ECONOMIC ANNALS, Volume LVI, No. 188 / January – March 2011
UDC: 3.33 ISSN: 0013-3264

SCIENTIFIC PAPERS

DOI:10.2298/EKA1188007L

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DETERMINANTS OF DEBT RESCHEDULING IN EASTERN EUROPEAN COUNTRIES

ABSTRACT: *This study utilizes Panel Logit Models applied to a set of macroeconomic, financial, and political variables to estimate the debt rescheduling probabilities of 15 Eastern European countries during the transition period from 1990-2005. These transition economies became a very attractive region for foreign investment. Specifically, the region became the largest recipient of net non-FDI flows among all emerging market regions in 2005. Therefore, it is relevant for policy makers and institutional and private foreign investors to investigate factors that influence debt rescheduling probabilities, as these may directly affect the size of and return on investments in these countries. Our findings suggest that policy efforts focused on reducing government expenditure, attracting foreign direct investment, increasing export revenues, and keeping a good repayment record result in low debt rescheduling probabilities and, in turn, decrease the cost of debt for these countries. This is a common finding for all countries in the sample, including those that have become EU members.*

KEY WORDS: *Country debt, rescheduling, Eastern Europe, transition, panel logit model*

JEL CLASSIFICATION: F33, F34

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1. INTRODUCTION

All major international investors and banks use sovereign debt default rates to price sovereign bonds and loans, as well as to determine country risk. Furthermore, in recent years many developing countries have negotiated new loan repayment schedules with their governments and commercial bank lenders. The aim of this study is to specify a model which would allow prediction of sovereign default/rescheduling rates with higher accuracy, particularly tailored for investors interested in the Eastern Europe (EE) region.

The group of 15 EE countries used in this study share similarities in respect of social, political, geographical, economic, and cultural characteristics. Most of the recent studies of sovereign debt problems looked at the middle income countries of Latin America, Asia, or Africa, but none of them paid special attention to the emerging markets of Eastern Europe and their transition period to market economies. Several earlier studies include data for some of these countries in their multi-country data set: however, due to specific common characteristics of EE countries, it is questionable whether conclusions from previous studies looking at all emerging markets can be directly applied to EE countries. Therefore this paper will focus on EE countries, as the very first attempt to model debt rescheduling probabilities for this region.

This paper aims to answer the following questions: (1) What are the most important determinants of EE sovereign debt rescheduling? (2) How accurately do those determinants predict sovereign debt rescheduling? (3) How to specify a model that would allow more accurate prediction of EE sovereign rescheduling? Answers to these questions could be used to derive implications for policy makers and potential creditors and investors in the region.

The countries included in the study are: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Poland, Romania, the Russian Federation, Serbia, Montenegro and the Slovak Republic. The regions' debt rescheduling probabilities are tested for the effects of a wide range of macroeconomic, financial, and political indicators.

2. LITERATURE REVIEW

A series of financial crises and defaults starting in the late 1970s and early 1980s (see e.g. Camdessus, 1986 and Cuddington and Smith, 1985), and later incidents,

culminating in Argentina's default in 2001, prompted an intense debate about how to prevent crises. As pointed out by Manasse, Roubini and Schimmelpfennig (2003) the literature on debt crisis falls into four broad categories: theoretical models of sovereign default, empirical studies of the determinants of debt crisis, empirical studies of the predictive power of credit ratings, and empirical studies of the determination of spreads. Given the aims of our study, the literature we review is focused on the determinants of debt rescheduling and the models used to predict it.

One of the earlier studies by Frank and Cline (1971) applied discriminate analysis to show that it is possible to obtain a very high prediction rate using only two factors, the debt service ratio and the average maturity of debt. Among the first studies using logit analysis were Feder and Just (1977) followed by Feder, Just and Ross (1981) and Feder and Uy (1985). The authors point out that the analysis of the growth record of many economies indicates that foreign capital is an important factor in the process of economic development. Eaton and Gersovitz (1981) developed a model of borrowing with default, showing that lenders establish debt ceilings above which they are unwilling to increase loans. Further, McFaden et al. (1985) estimate crisis probabilities using data on 93 countries from 1970-1982, concluding that although an econometric model can help to explain sovereign debt problems, it is extremely difficult to develop an early warning system that would predict debt crises in advance, as countries may experience heterogeneous repayment problems. They find that the debt burden, the level of per capita income, real GDP growth, and liquidity measures such as non-gold reserves are significant predictors of debt crisis, while the changes in real exchange rates are not.

In most of the empirical studies two groups of main variables were constantly included in the econometric analyses: short-term or liquidity factors (also known as traditional debt or financial ratios: debt/GDP, reserves/imports and debt service/export), and long term variables (GDP growth, investment, inflation). For example, Manasse, Roubini and Schimmelpfennig (2003) find solvency problems measured through high total external debt to GDP ratio and liquidity problems measured through short term debt to be highly associated with debt rescheduling. Hemming and Petrie (2000) present a discussion on fiscal sustainability and develop vulnerability indicators. Hemming and Chalk (2000) for the first time systematically examine the link between fiscal and external sustainability. Further, Detragiache and Spilimbergo (2001) study the importance of liquidity factors such as short-term debt, debt service, and the level of international reserves in predicting debt crises, and find that less liquid countries are more likely to default. Additionally, they find that countries that are more open are in

a better position to service debt and that an overvalued exchange rate hurts the future export performance of a country.

Krugman (1987) built a theoretical model that highlights the importance of the "debt overhang" of the developing nations and derives policy implications about the desirability of forgiving or refinancing such debt. Berg and Sachs (1988) found that higher income inequality is a significant predictor of a higher probability of debt rescheduling in the middle income countries. Also, the open trade regime is a significant predictor of a reduced probability of debt rescheduling. As they pointed out, earlier studies such as McFadden et al. (1985) identify variables that are more the symptoms of the crises rather than their fundamental causes.

Political risk and institutional variables are also found to play a key role in determining debt rescheduling among emerging market countries. Balkan (1992) was the first to find an inverse relationship between rescheduling probabilities for one country and its level of democracy, as well as a direct relationship between probability of rescheduling and political instability. More recent evidence of the significance of the political variable can be found in Haque, Nelson and Mathieson (1998). Brewer and Rivoli (1997) showed that the inclusion of political variables in forecasting models improves the correct prediction rate of rescheduling probability by 9% to 12% for the earlier periods and 18% to 35% for later periods. Citron and Nickelsburg (1986) point out that the political variable is in fact a non-diversifiable risk, and identify waves of default which tend to occur in approximately thirty year cycles and typically involve many countries. Georgievska et al. (2009) confirm the importance of political factors in determining debt rescheduling probabilities in emerging markets. Kraay and Nehru (2004) were the first to point out that the quality of institutions and policies has a key impact on rescheduling. Further, Butler and Fauver (2006) found that the quality of a country's legal and political institutions play a vital role in determining sovereign credit ratings. Reinhart and Rogoff (2004) find that the flows of capital from rich to poor countries are largely governed by sovereign default probabilities.

A number of studies are also assessing the impact of past debt repayment records on future rescheduling. For example, Carmen (1992), McFadden et al (1985) and Aylward and Thorne (1998) find that poor debt repayment history is a strong indicator of future problems.

Ciarlone and Trebeschi (2005) use financial market data to analyze the behaviour of CDSs spreads. Schwartz and Zurita (1992) develop a model which determines

the optimal amount of debt to borrow based on the production possibilities of the country, time preferences, and the risk-free interest rate. The study also gives the optimal level of debt default penalty: the higher the penalty that can be imposed on the country in the event of default the lower the probability of default but the higher the problem of underinvestment. These arguments are relevant when considering possible new debt authorization in the countries of Eastern Europe.

2.1. EE Countries' Recent Economic Position

The European Central Bank considers investing in EE countries during the transition period as potentially problematic due to two main reasons[1]: 1) credit growth can affect financial stability and financing 'bad' projects will eventually turn into bad debt or result in a build-up of large external debt, and 2) policymakers and market participants need to assess and monitor credit growth developments, as in the past they have been associated with the emergence of financial and currency crises.

In the early years of the transition most EE countries experienced a significant slump in GDP, which was followed by a period of rapid economic growth. In some cases rapid privatization of the banking sector and expansion of underdeveloped financial markets resulted in lending booms, followed by credit crunches and crises that spilled over to the region as a whole. Hoti (2005), for example, analyses country-specific and regional 1) economic, 2) financial, 3) political and 4) composite risk factors for six Balkan countries and documents significant country spill-over effects.

Eastern Europe is the only emerging market region with systematic current account deficits in 2005-2006. According to Roubini and Menegatti (2006) countries that have large current account deficits above 4% of GDP are Lithuania, Hungary, and Slovakia, while Schaffer (2007) reports that Estonia and Latvia have current account deficits even above 10%, which makes these countries similar to Romania, Bulgaria, Croatia, Bosnia and Herzegovina and the region of Serbia and Montenegro. At the same time some of these countries are recording high lending growth since most of them finance current account deficits by FDI. Most of the other emerging markets in Asia and Latin America are running current account surpluses. Since many previous episodes of financial crisis in emerging market economies have been associated, among other factors, with large current account deficits, it is important to examine the EE group of countries separately.

1 Financial Stability Rewiew, ECB (2006)

The average growth rate of credit in the 2001-2005 period has been very high in all countries in our sample except Poland, the Czech Republic and Slovakia (see Egert et al. (2006), Kiss and Nagy (2006), Coricelli et al. (2006), European Commission (2006), ECB Financial Stability Review (2006) and World Bank Regular Economic Report (2007)). In addition, Hungary observed asset bubbles in its equity and housing markets. Schafer (2006) indicates that these countries' economic boom is financed by foreign lending, and concludes that it may lead to financial crisis.

World Economic Outlook (2006) reports that the region's generally large current account deficit partly reflects favourable investment opportunities in the EE region. In some countries capital inflows were associated not just with private sector financial imbalances but also with substantial fiscal imbalances (e.g. Hungary, Poland, and Slovakia). However, WEO (2006) stresses that the large net capital inflows are increasing not in the form of FDI but rather in the form of other (more volatile) flows, including short-term debt. Specifically, the EE region became the largest recipient of net non-FDI flows among all emerging market regions in 2005. This has implications for policymakers and potential investors who need to examine the trade-off between sovereign capacities and risks involved.

Roubini and Menegatti (2006) distinguish between solvency and liquidity variables in the EE region, which are also potential determinants of sovereign debt rescheduling. This study reports high and rising levels of external debt as a share of GDP, especially for Hungary, Croatia, Slovenia, Latvia, and Estonia, and of debt to export ratio for Estonia, Hungary, Latvia, Poland, Slovenia, Croatia, and Romania. Liquidity risk measured as a share of money in foreign exchange reserves (M2/FX ratio) is well above one for all countries in the sample of this study. In addition, the short term debt/FX ratio is rising in Hungary, Croatia, Lithuania, Latvia, and Estonia. Gross external financing needs (measured as short term debt plus current account deficit as a share of foreign exchange reserves) are also greater than one for all countries. Public sector vulnerabilities are presented through the share of foreign currency public debt in total debt, which is greater than 50% in Estonia, Latvia, Lithuania, Croatia, Bulgaria, Romania, and Bosnia-Herzegovina. The share of short-term public debt in total debt is high (above 30%) in the Czech Republic and Poland, and medium (20-30%) in Hungary, Croatia, Lithuania, and Slovakia. Public debt to GDP ratio is high (above 50%) only in Hungary and Bosnia-Herzegovina. However, a more relevant measure of solvency, pubic debt to government revenues ratio, is relatively high (above 100%) in a larger set of countries: Hungary, Poland, Slovakia, Croatia, and Bosnia-Herzegovina. Overall, general government deficits are medium to high in Hungary, Slovakia, Croatia, the Czech Republic, Lithuania, Slovenia, and Romania.

Note that nine of the selected countries in our sample are members of the European Union (EU): Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Republic, and very recently Romania and Bulgaria. This will be taken into account in our models.

3. DATA SAMPLE

Annual data on rescheduling events and determinants of rescheduling is collected for 15 EE countries over the period 1990-2005. Our study includes countries of Central EE (Hungary, Czech Republic, Slovak Republic, Slovenia, and Poland), South EE (Croatia, Albania, Bosnia and Herzegovina, Serbia, Montenegro, Macedonia, Bulgaria, and Romania), Baltic countries (Estonia, Latvia, Lithuania) and Russia. The reason for this lies in their common historical heritage and initial economic conditions with which they started the period of transition in the early 1990s.

3.1. Defining the Dependent Variable: default or rescheduling event

Previous literature shows that there is no single empirical definition of what should constitute a sovereign debt crisis, a default, or a rescheduling event (see for example Manasse, Roubini and Schimmelpfennig (2003), Ciarlone and Trebeschi (2005), Eaton and Gersovitz (1981), Hajivassiliou (1987), Odedokun (1995) and Kraay and Nehru (2004)). Broadly speaking, a default is any failure by a debtor to meet its contractual obligations. The main event of default is missing a scheduled payment of principal or interest.

In this paper the dependent variable is defined as the "total amount of debt rescheduled", as is reported in the World Bank - Global Development Finance 2006 (GDF)[2]. If there was report of rescheduling on any of the component items, we have considered that the country rescheduled.

2 including debt stock rescheduled, interest rescheduled capitalized, interest rescheduled official, interest rescheduled private, principal rescheduled official, principal rescheduled private, and principal rescheduled. Debt from official creditors includes loans from international organizations (such as the World Bank, EBRD, or other multilateral and intergovernmental agencies) and loans from governments (bilateral loans). Debt from private creditors include bonds, commercial bank loans from private banks and other private financial institutions, and other private credits (from manufacturers, exporters, suppliers of goods, and bank credits covered by a guarantee of an export credit agency)

In the model that we intend to use the event of whether or not rescheduling took place is a dichotomous and qualitative variable. Therefore, the dependent variable is a binary variable possessing only two possible values or outcomes:

$$\text{Rescheduling } it = \begin{cases} 1 & \text{if sovereign i reschedules its debt in year t} \\ 0 & \text{if sovereign i does not reschedule its debt in year t} \end{cases}$$

Table 1: Sample and Data

Country	Period examined	Rescheduling
Albania	1993-2005	5
Bulgaria	1992-2005	5
Bosnia & Hertzegovina	2000-2005	1
Czeck Republic	1994-2005	0
Estonia	1994-2005	0
Croatia	1994-2005	4
Hungary	1990-2005	0
Lithuania	1994-2005	0
Latvia	1994-2005	0
Macedonia	1997-2005	3
Poland	1991-2005	4
Romania	1991-2005	0
Russia	1995-2005	10
Serbia & Montenegro	2001-2005	3
Slovak Republic	1994-2005	0
Total	1990-2005	35

Table 1 summarizes all the countries included in the analysis, the period examined for each country, and the actual rescheduling observations during the sample periods. The final sample is comprised of 176 observations and 35 rescheduling events.

3.2. Variables used as possible determinants of debt rescheduling

We start our analysis with 40 macroeconomic, financial, and political indicators that can potentially explain countries' sovereign debt rescheduling probabilities. This large number of variables will then be reduced to a significantly smaller number through several econometric steps, discussed in Section 4. The variables are divided into nine categories, specifically: 1) solvency, 2) liquidity, 3) variables used in currency crisis models, 4) macroeconomic variables, 5) external trade ratios, 6) public debt ratios, 7) financial variables, 8) past rescheduling record,

and 9) the political variable proxied by ICRG Index[3]. The list of all variables and the impact that each one is expected to have on the probability of rescheduling is shown in Table 2.

Table 2: Impact of selected variables on the probability of rescheduling

Variables	**Impact of the increase in value of the variable on probability of rescheduling**	
	Positive	**Negative**
Past rescheduling record:		
Lagged Rescheduling	×	
Political Variable:		
ICRG Rating		×
Solvency variables:		
Total Debt/GDP	×	
Total Debt/Exports	×	
Interest arrears on LDOD*/Exports	×	
Principal arrears on LDOD*/Exports	×	
Interest arrears on LDOD*/Debt	×	
Principal arrears on LDOD*/Debt	×	
Credit to private sector/GDP [(a)]		×
Real interest rate on international lending	×	
Risk Premium on international landing	×	
Exports/GDP		×
Exports growth rate		×
Multilateral Debt/Total Debt	×	
Concessional Debt/Total Debt	×	
Liquidity Variables:		
Short-term Debt/Total Debt [(b)]	ambiguous	ambiguous
Interest Service due/Exports	×	
Debt Service due/Exports	×	
PNG**, total private nonguaranteed creditors/Exports	×	
PPG***, official creditors/Exports	×	
International Reserves/GDP		×
Reserve/Total Debt		×
Reserves/Imports		×

3 In the ICRG index, the political risk rating contributes 50% of the composite rating, while the financial and economic risk ratings each contribute 25%. Each component is assigned a maximum numerical value (risk points), with the highest number of points indicating the lowest potential risk for that component and vice versa.

Variable used in currency crisis models:		
Devaluation of Exchange rate	×	
M2/Total Reserves	×	
Macroeconomic variables:		
Inflation rate (consumer prices)	×	
Inflation rate (GDP deflator)	×	
Unemployment rate	×	
Foreign Direct Investments/GDP		×
GDP per capita growth		×
GDP growth rate		×
Domestic Saving Rate		×
Extrenal trade ratios:		
Current Account Balance/GDP		×
Imports/GDP [(c)]	ambiguous	ambiguous
Public debt ratios:		
Government Expenditure/GDP	×	
General government balance/GDP		×
Government Revenue/GDP		×
PPG**, total public and publicly guaranteed debt/Exports	×	
Financial variables:		
S&P Emerging Market Index		×
Stock Traded Total Value/GDP		×

Note:

* Long-term debt outstanding

** Private non-guaranteed debt

*** Public and publicly guaranteed debt

(a) If the private sector debt increases relative to the overall economy, the probability of rescheduling by private banks and companies increases. However, in transition countries this variable can be the indicator of restructuring, development, and future potentials for GDP growth, which has a negative relationship with the probability of sovereign debt rescheduling. Thus, indirectly, we expect this variable to be negatively related to the probability of rescheduling.

(b) The impact of this variable is ambiguous since on one hand a higher proportion of short-term debt in total debt can lead to liquidity risks, but on the other investors can decrease their risk investing in a country short-term without being exposed to rescheduling probability in the long term future period. Detragiache and Spilimbergo (2001) stress that in fact countries with imminent debt crises can only borrow short-term.

(c) The higher the imports in relation to the size of the economy the more vulnerable the country to foreign shocks, and the more likely it is to reschedule its external debt. Thus the expected coefficient of this variable should be positive (Frenkel, 1983). However, it can be debated whether this is always true. The higher this ratio, the more open the economy is. Thus the country would not be willing to risk a trade embargo or being ostracised in the international economic arena due to defaulting on external debt (Odedokun, 1995).

The descriptive statistics associated with these variables for countries that have rescheduled during the sample period, as well as for those that have not, are presented in Table 3.

Table 3: Complete sample of sovereign debt rescheduling determinants: Descriptive Statistics

	All Countries			Countries that have rescheduled			Countries that have not rescheduled		
Variable	Obs	Mean	Std.dev.	Obs	Mean	Std.dev.	Obs	Mean	Std.dev.
Lagged Rescheduling	176	0.239	0.427	35	0.7157	0.458	126	0.119	0.325
ICRG Rating Assigned	141	0.507	0.291	27	0.513	0.234	101	0.562	0.276
Total Debt/GDP	176	0.474	0.251	35	0.581	0.324	126	0.436	0.221
Total Debt/Exports	169	1.036	0.563	32	1.488	0.755	125	0.919	0.456
Short-term Debt/Total Debt	176	0.204	0.177	35	0.149	0.167	126	0.217	0.178
Interest Service due/ Exports	169	0.041	0.027	32	0.036	0.019	125	0.0434	0.029
PNG, total private nonguaranteed/Exportsts	176	0.196	0.205	35	0.117	0.146	126	0.195	0.195
PPG, official creditors/ Exports	176	0.425	0.480	35	0.852	0.557	126	0.315	0.390
PPG, total public and publicly guaranteed/ Exports guaranteed/ Exports	176	0.754	0.630	35	1.365	0.707	126	0.608	0.517
Debt Service due/Exports	169	0.141	0.103	32	0.077	0.041	125	0.154	0.109
Reserves/Imports	168	0.035	0.014	31	0.030	0.016	125	0.036	0.012
Exports/GDP	176	0.431	0.179	35	0.317	0.113	126	0.458	0.180
Imports/GDP	176	0.509	0.174	35	0.384	0.152	126	0.536	0.166
Current Account Balance/ GDP	173	-0.05	0.064	35	-0.028	0.091	125	-0.057	0.048
International Reserves/ GDP	170	0.156	0.073	31	0.099	0.051	125	0.163	0.069
Credit to private sector/GDP	176	0.099	0.116	35	0.042	0.049	126	0.101	0.110
GDP per capita growth	175	0.033	0.058	34	0.020	0.089	126	0.033	0.048
GDP growth rate	175	0.028	0.051	34	0.012	0.065	126	0.029	0.048
Exports growth rate	168	0.095	0.140	33	0.072	0.227	120	0.095	0.113
Inflation rate (consumer prices)	174	0.515	1.774	35	1.328	3.306	124	0.343	1.077
Inflation rate (GDP deflator)	174	0.432	1.394	34	0.999	2.524	126	0.320	0.943
Devaluation of Exchange rate	174	-0.12	0.376	35	-0.284	0.534	124	-0.093	0.325
Interest arrears on LDOD/ Exports	176	0.039	0.173	35	0.174	0.356	126	0.005	0.034

Principal arrears on LDOD/Exports	176	0.073	0.267	35	0.302	0.529	126	0.016	0.070
Interest arrears on LDOD/ Debt	176	0.018	0.068	35	0.081	0.136	126	0.003	0.012
Principal arrears on LDOD/Debt	176	0.042	0.116	35	0.170	0.210	126	0.011	0.035
Domestic Saving Rate	176	0.153	0.131	35	0.123	0.201	126	0.163	0.104
Government Expenditure/ GDP	173	0.179	0.048	34	0.183	0.048	124	0.178	0.049
M2/Total Reserves	169	0.031	0.021	31	0.042	0.021	124	0.029	0.020
S&P Emerging Market Index	85	0.195	0.559	6	0.539	1.265	69	0.115	0.471
Foreign Direct Investments/GDP	176	0.038	0.030	35	0.018	0.024	126	0.043	0.030
Real interest rate	151	0.037	0.164	29	0.034	0.278	109	0.038	0.131
Risk Premium on Landing	83	0.073	0.176	15	0.207	0.392	64	0.043	0.030
Stock Traded Total Value/ GDP	134	0.044	0.063	23	0.029	0.045	98	0.045	0.065
Unemployment rate	127	0.129	0.060	20	0.141	0.057	103	0.126	0.060
Reserve/Total Debt	170	0.459	0.384	31	0.263	0.215	125	0.505	0.416
General government balance/GDP	122	-0.02	0.037	19	-0.032	0.046	98	-0.019	0.034
Government Revenue/GDP	123	13.38	45.06	19	74.312	82.76	99	0.291	0.112
Multilateral Debt/Total Debt	176	0.146	0.146	35	0.128	0.153	126	0.149	0.137
Concessional Debt/Total Debt	176	0.105	0.174	35	0.126	0.191	126	0.099	0.161

The three main sources of data used to compile the set of variables described in Sections 3.1. and 3.2. are: IMF's International Financial Statistics, World Bank's Global Development Finance, and World Bank Development Indicators. The political variable, the ICRG index, is provided by the PRS Group. The frequency of all data is annual. To ensure the predictive power of our models, all potential explanatory variables from Section 3.2. are lagged by one year.

4. EMPIRICAL MODEL SPECIFICATION

Using all 40 variables at the same time would result in an overly complicated model, with many potentially significant coefficients appearing as statistically indistinguishable from zero, i.e. multicolinearity and over-fitting of the model may cause biased values of the significance test. Therefore, to eliminate less relevant variables, we proceed along a three-stage strategy.

4.1. Stage 1: Selecting Relevant Variables - Univariate Panel Logit

To define a panel logit model, consider a country *i* observed over T periods of time, where $t = 1,\ldots,T$ and $i = 1,\ldots,N$. For this country there exists an unobservable[4] random variable y^*_{it} indicating latent propensity. Whilst we do not observe y^*_{it} directly, we do observe a binary outcome y_{it} such that $y_{it} = 1(y^*_{it} > 0)$ where y_{it} is termed the indicator function taking the value 1 if the condition within parentheses is satisfied, and 0 otherwise. An example of this might be the amount of total debt rescheduled (y_{it}), and the capability of the country to pay its debts (y^*_{it}). y^*_{it} is a function of explanatory variable(s) x_{it}, constant unobserved individual county effects α_i and random error term u_{it}. The following equation represents the above:

$$y^*_{it} = \alpha_i + x'_{it}\beta + u_{it} \tag{2}$$

y_{it} is a dummy variable defined by:

$$y_{it} = \begin{cases} 1 & \text{if } y^*_{it} > 0 \\ 0 & \text{otherwise} \end{cases}$$

For any β, the probability of observing the outcomes y_{it} is conditional on the values of variable x_{it}.

For the univariate panel logit model, the probability that a sovereign *i* will reschedule its debt at time *t* is given as:

$$\text{Prob}(Rescheduling_{it} = 1) = \frac{\exp(\alpha_i + \mathbf{x_{it}}\beta)}{1 + \exp(\alpha_i + \mathbf{x_{it}}\beta)} \tag{3}$$

At the first stage, we run univariate panel logit regressions for each of the 40 variables independently from one another. This will enable us to exclude from the final model all the variables that turn out to be insignificant in determining whether the sovereign reschedules its debt or not.

Through this procedure we extracted 17 variables, namely: Lagged Rescheduling Event, ICRG index, Export/GDP, Current Account/GDP, Total Debt/GDP, GDP growth rate, Foreign Direct Investment/GDP, General Government Expenditures/GDP, Credits to Private Sectors/GDP, Short Term Debt/Total Debt, Inflation Rate, Exchange Rate Devaluation, Interest Arrears/Total Debt, Principal Arrears/Total Debt, M2/Reserves, Imports/GDP and International Reserves/GDP. However,

4 'latent' variable

using 17 variables in the same model can still result in a biased coefficient and in turn biased interpretation of which variables increase the probability of debt rescheduling.

4.2. Stage 2: Selecting Relevant Variables - Principal Component Analysis

In order to eliminate any strong and persistent multicolinearity between the 17 explanatory variables obtained from the univariate panel logit approach, in this next stage we resort to the Principal Component Analysis (PCA). The PCA provides a method for simplification, combining many correlated variables into a smaller number of underlying factors (Hamilton (2004)). More specifically, PCA computes a new set of orthogonal values from a linear combination of the explanatory variables. PCA can be defined as:

$$L_i = \alpha_1 X_1 + ... + \alpha_n X_n \tag{4}$$

where $\sum_{n=1}^{n} \alpha = 1$; the variance of the equation is maximized and L_i the explanatory variable is orthogonal.

In order to select how many factors to use, we consider eigenvalues from the PCA. For the full set of 17 explanatory variables, it was found that 5 components (factors) have eigenvalues greater than 1, accounting for 71.24% of the total variability in the data, and therefore regarded as significant for our further analysis. After rotating the factor matrix from the identification of the highest factor loadings for each variable on each factor, we have determined the dimension of each of the 5 factors (components) named after the variables that dominate in each group:

- Factor 1 – *Solvency (Trade) Dimension*: Total Debt/GDP, Foreign Direct Investment/GDP, Credits to Private Sectors/GDP, Imports/GDP, and International Reserves/GDP
- Factor 2 – *Liquidity Dimension*: Interest Arrears/Total Debt, Principal Arrears/ Total Debt, and M2/Reserves
- Factor 3 – *Currency Crises/Macroeconomic Dimension*: Exchange Rate Devaluation Inflation Rate and GDP growth rate
- Factor 4 – *Public Debt Dimension*: General Government Expenditures/GDP and Short Term Debt/Total Debt
- Factor 5 – *External Debt Dimension*: Current Account/GDP.

Table 4: Rotated Component Analysis Factor Matrix
Rotated Factor Loadings – Verimax Rotation

Variable	1	2	3	4	5	Uniqueness
Dimension	**Solvency**	**Liquidity**	**Currency Crises**	**Public Debt**	**External Debt**	
Lagged rescheduling	-0.25901	**0.70869***	-0.04018	-0.1655	0.41683	0.22793
ICRG rating	**-0.422***	0.02938	-0.28118	0.06931	-0.37426	0.59711
Total debt/GDP	**0.63688***	0.43336	-0.26262	0.06086	0.00979	0.33381
Short-term Debt/Total Debt	0.13345	-0.25657	0.08085	**0.79881***	-0.09905	0.26191
Exports/GDP	**0.77124***	-0.14041	0.00282	0.40539	-0.08846	0.21329
Imports/GDP	**0.74658***	-0.18642	0.13958	0.37571	-0.32712	0.14022
Current Account Balance/GDP	-0.28283	0.1515	-0.12902	-0.05042	**0.80626***	0.22782
International Reserves/GDP	**0.7009***	-0.27745	0.30843	-0.06134	-0.00486	0.33285
Credit to private sector/GDP	**0.68583***	-0.12632	0.22248	0.17689	-0.06644	0.42848
GDP growth rate	0.11705	-0.23265	**0.75694***	0.09883	0.17676	0.3182
Inflation rate (consumer prices)	0.06741	0.00681	**-0.79758***	-0.10676	0.29335	0.26183
Devaluation of Exchange rate	0.21231	-0.07999	**0.87577***	0.06967	-0.06636	0.17229
Interest arrears on LDOD/Debt	-0.08535	**0.88884***	-0.17785	0.03769	0.12409	0.15423
Principal arrears on LDOD/ Debt	-0.1022	**0.84736***	-0.00989	-0.14006	-0.06261	0.2479
Government Expenditure/GDP	0.2096	0.12429	0.12928	**0.79534***	0.02363	0.29078
M2/Total Reserves	-0.41073	**0.49661***	-0.4685	0.05535	-0.1585	0.337
Foreign Direct Investments/ GDP	**0.66853***	-0.27788	0.20131	-0.06331	-0.29768	0.3427

Note: * the highest factor loading for each variable

Thus, from each dimension (component) we have selected no more than two to three variables (12 in total), according to the highest factor loading, which are sufficient to explain the whole dimension. The results of the rotated factor matrix are presented in Table 4.

4.3. Stage 3: Building the Multivariate Panel Logit Model: Stepwise Gradual Method

In this final stage we apply the Forward Stepwise Gradual Model Based Procedure for the multi-variate panel logit model construction, with the aim of developing parsimonious models, i.e. models that have a high degree of correct predictions and low Type I and Type II errors[5]. The reason for this gradual model building is to control for the variables that can be omitted (see Roubini, Mannase and

5 Type I error occurs when actual defaults/reschedulings are classified by the model as non-defaults/reschedulings. Type II error occurs when actual non-defaults/reschedulings are classified by the model as defaults/reschedulings. The cut-off point for classifying a probability as rescheduling or non-rescheduling is determined by default: cut off point of 0.5

Schimmelpfenning (2003) and Ciarlone and Trebeschi (2005) for stepwise model-building procedure).

Our Forward Stepwise multivariate panel logit regressions indicate that there is a persistence in statistical significance of three variables, namely: Total debt/GDP, Exports/GDP, and Current Account/GDP. We refer to those variables as 'fixed' variables in the further text, as proposed in Sala-i-Martin (1997). 'Fixed' variables are used as a basis for the models we examine, while additional variables to be included in these multivariate logit models are selected using the forward stepwise procedure. Therefore, we generate two models that we believe are more accurate than others:

1) Model I includes: the 'Fixed' variables, Foreign direct investments, General Government expenditures, Credits to private sector, Short-term debt, and the Lagged rescheduling record.
2) Model II includes: the 'Fixed' variables, the Lagged rescheduling record, GDP growth, M2/Reserves and ICRG composite index. However, 8 of the 15 countries analysed joined the EU during the sample period, which may lead to the improvement of the debt repayment record of a country. Thus, to test whether EU membership influences the probability of debt rescheduling, we add an EU dummy variable to Model II, taking value of 1 when a country becomes a member and zero otherwise, creating Model IIa.

Note that the probability of rescheduling in a multivariate panel logit framework is obtained in a similar manner to in equation (3):

$$\text{Prob}(Rescheduling_{it} = 1) = \frac{\exp(\alpha_i + \mathbf{x}'_{it}\beta)}{1 + \exp(\alpha_i + \mathbf{x}'_{it}\beta)} \tag{5}$$

where, in the multivariate panel logit model framework, β is a (k x 1) vector of parameters associated with the transposed vector of variables x_{it} selected for the model. Finally, following Hausman (1978) test results, we apply random-effect logit model estimation[6], indicating that state dependence appears to be very important in the case of sovereign debt rescheduling (as found in Aylward and Thorne (1998), Hajivassiliou (1989, 1994), McFadden et al. (1985), Brewer and Rivoli (1997), Carmen (1992) among many others).

6 Random effects panel logit model (REM) is appropriate when there are cross sectional differences or heterogeneity, and this hetereogeneity is assumed to be not correlated with the regressors of the model.

5. RESULTS

The results for Model I, Model II, and Model IIa are presented in detail in Table 5. All tested variables in Model I are highly statistically significant at the 1% and 5% level of statistical significance, except for the Lagged dependent variable (rescheduling event) that has a *p* value slightly above the 10% significance level, and Foreign direct investments that are significant at 10%. All significant variables in Model I have the expected sign. Model I and the explanatory variables are jointly statistically significant at the 5% level, as indicated by p-values of the Wald Chi-squared test.

Since the logit model is non-linear, the coefficients obtained by Model I do not explain the contribution of each variable to the probability of rescheduling, but instead they represent odds ratios which are not easily interpreted. Therefore we calculate the real marginal effects that each of the variables has on the dependent variable.

A closer look at the marginal effects for Model I shows a significant impact of explanatory variables on the probability of debt rescheduling, both 'fixed' explanatory variables and those less typically found in literature on emerging market debt rescheduling probabilities. For example, an increase in one unit of the 'fixed' variable Total Debt/GDP causes an increase in debt rescheduling probability by 2.55%, while a unit increase of Exports/GDP ratio causes decrease in sovereign debt rescheduling probability by 7.03%. An increase in a unit of Current Account/GDP ratio causes a 5.06% increase in sovereign debt rescheduling probability

This may seem counterintuitive, since it implies that the higher the current account surplus the more likely it is that the country will reschedule its debt. However for transitional economies, such as the countries in our sample, current account deficits may be associated with higher growth and financial integration in the region (see Abiad et. al., 2007), which in turn can lead to improvement of the debt repayment record of a country. The Foreign Direct Investment/GDP ratio variable shows the level of openness of the country, and is a significant indicator of the business climate in the country that wants to attract investment, so it is not a surprise that its unit increase causes a 9.4% decrease in sovereign debt rescheduling probability. Additionally, countries in transition are well known for their high levels of government spending; therefore, in our sample, a unit increase of Government Expenditure/GDP ratio causes a massive 19.25% increase in sovereign debt rescheduling probability.

Table 5: Estimation Results

Dependent variable: rescheduling	*Model I*		*Model II*		*Model IIa*	
Independent Variables:	**Coefficient (t-stat)**	**Marginal Effects % (dy/dx)[(a)]**	**Coefficient (t-stat)**	**Marginal Effects % (dy/dx)[(a)]**	**Coefficient (t-stat)**	**Marginal Effects % (dy/dx)[(a)]**
ICRG rating			-.0176371 (-0.01)	-.000071	-.0756585 (-0.04)	-.0000398
Lagged rescheduling	-1.576432 (-1.56)	-.0038672	3.013223 *** (2.83)	.0385583	2.986011*** (2.80)	.005028
Total debt/GDP	7.694058 *** (3.10)	.0255903	9.326913 *** (2.58)	.0379242	9.290832 *** (2.58)	.0048852
Exports/GDP	-21.16365 *** (6.18)	-.0703899	-25.3023 *** (-2.80)	-.102882	-25.15219 *** (-2.78)	-.0132253
Current Account Balance/GDP	15.22603 ** (2.05)	.0506415	22.84288 ** (2.33)	.0928816	22.75349 ** (2.33)	.0119641
GDP growth			-13.61478 * (-1.73)	-.0553592	-13.46319 * (-1.71)	-.0070791
Foreign Direct Investments/GDP	-28.29895 * (-1.68)	-.0941218				
Government Expenditure/ GDP	57.87097 *** (3.51)	.1924778				
Credit to private sector/GDP	-19.44009 ** (-2.48)	-.0646574				
Short term debt/Total Debt	-6.047547 ** (-2.11)	-.020114				
M2/Reserves			-24.15499 (-0.92)	-.0982168	-23.79202 (-0.91)	-.0125102
EU Dummy					-35.83584 (-0.00)	-.0042394
constant	-5.396614**		2.16618		2.176749	
Sigma_u	4.949668		.0009119		.0009119	
Rho	.8816129		2.53e-07		2.53e-07	
Log-Likelihood	-36.385		-20.783		-20.753	
Wald Chi-Squared	17.40		19.32		18.92	
P-value of Chi2	0.0262		0.0072		0.0153	
Cut off point	0.5		0.5		0.5	
Correct Classifications(%)	81.37		75.78		75.78	
Type I Error (%)	14.91		3.73		3.73	
Type II Error (%)	3.73		20.5		20.5	
No. of Observations	157		120		120	
No. of Countries Analysed	15		12		12	
Period Analysed	1990-2005		1990-2005		1990-2005	

Note: Marginal effects are calculated at the sample means of the independent variables except for the dummy lagged rescheduling variable where the marginal effect is calculated for discrete change from 0 to 1. * significant at 10% level of significance; ** significant at 5% level of significance; *** significant at 1% level of significance.

Furthermore, in Table 2, we show that the impact of credits to private sector/GDP and short term debt share in total debt variables on probability of debt rescheduling can be somewhat ambiguous. Both of those variables are significant at the 5% level and negatively related to the probability of debt rescheduling. Specifically, it seems that a country is less likely to reschedule if there is a higher percentage of short-term debt in total debt. In countries in transition, given their economic and other uncertainties and risks[7], it is not surprising that short-term debt is percieved as less likely to default than long-term debt. In terms of credits to private sector/GDP, it is possible that private sector investments in transition economies are perceived as showing higher levels of credibility than the public sector. Furthermore, this variable can be an indicator of ownership restructuring and potential for higher future GDP growth, which in turn decreases the probability of sovereign debt rescheduling. Thus an increase in credits to the private sector can decrease the risk of sovereign debt rescheduling probability as a strong indicator of private sector development in transition countries, which investors take into account when they calculate the net present values of their investments.

Model II and its explanatory variables are jointly significant at the 1% level. Although the majority of the variables used in the model are significant, such as the 'fixed' variables (at the 1% or 5% level), GDP growth (at the 1% level) and lagged rescheduling event (at the 1% level), our findings show that political factors (ICRG index) and liquidity variable M2/Reserves do not significanlty influence debt rescheduling in the region.

Marginal effects in Model II show that one additional debt rescheduling event increases the probability that the country will reschedule in the future by 3.85%. A unit increase in total debt/GDP and current account/GDP increases the probability of debt rescheduling by 3.79% and 9.29% respectively, whereas a unit increase in export/GDP and GDP growth rate decreases the probability of debt rescheduling by 10.29% and 5.54% respectively. The persistently high influence of export/GDP variable in both Model I and Model II can be explained by the fact that the countries that we are focusing on are mainly small open economies, highly influenced by terms of international trade and finance. At the same time exports are generating revenues and GDP growth, and represent the drivers of stability of these countries. In conclusion, besides the current account and the level of total debt burden, these small open economies' investment opportunities are highly dependent on their past rescheduling records.

7 For further details see Detragiache and Spilimbergo (2001)

One of the results of Model II that we believe requires more attention is the insignificance of the political variable, which has been found to be important in many previous studies. One reason for this could be the decrease of potential political risks and stabilisation in the region during the period observed in this study. Specifically, in the later part of our sample period, most of the countries entered the final phase of transition while some of them joined the European Union. To check for the ultimate importance of being a member of the European Union (perceived in this context as a political factor variable), we extend Model II by including an EU dummy variable to create Model IIa. The insignificant EU dummy coefficient in Model IIa implies that EU membership does not affect sovereign debt rescheduling probabilities in EE countries during the sample period.

Overall, in terms of determinants of debt rescheduling, it turns out that variables which are more specific for countries in transition have greater impact on debt rescheduling than variables traditionally considered as the most influential ones according to the literature (e.g. political factors, reserves to imports, total debt service payment to exports, inflation, indicators of exchange rate overvaluation, etc.)

In the search for the most accurate model, in terms of higher forecasting accuracy and lower Type I and Type II errors, Model I appears better than Model II and Model IIa in that it has a higher prediction level (81.37% of correct classification) and very low Type II error (3.73%). However, Type I error for Model I is quite high (14.9%). Since for international lenders it is potentially more important to correctly classify actual reschedulings (than actual non-reschedulings), that is to have a lower Type I error, Model II (and IIa) is better in this context, generating a very low level of Type I error (3.73%). However Model II and IIa have a lower number of total correct predictions (75.78%) compared to Model I, which also implies that Type II error has increased (20.5%). Such a Type II error in Model II (IIa) implies that the model is too restrictive, classifying 1/5 of non-rescheduling events as rescheduling. Thus applicability of this model is limited to only very risk-averse investors. Furthermore Model II could deter potential investors, as it overstates the possibility of rescheduling. This could decrease growth possibilities in these small open economies, slowing the speed of transition and increasing the debt burden while waiting for potential investors. Therefore the analysis suggests that in order to control both for model accuracy and Type I error, investors would find both of these models useful.

6. CONCLUDING REMARKS

This paper provides new empirical evidence about the determinants and importance of international and country-specific macroeconomic indicators of the sovereign debt rescheduling probabilities of the EE countries. During the economic transition the EE countries became a very attractive European region creating an investment boom. The region became the largest recipient of net non-FDI inflows among all emerging market regions in 2005. Developing models that can provide more accurate estimates of debt rescheduling probabilities in this region can benefit investors as well as the host countries.

This study estimates sovereign default/rescheduling probabilities using panel logit models on a sample of 15 EE countries over the period 1990-2005. Compared to previous studies performed in this area, this paper combines different econometric methodologies to develop models with a high degree of accuracy.

The findings show that in predicting the debt rescheduling probabilities one should utilise both of the two models suggested. Particularly, the models imply that EE countries that want to reduce their probabilities of rescheduling, therefore reducing cost of borrowing and/or improve access to credit, should generally:

1) Control and reduce their general government expenditures by restructuring the public sector, attract more Foreign Direct Investment and stimulate GDP growth.
2) Increase their export revenues by implementing a strategic trade policy in order to balance their current accounts
3) Demonstrate good repayment performance by limiting the size of the external debt compared to their GDP and not default on sovereign debt as a result of unwillingness, rather than inability, to repay.

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Received: March 22, 2011
Accepted: April 6, 2011