensure that the model is well specified and includes enough autoregressive AR(p), integrated I(d), moving-average MA(q) terms and P_t follows the stationary process. Thus, we apply the methodology proposed by Box and Jenkins (1970).

4.1 The Box and Jenkins procedure

4.1.1. Primary analysis

At this stage we plot our series and perform visual check as well as apply the unit-root test according to Dickey and Fuller (1976) in order to identify whether the series are stationary or not. In the Dickey-Fuller test one should obtain the results where H_0 hypothesis rejected to ensure that series are stationary. Non-stationarity issues can be solved by using first difference approach for integrated of order (1) series.

Speaking about differencing in more details, prices for agricultural commodities was always a hot topic for debates. As it is mentioned in Esposti (2017) the main source of confusion in model identification comes from contradictive results of theoretical studies and empirical ones. The theory says that prices for commodities follow stationary process, while empirical tests often indicate that the prices are nonstationary.

However, Wang and Tomek (2007) in empirical study of price behavior support the idea that the results which are obtained by empirical tests should be treated with skepticism as the nominal spot prices are subjects to structural breaks which cannot be tracked by empirical tests.

So, in this work we consider both options as optimal and make decision according the model specification taking into account goodness of fit.

The first difference of P_t is:

$$dP_t = P_t - P_{t-1} \tag{2}$$

4.1.2. Identification.

In order to define an optimal number of lags to be included into the model we can make use of two methods. The first one is visual investigation of

PACF and ACF charts where the number of lags which are outside of the confidence interval is an indication of the number of AR and MA terms to be controlled for. The second option is to investigate an Akaike Information Criterion (AIC).

The AIC can be calculated using the following equation:

$$AIC = 2 * k - 2 * ln(\hat{L}) \quad (3)$$

where k represents the number of variables within the model and $\hat{L}$ is the maximum likelihood value. The criterion developed in such a way so that there is a penalty for including additional variables into the model. The AIC helps to find the balance within the model in terms of the number of variables included to prevent overfitting and the goodness of fit. So, the interpretation is that among all of the models we should choose the one which has the lowest AIC.

4.1.3. Estimation.

Once the decision according to the number of AR(p), I(d) and MA(q) was made, the model can be written as ARIMA (p,d,q) process, where dP_t represents the first difference as defined by (2):

$$dP_t = \theta_1 dP_{t-1} + \ldots + \theta_p dP_{t-p} + e_t + \varphi_1 e_{t-1} + \ldots + \varphi_1 e_{t-q} \quad (3)$$

Then ARIMA model can be upgraded by adding exogenous regressors:

$$dP_t = \theta_1 dP_{t-1} + \ldots + \theta_p dP_{t-p} + e_t + \varphi_1 e_{t-1} + \ldots + \varphi_1 e_{t-q} + \beta_1 X_t \quad (4)$$

The specification of the model to estimate the effect of the MoU:

$$dP_t = \theta_1 dP_{t-1} + \ldots + \theta_p dP_{t-p} + e_t + \varphi_1 e_{t-1} + \ldots + \varphi_1 e_{t-q} + \beta_1 Quarter_t + \beta_2 VAT_t + \beta_3 MoU\ Ratio_t + \beta_4 VAT_t * MoURatio_t \quad (5)$$

where $Quarter_t$ – a set of quarterly dummies to control for changes in spread at different seasons

VAT_t - dummy for years when VAT exemptions for wheat was abandoned. The particular policy implied that traders did not receive compensation of VAT when wheat was exported[4].

$MoU\ Ratio$ – specified as dummy variable, where the dummy becomes 1 for observations where the ratio of cumulative export to the limits specified in memorandum above some threshold, and 0 otherwise. Later on we identify we which threshold of the MoU ratio is optimal to include into the model.

4.1.4. Diagnostics

The post estimation procedure can be divided into two parts. The first part is to examine residuals of the model in order to ensure that they are white noise indicating that they have zero mean and constant variance. The second part is to check how the model fits actual data.

[4] Mechanics of VAT exemptions https://voxukraine.org/uk/nevidshkoduvannya-pdv-eksporteram-soyi-abo-pro-ekonomichni-naslidki-soyevih-pravok/

4.2 Sensitivity of the results to the MoU ratio assumption

The MoU ratio appears to be the core variable of our analysis and the effect of which we try to capture. The only issue with that particular variable is that initially we do not know where the effect of the memorandum on the spread becomes significant. It might be the case that the variable does not have an effect on prices at all. Hence, it is important to vary assumption of the MoU Ratio variable in order to have a broader picture of the effect of the memorandum.

In order to tackle that particular issue we developed a cycle which fits an ARIMAX model to the data by changing the threshold of the MoU Ratio from 35% till 75% with a step of 1%. We chose 35% MoU Ratio as the starting point since we believe that when cumulative export is below 35% of limits specified in memorandum there is no reason for grain traders to worry about export. But when cumulative export volume going closer to limits traders expected to change their pricing strategy. The upper threshold of 75% was chosen, because when cumulative export reaches approximately 75-80% of memorandum limits traders and government renew discussion about export volumes. As a result of discussion they arrive at conclusion of whether traders are allowed to export more in this particular year or the limits stay the same. By the end of that analysis we obtain p-values and coefficients on the MoU Ratio variable and observe what is the most appropriate assumption of the MoU ratio in our model. The significant coefficient will indicate to us that the traders had reacted to the memorandum. However, we will be able to get intervals on the MoU Ratio variable, which may indicate the moments of rising concerns regarding future export and the point when these concerns fade.

Chapter 5

EMPIRICAL RESULTS

In this chapter we describe the results obtained by applying the ARIMAX model according to the methodology described in Chapter 4. However, we follow the structure which was explained in the exploratory data analysis section of Chapter 3. So, we are going to analyze three different time periods and try to catch the effect of the memorandum. For each of the three time periods we run sensitivity analysis for memorandum fulfillment rate assumption in order to identify where the effect of the memorandum starts. For intervals which demonstrate significant effect of memorandum we report the results

The stationarity tests of residuals as well as comparison of fitted values to the observed data provided in the Appendices B and C.

5.1. The results obtained for the whole sample

Taking into account that there is no clear evidence or suggestions of how many differences to include in the model we live that choice to the "autoarima" package which is implemented in R. The "autoarima" package does exactly the same procedure as it was described in methodology part. The package fits different models with various AR(p), I(d) and MA(q) parameters and selects the best model with the lowest AIC criterion.

According to AIC, we find that the most appropriate model specification for our model is ARIMAX (2,1,2) when estimated for the whole sample. The model was estimated with the assumption of the memorandum fulfillment rate of 70%. The logic of choosing that assumption was described in data description section (see Figure 6). Results of model selection are presented in the appendices (see Appendix A). However, we find that the model itself is

sensitive to the changes in the assumption of the MoU ratio. Thus, we fit multiple ARIMAX models by changing the threshold of the MoU ratio from 35% to 75% in order to examine the behavior of the parameter. We store estimated coefficients on the MoU ratio dummy variable as well as the significance of coefficients and plot them on the figure below (see Figure 7).

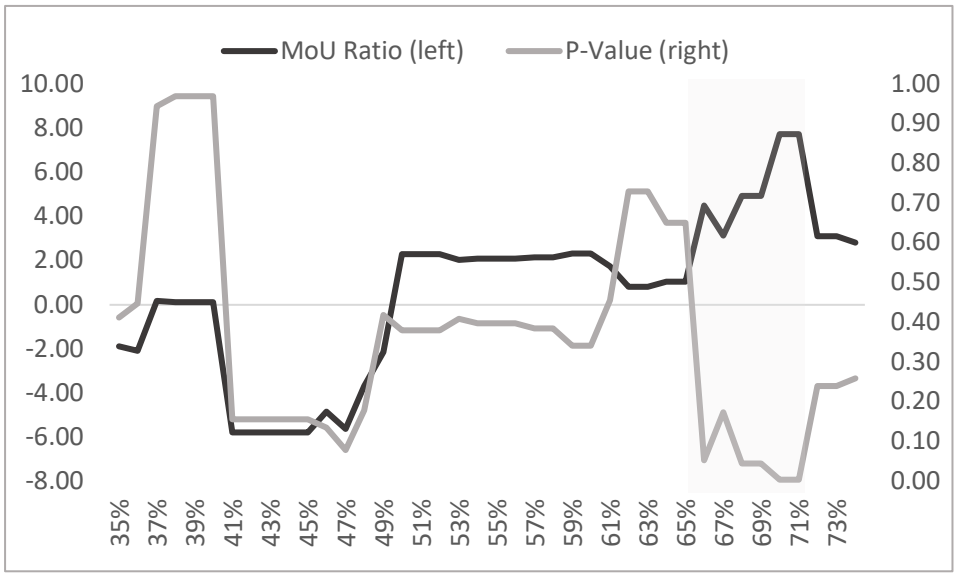

Figure 7. Sensitivity of the model to the MoU Ratio assumption.
Source: own estimations

One can interpret the results depicted above in the following way. When the marketing year starts memorandum does not have any effect on pricing strategies of traders. But when the cumulative export volume reaches the threshold of 66% - 71% of the initially discussed volumes traders experience uncertainty regarding the future export sales if there is no news regarding revised volumes. Such uncertainty might influence the decision of the traders into the following ways:

1) Traders are forced to wait until the beginning of the new marketing year when they are allowed to export again

2) Traders are forced to sell in the domestic market

By focusing on the second reason we can expect that the inflow of grain to the domestic market is going to decrease domestic price due to oversupply at that period. Once the government revises volumes and gives the signal to traders whether they are allowed to continue export or volumes stays the same the price stabilization occurs and the effect of memorandum vanishes.

Now let's look at outcomes of the regression where the coefficient on the MoU Ratio demonstrated significance (see Table 4).

Table 4. ARIMAX (2,1,2)

MoU Ratio	66%	67%	68%	69%	70%
Spread t-1	-0.105 (0.266)	-0.057 (0.126)	-0.063 (0.131)	-0.397 . (0.215)	-0.090 (0.108)
Spread t-2	-0.690*** (0.133)	-0.750*** (0.098)	-0.739*** (0.105)	0.153** (0.055)	-0.737*** (0.111)
MA t-1	0.217 (0.214)	0.158 (0.099)	0.166 (0.103)	-0.487* (0.211)	0.193* (0.084)
MA t-2	0.810*** (0.154)	0.850*** (0.091)	0.838*** (0.099)	-0.513* (0.211)	0.844*** (0.099)
Q2	-2.556 (1.827)	-2.934 (1.896)	-2.933 (1.871)	-3.313 . (1.929)	-2.909 (1.845)
Q3	8.849*** (2.301)	6.295** (2.300)	7.307** (2.390)	7.463 ** (2.452)	9.202*** (2.545)
Q4	7.734*** (1.904)	4.648* (1.869)	5.668** (1.989)	6.574 ** (2.028)	7.535*** (2.172)
VAT	-16.167* (6.601)	-11.858 . (6.683)	-10.281 (6.707)	-12.461 . (6.877)	-7.601 (6.789)
MoU Ratio	4.502 . (2.323)	3.151 (2.314)	4.933* (2.465)	5.758 * (6.877)	7.738** (2.694)
MoU Ratio * VAT	17.520*** (3.686)	14.118*** (3.724)	12.563*** (3.774)	12.643 *** (3.823)	10.191** (3.857)
AIC	2281.91	2296.82	2294.69	2294.69	2291.20

Notes: standard errors in parentheses, (.) p< .10;(*) p< .05; (**) p< .01; (***) < .001.

Analyzing the result we can observe that the memorandum has a positive effect on price spread. Such a result contradicts the evidence which was obtained during exploratory data analysis, which suggests that price spread should go down when export gets to some achieves 66 - 71% fulfillment rate. At the same time, we cannot rely much on the obtained results since having negative sign near the VAT variable is counterintuitive in this case. It is expected that when VAT exemption was canceled it negatively affected attractiveness to export. As a result, more grains are expected to be supplied to the domestic market and creates excess supply which itself pushes the domestic price down. So, cancellation of the VAT refund should positively affect the price difference between FOB price and EXW price. So, we think that we cannot rely much on the results which were obtained for the whole sample.

5.2. The results obtained for the MY 2011/12-2012/13

Obtained results in the previous part pushed us for further analysis of the data sample. We decided to focus more on the periods where we expect the MoU affect to be more explicit. In this case, turn attention to the MY 2011/12 and MY 2012/13. Let's refer to the data description part where we discussed cumulative export volumes dynamics (see Figure 4). As we can see from that chart the limits for MY 2011/12 were set far above realized export volumes for that particular year, but for MY 2012/13 limits specified by memorandum seems to be tight which might potentially restrict the export and have its effect on the prices. So, in such a case we see the importance of controlling for the MY 2012/13 as the year where a slowdown in the export pace has happened. However, here we try to assess the effect of the first structural break which was defined during moving window regression analysis (see Figure 8).

Once again we repeated the identification procedure in order to find the most optimal model using the Akaike Information Criterion (Appendix A). As a result, the model with parameters (1,0,2) was chosen with AIC of 701.85, which indicates that there is an improvement in the fit of the model compared to the estimated results for the whole sample. Let's now look at the sensitivity of the model to the MoU ratio parameter.

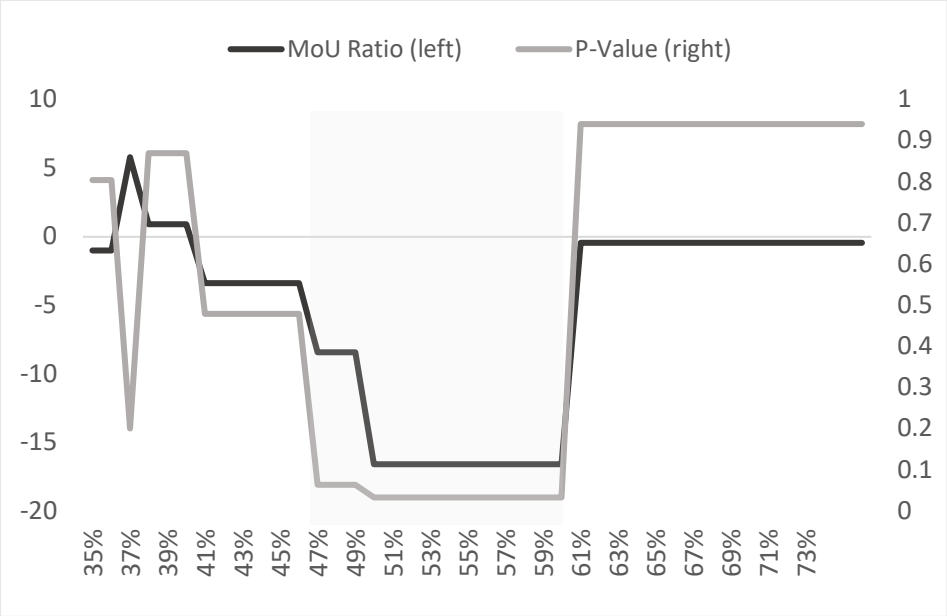

Figure 8. Sensitivity of the model to the MoU Ratio assumption.
Source: own estimations

Analyzing the sensitivity plot we can observe the change in the interval where the effect of the memorandum appears to be significant. The area of interest moved to the interval of the MoU Ratio from 47% to 60%. However, here we see an importance to control for 2012/13MY since the data sample covers only two years of the memorandum and the MoU values set for these year at completely different levels. Let's now examine new results (see Table 5).

Table 5. ARIMAX (1,0,2)

MoU Ratio	47%	50%	53%	56%	59%
Spread t-1	0.944*** (0.038)	0.949*** (0.037)	0.949*** (0.037)	0.949*** (0.037)	0.949*** (0.037)
MA t-1	0.282** (0.089)	0.288** (0.091)	0.288** (0.091)	0.288** (0.091)	0.288** (0.091)
MA t-2	0.399*** (0.105)	0.394*** (0.114)	0.394*** (0.114)	0.394*** (0.114)	0.394*** (0.114)
Intercept	60.285*** (16.796)	57.580** (17.720)	57.580** (17.720)	57.580** (17.720)	57.580** (17.720)
Q2	-0.369 (3.952)	-0.294 (3.969)	-0.294 (3.969)	-0.294 (3.969)	-0.294 (3.969)
Q3	-2.844 (6.088)	-7.008 (6.906)	-7.008 (6.906)	-7.008 (6.906)	-7.008 (6.906)
Q4	6.871 . (3.970)	6.828 . (3.972)	6.828 . (3.972)	6.828 . (3.972)	6.828 . (3.972)
MoU Ratio	-8.397 . (4.522)	-16.584* (7.784)	-16.584* (7.784)	-16.584* (7.784)	-16.584* (7.784)
2012/13 MY	20.220 * (9.390)	33.562*** (9.827)	33.562*** (9.827)	33.562*** (9.827)	33.562*** (9.827)
AIC	696.56	695.49	695.49	695.49	695.49

Note: standard errors in parentheses, (.) p< .10;(*) p< .05; (**) p< .01; (***) < .001.

The regressions output for the MoU Ratio assumption interval 47% - 60% shows no significant difference across the models. The AIC indicates that the model with MoU Ratio of 47% is slightly worse, but the difference is so small and we can say that models are almost identical in terms of goodness of fit.

Talking about the effect of memorandum we can say that the MoU ratio has a negative effect on the price spread from 8 USD/ton till 16 USD/ton. The obtained results has to be treated with caution because the effect seems to be slightly overestimated.

5.3. The results obtained for the 2016/17-2018/19 MY

The final piece of our analysis is done for the data period where memorandum is the only policy that is affecting the market. So, this piece of analysis is of high interest fto us. By obtaining the results we will be able to conclude whether in the most recent years the pricing strategies of traders were affected by memorandum.

The procedure of model identification shows that the most optimal model which fits this piece of data is ARIMAX (1,0,0) demonstrates AIC 783.20 (see Appendix A, Table 8). We run a sensitivity analysis of the MoU ratio in our model by changing it from 30% to 75% (see Figure 9).

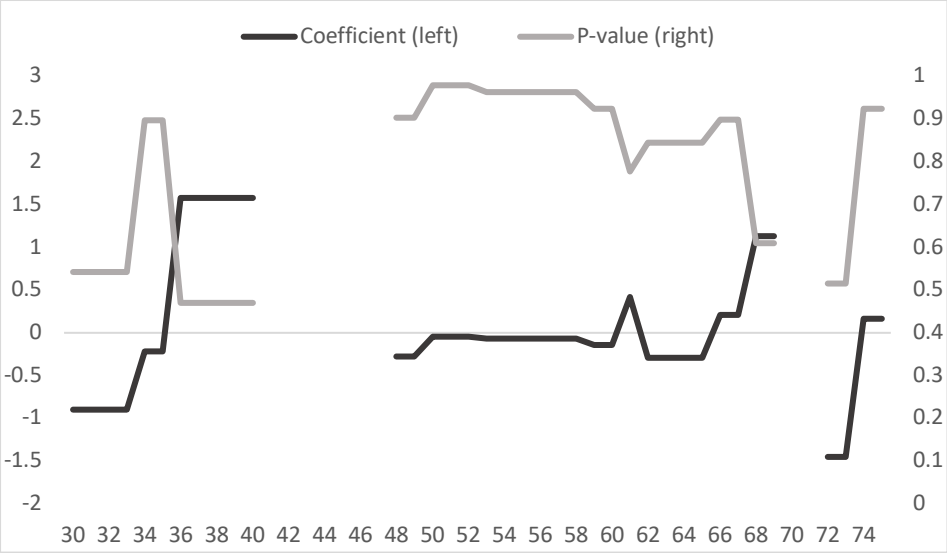

Figure 9. Sensitivity of the model to the MoU Ratio assumption.
Source: own estimations

Recalling our hypothesis (see description to Figure 6), we expected to have a negative effect of the memorandum on the pricing of 1 - 2 USD/ton. We identified that once total export reaches 70% - 75% cumulatively of the limits specified for a certain marketing year the price spread should fall and then recover till the end of the marketing year. By analyzing the sensitivity graph

we can see that the memorandum did not have a significant effect on the pricing. By looking at the graph one also can notice the gaps which cover the memorandum fulfillment rates of 40% - 47% and 69% - 71%. Unfortunately, we could not fix this issue which comes at the stage of fitting the ARIMAX. But we believe that having all data points in place would not lead to the change in our conclusions. For purposes of being consistent with our hypothesis we present the results of regressions with MoU Ratio near 70% - 75%.

Table 6. ARIMAX (1,0,0)

MoU Ratio	69%	72%	73%	74%	75%
Spread t-1	0.708*** (0.060)	0.709*** (0.060)	0.709*** (0.060)	0.714*** (0.059)	0.714*** (0.059)
Intercept	34.209*** (2.400)	36.537*** (2.230)	36.537*** (2.230)	35.173*** (1.673)	35.173*** (1.673)
Q2	-0.029 (1.388)	0.150 (1.412)	0.150 (1.412)	-0.052 (1.441)	-0.052 (1.441)
Q3	0.860 (2.478)	-1.402 (2.403)	-1.402 (2.403)	-0.046 (1.895)	-0.046 (1.895)
Q4	0.812 (2.204)	-1.262 (2.221)	-1.262 (2.221)	0.004 (1.665)	0.004 (1.665)
MoU Ratio	1.128 (2.207)	-1.449 (2.230)	-1.449 (2.230)	0.162 (1.687)	0.162 (1.687)
AIC	782.20	782.04	782.04	782.46	782.46

Note: standard errors in parentheses, (.) p< .10;(*) p< .05; (**) p< .01; (***) < .001.

Chapter 6

CONCLUSIONS

The main goal of the paper was to study the effect of the export restrictions on the wheat market in Ukraine. In a particular case, we investigated the Memorandum of understanding and provided empirical evidence of the effect. The obtained results contribute to the economic literature by expanding the field of study of the export restrictions in the Ukrainian export market of grains.

Initially, we assumed that the memorandum might lead to a decline in EXW price, while the FOB price stays the same. Also, we expected that the memorandum may lead to the price widening of the spread between FOB and EXW prices after reaching some threshold which is based on expectations of exporters regarding future sales to foreign markets.

In exploratory data analysis we discovered different price transmission mechanism from the expected one. We found evidence in MY 2012/13 of the drop in the FOB price, while EXW stayed relatively the same meaning that during the transmission mechanism FOB price is affected more than EXW price leading to decline of the price spread. However, during data exploration, we identified two major hypotheses to test in empirical part. We ran 13 weeks moving window regression of price spread on trend and found two structural breaks and some data patterns. The shape of data patterns was similar to the effect of the memorandum.

The empirical result of the first hypothesis shows that in the MY 2011/12 - 2012/13 the memorandum had a negative effect on the price spread between FOB and EXW prices leading to the decline in the spread of 8 - 16 USD/ton. The second hypothesis was to assess the pure effect of memorandum and check whether the patterns, which we have identified are happening due to

memorandum. The results obtained indicated that in the MY 2016/17 - 2018/19 memorandum does not have a significant effect on pricing.

After performing the analysis we have arrived at the conclusion that memorandum did not have an effect on price in recent years, which is a good sign for market players who were able to maximize their export revenues.

The policy implications for the grain market are the following. The memorandum can be considered as a good solution of having export restrictions in place in order to protect the domestic consumer and at the same time let market players benefit from the highest possible price and maximize their export revenues. The key advantage of the memorandum over other export restrictions is that memorandum improves communication between government and market players by allowing market players to plan the volumes which they are able to sell and improves their confidence regarding the future development of the market. However, the memorandum does not affect the price formation when there is no unexpected supply or demand shocks. The key issue which was tackled in the policy design of the memorandum is that it avoids any unexpected policy announcements which may affect attractiveness of the market for future investments.

WORKS CITED

Agropolit. 2019. *Agropolit.* 10 June. Accessed December 13, 2019. https://agropolit.com/news/12492-chastka-agrosektoru-u-vvp-ukrayini-torik-sklala-13.

Baffes, John, and Tassos Haniotis. 2010. *Placing the 2006/08 Commodity Price Boom into Perspective.* Policy Research Working Paper, The World Bank.

Box, George, and Gwilym Jenkins. 1970. "Time Series Analysis: Forecasting and Control."

Diao, Xinshen, Adam Kennedy, Athur Mabiso, and Angga Pradesha. 2013. "Economywide Impact of Maize Export Bans on Agricultural Growth and Household Welfare on Tanzania." August: 28.

Dickey, D, and W Fuller. 1981. "Likelihood Ratio Test for Autoregressive Time Series with a Unit Root." *Econometrica.*

Djuric, Ivan, Linde Götz, and Thomas Glauben. 2010. "Are export restrictions an effective instrument to insulate domestic prices against skyrocketing world market prices? The wheat export ban in Serbia." *Agribusiness* 14.

Dollive, Kendall. 2008. *The Impact of export Restraints on Rising Grain Prices.* Paper, Washington DC: U.S. International Trade Comission.

Esposti, Roberto. 2017. "What Makes Commodity Prices Move Together? An Answer From A Dynamic Factor Model." *International Congress.* Parma, Italy: European Association of Agricultural Economists.

Fellman, Thomas, Sophie Helaine, and Olexandr Nekhay. 2014. *Harvest failures, temporary export restrictions and global food security: the example of limited graine exports from Russia, Ukraine and Kazakhstan.* The Article, Springerlink.com.

Götz, Linde, Feng Qiu, Jean-Philippe Gervais, and Thomas Glauben. 2016. "Export Restrictions and Smooth Transition Cointegration: Export Quotas for Wheat in Ukraine." *Journal of Agricultural Economics* 22.

Götz, Linde, Ivan Djurič, and Thomas Glauben. 2004. “Price dampening and price insulating effects of wheat export restrictions in Kazakhstan, Russia, and Ukraine.” 19 September: 17.

Götz, Linde, Ivan Djuric, and Oleg Nivievskyi. 2016. “Regional Price Effects of Extreame Weather Events and Wheat Export Controls in Russia and Ukraine.” *Journal of Agricultural Economics* 23.

Garcia-Lembergman, Ezequiel, Martin Rossi, and Rodolfo Stucchi. 2018. “The Impact of Export Restrictions on Production.” *Economía , Vol. 18, No. 2 (Spring 2018)*, 147-173.

Gruenninger, Matthias, and Stephan Von Cramon. 2008. *Ukraine's Response to the Global Food Crisis.* The Note, The World Bank, 38.

Ihle, Rico, and Stephan von Cramon-Taubadel. 2008. “A Comparison of Threshold Cointegration and Markov-Switching Vector Error Correction Models in Price Transmission Analysis.” *Applied Commodity Price Analysis, Forecasting, and Market Risk Management.* St. Louis, Missouri. 48.

Jones, Darryl, and Andrzej Kwiecinski. 2010. “Policy responses in emerging economies to international agricultural commodity price surges.” *OECD food, agriculture and fisheries papers №. 34*, 90.

Kirschke, Dieter, Richard Moody, Mariia Didukh, Oleg Nivievskyi, and Leonid Tulush. 2019. *The Value Added Tax System in Ukrainian Agriculture: Analysis and Policy Options.* Kyiv, Berlin: Agritrade Ukraine.

Kirschke, Dieter, Richard Moody, Maria Didukh, Oleg Nivievskyi, and Leonid Tulush. 2019. *The Value Added Tax System in Ukriane Agriculture: Analysis and Policy Options.* The working paper, Kyiv, Berlin: German-Ukrainian Agritrade Ukraine (ATU).

Kulyk, Iryna, Thomas Herzfeld, and Oleg Nivievskyi. 2014. *Comparative assesement of Ukrainian grain export policies.* Agricultural Policy Report, Kiev: German-Ukrainian Agricultural Policy Dialogue.

Martin, Will, and Kim Anderson. 2011. “Export Restrictions and Price Insulation During Commodity Price Booms.” July: 23.

Mitra, Siddihartha, and Tim Josling. 2009. “Agricultural Export Restrictions: Welfare Implications and Trade Disciplines.” *Agricultural and Rural Developement Policy Series*, January: 45.

Sharma, Ramesh. 2011. *Food Export Restrictions: Review of the 2007-2010 Experience and Considerations for Disciplining Restrictive Measures.* Policy Research Working Paper, Rome: Trade and Market Division of the Food and Agriculture Organization of the Unated Nations (FAO).

von Cramon-Taubadel, Stephan, and Martin Raiser. 2006. *The Quotas on Grain Exports in Ukraine: Ineffective, inefficient, and non-transparent.* The Note, Kyiv: Institute for Economic Research and Policy Consulting in Ukriane.

Wang, Dabin, and William G Tomek. 2007. “Commodity Prices and Unit Root Tests.” *American Journal of Agricultural Economics, Vol. 89* 873-889.

APPENDIX A

Optimal model selection

Table 6. Autoarima function output fro the whole sample

Specification	AIC
ARIMA(0,1,0)	2298.216
ARIMA(0,1,1)	2296.662
ARIMA(0,1,2)	2294.28
ARIMA(0,1,3)	2293.399
ARIMA(0,1,4)	2295.489
ARIMA(0,1,5)	2297.582
ARIMA(1,1,0)	2295.948
ARIMA(1,1,1)	2297.134
ARIMA(1,1,2)	2293.735
ARIMA(1,1,3)	2295.49
ARIMA(1,1,4)	2297.594
ARIMA(2,1,0)	2295.604
ARIMA(2,1,1)	2294.948
ARIMA(2,1,2)	2291.128
ARIMA(2,1,3)	2293.113
ARIMA(3,1,0)	2293.942
ARIMA(3,1,1)	2295.674
ARIMA(3,1,2)	2293.201
ARIMA(4,1,0)	2295.449
ARIMA(4,1,1)	2297.534
ARIMA(5,1,0)	2297.447

Table 7. Autoarima function output for the MY 2011/12-2012/13

Specification	AIC
ARIMA(0,0,0)	1037.265
ARIMA(0,0,1)	955.0494
ARIMA(0,0,2)	899.7997
ARIMA(0,0,3)	868.5686
ARIMA(0,0,4)	Inf
ARIMA(0,0,5)	Inf
ARIMA(1,0,0)	Inf
ARIMA(1,0,1)	Inf
ARIMA(1,0,2)	701.8554
ARIMA(1,0,3)	704.2579
ARIMA(1,0,4)	705.7059
ARIMA(2,0,0)	706.4857
ARIMA(2,0,1)	706.7958
ARIMA(2,0,2)	704.2681
ARIMA(2,0,3)	706.5065
ARIMA(3,0,0)	704.4661
ARIMA(3,0,1)	704.0823
ARIMA(3,0,2)	706.5023
ARIMA(4,0,0)	704.311
ARIMA(4,0,1)	706.4716
ARIMA(5,0,0)	706.573

Table 8. Autoarima function output for MY 2016/17 - 2018/19

Specification	AIC
ARIMA(0,0,0)	879.72
ARIMA(0,0,1)	818.80
ARIMA(0,0,2)	797.23
ARIMA(0,0,3)	793.23
ARIMA(0,0,4)	791.80
ARIMA(0,0,5)	791.88
ARIMA(1,0,0)	783.20
ARIMA(1,0,1)	785.35
ARIMA(1,0,2)	787.12
ARIMA(1,0,3)	789.28
ARIMA(1,0,4)	790.47
ARIMA(2,0,0)	785.33
ARIMA(2,0,1)	786.99
ARIMA(2,0,2)	788.83
ARIMA(2,0,3)	791.11
ARIMA(3,0,0)	787.02
ARIMA(3,0,1)	789.21
ARIMA(3,0,2)	Inf
ARIMA(4,0,0)	789.21
ARIMA(4,0,1)	791.14
ARIMA(5,0,0)	790.30

APPENDIX B

Plot of the residuals for ARIMAX (2,1,2) whole sample

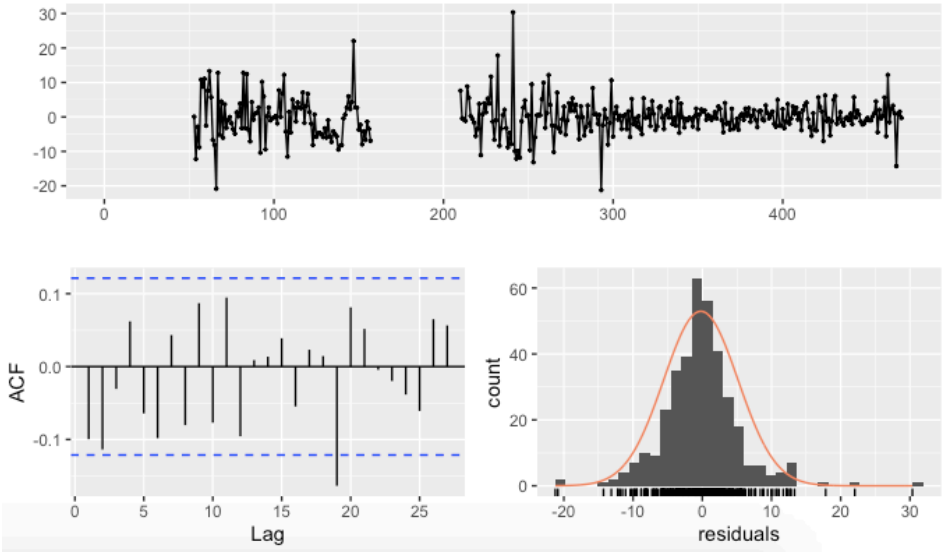

Figure 8. Check of the residuals of the ARIMAX (2,1,2) model estimated for the whole sample.

Plot of the residuals for ARIMAX (1,0,2) MY 2011/12.- 2012/13

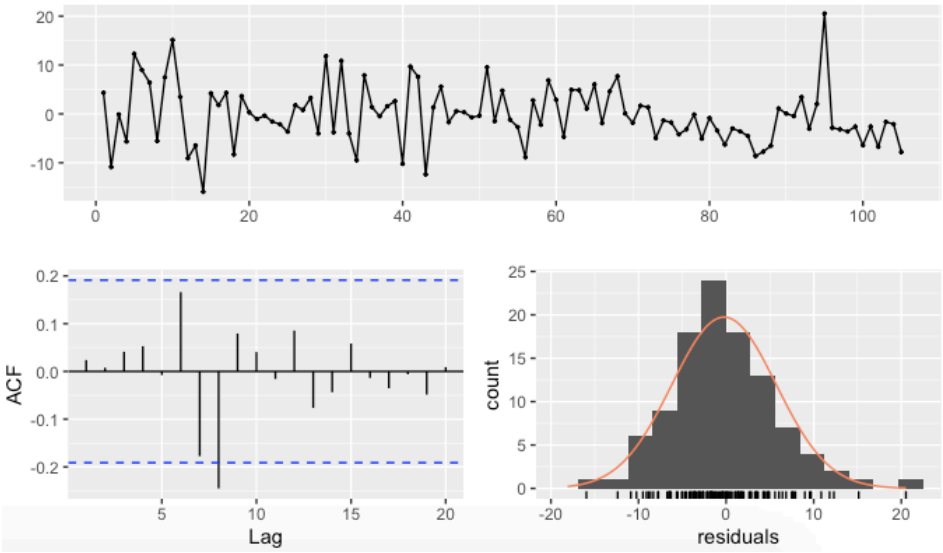

Figure 9. Check of the residuals of the ARIMAX (2,1,2) model estimated for the MY 2011/12 - 2012/13

APPENDIX C

Plot of the fitted values for ARIMAX (2,1,2)

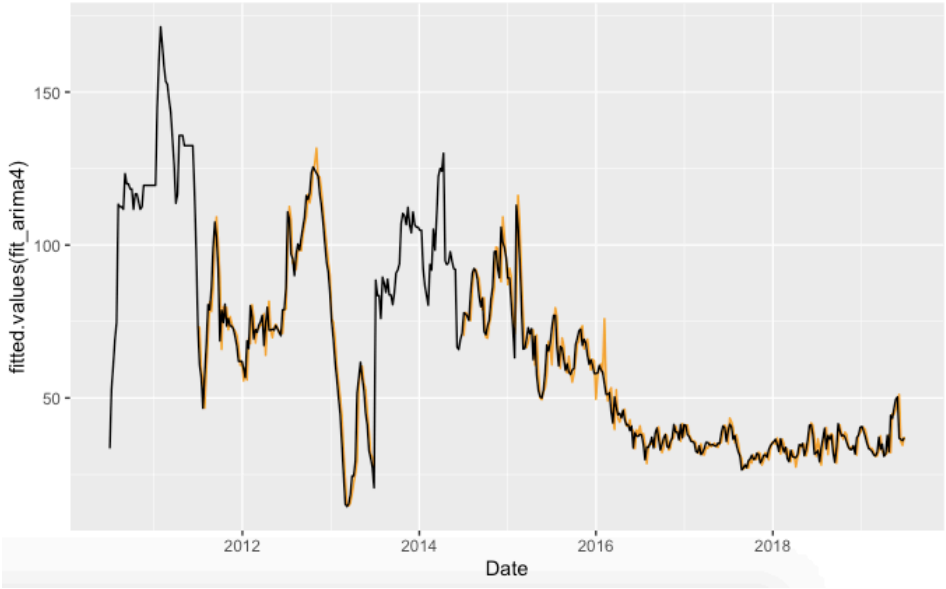

Figure 10. Plot of fitted values of ARIMAX (2,1,2) estimated for the whole sample and observed data

Plot of the fitted values for ARIMAX (1,0,2) MY 2011/12.- 2012/13

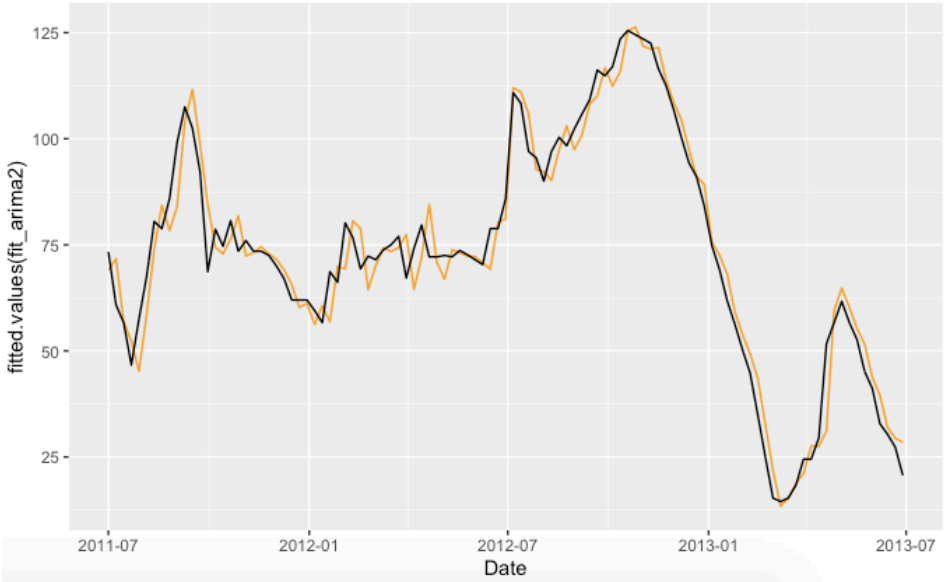

Figure 11. Plot of fitted values of the ARIMAX (1,0,2) model estimated for the MY 2011/12 - 2012/13.