Visegrad Four Countries and their Sovereign Credit Rating[1]

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Abstract

We study the sovereign credit rating determinants of Visegrad Four countries in the period 1993 – 2012. The ratings come from four major credit rating agencies – Moody's, S&P, Fitch and R&I. We use linear model with fixed effects. Besides the economic variables inflation, unemployment, broad money to GDP, import to export, openness of the economy, government gross debt, primary balance and size of the government we found out that voice & accountability score of Worldwide Governance Indicators is suitable representative of socio-political situation. Both EU and EMU membership provide additional information to other explanatory variables. The government finance is the most influential determinant in the researched dataset. Unlike in other academic papers, the growth of GDP was not significant variable to explain the sovereign ratings.

Keywords: *sovereign rating, Visegrad Four countries, panel data*

JEL Classification: F30, G15, G24

1. Introduction

The sovereign rating assigned by credit rating agencies has become a very influential measurement of creditworthiness of governments and significant signal for investors in governmental bonds and debt. Since the rating agencies have not been obliged to provide detailed methodology and fully disclose their rating procedures, this area has been an object of interest for researchers. Starting with the seminal paper of Cantor and Packer (1996) there were several studies focused on determinants of sovereign rating. Since the credit ratings of developed

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countries usually do not vary enough, developing countries typically form the main part of dataset for analysis.

The studies often include specific dummy variables discriminating countries according to their level of economic development; they do so in order to deal with the fact that the rating agencies do not necessarily use the same methodology for all countries. Even legislative requirement in European Union demands that rating agencies include an indicator for economic development in their research report on sovereign rating.[2]

This paper focuses on a smaller group of countries from the same geographic region with several common features one of them being the level of economic development. We selected four Central European countries from Visegrad Four group (V4).[3] In the last 25 years each of them went through large economic and political transformation. Politically the system of one ruling party changed into the democracy. Market economy was introduced instead of centrally planned economy. These countries used to be members of Council for Mutual Economic Assistance and Warsaw treaty. Following the change they became NATO members and later they all joined European Union (EU), one of them (Slovakia) also Economic and Monetary Union (EMU).

The rating agencies employ numerous quantitative and qualitative variables to rate the sovereigns. We aim to identify the key determinants of the sovereign rating[4] in the particular set of transitional economies. Besides macroeconomic and socio-political indicators we analyse the influence of EU membership and EMU membership as economic and geo-political variables. We analyse and compare criteria of the three major credit rating agencies Moody's Investors Service (Moody's), Standard&Poor's (S&P) and Fitch Ratings (Fitch) plus Rating&Investments Information (R&I), which is the largest rating agency headquartered in Japan. Most of the studies focus on Moody's and S&P; only few of them include Fitch. So far there are no studies including credit ratings of R&I.

We see the contribution of our paper to the existing literature in the three areas. First we analyse sovereign credit rating determinants of consistent subset of developing and at the same time transitional economies. Second we measure impact of particular variables EU and EMU membership. Third we research the rating determinants of the four rating agencies including R&I.

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[2] Regulation (EU) No. 462/2013 of the European Parliament and of the Council of 21 May 2013.

[3] Visegrad Four is an alliance of four Central European states: Czech Republic, Slovak Republic, Hungary and Poland. All 4 members became part of European Union on 1 May 2004.

[4] Foreign currency long-term sovereign rating is examined in this paper.

The paper is structured as follows. The second section provides overview of the existing literature. The methodology used in this study to analyse the determinants of the sovereign rating is described in detail in the third section. The fourth section presents the description of the data and since there are many potential determinants of the rating, we use principal component analysis to choose smaller subset of the best explanatory variables. The fifth section gives overview of the empirical results, which are further discussed in the sixth section. The last part of the paper gives conclusions.

2. Literature Overview

The empirical studies researching the determinants of the sovereign credit rating or the determinants of the sovereign default mainly focused on macroeconomic factors (Cantor and Packer, 1996; Haque, Kumar and Mathiesnon, 1996; Larrain, Helmut and Maltzan, 1997; Jüttner and McCarthy, 2000; Monfort and Mulder, 2000; Mulder and Perrelli, 2001 and Afonso, Gomes and Rother, 2011). Several studies also researched political factors in order to take a political risk into consideration (Brewer and Rivoli, 1990; Cosset and Roy, 1991; Lee, 1993; Haque, Mark and Mathiesnon, 1998 and McKenzie, 2002). Majority of these studies selects a group of explanatory variables with regard to theoretical literature, credit rating agencies' reports or to preceding empirical studies. McKenzie (2002) tried to identify main predictors of the default using correlations of 46 variables grouped within 7 sets of factors. Next in order to detect the key information of the data principal components analysis was used. Similar approach was adopted by Mellios and Paget-Blanc (2006) in study of determinants of sovereign rating. In our paper we use the technique of principal components analysis, as well; it helps us to define main factors carrying the essential information and also assists in dealing with an issue of multicollinearity.

The reference paper of Cantor and Packer (1996), which was the first study on the determinants of the sovereign ratings, claimed that the ratings of Moody's and S&P could be very well explained by 6 variables (per capita income, GDP growth, inflation, external debt, level of economic development, and default history). Afonso (2003) used the same methodology and his findings suggest that that GDP per capita is the main relevant variable in explaining the determinants of ratings of developed countries and external debt plays a key role for developing countries. Other studies following this pattern confirmed that even though the determinants of Cantor and Packer model explain a large part of variation in ratings, they miss some other important variables (i.e. Jüttner and McCarthy, 2000; Monfort and Mulder, 2000; Mulder and Perrelli, 2001). Further studies

incorporated more of fundamental macroeconomic variables, for example the unemployment rate and the investment-to-GDP ratio (Bissoondoyal-Bheenick, 2005). According to Monfort and Mulder (2000) there are also external indicators such as foreign reserves, current account balance, exports or terms of trade, which are significant rating determinants. Depken, La Fountain and Butters, (2006) particularly researched the influence of corruption on sovereign rating as a measurement of a political risk. According to their findings the corruption is indeed significant variable, as well as governmental budget balance and government debt as measurements of governmental fiscal policy.

When observing the econometric modelling, there are two main approaches to the credit rating determinants in academic research. The first approach, starting with Cantor and Packer (1996), uses linear regression methods on a numerical representation of the ratings. Their research utilized Ordinary Least Squares (OLS) regressions to a linear representation of the ratings, on a cross section of 45 countries. The similar methodology was used later by Monfort and Mulder (2000), Afonso (2003), Butler and Fauver (2006) and Mora (2006). Using OLS analysis on a numerical representation of the ratings is simple and allows for a straightforward generalization to panel data by performing fixed or random effects estimation. It has good fit and a good predictive power.

The critique argues that the use of OLS technique assumes the rating (dependent variables in the model) has been categorized into equally spaced discrete intervals rating categories. This suggests that the risk differential between two adjacent categories is the same (i.e. risk difference between AAA and AA+ rating is the same as between BB– and B+). Using OLS method is argued not to be the most suitable for some multinomial choice variables, which are inherently ordered, such as ratings (Moon and Stotsky, 1993). There is an assumption that the sovereign ratings represent an ordinal ranking of creditworthiness.

The second approach in modelling uses ordered response models. These methods should determine themselves the size of the differences between each category. The ordered probit model had been used for example in works of Hu, Kiesel and Perraudin (2002), Bissoondoyal-Bheenick, Brooks and Yip (2006) and Depken, La Fountain and Butters (2006). However, neither this estimation method is entirely satisfying. The issue is that the ordered probit asymptotic properties do not generalise for a small sample, it will not perform well with small range of observations. Another issue is that the ordered probit model requires the fulfilment of the parallel regressions assumption. This assumption cannot be tested in out dataset because of the insufficient number of observations in some of the rating categories. This is yet another reason why in this paper we opt for linear model approach.

3. Methodology

The linear model is the natural beginning point for the modelling of the sovereign credit rating. The panel data framework allows for the partial compensation for the time-invariant country specific unobserved characteristics. The general form of the model is the following:

$$R_{i,t+1} = \alpha + \sum_{j=1}^{k} \beta_j X_{j,i,t} + \gamma_i + e_{it} \qquad (1)$$

where

$R_{i,t+1}$ – transformation of the rating,

α – intercept,

β_j – slope coefficients,

$X_{j,i,t}$ – explanatory variables,

γ_i – country specific unobserved effects.

The index i denotes the country and the index t time period. Our model is constructed with prediction horizon of one year.

The first note to make regarding this model is the transformation of the ratings. The sovereign credit ratings are of ordinal nature and they need to be transformed firstly into cardinal scale for them to be used in regression. Since the credit ratings assess the credit risk, using a simple linear transformation assumes that one notch difference in the rating reflects the same difference in the default probability along the whole rating scale. There are at least two reasons to use the linear transformation: (1.) Credit rating agencies themselves do not outwardly express that there would exist any difference in "distance" between rating grades in various parts of the rating scale. (2.) There were just minor differences in the results reported when using the non-linear transformations (logistic and exponential) instead of the linear one (Afonso, 2003). The linear transformation of the ratings used in our study is in Table 1. None of the countries in our sample had in the period 1993 – 2012 the rating below BB– or Ba3.

The second note is about the model being predictive. The credit rating is supposed to be the forward-looking assessment of the default probability and thus it makes sense to explain the future ratings with the set of the contemporary predictors. From the statistical point of view the explanatory variables lagged in the relation to the outcome can be considered as exogenous. That is why the models estimated in this study are forward-looking.

The third note is about estimation of the linear model. Apart from the pooled regression assuming no country specific unobserved effects, there are fixed and random effects approaches. The key thing to consider is whether the country specific

effects are correlated with the regressors or not.[5] We consider reasonable to assume that the unobserved country effects are correlated with the regressors and that is why we prefer the fixed effects approach. Technically with our dataset the random effects model cannot be used due to small number of cross-sectional units.

T a b l e 1

Transformation of the Rating Measures into Numerical Values

		Moody's	S&P, Fitch, R&I	Numeric value
Investment Grade	Highest quality bonds	Aaa	AAA	16
	High quality	Aa1	AA+	15
		Aa2	AA	14
		Aa3	AA–	13
	Strong payment capacity	A1	A+	12
		A2	A	11
		A3	A–	10
	Adequate payment capacity	Baa1	BBB+	9
		Baa2	BBB	8
		Baa3	BBB–	7
Speculative Grade	Likely to fulfil obligations, on-going uncertainty	Ba1	BB+	6
		Ba2	BB	5
		Ba3	BB–	4
	High risk obligations	B1	B+	3
		B2	B	2
		B3	B–	1

Source: Moody's; S&P; Fitch; R&I.

4. Explanatory Variables

Table 2 gives overview of the explanatory variables used in the literature dedicated to modelling of the sovereign credit rating. The list of the studies is by no means exhaustive but offers good representative sample of the variables typically used in the literature. The variables mentioned in the fourth column proved to be statistically significant and economically meaningful explanatory variables for the country ratings.

Our choice of potential explanatory variables is based on the view that the credit rating *should address* the creditworthiness of the sovereign debtor regarding the ability and the willingness to pay back its debt in full and in the timely manner. The *ability* to pay is mostly determined by the country's short-term liquidity and long-term solvency, whereas the *willingness* of the government to be up to its obligations depends directly on the will of the political elite and in the broader sense is influenced by the general socio-political situation of the country. We divided possible explanatory variables into 4 groups and in what follows we list most of them with the reasons why do we think they may influence the rating and in which way.[6]

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[5] This is tested formally by Hausman test.

T a b l e 2

Overview of the Recent Studies on the Topic and Relevant Explanatory Variables

Study	Method	Data	Relevant explanatory variables
Cantor and Packer (1996)	Cross-section OLS	Cross section data 1995, 49 countries	Per capita income (+), GDP growth (+), Inflation (–), External debt (–), Fiscal balance (+), Economic development (+), Default history (–)
Monforta and Mulder (2000)	Pooled OLS, Error-correction specification	Panel data 1995 – 1999, 20 emerging economies	GDP growth (+), Inflation (–), External debt to export (–), Domestic debt (–), Fiscal balance (+), Export growth (+), Investments to GDP (+)
Eliasson (2002)	Static and dynamic model, Fixed effects OLS, Random effects	Panel data 1990 – 2000, 38 emerging markets	Current account to GDP (–), External debt (–), Fiscal balance (+), GDP per capita (+), GDP annual growth (+), Inflation (–), External debt to export (–), Export growth (+), Short-term debt to reserves (–)
Afonso (2003)	Cross-section OLS	Cross-section data 2001, 81 countries	GDP per capita (+), External debt as a percentage of exports (–), Level of economic development (+), Default history (–), Real growth rate (+), Inflation rate (–)
Borio and Packer (2004)	Cross section OLS of mean end-of-year ratings	Panel data 1996 – 2003, 52 countries	Per capita GDP (+), Inflation (–), GDP growth (+), Corruption perception index (–), Political risk score (–), Years since default (+), Frequency of high inflation periods (–), External debt (–)
Altenkirch (2005)	Ordered probit, Dynamic pooled OLS, Dynamic fixed effects OLS	Panel data 1990 – 2000, 26 countries	Foreign reserves to GDP (+), Inflation (–), Gross domestic savings (+), Current account to GDP (–), Total debt to GDP (–), Export growth rate (+), Revolutionary war (–), Political rights (+)
Bissoondoyal--Bheenick, Brooks and Yip (2006)	Ordered probit	Cross section 2001, 60 countries	GDP (+), Inflation (–), Current account to GDP (+), Real interest rates (–), Mobile phones (+)
Mellios and Paget-Blanc (2006)	Cross section OLS, Ordered logit	Cross section data 2002 – 2003, 86 countries	Default history (–), GNI per capita in PPP (+), Inflation (–), Real effective exchange rate (+), External debt (–), Corruption perception index (+), Non–manufactured goods (–), Trade dependency (–), Domestic savings (+), Government revenue (+), Reserves to M2 (+)
Mora (2006)	Fixed effects OLS, Random effects, ordered probit, ordered probit fixed effect	Panel data 1989 – 2001, 88 countries	GDP per capita (+), Inflation (–), Fiscal balance (+), External debt to exports (–), Default history (–), Spreads (on Eurobonds) (–)
Afonso, Gomes and Rother (2011)	Pooled OLS, Fixed effects OLS, Random effects, Ordered probit, Random effects ordered probit	Panel data 1995 – 2005, 130 countries	GDP per capita (+), GDP growth (+), Unemployment (+,–) Inflation (–), Government debt (–), Government balance (+), Government effectiveness (+), External debt (–), Current account (–), Reserves (+), Default history (–), EU dummy (+), Industrialised dummy (+), Latin America and Caribbean dummy (–)
Jaramillo (2010)	Binomial logit, Pooled OLS, Fixed effects OLS, Random effects	Panel data 1993 – 2008, 48 emerging economies	GDP per capita (+), External public debt to GDP (–), Domestic public debt to GDP (–), Broad money to GDP (+), Political risk index (+), Regional dummies (+,–)
Hill, Brooks and Faff (2010)	Cumulative probit	Panel data 1990 – 2006, 129 countries	GDP per capita (+), GDP growth (+), Inflation (–), External balance (–), Fiscal balance (+), External debt (–), Debt history (–), Inst. Investor rating (+), Risk premium (+)

Source: Authors' elaboration.

1. *Domestic Macroeconomic Situation*

GDP growth – high growth implies the decreasing of a relative debt burden and makes it easier to service the debt, the country can "grow out of the debt" (+).

Investments effectiveness, real gross capital formation growth – growth in any of these areas is indicative of the future growth capacity of the country's economy making it easier to cope with the repaying of the debt (+).

GDP per capita – high per capita income means greater potential tax base should the government decide to raise more money by increasing taxes; another reason why this variable should affect the ability of the country to repay its debt is the fact that the developed economies usually have more stable institutions and exhibit a greater government capacity to repay debt (+).

Inflation – a low and stable inflation rate suggests a well-managed monetary policy. Even though higher inflation may lead to reducing of the public debt denominated in the local currency, it may signal macroeconomic problems. At the same time high inflation may lead to public dissatisfaction and thus affect the social and political situation in the country (–).

Unemployment rate – a high unemployment is the sign of problems in the labour market; it induces the need of the social benefits and makes the base for taxation smaller (–).

Monetization of economy (Broad money to GDP) – the higher ratio means less liquidity problems with regard to the servicing of the domestic debt, it is an indicator of the government financial flexibility (+).

2. *External Sector*

Current account balance to GDP – a permanent current account deficit endangers the country's sustainability and increases the country's dependence on the foreign creditors (–).

The degree of openness of the economy – a well-integrated economy prevents/mitigates problems with the foreign liquidity. This variable is calculated as the sum of export and import divided by GDP. The country with higher volume of real exchange of goods and services with abroad will have better access to foreign currency. Consequently it will have positive impact on servicing the foreign debt (+).

Foreign reserves to import – higher reserves mean higher funds available to service the foreign debt (+).

Terms of trade – the higher terms of trade imply the greater competitiveness in the international trade and the greater ability to service the foreign debt (+).

Real effective exchange rate – a rise in the index means a loss of country's price and cost competitiveness relative to its principal competitors in international

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[6] Sign in the parentheses indicates the expected impact of the variable on the rating.

markets, on the other hand, it may signify the catching-up process of the economy (+/–).

3. *Government Finance*

Gross debt to GDP – the higher the debt, the greater the burden and the probability of default (–).

Fiscal balance to GDP – large and permanent fiscal deficits mean either the inability or the will of the government to collect the tax from the citizens and at the same time increases the debt burden (+).

Government consumption to GDP – on one hand the higher size of the government measured by the government consumption to GDP may mean more stable political environment and the greater strength of the government to be able to stabilize the economy in the case of the negative shocks. On the other hand higher government consumption might be a sign of excess consumption,[7] as was the case in Sout East Asia, see for example Kalotychou and Staikouras (2005). At the same time the stabilizing effects of the government consumption may reverse after reaching certain threshold level (Silgoner, Crespo-Cuaresma and Reitschuler, 2003) (+/–).

4. *Socio-political Situation and Dummy Variables*

Index of Economic Freedom (IEF) – sub-indices of this index cover property rights, freedom from corruption, government spending, fiscal, business, monetary, trade, investment, money and financial freedom; higher score means the greater freedom in given area, better overall social and economic situation of the country and thus greater likelihood to repay the debt (+).

Worldwide Governance Indicators (WGI) – sub-indices of this index assess voice and accountability, government effectiveness, political stability, regulatory quality, rule of law and control of corruption in the given country; generally these indices measure the socio-economic risk and are supposed to be proxies for the willingness of the country to pay back the debt (+).

European Union (EU) dummy variable – member countries of the EU are expected to have the well-developed system of law and the stable political situation thus creating more trustworthy environment, at the same time the economic policy is limited and subjected to monitoring from other member countries (+).

Economic and Monetary Union (EMU) dummy variable – member countries of the EMU are expected to adhere to the Growth and Stability Pact supposed to ensure the stable monetary and macroeconomic position (+).

The complete set of the variables considered in our analysis as potential explanatory variables is in Table 3.

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[7] The authors are grateful to an anonymous referee for this point.

T a b l e 3

The Complete set of Potential Explanatory Variables Considered for the Models

Sector	Variable	Unit of measurement	Source
Domestic macroeconomic situation	Real GDP growth	Annual % growth based on local constant currency	World Bank
	Growth of real gross fixed capital formation	Annual % growth based on constant 2000 USD	Calculation based on World Bank data
	Nominal per capita GDP	Current USD	World Bank
	Per capita GDP in PPP	Constant 2005 international $	World Bank
	Inflation, consumer prices	Annual %	World Bank
	Inflation, GDP deflator	Annual %	World Bank
	Unemployment	% of Total labour force	World Bank
	Broad Money to GDP – Financial depth	% GDP	World Bank
External sector	Current account balance	% of GDP	International Monetary Fund
	Import to Export Ratio	% of Export	Calculation based on Eurostat data
	Net export to GDP	% of real GDP	World Bank
	Real exports of goods and services growth	Annual % growth based on constant 2000 USD	Calculation based on World Bank data
	Degree of Openness of the economy	% of GDP	Calculation based on Eurostat data
	Foreign reserves as % of imports	% of Imports based on current USD	Calculation based on World Bank data
	Terms of trade	Index	Calculation based on World Bank data
	Real effective exchange rate	Index	Eurostat
Government finance	Government consolidated gross debt as percentage of GDP	% of GDP	Eurostat
	Net lending (+)/Net borrowing (–) under the EDP (Excessive Deficit Procedure)	% of GDP	Eurostat
	Primary balance	% of GDP	Eurostat
	General government final consumption expenditure	% of nominal GDP	World Bank
	Size of the government	% of real GDP	Calculation based on World Bank data
Socio-political situation and dummy variables	Voice and Accountability	Score from –2.5 to 2.5	World Bank – Governance Indicators
	Political Stability/Absence of Violence	Score from –2.5 to 2.5	World Bank – Governance Indicators
	Government Effectiveness	Score from –2.5 to 2.5	World Bank – Governance Indicators
	Regulatory Quality	Score from –2.5 to 2.5	World Bank – Governance Indicators
	Rule of Law	Score from –2.5 to 2.5	World Bank – Governance Indicators
	Control of Corruption	Score from –2.5 to 2.5	World Bank – Governance Indicators
	IEF Property rights	Score from 0 to 100	Heritage Foundation – Index of Economic Freedom
	IEF Freedom from corruption	Score from 0 to 100	Heritage Foundation – Index of Economic Freedom
	IEF Fiscal freedom	Score from 0 to 100	Heritage Foundation – Index of Economic Freedom
	IEF Government spending	Score from 0 to 100	Heritage Foundation – Index of Economic Freedom
	IEF Business freedom	Score from 0 to 100	Heritage Foundation – Index of Economic Freedom
	IEF Monetary freedom	Score from 0 to 100	Heritage Foundation – Index of Economic Freedom
	IEF Trade freedom	Score from 0 to 100	Heritage Foundation – Index of Economic Freedom
	IEF Investment freedom	Score from 0 to 100	Heritage Foundation – Index of Economic Freedom
	IEF Financial freedom	Score from 0 to 100	Heritage Foundation – Index of Economic Freedom
	European Union	Dummy variable	
	Economic and Monetary Union	Dummy variable	

Source: Authors' elaboration.

5. Empirical Results

5.1. Data

We model the sovereign credit ratings from the four credit rating agencies – Moody's, S&P, Fitch and R&I.[8] The sample consists of the V4 countries: Czech Republic, Hungary, Poland and Slovakia. Our data cover the years from 1993 to 2012 with not all of the data available for each country/year thus forming an unbalanced panel. Since we used the annual data and the ratings change throughout the year, the question arises how to assign the rating value to the given year. Some studies (e.g. Jaramillo, 2010) use end of the year value, some values at the end of June, some at the end of the March or September (e.g. Cantor and Packer, 1996; Hill, Brooks and Faff, 2010). In our study we decided to use the time series of the ratings assigned as of the end of the June of the given year (middle of the year). This gives us 4 panels of dependent variables – one for each credit rating agency.

5.2. Choosing the Subset of Variables Using the Principal Component Analysis

In order to determine the variables, which carry the most information we use principal component analysis (PCA). This method is used in econometrics to deal with multicollinearity while it also helps to detect the most important dimensions of the given set of variables. Since there is significant multicollinearity in our large dataset this technique is helping us to deal with the issue. In our paper we also use this method to select a representative variable of each factor out of initial large set. Interpretation of results is thus straightforward, unlike when working with principal component variables. Our representative variables are the ones, which are the most correlated with principal component factors. The same approach was used by Mellios and Paget-Blanc (2006). Table 4 shows the results of PCA after the rotation of factors. The criterion for the number of retained factors is the minimum eigenvalue 1. Nine factors were extracted and they represent more than 85% of total variance of the initial set.

Based on the PCA results we select the following 9 variables: real GDP growth, unemployment, import to export ratio, degree of openness of the economy, real effective exchange rate growth, government consolidated gross debt, primary balance, size of government, voice and accountability. In addition to it, we consider 2 other variables important and necessary: inflation and financial depth measured by broad money to GDP ratio. We have two primary reasons to

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[8] Ratings used in this paper: Moody's and S&P Foreign Currency Long-term Debt, Fitch Long-term Foreign Currency Issuer Default, R&I Foreign Currency Issuer Rating.

include them. First, we think each of variables measures important dimension of the countries' economy. Second, they were often used in empirical literature. Moreover none of them causes multicollinearity problem. Other 2 dummy variables are added too: membership in EU and membership in EMU.

T a b l e 4
Principal Component Analysis – Rotated Factor Loadings (pattern matrix) and Unique Variances

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9	Uniqueness
Real GDP growth					**0.88**					0.127
GDP p.c. PPP	–0.55		0.65							0.039
Capital formation					0.86					0.197
Nominal GDP p.c.	–0.68		0.54							0.059
Inflation CPI	0.79									0.096
GDP deflator	0.82									0.154
Unemployment							–0.75			0.079
M2 to GDP										0.173
Cur. account bal.			0.52		–0.55					0.227
Import to Export			**–0.90**							0.091
Net export to GDP			0.85							0.049
Real exports gr.					0.55					0.360
Openness				**0.88**						0.086
Foreign reserves				–0.70						0.224
Terms of trade				–0.86						0.100
REER growth									**0.81**	0.264
Gov. gross debt						–0.80				0.092
Net lending (EDP)								0.76		0.126
Primary balance								**0.85**		0.114
Gov. expenditure	0.53									0.140
Size of government	**0.85**									0.075
Voice & accountab.		**0.91**								0.105
Stability							0.56			0.332
Govern. effectiv.		0.68								0.135
Regulatory qual.		0.78								0.060
Rule of law		0.77								0.044
Corruption control		0.74								0.197
IEF property		0.59								0.158
IEF Corruption							0.65			0.143
IEF Fiscal freed.	–0.75									0.156
IEF Gov. spending	–0.81									0.186
IEF Business Fr.						0.67				0.139
IEF Monetary Fr	–0.58		0.54							0.185
IEF Trade Freedom	–0.77									0.196
IEF Investment Fr		0.64								0.215
IEF Financial Fr.						0.72				0.093

Note: Numbers in the table represent rotated factor loadings. The factor loadings with absolute value smaller than 0.5 are omitted. Variables in bold are chosen representatives of each factor.
Source: Authors' calculation.

Because we did not select principal component factors, which are orthogonal by construction, but chose a representative variable for each factor, we need to

measure extent of multicollinearity. Firstly we compute correlation matrix of all 13 variables (see Table 5). Only one pair has correlation substantially higher than 0.5 in absolute value (EU dummy and size of government). Next we perform multicollinearity check using variance inflation factors (VIF), see Table 5. Since there is no variable with VIF higher than 5, we conclude that there is no multicollinearity issue. Table 6 provides the sample averages of explanatory variables for respective rating agencies.

T a b l e 5

Multicollinearity Diagnostics and Correlation Matrix

A. Multicollinearity diagnostics using variance inflation factor (VIF)

Variable	VIF	SQRT VIF	Tolerance	R-Squared
Real GDP growth	2.32	1.52	0.4316	0.5684
Inflation CPI	2.04	1.43	0.4899	0.5101
Unemployment	2.33	1.53	0.4296	0.5704
M2 to GDP	4.7	2.17	0.2126	0.7874
Import to Export	2.55	1.6	0.392	0.608
Openness	3.32	1.82	0.3009	0.6991
REER growth	1.4	1.18	0.7165	0.2835
Gov. gross debt	2.35	1.53	0.4262	0.5738
Primary balance	1.86	1.36	0.5371	0.4629
Size of government	3.9	1.97	0.2565	0.7435
Voice & accountability	1.91	1.38	0.5231	0.4769
EU dummy	3.82	1.96	0.2615	0.7385
EMU dummy	1.73	1.32	0.5764	0.4236
Mean VIF	2.63			

B. Correlation matrix of explanatory variables

	Real GDP growth	Inflation CPI	Unemployment	M2 to GDP	Import to Export	Openness	REER growth	Gov. gross debt	Primary balance	Size of government	Voice & accountab.	EU dummy	EMU dummy
Real GDP growth	1												
Inflation CPI	–0.04	1											
Unemployment	0.09	–0.03	1										
M2 to GDP	–0.30	–0.12	–0.25	1									
Import to Export	0.22	0.22	0.48	–0.42	1								
Openness	0.08	0.17	–0.19	0.48	–0.39	1							
REER growth	0.21	0.37	–0.03	–0.01	0.09	0.14	1						
Gov. gross debt	–0.19	0.27	0.03	–0.28	–0.14	0.17	–0.17	1					
Primary balance	0.24	0.39	–0.12	–0.31	–0.06	0.07	0.18	0.24	1				
Size of government	–0.19	0.31	–0.29	–0.10	0.02	0.21	–0.05	0.23	–0.01	1			
Voice & accountability	–0.01	0.09	–0.31	–0.40	–0.17	–0.03	0.02	0.35	0.23	0.13	1		
EU dummy	0.10	–0.29	–0.16	0.21	–0.50	0.20	–0.05	0.16	0.08	–0.60	0.05	1	
EMU dummy	–0.24	–0.25	0.11	0.09	–0.09	0.17	–0.07	–0.06	–0.35	–0.12	–0.10	0.18	1

Source: Authors' calculation.

T a b l e 6

Sample Averages of Explanatory Variables by Rating Grade for Respective Rating Agencies

Variable	Moody's						
	Ba1	Baa3	Baa2	Baa1	A3	A2	A1
Real GDP growth	1.97	4.95	3.13	1.60	4.32	4.09	3.90
Inflation CPI	13.62	15.70	18.31	7.27	7.70	3.53	3.02
Unemployment	12.96	12.77	8.70	9.69	12.05	13.12	8.12
M2 to GDP	57.86	48.18	45.72	53.95	52.54	50.97	59.33
Import to export	107.84	109.19	97.80	106.49	104.70	104.29	99.85
Openness	139.56	98.46	109.49	109.13	150.19	106.34	136.95
REER growth	0.03	0.04	0.05	0.03	0.06	0.01	0.04
Gov. gross debt	49.54	51.34	62.90	39.43	48.65	49.06	37.42
Primary balance	–2.08	–1.38	3.00	–1.50	–0.52	–2.32	–2.98
Size of government	23.54	20.53	23.64	20.10	20.80	18.09	19.06
Voice & accountability	0.73	0.92	1.01	0.95	1.05	0.96	0.99
EU dummy	0.13	0.09	0.00	0.17	0.00	0.87	0.79
EMU dummy	0.00	0.00	0.00	0.00	0.00	0.07	0.11

Variable	S & P									
	BB–	BB	BB+	BBB–	BBB	BBB+	A–	A	A+	AA–
Real GDP growth	–3.70	5.29	2.19	3.30	3.43	3.32	4.16	4.14	1.67	1.89
Inflation CPI		33.25	14.54	12.42	9.74	5.78	4.39	4.74	2.39	1.94
Unemployment	12.20	14.40	13.19	11.68	10.35	13.38	8.40	8.22	12.03	6.70
M2 to GDP	61.15	31.99	57.56	52.54	51.70	47.95	54.43	64.08	58.01	73.86
Import to export			105.50	105.39	110.30	108.32	102.53	101.25	101.28	94.46
Openness			143.86	117.74	110.36	99.38	115.36	139.00	157.34	141.07
REER growth			0.03	0.02	0.04	0.03	0.04	0.04	0.04	0.02
Gov. gross debt			53.50	56.99	47.73	49.49	39.98	29.07	34.83	40.80
Primary balance			–1.62	–0.73	–2.55	–1.85	–2.47	–1.98	–4.57	–1.90
Size of government	25.35	20.62	23.61	20.83	20.94	19.22	19.88	18.58	17.75	17.15
Voice & accountability			0.75	0.89	1.04	1.03	0.96	0.97	0.89	0.98
EU dummy	0.00	0.00	0.22	0.25	0.00	0.38	0.52	0.73	1.00	1.00
EMU dummy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.67	0.00

Variable	Fitch						
	BB+	BBB–	BBB	BBB+	A–	A	A+
Real GDP growth	2.19	3.53	2.92	2.95	4.45	7.85	1.90
Inflation CPI	8.12	11.28	14.72	5.93	4.97	2.86	2.75
Unemployment	15.60	11.15	11.08	12.07	8.07	11.10	8.89
M2 to GDP	63.06	58.89	47.02	50.34	53.76	57.45	65.12
Import to export	106.63	109.99	103.14	107.53	104.07	100.69	97.60
Openness	145.79	135.72	111.38	100.91	112.54	152.41	143.99
REER growth	0.02	0.03	0.01	0.04	0.03	0.05	0.03
Gov. gross debt	52.58	48.87	59.84	39.86	45.17	30.20	35.24
Primary balance	–1.80	–3.87	0.53	–2.28	–2.29	–1.34	–3.08
Size of government	20.31	21.89	21.01	19.37	19.98	18.03	17.57
Voice & accountability	0.76	0.72	1.00	0.98	1.01	0.92	0.95
EU dummy	0.20	0.25	0.22	0.28	0.53	1.00	1.00
EMU dummy	0.00	0.00	0.00	0.00	0.00	0.00	0.33

Variable	R&I					
	BB+	BBB–	BBB	BBB+	A–	A
Real GDP growth	0.04	3.07	0.95	3.59	4.05	2.41
Inflation CPI	10.57	7.23	5.24	4.47	4.53	2.73
Unemployment	16.40	14.70	14.33	16.96	8.10	8.71
M2 to GDP	61.67	63.12	61.09	47.05	54.62	64.73
Import to export	107.34	108.59	99.76	108.33	102.90	97.39
Openness	126.82	144.90	155.20	96.96	121.75	142.68
REER growth	–0.02	0.04	0.03	0.04	0.03	0.03
Gov. gross debt	47.80	49.76	61.85	45.02	41.48	34.55
Primary balance	–4.00	–1.78	–1.30	–1.34	–2.61	–2.90
Size of government	19.51	20.63	20.19	17.98	19.90	17.62
Voice & accountability	0.68	0.75	0.93	0.99	0.97	0.95
EU dummy	0.00	0.20	0.50	0.56	0.56	1.00
EMU dummy	0.00	0.00	0.00	0.00	0.00	0.30

Source: Authors' calculation.

5.3. Linear Model Estimation Results

We use ordinary least squares regression with fixed effects to estimate the parameters of interest. To verify the assumption of no heteroscedasticity, we calculate modified Wald statistic for groupwise heteroscedasticity in the residuals of a fixed effects regression model, following Greene (2003). To verify the assumption about no autocorrelation of random errors we implement a test for serial correlation in the idiosyncratic errors of a linear panel-data model discussed by Wooldridge (2010). The presence of the cross-sectional dependence is tested using the Breusch-Pagan test for cross sectional dependence.[9] We have tested non-linear effects of explanatory variables, adding their squared terms to the regression equations. Only the quadratic term of gross debt and inflation proved to be statistically significant. In the regressions we finally kept only quadratic term of gross debt. In line with other empirical studies we use inflation in the form of natural logarithm.[10]

Table 7 shows the results of fixed effects panel OLS regression with all variables included. We use general-to-specific approach to arrive to preferred models. In each step we have excluded the variable with the smallest absolute value of t-statistic. Hence in the preferred models we kept only the variables that were statistically significant. There is only one exception to this rule. In one of the preferred models (namely R&I model) we have removed variable primary balance, because the estimated coefficient had the sign opposite to expectations based on the economic reasoning. We do not see any logic in or justification of

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[9] We considered two tests to test for cross-sectional dependance – Pesaran's test and Breusch-Pagan test. Pesaran`s test is used for datasets in the form of small T and large N and Breusch-Pagan test is valid for datasets with small number of units. We have performed both tests and results of both confirmed no cross-sectional dependence. We report Breusch-Pagan test since it suits better for our type of dataset.

[10] We choose logarithmic transformation of inflation similar to Cantor and Packer (1996).

an inverse relationship between credit rating and primary balance (increase in primary balance leads to lower rating). In those empirical studies in which primary balance was statistically significant, its impact on the sovereign rating was always positive (Cantor and Packer, 1996; Monfort and Mulder, 2000 and others; see Table 2 for details).

T a b l e 7

Linear Models Results

Variable	(1) Moody's	(2) Moody's	(3) S&P	(4) S&P	(5) Fitch	(6) Fitch	(7) R&I	(8) R&I
Real GDP growth	0.0604	–0.0134	0.0246	–0.0381	0.0457	–0.0246	0.0219	–0.0182
	(1.03)	(–0.22)	(0.44)	(–0.66)	(0.99)	(–0.56)	(0.75)	(–0.67)
Inflation CPI	–0.810***	–0.747***	–0.342*	–0.288	–0.546***	–0.485***	–0.239**	–0.205**
	(–4.10)	(–4.11)	(–1.83)	(–1.64)	(–3.51)	(–3.59)	(–2.60)	(–2.58)
Unemployment	–0.0729	–0.0285	–0.0893*	–0.0515	–0.134***	–0.0918**	–0.0705***	–0.0471**
	(–1.35)	(–0.55)	(–1.75)	(–1.03)	(–3.15)	(–2.39)	(–2.82)	(–2.11)
M2 to GDP	–0.0550	–0.0331	0.0413	0.0599	–0.00236	0.0186	0.0247	0.0361*
	(–1.11)	(–0.72)	(0.88)	(1.35)	(–0.06)	(0.54)	(1.06)	(1.79)
Import to Export	–0.0366	–0.0417	–0.0507	–0.0551*	–0.0645**	–0.0694***	–0.0238	–0.0263
	(–1.00)	(–1.25)	(–1.47)	(–1.71)	(–2.24)	(–2.80)	(–1.23)	(–1.59)
Openness	0.00559	0.0213	0.0219	0.0353**	–0.00629	0.00873	0.0194**	0.0280***
	(0.40)	(1.53)	(1.65)	(2.63)	(–0.57)	(0.85)	(2.57)	(4.07)
REER growth	2.781	2.132	0.443	–0.110	1.718	1.098	0.897	0.543
	(1.25)	(1.05)	(0.21)	(–0.06)	(0.98)	(0.73)	(0.88)	(0.62)
Gov. gross debt	–0.0261	0.0726	–0.102***	–0.0180	–0.0423	0.0518	–0.0709***	–0.0174
	(–0.80)	(1.60)	(–3.29)	(–0.41)	(–1.64)	(1.54)	(–4.67)	(–0.89)
Gov. gross debt squared		–0.00156***		–0.00132**		–0.00148***		–0.000838***
		(–2.90)		(–2.55)		(–3.72)		(–3.67)
Primary balance	–0.0765	–0.0580	0.0426	0.0583	0.0904*	0.108**	–0.0515	–0.0409
	(–1.13)	(–0.94)	(0.67)	(0.97)	(1.70)	(2.35)	(–1.42)	(–1.31)
Size of government	–0.131	–0.0133	–0.0715	0.0285	–0.349**	–0.237*	–0.134	–0.0710
	(–0.75)	(–0.08)	(–0.43)	(0.18)	(–2.53)	(–1.93)	(–1.61)	(–0.97)
Voice & accountability	7.042***	5.763***	5.216***	4.129***	5.095***	3.876***	2.783***	2.096***
	(5.44)	(4.57)	(4.26)	(3.39)	(5.00)	(4.14)	(4.72)	(3.89)
EU dummy	1.150**	1.405***	0.151	0.368	0.206	0.450	0.259	0.393**
	(2.67)	(3.49)	(0.37)	(0.95)	(0.61)	(1.51)	(1.31)	(2.27)
EMU dummy	0.381	0.0758	2.181***	1.921**	1.914***	1.622***	1.608***	1.447***
	(0.48)	(0.10)	(2.88)	(2.69)	(3.04)	(2.96)	(4.21)	(4.39)
Constant	14.21**	9.138	11.79*	7.477	22.85***	18.01***	11.74***	8.967***
	(2.09)	(1.41)	(1.83)	(1.20)	(4.26)	(3.75)	(3.67)	(3.16)
Observations	54	54	54	54	54	54	51	51
Adjusted R-squared	0.792	0.827	0.722	0.758	0.825	0.870	0.874	0.908
F-test[x]	0.983	0.607	0.164	0.024	0.391	0.463	0.001	0.000
Serial correlation[xx]	0.064	0.230	0.001	0.003	0.033	0.076	0.020	0.001
Heteroscedasticity[xxx]	0.386	0.237	0.149	0.012	0.046	0.048	0.955	0.042
Cross-sectional dependence[xxxx]	0.016	0.010	0.350	0.549	0.554	0.590	0.724	0.548

Note: The table presents estimation results for the models of all rating agencies using fixed effects panel OLS regression.

t-statistics in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

[x] F-test (FE) displays p-value of F-test for fixed effect in a panel regression, the null hypothesis is that all fixed effects are not statistically significant

[xx] Serial correlation displays p-value of a test for serial correlation in the idiosyncratic errors, the null hypothesis is that there is no serial correlation in the disturbances

[xxx] Heteroscedasticity displays p-value of a modified Wald statistic for groupwise heteroskedasticity, the null hypothesis is that disturbances are homoscedastic.

[xxxx] Cross-sectional dependence displays p-value of the Breusch-Pagan statistic for cross-sectional independence in the residuals, the null hypothesis is that there is no cross-sectional dependence.

Source: Authors' calculation.

All other estimated coefficients of remaining variables have sign as expected. The fixed effects are statistically significant in all preferred models. The results of preferred models are reported in Table 8.

T a b l e 8
Linear Preferred Models Results

Variable	(1) Moody's	(2) S&P	(3) Fitch	(4) R&I
Inflation CPI	–0.905*** (–6.79)	–0.524* (–2.49)	–0.532*** (–4.17)	–0.205** (–2.36)
Unemployment		–0.0827** (–3.52)	–0.155*** (–4.73)	–0.0985*** (–4.23)
M2 to GDP		0.0810** (3.67)		
Import to Export	–0.0577** (–2.24)	–0.109* (–2.88)	–0.0679*** (–2.87)	
Openness				0.0196*** (3.36)
Gov. gross debt	0.0748* (1.88)	–0.132*** (–7.13)	–0.0448*** (–2.81)	–0.0563*** (–5.80)
Gov. gross debt squared	–0.00185*** (–4.54)			
Primary Balance			0.124*** (2.88)	
Size of government			–0.302*** (–3.93)	
Voice & accountability	5.709*** (5.27)	6.095** (3.72)	5.150*** (5.75)	3.504*** (5.99)
EU dummy	1.751*** (6.47)			0.567*** (3.14)
EMU dummy		1.302** (3.38)	1.774*** (3.25)	1.657*** (5.43)
Constant	11.77*** (3.43)	17.79** (4.64)	22.05*** (7.14)	7.083*** (7.32)
Fixed effects				
Czech Republic	–1.04	–2.71	–0.66	–0.26
Hungary	1.77	1.31	–0.15	0.08
Poland	–0.28	1.50	0.23	1.40
Slovakia	–0.51	–0.10	0.68	–0.93
Observations	63	64	57	54
Adjusted R-squared	0.840	0.722	0.823	0.843
F-test [x]	0.001	0.000	0.029	0.001
Serial correlation [xx]	0.098	0.008	0.063	0.207
Heteroscedasticity [xxx]	0.976	0.086	0.115	0.202
Cross-sectional dependence [xxxx]	0.060	0.673	0.416	0.366

Note: The table presents estimation results for the models of all rating agencies. Models (1), (3) and (4) using fixed effects panel OLS regression. Model (2) using fixed effects panel OLS regression with cluster robust standard errors.
t-statistics in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
[x] F-test (FE) displays p-value of F-test for fixed effect in a panel regression, the null hypothesis is that all fixed effects are not statistically significant.
[xx] Serial correlation displays p-value of a test for serial correlation in the idiosyncratic errors, the null hypothesis is that there is no serial correlation in the disturbances.
[xxx] Heteroscedasticity displays p-value of a modified Wald statistic for groupwise heteroskedasticity, the null hypothesis is that disturbances are homoscedastic.
[xxxx] Cross-sectional dependence displays p-value of the Breusch-Pagan statistic for cross-sectional independence in the residuals, the null hypothesis is that there is no cross-sectional dependence.

Source: Authors' calculation.

Our results suggest that a large proportion of the variability of the sovereign credit rating can be explained by relatively small number of variables; in case of Moody's it is 84%, Standard&Poor's 72%, Fitch 82% and R&I 84% of the sovereign credit rating variability.

From among 13 explanatory variables 10 are of macroeconomic nature (real GDP growth, inflation, unemployment, broad money to GDP, import to export ratio, openness of the economy, real effective exchange rate growth, government consolidated gross debt to GDP, primary balance, size of government), 1 of them represents socio-political factor (voice and accountability) and 2 of them are dummy variables (EU membership and EMU membership). Socio-political variable is highly significant for each agency's model. From among dummy variables EMU membership is significant in three models (S&P, Fitch and R&I) and the EU membership in two models (Moody's and R&I). From the group of ten macroeconomic variables six of them are significant in the model of Fitch, five in the S&P model, four in the R&I model and only three in the Moody's model. Table 8 provides results for detailed comparison.

6. Discussion

We describe the magnitudes of the explanatory variables effects' from the two viewpoints: firstly we compare the effect of the given explanatory variable between various agencies and secondly we analyse the relative importance of explanatory variable within the same model. The results are summarized in Table 9.

Comparison between the different agencies is relatively easy and apparently can be done by simply looking at the estimated coefficients. But to get an idea of the size of the influence (expressed in notches) within our dataset we need to connect the estimated coefficients to the variability of the explanatory variables within the sample. We do it by calculating the product of the estimated coefficient and the difference between the 10th and the 90th percentile of the given explanatory variable in the sample.[11] This is what is presented in the first columns for each rating agency in Table 9.

Then we want to analyse the relative importance of the explanatory variables within each rating agency. We do this by looking at the relative weights calculated using the formula:

$$RW_i = \frac{|\beta_i| change_i}{\sum_{j=1}^{m} |\beta_j| change_j} \tag{2}$$

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[11] Except for dummy variables EMU and EU membership; their impact is calculated for the change from 0 to 1.

where

    RW_i – the relative weight of the *i-th* explanatory variable,

    β_i – its estimated coefficient,

    change$_i$ – the difference between the 90th and the 10th percentile of its sample distri-
bution (for dummy variables the change is equal to one),

    m   – the number of significant explanatory variables in the model.

T a b l e 9

**Comparison of the Explanatory Variables' Absolute and Relative Impact
on the Sovereign Credit Rating in our Sample**

	Moody's		S&P		Fitch		R&I	
	absolute	relative (%)	absolute	relative (%)	absolute	relative (%)	absolute	relative (%)
Inflation CPI	–1.79	16.93	–1.04	6.96	–1.05	8.93	–0.41	4.38
Unemployment			–1.02	6.82	–1.91	16.18	–1.21	13.04
M2 to GDP			1.91	12.82				
Import to Export	–1.23	11.59	–2.32	15.55	–1.44	12.24		
Openness							2.00	21.54
Gov. gross debt	–3.77	35.57	–5.13	34.40	–1.74	14.74	–2.18	23.51
Primary Balance					0.75	6.32		
Size of government					–1.28	10.85		
Voice & accountability	2.06	19.39	2.19	14.71	1.85	15.71	1.26	13.58
EU dummy	1.75	16.52					0.57	6.11
EMU dummy			1.30	8.73	1.77	15.04	1.66	17.84

Note: The table presents the absolute and relative impact of explanatory variables to the rating. The first column for each agency displays upgrade or downgrade in notches caused by increase of explanatory variable from the 10th to the 90th percentile of the sample (calculated as the difference between the 10th and 90th percentile of the respective explanatory variable multiplied by its estimated coefficient). The second column displays relative weight of the given explanatory variable within the same rating agency.

Source: Authors' calculation.

The inflation is used in the form of natural logarithm. Such nonlinear form describes well the possible effect of inflation; increase of inflation from 3 to 6 percentage points (p. p.) is expected to have bigger impact on the economy than similar increase from 15 to 18 p. p. At the same time the logarithmic form diminishes possible impact of outliers. The inflation is statistically significant in all models with negative impact on the sovereign rating. However, its influence on the rating is very different across agencies; the strongest is in the Moody's and the weakest in the R&I model. Its relative importance compared to other explanatory variables is small in all models except for Moody's where it belongs to the variables with average relative weight. The inflation is one of the most frequently used variables in empirical studies on the sovereign rating determinants and its estimated coefficient was always negative. Its impact according to various studies cannot be easily compared, because it has been used in many different transformations.

The unemployment is significant in the models for S&P, Fitch and R&I; it has negative influence on the sovereign rating. Its economic impact is the strongest in Fitch model. In the model for this agency it is the variables with the greatest relative importance. In the R&I model it is one of the variables with average impact and in the S&P model with the minor impact. Even though this variable measures an important dimension of the economy, it is interesting that besides Afonso, Gomes and Rother (2011) it was not used as sovereign rating determinant in empirical studies. Even there its influence on rating is not clear; for some agencies or model settings the sign of its coefficient was positive while in others it was negative. The reasons for these findings may lie in the fact that the unemployment does not directly influence the ability or willingness of the country to pay in time and in full its debt and thus its effect may be cancelled out in the larger samples. But in our sample consisting of transition countries the level of unemployment plays an important role.

The variable broad money to GDP ratio is only significant in the S&P model. Increase in the ratio results in the rating upgrade. The magnitude of the impact is average compared to other variables in the S&P model. Broad money to GDP ratio was used as one of the investment grade determinants in Jaramillo (2010) with the same impact as in our model.

The import to export ratio is significant in all models except for R&I. Increase in the ratio implies rating downgrade. The strongest impact is observed in the S&P model. When analysing its relative importance it is one of the variables with average impact in the S&P and Fitch models while in the Moody's model it is the one with minor impact. In other empirical studies the external balance is usually represented by current account to GDP ratio. Its estimated coefficient is sometimes positive and sometimes negative. Afonso, Gomes and Rother (2011) distinguish between short-term and long-term influence. Short-term current account deficit may indicate willingness of foreign investors to fund the deficit through loans or investments and thus positively influence the rating. However, if the deficit persists in the long-term it will affect the rating adversely. In our case of transitional economies we observe the latter effect.

The degree of openness of the economy is significant only in the R&I model with the positive impact on the rating. Compared to other variables in the R&I model it has the highest influence together with the governmental debt. This measure of the trade openness of an economy is absent in other empirical studies except for Bissoondoyal-Bheenick, Brooks and Yip (2006). However, it was not statistically significant in their study of rating determinants using the Moody's, S&P and Fitch ratings. We confirm their findings in the models of the three agencies (where it was not statistically significant) but for our additional R&I model it is one of the key rating determinants.

The government consolidated gross debt to GDP (gross debt) is significant rating predictor in all models. Gross debt has nonlinear effect in the Moody's model; increase in gross debt to GDP ratio up to 20.2 p. p. results in rating upgrade. Any increase after this threshold causes rating downgrade at accelerating rate. In models of the other agencies any increase of gross debt implies rating downgrade since the quadratic term was not statistically significant there. The influence of the gross debt on the rating is very different across agencies; the strongest is in the S&P and the weakest in the Fitch model. Its relative importance compared to other variables is the highest in the Moody's, S&P and R&I models and it is one of the major determinants in the Fitch model. Level of indebtedness is significant determinant of sovereign rating in almost all other empirical studies, as well (one exception is Bissoondoyal-Bheenick, Brooks and Yip, 2006).

The primary balance is significant only in the Fitch model with the positive impact on the rating. The relative importance of the primary balance is the smallest from among all the variables in this model. In some of the empirical studies primary balance (or fiscal balance) is a significant rating determinant with the positive impact similar to our model. Afonso, Gomes and Rother (2011) suggest that the effect of fiscal balance should be seen together with the effect of government indebtedness. Our results indicate that in the case of transition economies the primary balance is generally not important rating predictor.

The government consumption to GDP (size of government) is also significant only in the Fitch model with the negative impact on the rating. Its relative importance compared to other variables in the model is average. This measure of government finance has not been considered in other empirical studies so far. We suggest that the impact of the size of government is considered together with the impact of fiscal balance and government indebtedness. If we measure their cumulative relative impact on the rating in the Fitch model we will arrive to 32%. The dimension of the government finance in the other models is captured mostly by the government debt. The relative importance is similar; in the Moody's and S&P models it is about 35% and in the R&I model it is 23.5%.

The voice and accountability score, a sub-index of the Worldwide Governance Indicators, is statistically significant in all models. The higher score represents higher degree of citizens' participation in selecting their government, as well as higher freedom of expression, freedom of association, and a free media. Its impact on the credit rating is very similar in the Moody's, S&P and Fitch models, in the case of the R&I model it is slightly smaller. Its relative importance compared to other variables is average or above average in each of the models (between 14 – 20%). The importance of various measures of socio-political indicators has

been recognized in the empirical literature on sovereign rating determinants from the very beginning, starting with Cantor and Packer (1996) who included economic development indicator in their study. Range of socio-political factors significant in other studies includes Corruption Perception Index from Transparency International used by Borio and Packer (2004), Mellios and Paget-Blanc (2006), Political Risk Score from International Country Risk Guide used by Jaramillo (2010), Borio and Packer (2004), Political Rights by Altenkirch (2005) and also Worldwide Governance Indicators by World Bank used by Afonso, Gomes and Rother (2011).

EU dummy variable is significant in two models – the Moody's and the R&I. Its effect and relative importance is about three times stronger in the Moody's model than in the R&I. Also in the R&I it belongs to the least important variables whereas in the Moody's to the average ones suggesting nearly two notches upgrade after joining the EU. EU dummy is used also in the work of Afonso, Gomes and Rother (2011). Their findings are very similar to ours; EU membership implies rating upgrade by more than 1.5 notches in Moody's model and relatively small upgrade of around 0.4 notches in the S&P and the Fitch models.

EMU dummy variable is significant in three models – the S&P, the Fitch and the R&I. The magnitude of its effect is very similar across all three agencies – about 1.5 notches upgrade after joining the EMU. Its relative importance compared to other variables is average in the Fitch and R&I models but one of the smallest in the S&P model. This dummy variable has not been used in other empirical studies yet.

When analysing the group of main determinants we found out that, unlike in other academic papers, GDP growth is not significant variable to explain the sovereign ratings. All countries in our sample went through a transformation process, where systematic and structural economic reforms took place. However, GDP growth didn't show any trend during the analysed period, it was rather fluctuating.

The fixed effects, representing the unobserved country specific effects, are jointly statistically significant in all models. However, their impact on the rating varies. The results suggest that the actual rating for Czech Republic is lower than the one predicted on the basis of explanatory variables. This holds for all agencies, most notably in the S&P model. The situation of Slovakia is similar, just the magnitude of the effect is smaller. Contrary to that the actual rating of Hungary and Poland is mostly higher than predicted. These effects may be a combination of other soft factors not included in the models and of the variables, which did not vary enough over the time even though the credit rating agencies take them into account when issuing the sovereign rating.

Having described the estimation results of the preferred models the question arises what are the practical implications of this exercise. What can a country do to improve its rating? All of the V4 countries are the EU members and thus a part of the significant rating determinants is not fully or directly "in the hands" of the policy makers. Especially the group of the monetary indicators or monetary and cohesion policy (e.g. inflation, broad money to GDP, unemployment) can be viewed as exogenous or partially exogenous for EU and EMU members.

Our findings suggest that the area of the government finance is the most influential determinant of the sovereign rating. The main factor is government debt and the additional measures are primary balance and government consumption. A country wishing to improve its sovereign rating should put more emphasis on stabilising and lowering government debt, which is naturally connected to the fiscal balance, i.e. increasing revenues and decreasing expenditures. The second most important area is the domestic macro-economic situation. The monetary variables (inflation and monetization of economy) play the important role together with the unemployment. Next in importance are external sector and socio--political situation. Import to export ratio and openness of the economy are main representatives of external sector. Citizens' participation in selecting their government, freedom of expression, association and free media are important factors for the rating agencies as the proxy for socio-political situation. Lastly, the fact that a country joined the EU or EMU reflects in the rating improvement. All countries in the sample are EU members already but the access to EMU and therefore expected rating upgrade connected with the membership is still possible for three of them.

However, the above analysis doesn't take into account the political and economic costs of the reforms and policies leading to improvement in the key rating determinants. Pragmatic policymakers need to consider these costs, too.

Conclusion

In this paper we have studied the sovereign credit rating determinants of Visegrad Four countries in the period 1993 – 2012. The foreign currency long-term ratings from four credit ratings agencies were used.

Based on economic theory and previous empirical studies we identified 38 potential explanatory variables. With the help of principal component analysis we determined the subset of variables with no significant multicollinearity. The linear model with fixed effects was used to estimate parameters and to identify relevant determinants of the sovereign credit rating.

Based on the linear models' results we detected a set of main determinants of the sovereign rating: inflation, unemployment, broad money to GDP, import to export ratio, openness of the economy, government gross debt, primary balance, size of the government, voice&accountability, EU dummy and EMU dummy. Unlike in other academic papers, the growth of GDP was not significant variable to explain the sovereign ratings. The impact of selected determinants on sovereign rating was further analysed and described in detail. The effect of significant explanatory variables was compared for different agencies and relative weights of rating determinants within the same agency were calculated, as well. The government finance is the most influential determinant of the sovereign rating. The main factor is government debt and the additional measures are primary balance and government consumption.

We included R&I among rating agencies researched in our paper. There was no surprising finding; the main explanatory variables of other rating agencies apply here as well. The variable degree of openness of the economy was significant only in R&I model, which makes it slightly distinctive, but so was the variable broad money to GDP for S&P or primary balance and government size for Fitch. The differences in the set of significant explanatory variables for the respective agencies may be actually consequence of different weights ascribed to the variables and the modelling method chosen. There were differences between agencies regarding the relative weights of the significant explanatory variables, as well. When the variables were aggregated to the broader groups, the differences between agencies got smaller but did not disappear.

Even though the rating agencies use variety of macroeconomic, socio-political and other qualitative variables to determine sovereign credit rating, empirical studies including our paper identify main factors influencing the sovereign rating changes in a set of selected countries in the given time period. Choosing a smaller subset of countries offers the opportunity to explore particularities of a given group and compare results with other studies.

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