THE IMPACT OF AGRICULTURAL COMMODITY MARKETS ON BOND YIELDS: THE CASE OF UKRAINE

by

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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

2018

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Date _____

Kyiv School of Economics

Abstract

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Emerging markets are often characterized by a high share of commodities in their total exports and imports, respectively, by a dependence on the global commodities price fluctuations. A rapid fall in key export commodity prices can lead to a fall in exports revenues thus having a negative impact on the economic stability of such economy, which may increase credit risk of a country and decrease its ability to service its external debt. When making an investment decision on buying international bonds of an emerging country, the global investor will likely adjust his/her expectations accordingly and require higher yield.

The main hypothesis of the research is that Ukrainian bond yields are positively related to the price returns on the key export agricultural commodities, such as sunflower oil, corn and wheat. I estimate the OLS-model, using monthly data on Ukrainian bond yields and controlling for a set of macroeconomic, country-specific and international factors from February, 2011 to April, 2018.

I obtained no significant impact of agricultural commodity price returns on Ukrainian bond yields.

TABLE OF CONTENTS

LIST OF FIGURES

Number *Page*

LIST OF TABLES

Number *Page*

ACKNOWLEDGMENTS

I would like to express my deepest and sincerest gratitude to my thesis supervisor Prof. Olesia Verchenko for her efforts, experience, time and support, dedicated to my research. Her suggestions, tips and permanent mentorship were crucial and helpful for me. Olesia was always available for consultations and played a role of not just a thesis supervisor but a professional psychologist and an 'emergency contact point' during the most difficult periods of writing this very research.

I am extremely grateful to my parents, who gave me both the life and the opportunity to study at KSE. It would be impossible without their moral and financial support. They are angels of my life, who support and trust in me regardless of everything.

My studying at KSE still would be impossible without generous KSE donors, professional faculty, incredible group mates and successful, open-minded alumni. I am proud to be a small part of this awesome community. Two year ago I could not even dream about this.

In addition, I would like to thank Natalia Kalinina, who is the best specialist in English I have ever known. She made this research more readable.

Also I would like to thank my current employer – Nick Piazza (SP Advisors) and my supervisors – Oleksandr Tsapin (KSE '2010) and Alexey Yeremin for an opportunity to analyze the topic, applying practical experience, which I gained while working in the company.

Finally, I want to express personal thanks to my buddy – Solomiia Brychka and my friend – Olga Halytsya for standing with me during the research period, for useful tips, alternative, 'fresh' views and making my life significantly happier.

GLOSSARY

Bond - a fixed income investment instrument in which an investor loans money to an entity (typically corporate or governmental) which borrows the funds for a defined period of time at a variable or fixed interest rate.

Sovereign Bond Yield - is the interest rate earned on a government (sovereign) bond, at which a national government can effectively borrow.

Sovereign Bond Spread - the difference between yields on debt instruments of varying maturities, credit ratings and risk, calculated by deducting the yield of one instrument from another.

J.P.Morgan EMBI Index - the emerging markets bond index that is a benchmark index for measuring the total return performance of international government bonds issued by emerging market countries.

C h a p t e r 1

INTRODUCTION

Emerging markets are often characterized by a high share of commodities as a part of their either export or import or both simultaneously. This implies, that shocks in commodities prices may lead to substantial consequences in terms of economic stability in commodity-oriented countries. Shocks in commodity prices may destabilize the balance of payment, cause some market distortions and shatter the financial stability of emerging markets. So, commodities price fluctuations are an important issue in terms of financial fragility.

Ukraine, as a post-socialistic, transitory emerging market has a commodity-oriented economy. For example, in 2017 only three groups - cereals, vegetable oil, and ferrous metals - accounted for 55.3 % of all Ukrainian exports[1]. At the same time, the share of fuel, oil, and other minerals in Ukrainian imports exceeded 25%. Being an open (Ukrainian trade turnover in 2017 was about 83 % of country's GDP) and small (Ukrainian economy accounts for about 0.15 % of world GDP as for 2017[2]) economy implies a high level of dependence on global macroeconomic trends.

Sovereign bond spreads serve as one of the key measures of sovereign risk. They measure the default, political and other risks that a country faces. High bond spreads can limit the scope of available instruments that government has to borrow from international markets and lead to large interest expenses.

After the economic crisis, followed by an increase in bond spreads, volatility and uncertainty, emerging markets nowadays are again considered as an

[1] Goods structure of Ukrainian trade in 2016, Ukrainian statistics service - http://www.ukrstat.gov.ua/

[2] World Development Indicators, World Bank - https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?year_high_desc=true

attractive option for the global investors when interesting in diversifying their portfolios. This is also reflected in the dynamics of the related Index - Emerging Market Bond Spreads (EMBI Global), which is continually increasing over the last couple of years (Damodaran, 2017).

Another important but similar estimate of sovereign risk is Sovereign Bond Yield, which measures yield to maturity on sovereign bonds issued by countries. The only difference is that sovereign bond yields include risk-free rates on the U.S. bonds.

As for today, emerging markets bonds yields are fluctuating around the average value as for the observed period, whereas EMBI Global Return Index was steadily increasing over time. [3] (Figure 1).

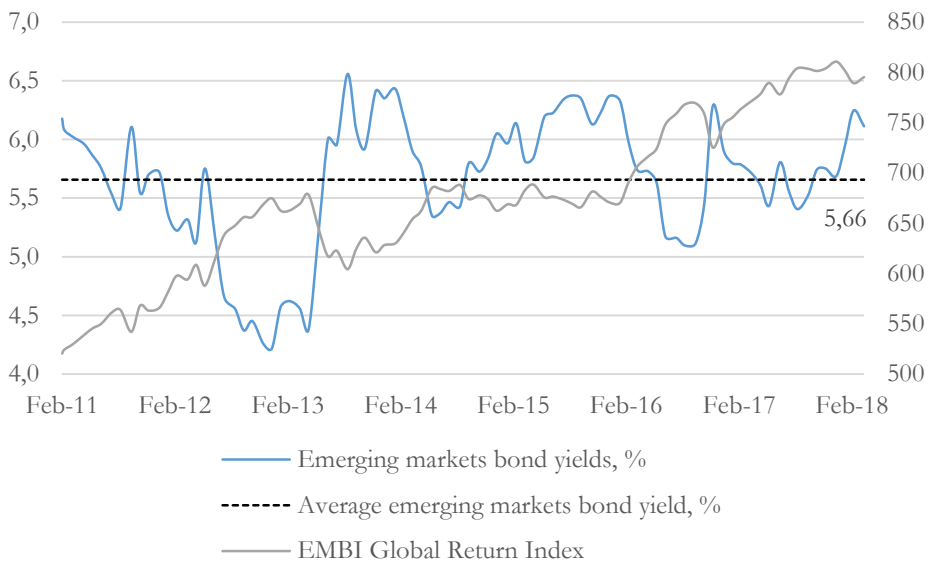

Figure 1. Emerging markets bonds yields vs. EMBI Global Return Index (2008-2018)
Source: Bloomberg

The J.P.Morgan Emerging Markets Bond Index Global ("EMBI Global") tracks total returns for traded external debt instruments (external meaning

foreign currency denominated fixed income) in the emerging markets[3]. EMBI Global tracks U.S. dollar-denominated Brady bonds, loans, and Eurobonds with an outstanding face value of at least $500 million. Emerging markets fixed income instrument are nowadays considered as an attractive direction of diversifying risks. Ukraine as an emerging market, beyond question, gains from such a situation via getting more opportunities to attract capital inflow with relatively lower required yields.

In September of 2017, Ukraine issued 15-year bonds[4] – for the first time after debt restructuring in 2015, with a coupon of 7.375 percent. It became the first case of issuing bonds for such a long maturity period in Ukraine. Ukraine obviously benefited from favorable situation, which appeared to be more or less the same for all emerging markets across the globe, but experts are suspicious about the persistence of such a situation[5]

After the political and economic crisis in Ukraine in 2014-2015, international loans became an important source of financing crucial for supporting macroeconomic stability by Ukrainian authorities. Therefore, the opportunity to issue bonds with low coupon rates is very important for Ukraine. In order to achieve this objective, Ukrainian policymakers need to be aware of the key determinants of sovereign bonds yields.

Ukrainian government debt increased over 2011-2014 by almost USD 20 bln. At the same time, difficulties in the debt serving process were also reinforced by a rapid fall in the NBU reserves as a result of following the fixed exchange rate regime policy. This was reflected in a spike in Ukrainian sovereign bonds

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[3] J.P.Morgan - Index Suite (Emerging Markets Indices): https://www.jpmorgan.com/country/US/EN/jpmorgan/investbk/solutions/research/indices/product

[4] Ukraine raises $3 billion with first bond since debt restructured - https://www.reuters.com/article/us-ukraine-eurobonds/ukraine-raises-3-billion-with-first-bond-since-debt-restructured-idUSKCN1BT19T

[5] FT: How long can emerging market debt continue to shy? - https://www.ft.com/content/b242b974-02aa-11e8-9650-9c0ad2d7c5b5

yields in the spring of 2015, when reserves fell below the threshold of USD 5 bln.

The crisis in Ukraine was followed by a depreciation of the local currency and by a military conflict in Donbass, as well as occupation of the Crimea. The essential need in increasing military budget became another burden for the Ukrainian budget, shaping the payment capacity of our country. As a result of the factors, mentioned above, interest payments of the Ukrainian government as a share of the government revenue keep increasing (Figure 2) and is expected to remain at the high level due to the significant payments, maturing in 2018-2020 years (around 20 bln. USD)[6]

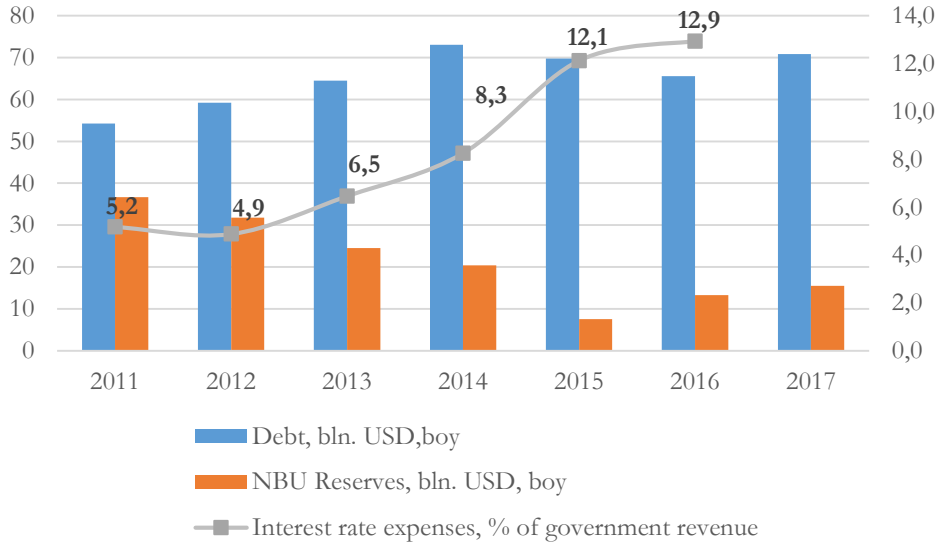

Figure 2. Ukrainian government debt burden dynamics (2011-2017)
Source: World Bank, National Bank of Ukraine, IMF

Ukraine is among countries, which experienced the most significant drop in GDP during the 2008-2009 years. The economic recovery was sluggish and was interrupted by the political crisis in 2014-2015. The trajectory of the

[6] S&P estimates debt repayments in 2017-2020 at over 20 bln.USD - https://www.kyivpost.com/ukraine-politics/sp-estimates-ukrainian-debt-repayments-2017-2020-20-bln.html

Ukrainian economy development is different from that of both transitory post-USSR countries and other emerging markets (Figure 3). This makes the Ukrainian case unique: Ukraine, combining the features of the post-Soviet regime (transition economy), is injured by war and increases the share of agricultural export. In my thesis, I would like to study whether Ukrainian dependence on commodities markets is strong and significant.

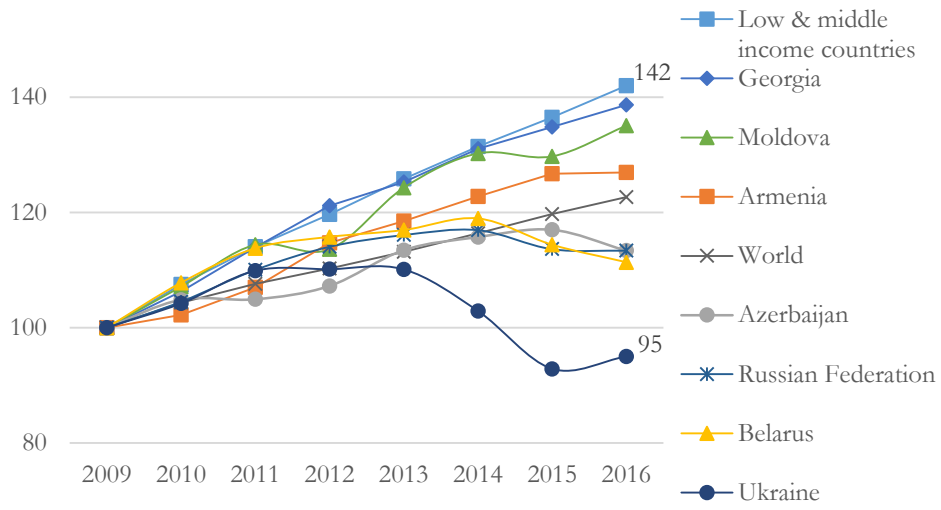

Figure 3. Post-crisis GDP recovery in some CIS countries and other low & middle income countries, 2009 = 100 (2009-2016)
Source: World Bank

During the last years, Ukraine became increasingly dependent on the agricultural sector, especially, in terms of exports of goods (Figure 4).

The main interest for me is to develop the model, which will ease the understanding of Ukrainian bonds yields setting process subject to the expected fluctuations in prices of the main Ukrainian agrarian export goods.

I would like to focus on export goods for two reasons:

1. Ukraine is a net-exporter of commodities;

2. Agricultural export accounts for more than 40 % of total Ukrainian export (Figure 5)[7].

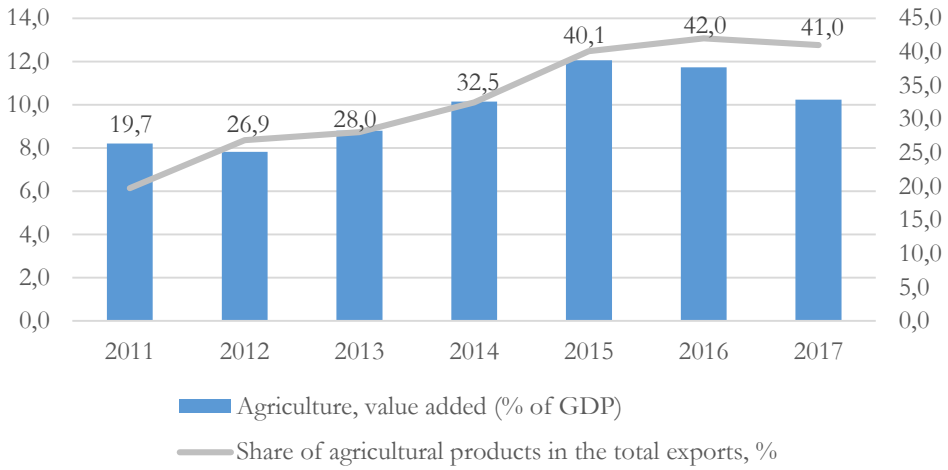

Figure 4. The share of agricultural goods in Ukrainian exports and GDP, %
Source: World Bank, State Statistics Service of Ukraine

My aim is to develop a model customized for Ukraine to account for all significant economic, political and credit risks so that I could obtain separate effects of each of the main agricultural commodities price fluctuations on Ukrainian bonds yields.

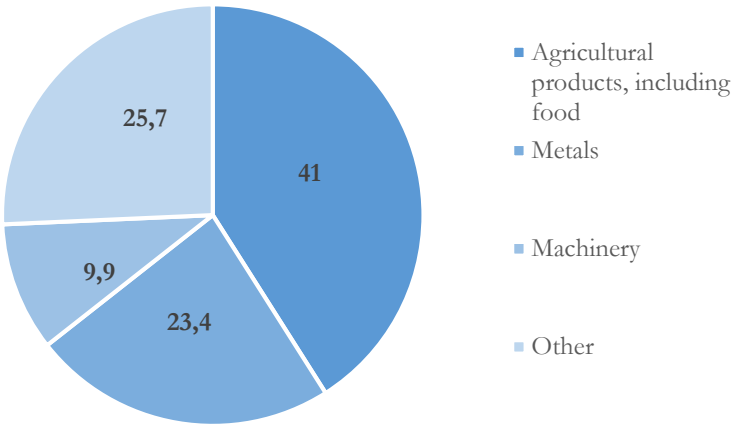

Figure 5. Ukrainian exports of goods structure (2017), %
Source: State Statistics Service of Ukraine

[7] Ukrainian Statistics Service – Structure of goods exports, 2017

Controlling for risks, especially: political, is crucial in the case of Ukraine since political instability was closely related to the economic crisis and was the core reason technical default in 2015. It caused a rapid increase in Ukrainian bonds yields in 2015[8].

During the same period (2011-2017), global commodities prices decreased almost twofold. In April of 2018 Bloomberg Commodities Index was at 53 % as compared to its level in February of 2011 (Figure 6).

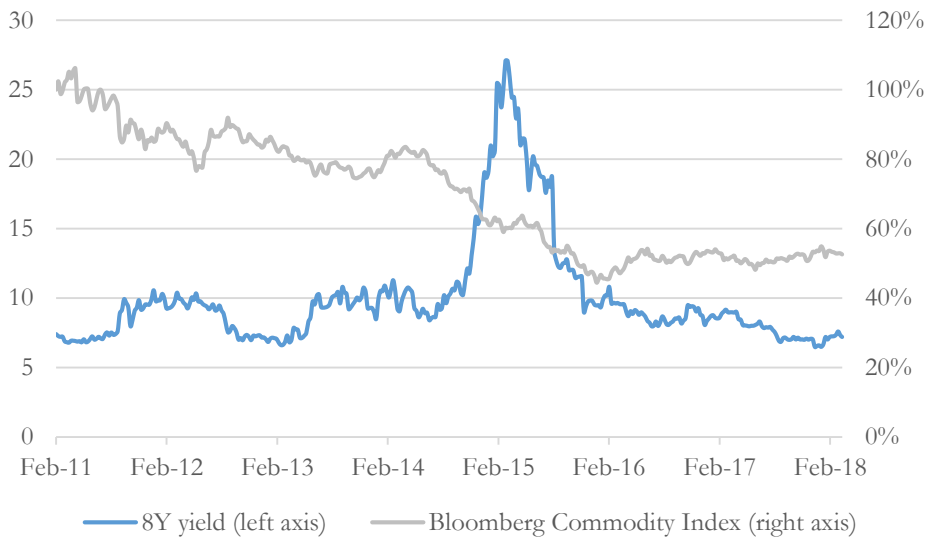

Figure 6. 8-year Ukrainian bonds yields, % (USD) vs. Bloomberg Commodity Index
Source: Bloomberg

The model of the key determinants of Ukrainian bonds yields that would account for the fluctuations in global commodities prices should be useful for the following key stakeholders:

1. Ukrainian policymakers (first of all, the Ministry of Finance and the National Bank) in terms of making more informed, evidence-based decisions on when issuing new debt and refinancing the outstanding debt, having the

[8] BLOOMBERG data – Ukrainian bonds yields

information on interdependencies between international commodities prices and bonds prices projections;

2. International investors, who, while making the decisions on constructing their portfolios, need to analyze the attractiveness of investments in Ukrainian sovereign fixed income securities.

The following thesis is constructed as follows. In the literature review we discuss and summarize theoretical and practical approaches on sovereign bond yields determinants. In Chapter 3 we introduce the data from different sources, discuss the issues, related to the dataset construction etc. In Chapter 4 we analyze an appropriate methodology and adjust it to the Ukrainian case via extending the basic model. In Chapter 5 we present the estimation results, based on the available dataset and provide an interpretation of the obtained estimated. Also we report the results of post-estimation test. In Chapter 6 we make conclusions, dedicated to the key question of the research and develop some policy recommendations.

Chapter 2

LITERATURE REVIEW

In general, the problem of determining bonds yields (particularly, in emerging markets) is not a new one. There are numerous research papers, in which authors try to specify the main groups of risks and their impact on bonds yields. Nonetheless, there are only a few recent papers, discussing the impact of commodity price fluctuations on sovereign bond yields. Such a study has not been done in regards to Ukraine.

In order to build a plausible model, analyzing interdependencies in Ukrainian bonds yields and the key export commodity price fluctuations, one should be aware of several substantial theoretical findings, such as:

1. General theory on the determinants of sovereign bonds yields, applicable and significant in regards to any country, such as the effects of macroeconomic context, political, economic and financial risks profile etc.;
2. Features, characterizing emerging markets bonds premium, e.g. accounting for the risk aversion of the global investor towards emerging markets in general. Advanced and emerging markets historically demonstrated quite different sensitivities to the global crisis and the effects of the same macroeconomic circumstances can vary a lot (it will be discussed later);
3. Actually, one should obtain the level of the dependence of the emerging countries on the commodities and account for that when making an investment decision;
4. National-level peculiar properties, given that some countries are transitory and may combine different features simultaneously or, on the contrary, may have some specific circumstances (in particular, Ukraine as a post-Soviet emerging country with a transitory economy, experiencing occupation (Crimea), being involved in the war conflict in Donbass and being

increasingly dependent on commodities markets), may have different, as compared to 'peers' effects *ceteris paribus*.

Damodaran (2017) provides a core understanding of risks and reasons for the importance of understanding their nature. The author investigates the history of government defaults and credit default swaps as measures of sovereign default risk. He introduces the structure of risks, consisting of political, legal and economic ones. Also, this author analyzes the key reasons for international capital mobility and the role of bonds as an instrument, which ensures the transmission of capital flows across the globe. The key measures of sovereign default risk, according to Damodaran (2017), are the following:

1. The degree of indebtedness;
2. Pensions/Social Service Commitments;
3. Revenues/Inflows to the government;
4. Stability of revenues;
5. Political risk;
6. Implicit backing from other entities.

The set of indicators listed above is important for any country. In addition to some common estimates, investors are also likely to consider additional factors, such as inflation, budgetary and current account imbalances, real effective exchange rates and liquidity, as Afonso, Rault (2010) suggest.

Afonso et al. (2015) focus on the determinants of long-term sovereign bond yield spreads in emerging European markets (which is of high interest in terms of my research) and come to a conclusion that the sensitivity of bond prices to fundamentals are also necessary to explain yields over the crisis period. This finding is important while thinking of the appropriate methodology for my thesis since the impact of external and internal factors, affecting Ukrainian bonds yields, were extremely robust over time: in the chapter, dedicated to the data description, while analyzing the initial data we will observe three periods of time, two of which lie in a relative

correspondence with global trends and one (characterized by political, economic and financial crisis in Ukraine – not).

Analyzing Ukrainian bonds requires differencing between local and global factors in order to treat exogenous and endogenous variables in an appropriate way. Csonto and Ivaschenko (2013) split all factors, affecting emerging markets bonds yields in two groups – local and global. The key finding is that during severe economic distress, global factors are the key drivers of changes in the spreads and that the misalignment increases in magnitude. We will have an opportunity to check whether this works in Ukrainian case.

Local fundamentals are crucial factors, affecting the ability of low-income developing countries to issue bonds in international capital markets. In particular, Presbitero et al. (2015) discovered that spreads (and, respectively, yields) on sovereign bonds are lower for countries with strong external and fiscal positions. An important finding in regards to my research is that the author came up with the finding that global sovereign bond spreads are reduced in periods of lower market volatility. As is shown in descriptive analysis in the next chapters, volatility of Ukrainian bonds is a few times higher than on average in emerging markets and reasons for instability during 2014-2015 have an endogenous nature.

Imperfections in the functioning of the financial system may also lead to the less credibility of a country with an emerging economy and may cause higher (ceteris paribus) yields. Changes in investment grades, set by the top agencies (such as S&P, Moody's and Fitch) create a huge information flow and, as a research by Jaramillo and Tejada (2011) suggest having an investment grade status reduces spreads by 36 percent, above and beyond what is implied by macroeconomic fundamentals. In terms of my research, this finding is important as default grade, which Ukraine had over the last year, can partially be explained by changes in sovereign credit ratings.

The core question of the research deals with choosing the 'correct' dependent variable as a measure of emerging markets sovereign risk. The existing literature proposes different options but there are some common trends and motivations behind the choice of each specific variable.

For example, Ferrucci (2003) used JP Morgan EMBI Index as the dependent variable as a measure of emerging markets bond yields. This is interesting for purposes of my own research since I need to control for the global trends in the emerging markets bonds. The author's main conclusion is that a debtor country's fundamentals and external liquidity conditions are important determinants of market spreads.

Jaramillo and Tejada (2011) consider an important for Ukraine question, dealing with investment grades, which shatter an access to international capital markets. They analyzed 35 emerging markets between 1997 and 2010 and concluded that countries with investment grades attract borrowings by 36% cheaper (lower) rate. Even though global financial conditions tend to play a core role in determining spreads, market positions appear to be improved with lower external public debt as a part of GDP. It is interesting to check whether relatively higher indebtedness, which Ukraine faces with over the last years, lead to higher yields on Eurobonds in specific Ukrainian case.

Belhocine and Dell'Erba (2013) name indebtedness as an important problem, affecting negatively the opportunities for issuing bonds with low interest rates. The authors find that the sensitivity of spreads to debt sustainability doubles as public debt increases above 45 percent of GDP. This implies that market interest rates react more to debt sustainability concerns in a country with a high level of debt compared to a country with a low level of debt. And it is the case for Ukraine (as was analyzed in the introduction, debt burden increased substantially over the last years). Hadzi-Vaskov and Ricci (2016) analyze emerging market economies and provide another empirical evidence

of the positive relationship between the share of debt (as a % of GDP) and the sovereign bonds spreads: an increase in net debt by 10 percentage points of GDP implies an increase in the spread by 100–120 basis points, and the effect is larger during periods of the domestic distress.

Eichengreen and Mody (2000) analyze about 1000 bonds issued by developing countries and confirmed their hypothesis that higher credit ranking increases the chances of issuing bonds with relatively higher yields. Therefore, in my thesis I will check whether the effect persists in Ukrainian case.

Actually, indebtedness is not the only significant factor when estimating countries' default risk and, respectively, bond yields. Presbitero et al. (2016) in one of the most recent studies on 105 studies during the period of 1995–2014 find that larger economic size, higher GDP per capita, lower public debt and more efficient government ease the bond issuing process with relatively lower yields. In addition, they contributed one important outcome: during periods of global liquidity and high commodity prices bonds are being issued with higher probability.

The majority of studies represent the multi-country panel-data while in my research I would like to concentrate on Ukraine (so, EMBI Index can be used as a control variable but not as a dependent one). Thus, single-study studies can be considered as a priority in terms of coming up with a framework for my own one.

Naumoski (2012) considers the case study on Macedonia and approaches the key question from the point of view of the Capital Asset Pricing Model. The author built the model in line with the theoretical concepts of Modern Portfolio Theory, developed by Sharp and Markowitz. There is an important concern, though: MPT requires the rationality from the investors, who maximize their utility and this appears to be a very strong claim. Nevertheless, regardless the level of individual rationality, investors try to avoid risks and

require an additional risk premium in case when they are faced with some risks. So, the concept of uncovered interest parity could be one of the alternative ways to calculate country risk premium (CRP). In order not to miss the effect of the uncovered interest parity, I will consider only Eurobonds, nominated in single currency – U.S. dollar.

Naidu et al. (2016) in the research on India obtain the results of the importance of the exchange rate, federal reserve rate, oil price, the US bond yield, gold price and real interest rate as determinants of the emerging economies' bond yields. Nevertheless, when doing research about Ukraine, one should think of a feasibility of choosing any specific variable. For example, in Ukraine before 2015 in fact there was limited scope for independent monetary policy and the only objective of the National Bank of Ukraine was keeping the exchange rate constant at the level of 8UAH/USD, which reflected in changes (actually, rapid fall) of the reserves and in accumulation of debts. So, when using exchange rate returns, especially in regards to the period before 2015, one, doing research on Ukraine, should account for changes in reserves, as a real cost of fixed exchange rate regime.

My colleague from Portugal (in the status of being MA student) – Rosa (2014) in his master's thesis investigates the factors, affecting Portuguese bond spreads, which is interesting and may be applicable for Ukraine, because both countries have large debts and face different problems, which are common for both countries even though the level of the economic development differs a lot. The author finds no persistence in the factors affecting Portuguese bond yield spread. For example, in regards to one observed sub-period, fundamental factors (debt ratio and government balance in % of GDP) are the main drivers behind the surge of the yield spread during the first two years of the sample.

As mentioned above in the introduction, commodities are among the most important factors of (in) stability in emerging markets. One of the specific

(commodities-oriented) and the recent studies are made by Morrison (2016), who focuses on the impact of oil price innovations on emerging market sovereign total bond returns during 2004-2015. The author proved the significance of oil price on bond returns, using the data on emerging oil-exporting countries.

Alexandre and De Benoist (2017) analyze the time-series data from 1998 to 2008 and also obtain the result of the impact of the price of oil on the risks, associated with government bonds. The authors find the statistically significant positive impact of the oil price on risk premiums of government bonds.

Gormus et al. (2017) study whether price shocks on energy impact energy companies' bonds and sovereign bond yields, observe the transmission from energy price fluctuations to high-yield bond markets and give the evidence that increase in prices on energy are associated with higher yields on emerging countries sovereign bond yields.

As can be seen, there are many publications on an issue of bonds pricing, particularly, in emerging markets. But only a few of them distinguish the impact of commodities' prices on bond yields. Finally, none of them study the interrelations between commodities' (primarily, agricultural) prices on sovereign bond yields. Such a study has never been done for Ukraine, as well.

The effects of commodity markets on emerging economies may differ from those of energy markets, since oil prices affect the prices of almost all good and services, produced or consumed in the economy due to the high transmission effect (compared to the fluctuations in commodities prices).

Therefore, getting answers for previously set questions should contribute to both practical decision-making process at the level of Ukrainian policymakers and to the pool of researches on the matter of the financial markets' understanding in the post-Soviet transitory countries with emerging markets.

Chapter 3

DATA OVERVIEW

3.1. Data source

The most of the data is collected from Bloomberg through Bloomberg Terminal Database. The Bloomberg Terminal is a computer software system provided by the financial data vendor Bloomberg L.P. that enables professionals in the financial service sector and other industries to access the Bloomberg Professional service through which users can monitor and analyze real-time financial market data and place[9].

We consider both weekly and monthly data on Ukrainian bonds yields as a dependent variable. Since Ukraine was borrowing money for different horizons (and also there were periods when Ukraine issued no international bonds at all), there was no time-series for any of the periods without missing values. Therefore, when deciding on which bond maturity to choose for our analysis, we have stopped on 8 years for two reasons:

1. Eight-year period is large enough in order to observe long-term effects. In the literature the most commonly used maturity period is 10 years. Therefore, even if not being at the same page, the choice on dependent variable is close to what the literature suggests;
2. The available sample of the data is the fullest compared to all reasonable alternatives.

Other data sources were also used. In particular, the data on Ukrainian import and the economic growth were obtained at the State Statistics service of Ukraine.

[9] Bloomberg Termial - https://www.bloomberg.com/professional/

The data on reserves, real and nominal effective exchange rate were uploaded from the official webpage of the National Bank of Ukraine. This source was also used to identify the date when Ukraine officially switched to the inflation targeting regime.

The data on the current account balance was found at the IMF database.

Also we used dummies for the periods of ATO (1 – ATO, 0 – no ATO) and IMF program (1 – IMF funding program period; 0 – before the approval of the program).

3.2. Data description

In order to get rid of numerous gaps in the data (Figure 7) in 8-yers Ukrainian bond yields, we used 7-year and 5-year Ukrainian bonds yields as a proxy for the key dependent variable (8-year Ukrainian bonds yields). In order to fill the data, we run OLS-regressions and used fitted values from regressions (obtaining the dependence of 8Y yields on 7Y yields and 8Y yields on 5Y yields respectively). This approach requires the assumption of the relatively similar term structure over the time. Given that in Bloomberg there is available at maximum 6 options for Ukrainian international bonds yields (4Y, 5Y, 7Y, 8Y, 9Y and 9Y) and not more than 3 of them for the majority of observations, subject to the non-linear nature of yield curve, it is impossible to derive it appropriately for any specific period of time. This is important in terms of coming with the best possible approximation. Therefore, given that deriving yield curve for each specific point of time is impossible subject to the number of observations, the OLS-method is appeared to be the most feasible way to generate missing observations with the minimized deviations from the values, which would be the case if such data were available at all.

Figure 7 illustrates the dynamics of the initial 8Y yield time-series, 8Y fitted values, 7Y and, 5Y yields, which we used as a proxy.

The blue line denotes the initial average yields on Ukrainian 8Y bonds, the red line illustrates the fitted values for periods, when the data for 8Y yields were not available. Luckily, these periods were characterized by a relatively stable situation and the generated data are pretty close to 7Y yields (orange line) and 5Y yields (grey line). There was no need to apply any data generating tools for the period of spike (crisis), originated in February-March, 2015 in Ukraine, when, as can be concluded from the graph, the yield curve was upward-sloping (yields on 7Y bonds were higher than on 8Y bonds). This issue is important since during the period of economic crisis, followed by the risk of an ongoing default, it is highly likely that the government will go bankrupt. But in case of surviving during the most dangerous period, the economy stabilizes and yields decrease. This is the case for Ukraine, as well.

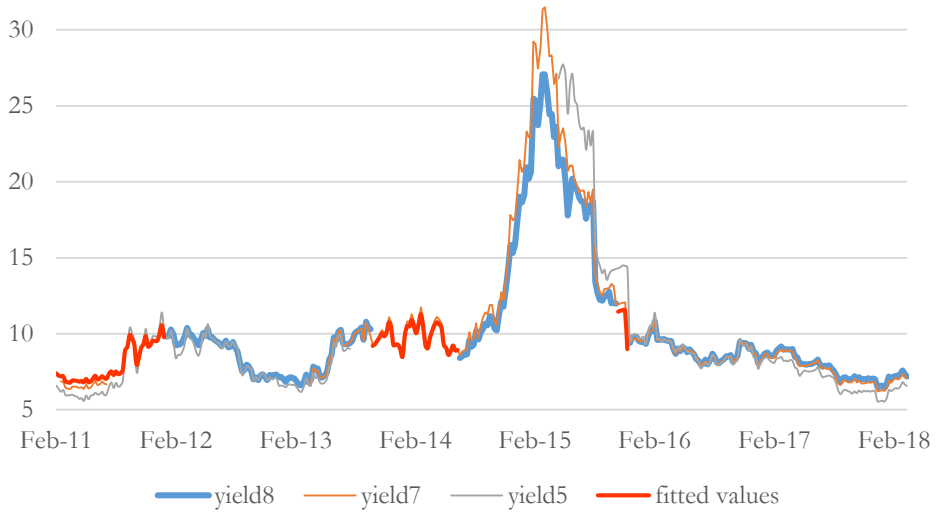

Figure 7. Dynamics of Ukrainian sovereign bonds yields (2011-2018), %
Source: Bloomberg, author's calculations

It should be mentioned here, that the nature of the crisis in 2015 was endogenous and was not followed by other emerging markets. Figure 8 represents the dependence between yields of Ukrainian bonds and yields of

other emerging markets. Emerging markets yields were calculated as a sum of EMBI Global Sovereign Spread and U.S. 10 Year Treasury bonds yields.

It is obvious that in 2015 domestic circumstances prevailed over the global trends because, while in Ukraine and hit all-time high, both U.S. yields and emerging market yields (and, respectively, spreads) were stable and characterized by low volatility.

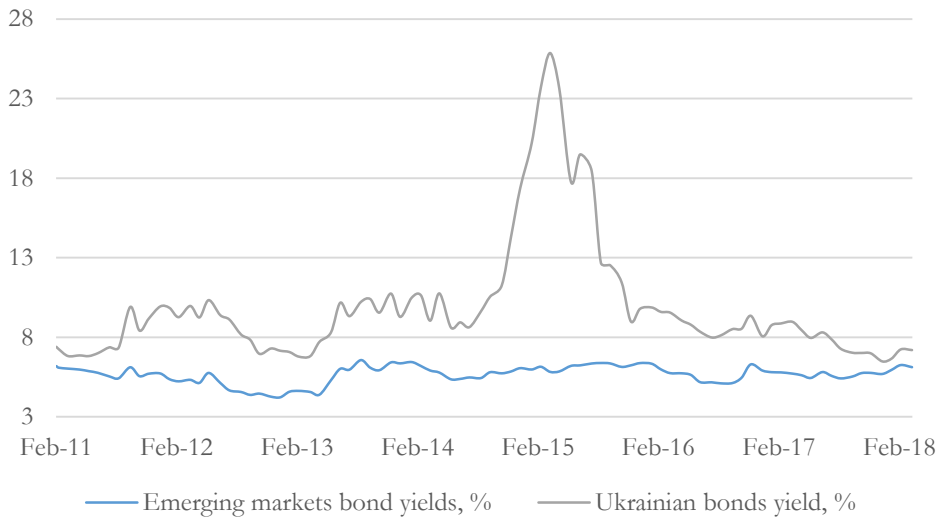

Figure 8. Dynamics of Ukrainian and other emerging markets yields (2011-2018), %
Source: Bloomberg, author's calculations

We split all the variables in difference groups:

The first group of variables includes the key dependent variables, such as commodities prices, which are of the key interest of the research. In particular, we considered prices returns on the key Ukrainian export agricultural goods: sunflower oil, corn, wheat (Figure 9).

According to the data, these three goods account for almost 2/3 of Ukrainian agricultural exports so there is no need to include other commodity-related variables since cereals price are jointly correlated and it makes sense.

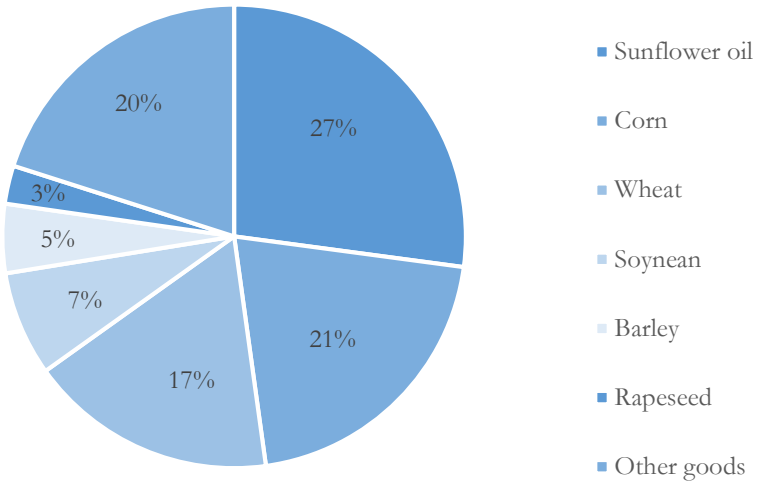

Figure 9. Structure of agricultural goods exports of Ukraine (2017), %
Source: Baker Tilly annual agriculture report, State Statistics Service of Ukraine

sunoil_return**:** since sunflower oil is not traded on Chicago Mercantile Exchange, the data on FH South African Origin high oil content Sunflower seeds meeting specified criteria was used. Prices are set in USD for metric tons.

corn_return and wheat_return prices returns were calculated, based on the data on prices, which were uploaded from Chicago Mercantile Exchange in cents per bushel.

Figure 10 illustrates the dynamics of prices on top-3 Ukrainian export goods and Bloomberg Commodity Index, rebased for February, 2011 (the starting point of the sample). It shows that the trajectory of prices on the key Ukrainian export agricultural commodities differed a lot. Particularly, prices on sunflower oil increased over the analyzed period, whereas prices on cereals (particularly, wheat and corn) decreased substantially.

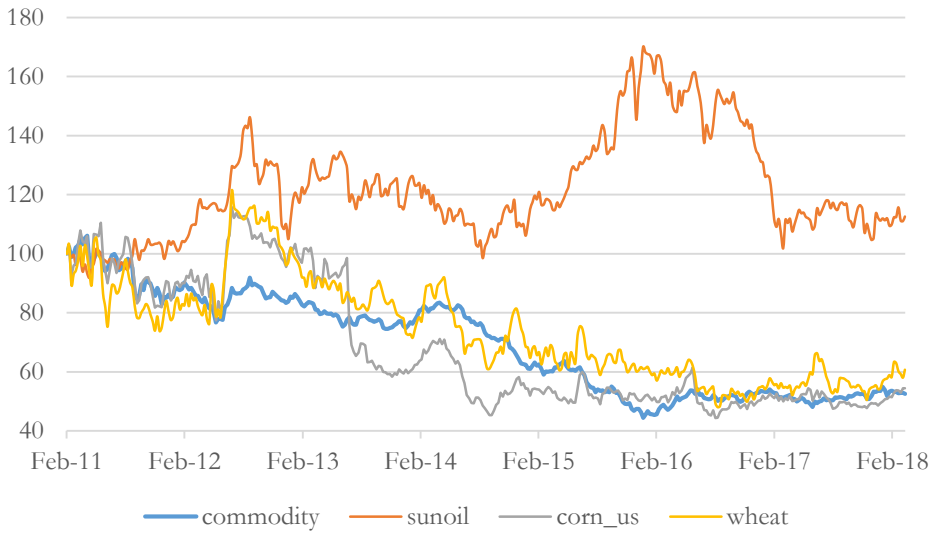

Figure 10. Dynamics of global prices of commodities, sunflower roil, corn and wheat (rebased as for February, 2011), %

Second group of variables: the key control variables, having international (exogenous) nature and determining the global situation on fixed income market and investors risk aversion.

embi_spread_sovereign: J.P. Morgan EMBI Spreads - The Emerging Markets Bond Index Plus (EMBI+) tracks total returns for traded external sovereign debt instruments in the emerging markets. It is measured in basic points. For purposes of the research, we transformed it in % by multiplying by 100.

us_yield: generic United States on-the-run government bill/note/bond indices pre-tax yield to maturity. The variable is measured in %.

vix: Chicago Board Options Exchange SPX Volatility Index, reflects a market estimate of future volatility, based on the weighted average of the implied volatilities for a wide range of strikes. It is measured in %. Higher VIX index denoted higher risk aversion among investors.

Third group of variables: macroeconomic, country specific variables + risks
This group of variables represents features, which characterize current position of Ukraine, including countries risk profile, financial, political and macroeconomic (including monetary) conditions.

Bloomberg Risk Score (political, economic, financial): Bloomberg Country Risk Score measures a country's overall risk across financial, economic and political sectors relative to the performance of other emerging and developed countries. Higher scores indicate more stability and less risk.

gdp_growth**:** is a macroeconomic variable, measuring real economy growth in %, measured on y-o-y basis.

neer_return: nominal exchange rate is an unadjusted weighted average rate at which one Ukraine's currency exchanges for a basket of multiple foreign currencies. Given that during the major part of the sample Ukraine had a fixed exchange rate regime, it makes sense to control also for reserves and government debt (since accumulating debt and spending reserves) are usually the basic sources of covering the shortage of the international currency on the local currency exchange market.

reer_return: real exchange rate – differs from nominal by adjusting on the effects of inflation.

reserves: NBU international reserves in mln. USD.

import: total quarterly value of imported goods. The variable is used for calculation of the ratio between current total reserves of the National bank of Ukraine as compared to the quarterly import. This ratio is often used for evaluation of country's solvency).

icoverage: import coverage ratio. We calculated this ration by dividing reverves by import. This variable explains how much times current reserves of the National Bank of Ukraine exceed the total value of quarterly import.

indebtedness: total government debt as a part of GDP, %. Higher indebtedness is expected to be positively correlated with Ukrainian bonds yields.

credit rating: it is a rating, developed and attached by one of the credit ratings agencies (such as S&P, Fitch, Moody's). We used long-term credit rating in foreign currency for Ukraine, developed by Fitch. We preferred Fitch to other agencies due to more frequent updates in ratings, as compared to other agencies. Fitch ratings system consists of 25 different ratings levels (where AAA is a 'prime' rating, denoting the best possible grade and DDD is the worst default grade). We denoted 1 for AAA ratings and, respectively, 25.

Since the data on all variables (except for the data on nominal and real exchange rates) from this group have lower frequency than the key dependent variable in the model (monthly), some of the variables were obtained, applying liner interpolation method.

Fourth group of variables: dummies for controlling different actions.

Since the sample is not homogeneous we proposed adding few dummies for controlling for substantial changes

ATO: the war in Ukraine, started in 2014, became an important negative factor, which frightened, actually, the entire world and prevented investors from considering Ukrainian securities as an attractive way of diversifying portfolio. We use the value of 1 for all observations, which belong to the period, starting from 04/14/2014.

IMF/Minsk-2: after NBU's reserves were exhausted in 2015 and ATO was in its active phase, Ukrainian bonds yields hit all time high and Ukraine, being unable to repay outstanding liabilities. In this case the access to international capital inflows into Ukraine would close entirely. After IMF approved 17.5 bln. USD credit line, Ukraine was able to return to the international borrowing market. This decision was taken almost at the same time as Minsk-2 agreement was signed, which decreased the intensity of the war in Donbass. Therefore, due to the multicollinearity we can use only one of this dummies as a control.

Targeting: since the National Bank of Ukraine announced switching from the fixed exchange rate regime to inflation targeting regime in 2015, dealt all technical issues and, finally, implemented it, start from January, 2016, we control for the exchange rate regime by a dummy that takes a value of 1 for all observations in 2016-2018.

Crisis: as was mentioned in the literature review, the effect of variables (international and domestic), are different, depending on the context. As shown in a Figure 8 above, Ukrainian bonds yields in some periods in 2015-2016 had nothing to do with the global dynamics so we expect to obtain large differences in the coefficients, controlling for the crisis period.

Table 1 represents the correlation between Ukrainian, emerging markets yields and U.S. yields. In order to distinguish the difference in the levels of correlation during the period of no crisis, during the crisis in Ukraine and the overall, we provide statistics for crisis period (Dec 2014 – Aug 2015), when Ukrainian bond yields dynamics did not emerge in a correspondence with the global trends (as it was shown on a Figure 8 before), for the rest of the time (crisis = 0) and overall statistics.

As one may observe, the difference is crucial. Negative correlation coefficients during the crisis do not make any economic sense in the long-run

because Ukrainian bond yields cannot increase infinitely, when other emerging markets do not follow such dynamics. Rapid increase in bond yields will lead to the default. Moreover, in another case, when the government serves its debt, the bond yields converge to the initial coupon rate as closer the maturity period becomes.

Table 1. Correlation between Ukrainian sovereign bonds yields, emerging markets bonds and spread during the non-crisis periods

Estimator	Period	Ukrainian bond yields	Emerging markets bond yields	Ukrainian bond spread	Emerging markets bond spread
Emerging market yield	Non-crisis	0.45	1	X	X
	Crisis	- 0.26	1	X	X
	Overall	0.35	1	X	X
Emerging market spread	Non-crisis	X	X	0.68	1
	Crisis	X	X	0.33	1
	Overall	X	X	0.55	1
U.S. yield	Non-crisis	-0.10	0.62	X	X
	Crisis	-0.57	0.53	X	X
	Overall	-0.11	0.58	X	X

As we see, the level of correlation between Ukraine and other emerging markets vary drastically.

Ukrainian bond yields were low correlated with emerging markets bond yields – 0.35, whereas during the economic crisis in Ukraine the direction of Ukrainian yields dynamics were opposite to emerging markets bond yields. It means, that shocks during the crisis period were more powerful than the global trends.

Ukrainian bond spreads were also less correlated with emerging markets bond spread during the crisis (0.33) rather than during the periods before and after the crisis (0.68). Overall the level of correlation between Ukrainian and

emerging bond spreads was 0.55, which is high above the level of correlation between Ukrainian and emerging markets yields (0.35).

Precise descriptive statistics on monthly dataset is provided on the Table 2. We prefer monthly dataset to weekly in order to obtain effects, which are not contemporary, which need a certain amount of time (meaning that one week is not enough for transmission mechanism) to affect the dependent variable.

We decided to use 8Y Ukrainian bond yields as the key dependent variable. Also we will use 8Y Ukrainian bond spreads as a dependent variable for the purposes of robustness check.

As we see, Ukrainian bond yields were almost twice as volatile as U.S. yields and around 4 times as volatile as emerging market bonds yields. Ukrainian bonds spreads volatility are also 3.5 times more volatile than emerging markets bond spreads on average.

All three commodities, generating the largest share in Ukrainian agricultural exports revenue, were highly volatile. An increase in price return are expected to be inversely related with Ukrainian bond yields.

Among three Bloomberg risk scores, calculated for Ukraine, financial one are the most volatile, which represents the nature of the crisis and is a consequence of a technical default, which Ukraine experienced in 2015.

Quarterly GDP growth over the analyzed period was also highly instable (from -16 % to +6.7 %) and volatile. The expected sign of the impact of economic growth on Ukrainian bond yields is negative. The key hypothesis is that during the economic downturn the country becomes less attractive for foreign investors.

Table 2. Descriptive statistics

Variable	Obser-vations	Mean	Min	Max	St.dev.	Variance
8Y yield, %	87	9.89	6.48	25.87	3.90	39.43
8Y spread, %	87	7.62	3.37	24.03	3.98	52.23
Emerging markets bonds yields,%	87	5.66	4.22	6.56	0.56	9.89
Emerging markets bonds spread, %	87	3.39	2.32	4.49	0.48	14.16
US_yield, %	87	2.26	1.44	3.49	0.47	20.80
Sunoil_return, %	86	0.31	-15.55	15.23	5.81	1874
Corn_return, %	86	- 0.32	-30.49	34.77	8.75	2734
Wheat_return,%	86	- 0.20	-24.46	29.24	8.73	4365
VIX, %	87	16.0	9.14	36.2	5.37	33.56
Bloomberg political	87	12.49	7.17	19.66	4.12	32.99
Bloomberg economic	87	24.13	5.17	39.72	10.60	43.93
Bloomberg financial	87	27.15	1.78	65.45	13.64	50.24
GDP_growth, %	86	-0.74	-16.00	6.7	5.87	793
Nominal exchan-ge rate return , %	86	0.79	0.45	1.12	0.26	32.91
Real exchange rate return, %	86	0.87	0.56	1.06	0.12	13.79
Import coverage ratio	87	1.35	0.65	1.85	0.25	14.07
Indebtedness, %	87	64.34	36.88	81.25	18.27	28.39
Credit rating	87	16.62	15	22	1.77	10.65
ATO	87	0.55	0	1	X	X
IMF	87	0.43	0	1	X	X
Targeting	87	0.32	0	1	X	X
Crisis	87	0.10	0	1	X	X

Real and nominal exchange rates decreased over the analyzed period, meaning that Ukrainian currency depreciated against the basket of foreign currencies both in nominal and in real terms. Depreciation is expected to be among the factor, exaggerating the negative impact of crisis on the ability of Ukrainian government to serve its debt. Therefore,

The negative relationship between independent variables and Ukrainian bond yields is also expected to be the case in regards to the import coverage ratio (since more reserves determine more financial stability and more ability to pay bills).

In contrast, the literature suggests that higher indebtedness shatters the opportunity for the government to attract new debt. Therefore, the expected sign between indebtedness and the dependent variable is positive.

Taking into account relatively small number of observation, we decided not to split the sample into smaller periods and to accept estimation results as significant, starting from 10 % significance level.

Chapter 4

METHODOLOGY

The literature suggests, that different models can be used to study the determinants of bond yields.

A standard model of yields representation is a linear relationship of the following form:

$$\log yield = f(X) + u \quad (1)$$

where X is a set of characteristics, discussed in the previous chapter.

Such a representation is in line with the commonly used model, originally developed by Edwards (1986) and, among others, applied by Akitoby and Stratmann (2008) to secondary market sovereign bond spreads.

Arghyrou and Kontonikas (2012) and Afonso et al. (2012) proposed a specification to assess potential determinants of sovereign long-term bond spreads that can be written as:

$$spread_t = \alpha + \beta_1 * spread_{t-1} + \beta_2 * vix_t + \beta_3 * ba_t + \beta_4 * balance_t + \beta_5 * debt_t + \beta_6 * q_t + \beta_7 * gind_t + \beta_8 * pc2_t + \gamma_t + \varepsilon_t \text{ , where} \quad (2)$$

$spread_{t-1}$ – lagged value of the spread over the 10Y Germany bonds;

vix_t – S&P 500 implied stock market volatility index

ba_t denotes the 10-year government bond bid-ask spread;

$balance_t$ and $debt_t$ enote the expected fiscal position variables, namely, the expected (one-year ahead) government budget balance-to-GDP ratio and the expected government debt-to-GDP ratio;

q_t is the log of the real effective exchange rate. This variable generally captures credit risks originating from general macroeconomic disequilibrium;

$gind_t$ is the annual growth rate of industrial production. This variable is used as a proxy for the effects of economic growth on spreads;

$pc2_t$ attempts to capture potential heterogeneity between the group of periphery countries and the group of core countries, derived using principal components analysis on government bond yields spreads

In our opinion, the theoretical model by Arghyrou and Kontonikas (2012), Afonso et al. (2012) can be used as a basis for constructing the model, estimating Ukrainian bond yields. It accounts for both macroeconomic fundamental and global trends. At the same time, it is multi-country research and therefore we would like to modify it, corresponding to the aim of our research.

First of all, as mentioned in the introduction, Ukraine is an emerging country with a short history, so the data on bid-ask spread for Ukrainian bonds are quite limited. Being a new lender on the global fixed income market can lead to a relatively higher spread during the first period of issuing bonds.

Also it is obvious that, doing a single-country research, the last term - $pc2_t$ capturing heterogeneity between the group of periphery countries and the group of core countries is not feasible in our particular research.

At the same time, Ukrainian bond spreads are expected to be affected by the global trends on emerging markets fixed income securities. Therefore, we suggest that adding EMBI Sovereign Spread Index be useful in explaining the Ukrainian bonds spreads.

In addition, due to the change in the exchange rate regime (particularly, the implementation of the inflation targeting regime), a current account balance

is not expected to be a representative variable since the fixed exchange rate regime tend to lead to imbalances in trade e.g. overvalued national currency stimulates an increase in import and makes domestic products much more difficult to be exported. Therefore, changes in Ukrainian local currency real exchange rate return is expected to be an informative variable, which pre-determines current account balance.

Since Ukraine is a high-risk country, we tried using Ukrainian 7Y Credit Default Swap to control for the country credit risk. However, we observed very high correlation between swaps rates and bonds yields (0.962). This finding makes sense because credit default swaps are 'insurance' instruments against sovereign default. Therefore, we decided not to include swaps into our empirical specification to avoid the problem of likely endogeneity.

Also, we suggest using general GDP growth rate instead of industrial production growth rate as a proxy for an economic activity since the industry sector accounts for less than 28% of the Ukrainian economy[10], which is close to the world average but still below than in the poorest emerging commodity-dependent countries. However, this variable might have little explanatory power since the State Statistics Service of Ukraine provides information on economic growth rate only on the quarterly basis.

Finally, in order to control for the solvency of Ukraine, we add a quarterly import coverage ratio. As mentioned in the introduction, as for 2015, Ukraine experienced a critical shortage of international reserves, which appeared to be a significant risk for the financial stability of Ukraine. After implementing the inflation targeting regime, which is inherently a floating exchange rate regime, there is no need to spend reserves for supporting the national currency.

[10] Index Mudi. Ukraine Economic Profile - https://www.indexmundi.com/ukraine/economy_profile.html

The suggested model for estimating Ukrainian bond yields, based on Arghyrou and Kontonikas, Afonso et al. (2012) findings, updated by our suggestions and specified for Ukraine, is as follows:

$$yield_t = \alpha + \beta_1 * yields_{t-1} + \beta_2 * EMBIspread_t + \beta_3 * US_{yield_t} + \beta_4 * vix_t + \beta_5 * icoverage_t + \beta_6 * real_t + \beta_7 * debt_t + \beta_8 * gdp_{growth_t} + \beta_9 * IMF + \beta_{10} * ATO + \beta_{11} * IMF + \beta_n commodities\ price\ returns_t + \gamma_t + \varepsilon_t \quad (3)$$

In the model for estimation we will also add commodities price returns, introduced in the data overview chapter and dummy variables, controlling for ATO and IMF.

At this stage we do not specify the exact set of commodities out of top-3 export revenue-generating ones (in formula (3) *n* represents the number of commodities to be included in the OLS-estimation).

Nevertheless, in order to have enough degrees of freedom subject to the available number of observations, we will need to remove the variables, which add little to the explanation of the variance in the dependent variable.

In the next chapter, dedicated to estimation results, we will discuss the motivation, economic intuition, the common sense and the logic, standing behind different model specifications and will choose, explain in more details and identify the most appropriate one.

Also, we will perform two robustness checks. The first one deals with changing the dependent variable (we will estimate the model for Ukrainian bond spreads as well as for yields), while the second one deals with running the basic model on a weekly dataset and checking whether the effects, obtained on weekly dataset have enough in common with ones, obtained on a monthly dataset.

Chapter 5

EMPIRICAL RESULTS

At the first stage of the empirical estimation we will perform a test for stationarity of the dependent and all independent variables. The stationarity is tested using the standard Dickey-Fuller test.

A stochastic process is stationary if its unconditional joint probability distribution does not change over the time. Or, in simpler terms, mean and variance are constant over time.

Stationarity is important for the purposes of the analysis, particularly, for OLS-estimation.

In the initial dataset there is an issue with a crisis period: monthly dataset contains only 9 observations during the crisis (we derived crisis as a period, during which Ukrainian bond yields dynamics trajectory was completely different to one, observed in other emerging markets), and this has two implications:

1. We do not have any opportunities for an appropriate analysis of this period separately, which would be helpful in order to obtain the differences in the level of impact, coming from the Ukrainian bond yields during the period of relative stability and during the crisis period. Moreover, we expect that the dynamics of yields, which was the case in 2015, will not be a persistent one in the future.

2. We do not appreciate splitting the whole dataset due to the limited number of observations. Therefore, even if some errors due to the non-homogeneity of the dataset will appear, they will be included in 5% significance interval (which is common to the literature).

At the second stage we obtain correlation between independent variables. This is important in order to avoid a multicollinearity problem in the final model. The correlation matrix is provided on the Table 4 in Appendix.

The results of the Table 4 in Appendix lead to some findings:

1. Bloomberg economic, financial and political scores are not appeared to be appropriate variables for the model subject to the limited number of unique observations and extreme non-stationarity. Credit rating as a determinant of Ukrainian bond yields was also rejected to be included in the regression for the same reasons, as Bloomberg risk scores.

2. Economic growth rate in Ukraine is also extremely various and (due to the crisis and a rapid fall in 2015-2016) the whole series is non-stationary, whereas, in contrast to the GDP level, the growth rate cannot be constantly increasing or decreasing. From the economic theory, in a steady-state GDP growth level converges to some compound annual growth rate.

3. Exchange rate was found to be non-stationary but such a state is natural, especially for emerging markets, whose national currencies often experience a permanent depreciation. Therefore, we suggest that estimating the model, using exchange rate returns (which is common in the literature) should be appropriate for this research. Moreover, taking into consideration that we rebased the real exchange rate (the beginning of the analyzed period = 100), interpretation of the results in not going to be a tricky thing to explain.

4. Non-stationarity of indebtedness and of the import coverage ratio both appear to be caused by linked events. When the National Bank of Ukraine lost almost all of its reserves (and, therefore, import coverage ratio dropped rapidly) it had no choice but to let the national currency depreciate significantly, which led to the increase in the country's indebtedness level (the largest share of the Ukrainian government debt is denominated in foreign currency).

At the second stage we would like to examine the correlation matrix of our variables, presented in Table 5 in Appendix. From the results of the table we come up with some important findings:

1. VIX Index is fully uncorrelated with the dependent variable (Ukrainian bond yield) thus it does not make sense to include this variable.

2. Corn and wheat price returns are highly correlated (the correlation level is 0.66), because these two goods belong to the same group of cereals. This is in line with what we could see on Figure 10. We suggest using only corn price in the empirical model since corn has a relatively higher share in the total Ukrainian agricultural export, as shown on Figure 9.

3. High correlation between indebtedness and real exchange rate, combined with a non-stationary nature of the real exchange rate leads to the need for using real exchange rate in terms of growth rates.

Taking into consideration the results of the stationarity tests and the correlation analysis, we suggest adjusting the model, specified in the previous chapter in the following way:

$$yield_t = \alpha + \beta_1 * yields_{t-1} + \beta_2 * EMBIspread_t + \beta_3 * US_{yield_t} +$$
$$+\beta_4 * icoverage_t + \beta_5 * real\_return_t + \beta_6 * debt_t +$$
$$\beta_7\, sunoil\_return_t + \beta_8\, corn\_return_t + \beta_9 * IMF + \beta_{10} * ATO + \gamma_t + \varepsilon_t \quad (5),$$

Where:
Yield – Ukrainian bond yields
$Yield_{t-1}$ – lagged value of Ukrainian bond yields
EMBI spread – emerging markets bonds sovereign spread
US yield – US bond yields
Icoverage – import coverage ratio
Real_return – real exchange rate return
Debt – indebtedness, measures as % of GDP

Sunoil_return – sunflower oil price returns
Corn_return – corn price returns
ATO, IMF – dummies for periods of ATO and cooperation with IMF

At the third stage we check the model the residuals of the model for heteroscedasticity, using Breusch-Pagan / Cook-Weisberg test for heteroscedasticity. The results of the test are presented in Table 6. Since we reject the hypothesis of constant variance, all estimations will be with robust error terms.

As it was mentioned in the introduction and as it was shown on a Figure 8, there was a period of time (crisis), when Ukrainian bond yields was very far from one, obtained on other emerging markets. We suppose that there was a structural break. In order to check this, we did a formal Wald test for a structural break (Table 7). The formal test proved our suggestions that the crisis period is a structural break. Given that crisis period cannot be maintained in the long-run (in this case crisis conditions would not be treated as such), for the purposes of doing more precise estimation and getting consistent over time results, we limited the dataset only by non-crisis period.

Our estimation results are presented in Table 3. We estimated one main model and did then two robustness checks – one, dealing with the changing the dependent variable and another, dealing with the estimating the same model on Ukrainian bond yields, on the weekly data.

The optimal number of lags of the dependent variable to be included was observed by the partial autocorrelation function, represented on a Figure 11 (Appendix).

Estimation results contain several important findings.

First of all, external factors are of key importance in terms of determining Ukrainian bond yields. In particular, the EMBI spread is significant at 99%

confidence interval. In addition, the US yield is significant at 98% confidence interval. Coefficient by EMBI spread is 1.87, which represents a higher magnitude of Ukrainian bond yields as compared to other emerging markets, tracked by EMBI Index. The transmission from the U.S. bond yields to Ukrainian bond yields is significantly less – 0.41, which means that changes in the US bond yields are only partially represented in Ukrainian bond yields.

Table 3
OLS-estimation results

Estimator	Yield	p-value	Spread	p-value	Yield_w	p-value
$Yield_{t-1}/Spread_{t-1}$	0.332	0.000	0.354	0.000	0.772	0.000
EMBI spread	1.874	0.000	1.960	0.000	0.723	0.000
US yield	0.406	0.019	X	X	0.132	0.004
Icoverage	-2.003	0.001	-2.279	0.000	-0.661	0.000
Real_return	0.014	0.546	0.014	0.545	0.050	0.126
Debt	-0.012	0.362	-0.023	0.023	-0.004	0.368
Sunoil_return	0.002	0.873	0.001	0.932	1.050	0.155
Corn_return	0.005	0.546	0.005	0.537	-0.351	0.528
ATO	0.771	0.029	0.974	0.003	0.300	0.030
IMF	-1.287	0.000	-1.153	0.000	-0.480	0.000
Constant	2.302	0.041	2.216	0.044	0.489	0.173
Number of observations	76	X	76	X	366	X
Adjusted R-squared	0.87	X	0.88	X	0.93	X

Second, macroeconomic fundamental factors determine Ukrainian bond yields, rather than commodities prices (both corn and sunflower oil price returns are insignificant). In particular, accumulating additional reserves, corresponding to the value of quarterly import, would *ceteris paribus* lower Ukrainian bond yields by 2%. At the same time an indebtedness level is found to be insignificant when estimating yields but significant in the model for spread. And this is the only variable, which effect is not persistent over the

robustness check. Moreover, the sign is counterintuitive. This is an interesting issue, which might be explained by an extra effect of the cooperation with an International Monetary Fund. In addition to the loans, provided by the Fund, the positive signal for international investors leads to the increase in the volumes of debt, which country can borrow. Accumulating relatively cheaper debt may be positively treated by economic agents, which reflects in relatively lower yields.

Third, ATO and IMF dummy variables are significant with expected signs and both statistically significant.

ATO as a war and an additional risk for foreign investors, increase Ukrainian bond yields on average by 0.77%, whereas the cooperation with the International Monetary Fund can be considered by investors treated as a signal that Ukraine is back to the international capital markets (particularly, fixed income market, given that nobody was willing to end Ukraine in the most difficult period in 2015). As for today, Ukraine is no longer on the verge of bankruptcy, which is reflected in lower bond yields by 1.29%.

The results of the first robustness check (substituting yields by spread as a dependent variable) shows the persistence of the obtained results both in terms of the signs of explanatory variables, which are quite similar, and in terms of their significance levels in regards to all variables, except for indebtedness level.

In order to check the appropriateness of the OLS-estimation, we made up several post-estimation tests.

First, there is no multicollinearity in the model, which we can see from the results of the Appendix, Table 5 (correlation matrix), none of the regressors have correlation between each other at the level, higher than 0.55 in absolute level. Also, the highest correlation between the dependent variable (yield) and

independent variable is - 0.63, particularly with indebtess (debt-to-GDP ratio, %).

We can also check errors for serial correlation. The results of the tests for white noise show that there is no serial correlation in the errors and are presented in Table 7 in Appendix.

Finally, we checked the model for the omitted variable, using Ramsey test and failed to reject the hypothesis that the model has no omitted variables. The results are represented in the Appendix D (Table 8). As a result of the test we failed to reject the hypothesis that there are no omitted variables in the model therefore we assume that the most important factors were considered in the model.

At the same time, the model can suffer from endogeneity, which is very common for such types of research, where a lot of macro variables are used as controls. The opportunities for getting rid of endogeneity are limited by the available dataset, single-country study etc. and may become an issue to deal with in further research.

The results of this research provide potential investors with an important insight that even though Ukraine is a risky country with a commodity-oriented economy and that Ukrainian securities are characterized by historically high volatility, the attractiveness of making investment in Ukrainian fixed income securities is closely related to the situation in other emerging markets. Thus, shocks in the commodity markets should not scare investors and prevent them from buying Ukrainian bonds.

Chapter 6

CONCLUSIONS

The study investigates the link between the dynamics of key Ukrainian agricultural commodity prices returns and sovereign bond yields.

We consider monthly data on price changes on sunflower oil, wheat and corn as key independent variables and 8-year Ukrainian bond yields as a dependent variable. The sample covers around 7 years of observations – from M2 2011 to M4 2018. We checked the presence of the effects by running an OLS regression.

We controlled for both international and domestic condition, with the help of such variables as the EMBI Index, VIX Index (Options Volatility Index), U.S. Treasury bond yields, indebtedness (debt-to-GDP ratio), import coverage ratio (the ratio between the National Bank of Ukraine reserves and the quarterly import), GDP growth.

We controlled for bot specific circumstances, such as ATO in Donbass, IMF credit line program for Ukraine, implementation of inflation targeting regime by the National Bank of Ukraine.

We find that the key factors, affecting Ukrainian bond yields are related to the international conditions (general interest of the global investor towards emerging markets, expressed by emerging markets bonds spread) and to the macroeconomic conditions of Ukraine (particularly, import coverage ratio as a measure of sufficiency of reserves), level of indebtedness etc.

Finally, our baseline regression did not detect statistically significant relation between agricultural commodity price and Ukrainian sovereign bond yields.

Results of the research touch on raise some important policy implication.

The general one is that the while – positive dynamics of world prices for the key Ukrainian agricultural commodities can potentially benefit the economy in other ways, they have insignificant effects on government bond yields. Therefore, while issuing new debt, timing the market in this sense will bring no significant results.

Instead, the Ministry of Finance of Ukraine should focus on trends in the international emerging countries fixed income securities market.

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APPENDIX

Table 4. Test for stationarity

Estimator	The whole period		Non-crisis period	
	Optimal number of lags	P-value	Optimal number of lags	P-value
Yield	4	0.027	4	0.000
Spread	4	0.029	4	0.000
U.S. yield	1	0.031	1	0.049
EMBI Index	1	0.043	1	0.025
VIX	1	0.012	1	0.025
Real exchange rate	3	0.592	4	0.830
Real exchange rate return	2	0.000	3	0.001
Sunflower oil return	1	0.000	1	0.000
Wheat return	2	0.000	0	0.000
Corn return	1	0.000	1	0.000
Bloomberg financial score	4	0.087	4	0.061
Bloomberg political score	4	0.876	4	0.900
Bloomberg economic score	4	0.259	4	0.329
Current account balance	2	0.818	2	0.688
Indebtedness	2	0.279	2	0.396
Import coverage	1	0.184	1	0.393
Emerging markets average yield	1	0.136	1	0.114
GDP growth	4	0.289	4	0.910

Table 5. Correlation matrix

Variable	1	2	3	4	5	6	7	8	9	10	11	12
Yield (1)	1											
Spread (2)	0.99	1										
US_yield (3)	-0.09	-0.20	1									
Emerging markets spread (4)	0.52	0.55	-0.28	1								
VIX (5)	0.00	0.54	-0.11	0.26	1							
Real exchange rate (6)	-0.38	-0.37	-0.01	-0.34	0.44	1						
Real exchange rate return (7)	0.17	0.17	-0.04	0.04	0.05	0.12	1					
Sunflower oil return (8)	0.12	0.13	-0.11	0.17	0.14	0.07	-0.13	1				
Corn return (9)	0.02	0.02	-0.06	0.03	0.00	0.01	-0.06	0.17	1			
Wheat return (10)	0.00	0.01	-0.07	0.07	0.05	0.04	-0.02	0.04	0.66	1		
Indebtedness (11)	0.35	0.34	0.03	0.51	-0.47	-0.89	0.02	-0.07	-0.01	-0.02	1	
Import coverage ratio (12)	-0.63	-0.64	0.11	-0.24	0.37	0.46	0.08	-0.01	0.02	-0.02	-0.44	1

Table 6. Test for heteroscedasticity

Breusch-Pagan / Cook-Weisberg test for heteroscedasticity
Ho: Constant variance
Variables: fitted values of yield
chi2(1) = 90.27
Prob > chi2 = 0.00

Table 7. Wald test for structural break

Ho: No structural break	
chi2(9) = 58.87	chi2(9) = 53.23
Prob > chi2 = 0.00	Prob > chi2 = 0.00
Date: 2014m12	Date: 2015m9

Table 8. Test for serial correlation

Portmanteau test for white noise
Ho: No serial correlation
Portmanteau (Q) statistic = 7.53
Prob > chi2(4) = 0.11

Table 9.
Test for omitted variable

Ramsey RESET test using powers of the fitted values of yield
Ho: model has no omitted variables
F(3, 62) = 0.33
Prob > F = 0.81

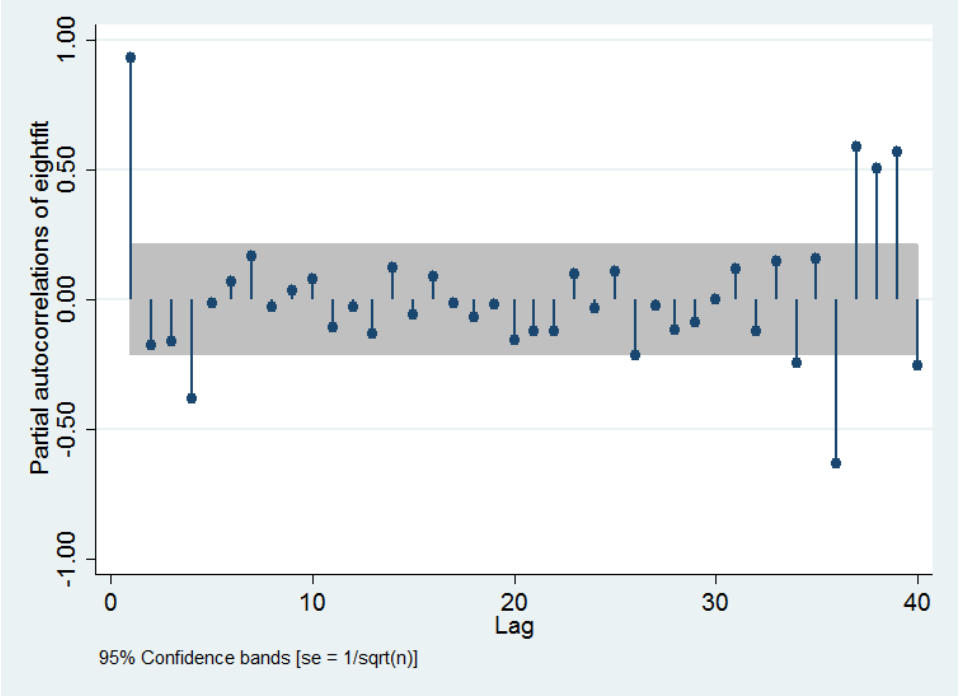

Figure 11. Partial autocorrelation function for Ukrainian bond yield