

Sergii V. Leonov¹, Olena V. Isaieva²

DETERMINANTS OF GOVERNMENT BOND SPREADS IN UKRAINE AND NEW EU MEMBERS

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

Keyword: government bond yield; bond yield spread; financial market; new EU members.

Сергій В. Леонов, Олена В. Ісаєва

ДЕТЕРМІНАНТИ СПРЕДУ ДОХІДНОСТІ ДЕРЖАВНИХ ОБЛІГАЦІЙ В УКРАЇНІ ТА НОВИХ ЧЛЕНІВ ЄС

У статті розглянуто 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 побудовано адекватну трьохкомпонентну модель, що включає усі початкові фактори й описує зміни спреду державних облігацій України.

Ключові слова: дохідність державних облігацій; спред дохідності облігацій; фінансовий ринок; нові члени ЄС.

Рис. 4. Табл. 6. Літ. 10.

Сергей В. Леонов, Елена В. Исаева

ДЕТЕРМИНАНТЫ СПРЕДА ДОХОДНОСТИ ГОСУДАРСТВЕННЫХ ОБЛИГАЦИЙ В УКРАИНЕ И НОВЫХ ЧЛЕНОВ ЕС

В статье рассмотрены 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 построена адекватная трехкомпонентная модель, которая включает все исходные факторы и описывает изменения спреда государственных облигаций Украины.

Ключевые слова: доходность государственных облигаций; спред доходности облигаций; финансовый рынок; новые члены ЕС.

Introduction

Current economic development of Ukraine requires efficiently organized financial market, which will provide requirements in investments by accumulation of temporarily 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 need for research on government bond spreads, both in Ukraine and in other countries. The construction of a proper model and its practical use is appropriate for forecasting and purposeful management demands.

Research and publications on the issue analysis

Research of government bonds yields is reflected in many scientific studies by I. Alexopoulou, I. Bunda and A. Ferrando (2009), F. Comelli (2012), G. Ferrucci

¹ Ukrainian Academy of Banking of the National Bank of Ukraine, Sumy, Ukraine.

² Ukrainian Academy of Banking of the National Bank of Ukraine, Sumy, Ukraine.

(2003), L. Schuknecht, J. von Hagen and G. Wolswijk (2010), H.G. Min (1998) and others. However, despite the significant amount of the research, many practical aspects regarding the determinants of influence on government bond yield spreads are not fully disclosed. And this limits effective forecasting.

The research object

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.

Key research findings

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).

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 country specific factors. The basis for 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 macroprudential indicators that affect solvency and liquidity of a country (Ferrucci, 2003).

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

According to the Eurointegration priority of financial and economic development of Ukraine, we consider as appropriate to compare it with a group of the 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 their counterparts in European countries within the limits of regional economic association – the 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 the European Central Bank specialists I. Alexopoulou, I. Bunda and A. Ferrando (2009).

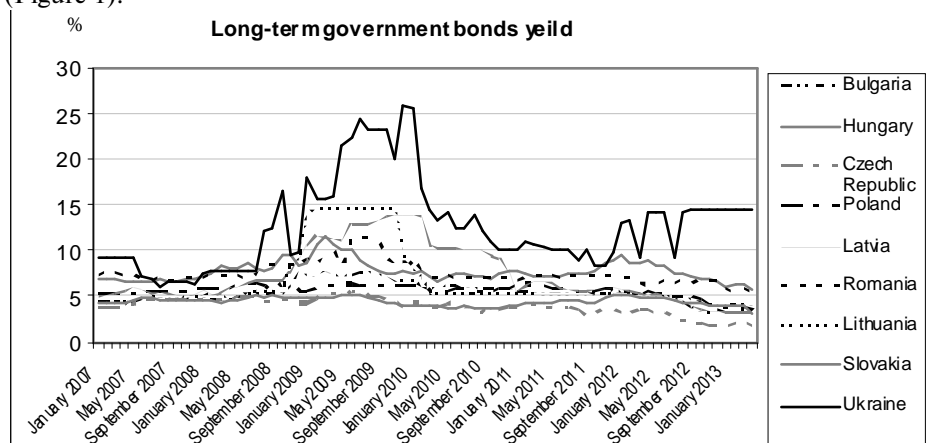
Variables are grouped by their ability to explain differences between financial, environmental conditions and conditions of the money market, as well as nominal convergence and international openness (Schuknecht, von Hagen, Wolswijk, 2010). More specifically, we consider the variables that belong to the following groups:

- fiscal fundamentals;
- external position;
- country openness;

- inflation rate;
- state of real convergence;
- exchange rate level;
- money market rates;
- common (the euro zone) factor.

For the new EU members an additional indicator – general factor of the euro zone is added to the analysis. It refers 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 the euro zone, calculated by the Eurosystem to assess the stability of convergence process of member countries (Figure 1).



Source: Based on the data from ECB statistics, Eurostat statistics and the annual reports of the National Bank of Ukraine.

Figure 1. Long-term government bonds yields of new EU members and Ukraine in 2007 – April 2013

As we can see from Figure 1, almost throughout the analyzed period the yield of Ukrainian government bonds was much higher than the yield of bonds in all other analyzed countries. The only exception was in 2008, when it approached the level of the new EU members with a high yield (Hungary, Romania). However, starting from 2009 the gap began to increase, reaching the unprecedented level in late 2009 and early 2010, when the domestic bond yields reached the record value – over 25%, while the highest yield in Lithuania and Latvia did not exceed 14.5%. The lowest yield among European countries was observed in Czech Republic and Slovakia.

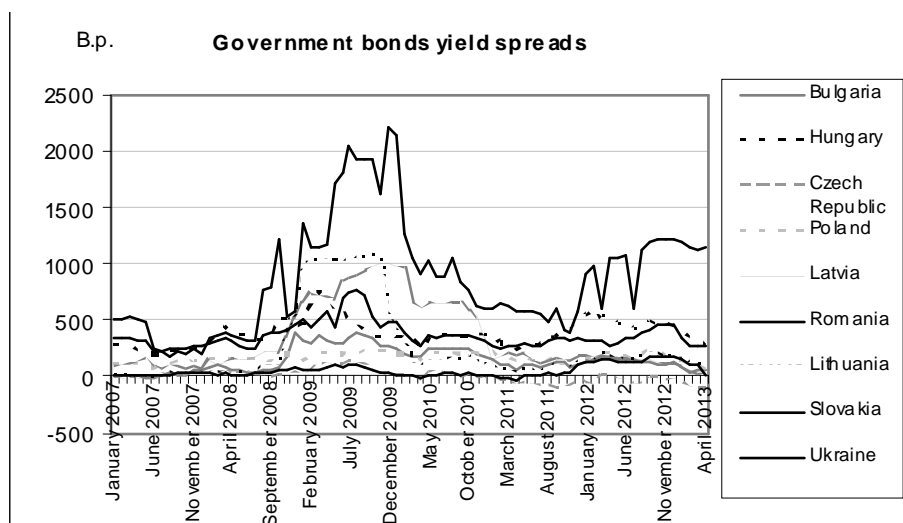
Growth rates of return have been accelerated since 2008, due to the financial crisis spread. The most affected by it were the countries that had high levels of volatility in returns in the past. In general, from 2011 a downward trend in the overall yield in the EU new members takes place, which is related to stabilizing of general econom-

ic 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 EU financial market.

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

The closest to the index on the euro zone are Czech Republic and also Slovakia, where the 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 the countries are connected with the perception of credit risk and domestic macroeconomic policies. In Ukraine the general direction of changes coincides with 8 other countries, however the level of spread is several times higher.



Source: Based on the data from ECB statistics, Eurostat statistics and the annual reports of the National Bank of Ukraine.

Figure 2. Spreads of long-term government bond yields in new EU members and Ukraine in 2007 – April, 2013

It's worth to analyze, whether the offered in academic literature factors influence yield spreads on practice by using the tools of correlation-regression analysis. The results of the research on potential determinants of government bond spreads significance in 8 new EU members are presented in Table 1. The values of coefficient correlations, which exceed the critical and confirm the presence of connection between indices, are marked by 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 the world economy some factors began to lose their value. As it is evident from Table 1, not meaningful for any country became such a factor as deficit or surplus of the general government to GDP. Ponderable are such factors as (Table 1):

Table 1. Pair correlation between the yield of government bonds and the factors of influence in the new EU members

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

Source: Calculated by authors.

- 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 monetary 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 the countries in 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 facilitate access to financing at the markets of state bonds for the new EU members. At the same time enhanceable influence of capital flows, which accompanied trade open-

ness of the 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 the 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 real convergence during the period partially explain the dynamics of spread in these countries.

The inflation rate to a certain extent influences the solvency of governments in Bulgaria, Hungary, Latvia and Poland. The last positive coefficient can be interpreted that 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 the countries and they are statistically significant for Hungary, Poland, Latvia and Romania.

Among the financial variables external debt to GDP ratio appeared as 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 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 affects 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 short-term prospects (Alexopoulou, Bunda, Ferrando, 2009).

Similarly, we verify whether these factors have any effect on the yield of Ukrainian government bonds (Table 2). Most of the factors, that affect the yield of government bonds in the new EU members, are important for Ukraine.

4 factors among the listed ones render especially considerable influence:

- spread of short-term interest rates;
- deficit / surplus of the general government to GDP;
- government interest payments;
- per capita income.

Table 2. Factor influence on the yield of Ukrainian government bonds

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

Source: Calculated by the authors.

Unlike 8 other countries, where none was found the effects of such a factor, as the deficit/surplus of the general government to GDP, in Ukraine it was significant. While trade openness, crucial for the 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 perform regression analysis and construct an 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 reducing significantly the dimensionality of data almost without losing information. All the 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 we use the special instrument – Excel Xlstat.

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

Table 3. Initial data for the factors of influence on government bonds yield spread 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

Source: Based on the data from the annual reports of the National Bank of Ukraine

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 required informa-

tion. Noise and redundancy of data occur through the correlations between variables. So the next step of analysis is the calculation of Pearson correlation coefficients for all the factors that have 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

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
Int Paym	0.918	-0.941	0.651	1	0.963	-0.757	0.909	0.857	0.137	-0.663	0.080
Ext Debt	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 IR Spread	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

Source: Calculated in Xlstat.

As Table 4 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 of stock market volatility is less connected with others.

The method of principal components is an 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.

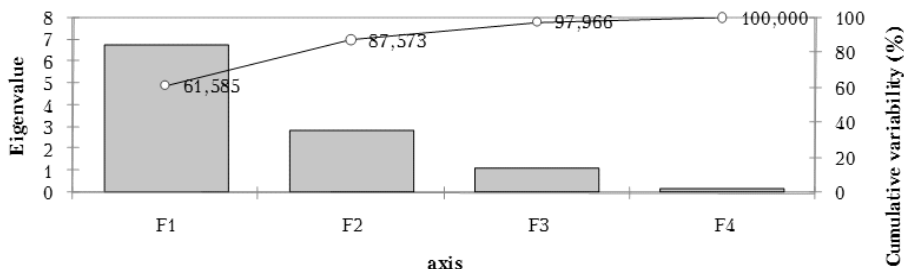
Table 5. Principal components for the government bonds yield spread of Ukraine and their load

	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

Source: Calculated in Xlstat

The program has made data grouping for 4 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 shows that the correct number of principal components is 3, because 3 components explain 98% of the initial variation, thus component F1 explains 61.6% of changes, F2 – about 26% and F3 – 10.4% (at 5% possible error).



Source: Calculated in XLstat.

Figure 3. The load on the principal components and explained dispersion depending on the number of components

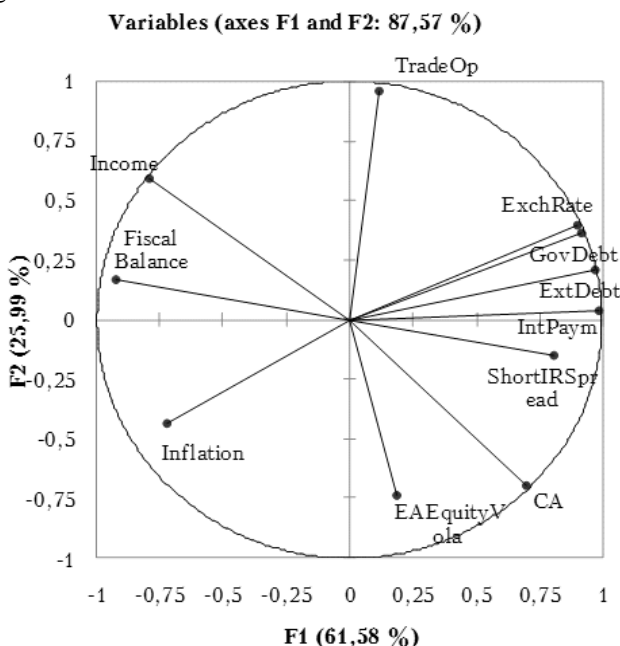
The equations of principal components based on the estimated by program factor loadings are:

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

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

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

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



Source: Calculated in XLstat.

Figure 4. Distribution of the factors between the principal components

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

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

Source: Calculated by the authors.

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

$$y = 1765 + 34.45F1 - 38.62F2 - 33.24F3.$$

This linear dependence between government bonds yield spread in Ukraine and the principal components, based on the 11 macroprudential 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 the new EU members and Ukraine. It was founded out that under current 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 the 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 the three-component model, which describes the changes of government bonds spread of Ukraine. The model includes all the initial factors, is adequate and can be used in practice to forecast government bonds yield spread of Ukraine.

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