S.V. Leonov, O.V. Isaieva

DETERMINANTS OF GOVERNMENT BOND SPREADS IN UKRAINE AND NEW EU MEMBERS

The article deals with the problems of government bond spread forming as an important indicator of country's financial market vulnerability. The key determinants of its exposure in new EU members and Ukraine are investigated, and their comparison is done. Using the PCA method an adequate three-component model, which includes all initial factors and describes the changes in government bond spread of Ukraine, was built

Keyword: government bond yield, bond yield spread, determinants of bond yield spread, financial market, new EU members.

С.В. Лєонов, О.В. Ісаєва

ДЕТЕРМІНАНТИ СПРЕДУ ДОХІДНОСТІ ДЕРЖАВНИХ ОБЛІГАЦІЙ В УКРАЇНІ ТА НОВИХ ЧЛЕНАХ ЄС

У статті розглядаються проблеми формування спреду державних облігацій як важливого показника вразливості фінансового ринку країни. Досліджено ключові детермінанти впливу на нього у країнах, що є новими членами ЄС та в Україні, здійснено їх порівняння. За допомогою методу головних компонент було побудовано адекватну трьохкомпонентну модель, що включає усі початкові фактори й описує зміни спреду державних облігацій України.

Ключові слова: дохідність державних облігацій, спред дохідності облігацій, детермінанти спреду дохідності облігацій, фінансовий ринок, нові члени ЄС.

С.В. Лєонов, Е.В. Исаева

ДЕТЕРМИНАНТЫ СПРЕДА ДОХОДНОСТИ ГОСУДАРСТВЕННЫХ ОБЛИГАЦИЙ В УКРАИНЕ И НОВЫХ ЧЛЕНАХ ЕС

В статье рассматриваются проблемы формирования спреда государственных облигаций как важного показателя уязвимости финансового рынка страны. Исследованы ключевые детерминанты влияния на него в странах, являющихся новыми членами ЕС и в Украине, осуществлено их сравнение. С помощью метода главных компонент было построено адекватную трехкомпонентную модель, которая включает все исходные факторы и описывает изменения спреда государственных облигаций Украины.

Ключевые слова: доходность государственных облигаций, спред доходности облигаций, детерминанты спреда доходности облигаций, финансовый рынок, новые члены ЕС.

Introduction. Modern economic development of Ukraine requires efficiently organized financial market, which will provide requirements in investments by accumulation temporally free financial resources. In terms of return on investment estimates the yield of government securities, such as bonds, is very important for investors. This study identifies the necessity of research of government bond spreads both in Ukraine and in other countries, the level of which it seeks to achieve. A construction of the proper model and its practical using is appropriate for prognostication and providing purposeful management demand of government bonds.

Analysis of the research and publications. Research of government bonds yield is reflected in many scientific studies by I. Alexopoulou (2009), I. Bunda (2009), F. Comelli (2012), A. Ferrando (2009), G. Ferrucci (2003), J. von Hagen (2010), H. G. Min (1998), L. Schuknecht (2010), G. Wolswijk (2010) and others. However, despite the significant amount of the research, many practical aspects regarding determinants of influence on government bond yield spreads are not fully disclosed. And this limits effective forecasting.

Task raising. The purpose of this article is to research main determinants of government bond yield spreads in Ukraine and new EU members and to build a model that describes the factors influencing the spread in the conditions of Ukrainian financial market.

Results. For emerging economies yield of government bonds is an important indicator of financial vulnerability. It is generally used as a measure of market default risk perception and assessment of external financing conditions (Min, 1998).

Yield spread shows premium, required by investors, to hold securities, issued by borrowers of emerging markets and have higher default risk than in developed economies. In fact, this premium is aimed to compensate bondholders for the risks they are exposed to: credit risk, market risk and liquidity risk, as well as other factors such as transaction costs and market behavior (Comelli, 2012).

In order to explain the determinants of long-term bond yield spread in Ukraine we have to build an empirical model that links the spread with a set of specific for a country factors. The basis of assessment is the understanding that the fair value of

bonds is a function of the default probability and the recovery rate in case of default. In turn, the probability of default associated with a set of macro-prudential indicators that affect the solvency and liquidity of the country (Ferrucci, 2003).

There is a far enough of dynamic models in economic literature. In our study the most appropriate will be PMG (pooled mean group technique), developed by Pesaran, Shin and Smith in 1999, which allows to analyze small group of countries, showing general lines and taking into account differences (Alexopoulou, Bunda, Ferrando, 2009).

According to eurointegration priority of financial and economic development of Ukraine, we consider as appropriate to compare it with a group of EU members, and in particular the new member states (Czech Republic, Poland, Lithuania, Latvia, Slovakia, Hungary, Bulgaria and Romania). Eurointegration of financial markets for Ukraine means unification, rapprochement and gradual association of subsystems of domestic fund market with the analogical subsystems of fund markets of European countries within the limits of regional economic association – EU.

Explanatory variables used in the analysis of government bond spreads were selected on the basis of convergence criteria and the existing literature on the determinants of spread in various countries, in particular research of European Central Bank specialists I. Alexopoulou, I. Bunda and A. Ferrando (2009).

Variables are grouped according to their ability to explain the differences between financial, environmental conditions and conditions of the money market, as well as nominal convergence and international openness (Schuknecht, von Hagen, Wolswijk, 2010). More specifically, we consider the variables that belong to the following groups:
- fiscal fundamentals;
- external position;
- country openness;
- inflation rate;
- state of real convergence;
- exchange rate level;

- money market rates;

- common (euro area) factor.

For the new EU members an additional factor – general factor of euro area is entered in analysis. It is related to the necessity to take into account global financial terms which can affect the spreads on government bonds. As the common factor we consider the volatility of the stock market, which can be measured by the price index stocks. Sensitivity of government bond spreads of new EU members to changes in the euro area capital markets reflects the redistribution of funds between the portfolio of bonds, stocks and money (Alexopoulou, Bunda, Ferrando, 2009).

The dependent variable is given by monthly average yield spread of long-term government bonds, calculated in relation to the average for euro area, calculated Eurosystem to assess the stability of convergence process of member countries (Figure 1).
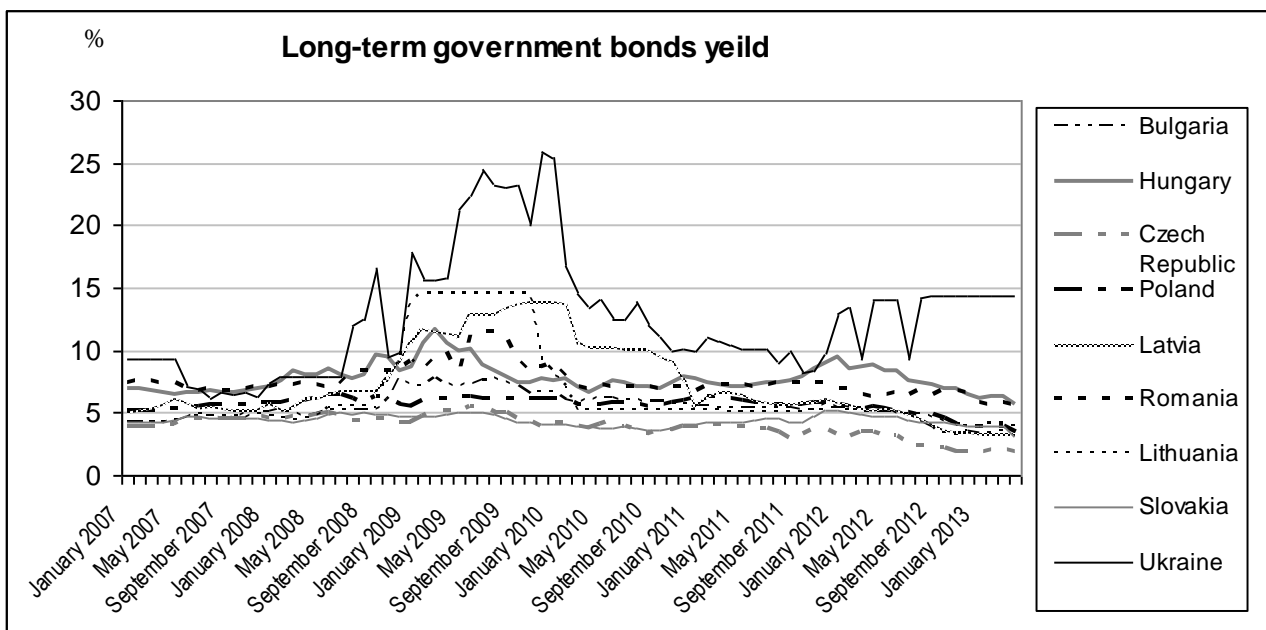
Figure 1 – Graph of long-term government bonds yields of new EU members and Ukraine in 2007 – April 2013. *Based on the data from ECB statistics, Eurostat statistics and annual report of the National bank of Ukraine*

As you can see from the figure, almost throughout the analyzed period the

yield of Ukrainian government bonds was much higher than the yield of bonds in all analyzed countries. The only exception was in 2008, when it approached the level of new EU members with a high yield (Hungary, Romania). However, starting from 2009 the gap began to increase, reaching unprecedented level in late 2009 and early 2010, when the domestic bond yields the record value – over 25%, while the highest yield was in Lithuania and Latvia and it did not exceed 14.5%. The lowest yield among European countries observed in the Czech Republic and Slovakia.

Growth rates of return have been accelerated since 2008, due to the financial crisis spread. The most affected by it were the countries that had high levels of volatility in returns in the past. In general from 2011 a downward trend in overall yield in the EU new members takes place, which is related to stabilizing of general economic situation and risk level reduction. At the same time the index is unstable and prone to sudden fluctuations in Ukraine. It should be noted that since the end of 2012 government bonds issuing did not take place in Ukraine.

Eurobond yield tends to decrease during the analyzed period: from 4.1% in early 2007 to 2.86% in April 2013, which is the positive phenomenon which testifies to stability of the financial market of the EU.

Figure 2 shows the yield spreads of long-term government bonds of new EU members and Ukraine. Spreads in 8 EU countries is characterized by significant heterogeneity. Some countries, such as Latvia, Lithuania and Romania in 2009-2010 had a historical maximum of this index, while in others there has been a gradual reduction (Czech Republic, Poland and Slovakia). In the first such changes reflect both the certain worsening of economic aspects and external terms, and difficulties in providing funding requirements, which is a side effect of harsh financing conditions in the euro area.

As you can see, the closest to the index on the euro area is Czech Republic and also Slovakia, where a level of securities yield is often lower than the average level. Lithuania and Latvia have high levels of rejection. At the certain unipath of changes obvious differences between countries are connected with perception of credit risk and domestic macroeconomic policy. In Ukraine the general direction of changes

coincides from 8 other countries, however the level of spread is several times higher.
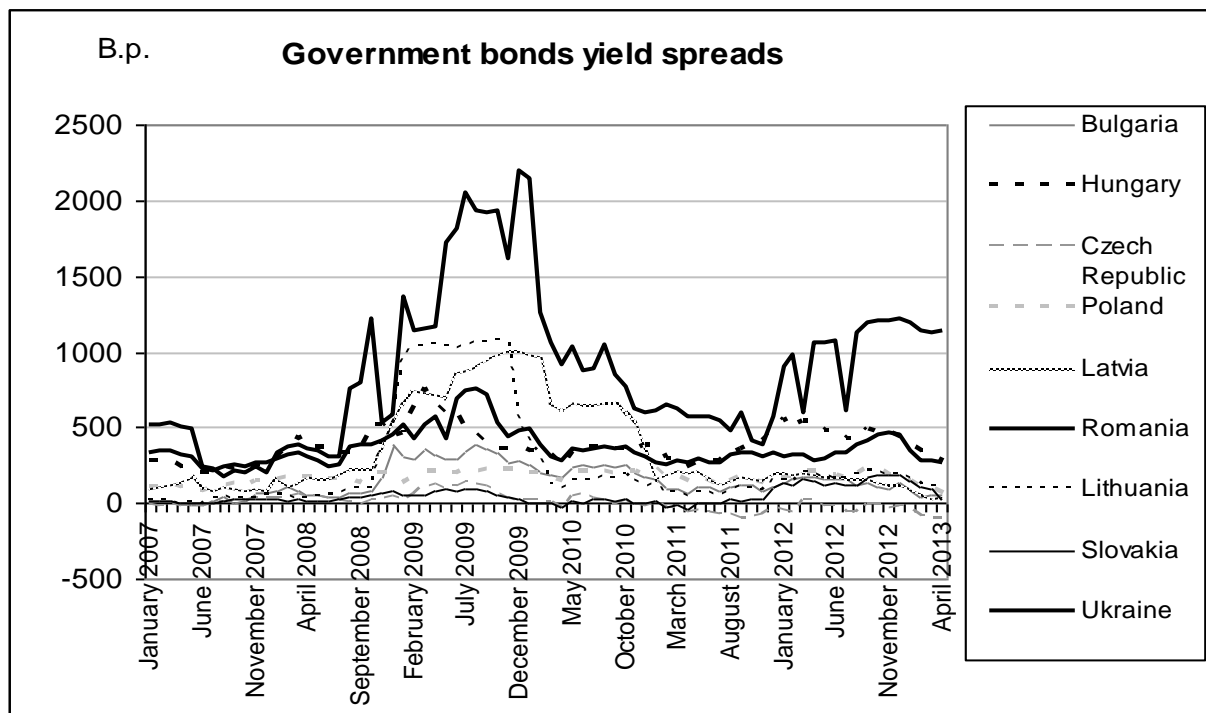

Figure 2 – Spreads of long-term government bond yields in new EU members and Ukraine in 2007 – April 2013. *Based on the data from ECB statistics, Eurostat statistics and annual report of the National bank of Ukraine*

It's worth to analyze, whether the offered in literature factors influence yield spreads on practice by using the tools of correlation-regression analysis. The results of research of potential determinants of government bond spreads significance in 8 new EU members are presented in Table 1. The values of coefficient correlations, which exceed critical and confirm the presence of connection between indexes, are marked by a semi-bold font.

Note that this list of factors was formulated before the financial crisis (until 2008), but after the crisis and scale changes in a world economy some factors began to lose the value. As evidently from a table, not meaningful for any country is such factor as deficit or surplus of the general government to GDP. Ponderable are such factors as:

Table 1 – The results of analysis of pair correlation between the yield of government bonds and the factors of influence in the new EU members. *Calculated by authors*

Countries / Factors	Bulgaria	Hungary	Czech Republic	Poland	Latvia	Romania	Lithuania	Slovakia
External debt to GDP	**0.71**	**-0.56**	**-0.79**	-0.03	**0.81**	-0.06	**0.54**	0.09
Spread of short-term interest rates	**0.84**	**0.82**	**0.40**	**0.88**	**0.77**	**0.70**	**0.43**	-0.07
Trade openness	**-0.90**	**-0.75**	**-0.76**	-0.30	**-0.78**	**-0.88**	**-0.50**	**-0.68**
Consolidated gross government debt to GDP	-0.30	-0.37	-0.28	-0.09	0.26	0.04	-0.01	**0.89**
Deficit / surplus of the general government to GDP	0.09	-0.26	-0.29	0.19	-0.27	0.01	0.01	0.37
Current account to GDP	**0.53**	0.38	0.35	**0.67**	**0.85**	**0.51**	**0.71**	0.11
Government interest payments	-0.02	**-0.66**	**0.89**	**0.53**	**-0.48**	-0.02	**-0.63**	**-0.47**
Per capita income (ln)	0.37	**0.44**	-0.20	**0.55**	**-0.44**	0.10	**-0.46**	-0.09
Inflation rate	**-0.57**	**-0.53**	-0.15	**0.41**	**-0.51**	-0.03	-0.16	0.26
Exchange rate	0.00	**0.73**	0.38	**0.55**	**0.70**	**0.43**	0.00	0.00
Stock market volatility	0.07	**0.46**	0.18	0.22	**0.44**	0.30	**0.40**	-0.21

- spread of short-term interest rates (in 7 countries);

- trade openness (in 7 countries);

- government interest payments (in 6 countries);

- external debt to GDP (in 5 countries);

- current account to GDP (in 5 countries);

- per capita income (in 4 countries);

- inflation rate (in 4 countries);

- exchange rate (in 4 countries);

- stock market volatility (in 3 countries);

- consolidated gross government debt to GDP (in 1 country).

Liquidity conditions at the money market, reflected in the short-term spread of interest rates, play an important role in the dynamics of bond spread. Coefficients are positive and meaningful for all countries from the group, except Slovakia.

Trade openness plays an important role as a factor of influence on the yield of

government bonds in Bulgaria, Hungary, Czech Republic, Latvia, Lithuania, Slovakia and Romania. This suggests that increased trade integration helped to facilitate access to financing on the markets of state bonds for the new EU members. At the same time enhanceable influence of capital flows, which accompanied the trade openness of new EU members, tended to increase their sovereign risks (particularly in Poland).

Although it is generally confirmed that greater trade openness implies that the country has better ability to finance its debts in the future through active balance of trade. Meaningful coefficients for current account to GDP in a number of countries (Bulgaria, Poland, Latvia, Lithuania, Romania) testifies that the openness of country is associated with a negative current account and may actually increase long-term profitability.

Changes in per capita income may affect the assessment of the market for public bonds in the short term, mainly in Poland, where the correlation coefficient has the highest statistical significance, and to a lesser extent in Hungary, Latvia and Lithuania. The analysis results show that the improvement in the real convergence during the period partially explain the dynamics of spread of these countries.

The inflation rate to a certain extent influences solvency of governments in Bulgaria, Hungary, Latvia and Poland. In the last positive coefficient can be interpreted so that the financial markets believe that target inflation and monetary policy of central bank are very important determinants of government bonds spreads. Inflationary changes in Latvia, Hungary and Bulgaria have an opposite influence on spreads in the short term, despite the fact that for new EU members, which target exchange rate, inflation is seen primarily as a structural phenomenon.

As expected, the exchange rate has positive coefficients for all countries and they are statistically significant for Hungary, Poland, Latvia and Romania.

Among the financial variables external debt to GDP ratio appeared the most influential factor. It plays an important role in the change of government bonds spread for Bulgaria, Hungary, Czech republic, Latvia, Lithuania. At the same time, consolidated gross government debt to GDP ratio has an impact on output indicators only in Slovakia. Government interest payments had a significant effect on the yield

of government bonds in Hungary, Czech Republic, Poland, Slovakia, Lithuania and Latvia, although this effect has been mixed.

The common factor, reflected in stock market volatility, to some extent affect bond spreads, which is showed by positive and statistically meaningful coefficients for Hungary, Latvia and Lithuania. This indicates the presence of possible discrimination of investors in relation to bonds, issued by new EU members. The highest positive coefficient indicates less risky bonds. This short-term function with unsteady influence in a long-term prospect can testify that sovereign spreads may have different resistance to common external factors both in long-term and in a short-term prospect (Alexopoulou, Bunda, Ferrando, 2009).

Similarly we'll verify whether these factors have an effect on the yield of Ukrainian government bonds (Table 2). Most of the factors, that affect the yield of government bonds in new EU members, are important for Ukraine, in particular 8 factors: external debt to GDP, spread of short-term interest rates, consolidated government debt to GDP, deficit / surplus of the general government to GDP, current account to GDP, government interest payments, per capita income and exchange rate.

Table 2 – The estimation results of factor influence on the yield of Ukrainian government bonds. *Calculated by authors*

Factors	Correlation coefficient	t-Student test
External debt to GDP	**0.70**	1.71
Spread of short-term interest rates	**0.97**	**6.60**
Trade openness	-0.35	-0.65
Consolidated gross government debt to GDP	**0.56**	1.17
Deficit / surplus of the general government to GDP	**-0.83**	**-2.61**
Current account to GDP	**0.73**	1.84
Government interest payments	**0.84**	**2.67**
Per capita income (ln)	**-0.88**	**-3.34**
Inflation rate	-0.29	-0.61
Exchange rate	**0.66**	1.74
Stock market volatility	0.08	0.16

Four factors among the listed render especially considerable influence:

- spread of short-term interest rates;

- deficit / surplus of the general government to GDP;

- government interest payments;

- per capita income.

Unlike 8 other countries, where none was found effects of such factor, as the deficit / surplus of the general government to GDP, in Ukraine it was significant. While trade openness, crucial for new EU members, does not affect Ukrainian government bonds. However, the majority of determinants show unity.

As the number of factors that affect government bond yield spreads in Ukraine is 11, and the number of periods with available evidence is 5, we can not make regression analysis and construct adequate model directly, because the rule that says that a number of factors can not exceed a number of observations minus 1, is violated.

Therefore, to solve this problem we use the method of principal components, which allows to reduce significantly the dimensionality of data almost without losing information. All variables are taken into account, nothing is discarded. Determined by the primary factors new factors – the principal components – the unknown hidden variables that manage the construction of information. For this purpose will use special instrument Excel Xlstat.

Initial data for the analysis are presented in Table 3. The value of all factors are statistically comparable, a unit is percent.

Table 3 – Initial data for the factors of influence on government bonds yield spread of Ukraine. *Based on the data from annual report of the National bank of Ukraine*

Factors / Years	2007	2008	2009	2010	2011
External debt to GDP (ExtDebt)	54.9	54.3	84.7	85.1	81.4
Spread of short-term interest rates (ShortIRSpread)	3.4	7.0	13.1	9.6	6.6
Trade openness (TradeOp)	95.0	102.0	94.0	105.0	113.0
Consolidated gross government debt to GDP (GovDebt)	12.3	13.8	24.9	29.9	27.1
Deficit / surplus of the general government to GDP (FiscalBalance)	-0.9	-1.5	-5.6	-6.5	-2.3
Current account to GDP (CA)	-3.7	-7.1	-1.5	-2.2	-6.2
Government interest payments (IntPaym)	17.8	20.0	39.6	39.0	30.8
Per capita income (ln) (Income)	6.9	7.3	6.2	6.6	7.0
Inflation rate (Inflation)	16.6	22.3	12.3	9.1	4.6
Exchange rate (ExchRate)	109.2	121.6	171.5	166.2	174.7
Stock market volatility (EAEquityVola)	112.2	-8.2	31.1	53.8	-36.3

It should be noted that the data contain undesirable component that is called noise. In many cases noise is a piece of data that does not contain the required information. The noise and redundancy of data must occur through the correlations between variables. So the next step of analysis is the calculation of Pearson correlation coefficients of all factors that have an impact on government bonds yield spread (Table 4).

Table 4 – The correlation matrix for the factors of influence on government bonds yield spread of Ukraine. *Calculated by Xlstat*

Variables	Gov Debt	Fiscal Balance	CA	Int Paym	Ext Debt	Income	Exch Rate	Short IR Spread	Trade Op	Inflation	EAEquity Vola
Gov Debt	1	-0.802	0.414	0.918	0.971	-0.494	0.953	0.621	0.496	-0.855	-0.022
Fiscal Balance	-0.802	1	-0.753	-0.941	-0.832	0.787	-0.726	-0.848	0.037	0.451	-0.200
CA	0.414	-0.753	1	0.651	0.539	-0.955	0.343	0.575	-0.538	-0.271	0.742
IntPaym	0.918	-0.941	0.651	1	0.963	-0.757	0.909	0.857	0.137	-0.663	0.080
ExtDebt	0.971	-0.832	0.539	0.963	1	-0.651	0.971	0.721	0.322	-0.836	0.059
Income	-0.494	0.787	-0.955	-0.757	-0.651	1	-0.505	-0.744	0.501	0.327	-0.559
Exch Rate	0.953	-0.726	0.343	0.909	0.971	-0.505	1	0.703	0.451	-0.830	-0.159
Short IRSpread	0.621	-0.848	0.575	0.857	0.721	-0.744	0.703	1	-0.176	-0.234	-0.120
Trade Op	0.496	0.037	-0.538	0.137	0.322	0.501	0.451	-0.176	1	-0.583	-0.528
Inflation	-0.855	0.451	-0.271	-0.663	-0.836	0.327	-0.830	-0.234	-0.583	1	-0.137
EAEquity Vola	-0.022	-0.200	0.742	0.080	0.059	-0.559	-0.159	-0.120	-0.528	-0.137	1

As the table shows, the degree of correlation between plenty of variables is high, especially in the group of fiscal variables (external debt, government debt, government interest payments, budget deficit or surplus). Only the factor stock market volatility is less connected with others.

The method of principal components is iteration procedure, where new components are added consistently, one by one. It is important here to set their correct number, because with few components description of process will be incomplete, and with surplus we'll get an overvalue and model noise rather than meaningful information (Pomerantsev, 2008).

The value of new components for government bonds yield spread of Ukraine and their load are presented in Table 5.

Table 5 – Principal components for the government bonds yield spread of Ukraine and their load. *Calculated by Xlstat*

	F1	F2	F3	F4
Eigenvalue	6.774	2.859	1.143	0.224
Variability (%)	61.585	25.989	10.392	2.034
Cumulative %	61.585	87.573	97.966	100.000

The program has made data grouping for four components (F1 – F4), which explain 100% of initial variation. For the choice of components number we will use the graph of explained dispersion depending on the number of principal components (Figure 3).
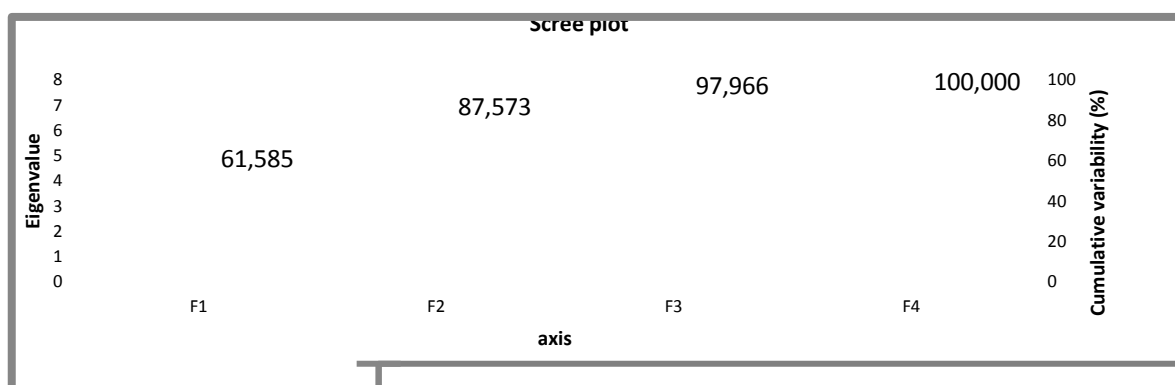
Figure 3 – The load on the principal components and explained dispersion depending on the number of components. *Calculated by Xlstat*

Figure 3 shows that the correct number of principal components is three, because three components explain 98% of initial variation, thus component F1 explains 61.6% of changes, F2 – about 26% and F3 – 10.4% (at 5% possible error).

The equations of principal components based on the estimated by program factor loadings are:

F1 = 0.353GovDebt − 0.354FiscalBalance + 0.269CA + 0.381IntPaym + 0.374ExtDebt − 0.304Income + 0.347ExchRate + 0.310ShortIRSpread + 0.046TradeOp − 0.276Inflation + 0.070EAEquityVola

F2 = 0.215GovDebt + 0.099FiscalBalance − 0.411CA + 0.023IntPaym + 0.126ExtDebt + 0.351Income + 0.234ExchRate − 0.086ShortIRSpread + 0.565TradeOp − 0.256Inflation − 0.434EAEquityVola

F3 = 0.098GovDebt + 0.163FiscalBalance + 0.143CA − 0.109IntPaym + 0.060ExtDebt + 0.016Income − 0.034ExchRate − 0.532ShortIRSpread + 0.200TradeOp − 0.483Inflation + 0.608EAEquityVola

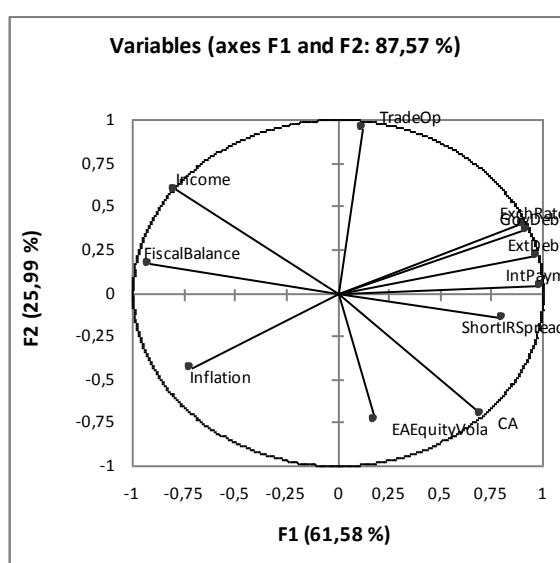Graphically the distribution of initial factors between principal components is shown on Figure 4.

Figure 4 – Distribution of factors between principal components. *Calculated by Xlstat*

Next we will find the value of principal components for the analyzed period for the multiple regression construction (Table 6).

Table 6 – Values of principal components and government bonds yield spread of Ukraine in 2007-2011. *Calculated by authors*

Government bonds spread	F1	F2	F3
338	75.51	39.75	75.69
526	66.35	130.98	-46.98
1667	121.94	94.57	21.13
1006	123.71	92.27	41.07
550	112.78	140.24	-8.13

The construction of mathematical model based on multiple regression analysis by Excel is the following:

y = 1765 + 34.45F1 − 38.62F2 − 33.24F3

This linear dependence between government bonds yield spread of Ukraine and the principal components, based on the 11 macro-prudential factors, makes it possible to forecast changes in yield spreads in the future. The model is adequate, as its coefficient of determination is 0.99.

Conclusions. We have analyzed the determinants of yield spread of long-term government bonds in 8 countries, which are new EU members, and Ukraine. It was found out that in modern conditions after the global financial crisis spread is affected by 10 key factors related to fiscal and external conditions of countries, money market conditions, as well as their degree of convergence and international openness. Carrying out verification of their meaningfulness for Ukraine, we came to the conclusion, that majority of analyzed factors are meaningful. As a dimension of the available data did not allow to carry out regression analysis directly, we used the method of principal components for the construction of three-component model, which describes the changes of government bonds spread of Ukraine. The model includes all initial factors, is adequate and can be used in practice to forecast government bonds yield spread of Ukraine.

References:

Померанцев, А. Метод главных компонент (PCA) // www.chemometrics.ru/materials/textbooks/pca.htm.

Річний звіт НБУ за 2011 рік // www.bank.gov.ua/doccatalog/document?id=121938.

Alexopoulou, I., Bunda, I., Ferrando, A. (2009). Determinants of government bond spreads in new EU countries. European Central Bank Working Paper N1093/September 2009.

Comelli, F. (2012). Emerging Market Sovereign Bond Spreads: Estimation and Back-testing. IMF Working Paper WP/12/212.

ECB: Statistics // www.ecb.int/stats/html/index.en.html.

Eurostat   Statistics   //
epp.eurostat.ec.europa.eu/portal/page/portal/statistics/themes.

Ferrucci, G. (2003). Empirical determinants of emerging market economies' sovereign bond spreads. Bank of England Working Paper no.205.

Indicators // data.worldbank.org/indicator.

Min, H. G. (1998). Determinants of Emerging Market Bond Spread: Do Economic Fundamentals Matter. World Bank Policy Research Working Paper No. 1899.

Schuknecht, L., von Hagen, J., Wolswijk, G. (2010). Government bond risk in the EU revisited. The impact of financial crisis. European Central Bank Working Paper N1152/February 2010.