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THREE SISTERS: THE INTERLINKAGE BETWEEN SOVEREIGN DEBT, CURRENCY AND BANKING CRISES

Sylvester C. W. Eijffinger and Bilge Karataş

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Sylvester C. W. Eijffinger, CentER, European Banking Center Tilburg University and CEPR
Bilge Karataş, CentER and the Graduate School of Economics, Tilburg University, and ASIS, Avians University of Applied Sciences

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ABSTRACT

Three Sisters: The Interlinkage between Sovereign Debt, Currency and Banking Crises

The sovereign debt default and the linkages from banking and currency crisis have been rarely explored in the crisis literature. This study attempts to dive into this unexplored area by applying panel data binary choice model on a sample with 20 emerging countries having monthly observations for the years between 1985 and 2007. The non-linear linkages from currency and banking crises to sovereign defaults are explored by using the interactions of these crises with international illiquidity, appreciated real exchange rates and real international monetary policy rates. It is discovered that currency, banking and debt crises tend to occur simultaneously. Prior occurrence of a currency crisis increases the sovereign default probability through appreciated real exchange rates, and in countries with high short-term indebtedness the occurrence of banking crisis raises the probability of a debt crisis.

Sylvester C. W. Eijffinger
Department of Economics
CentER Tilburg University
PO Box 90153
5000 LE Tilburg
NETHERLANDS

Email: s.c.w.eijffinger@uvt.nl

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Bilge Karataş
CentER
Department of Economics
PO Box 90153
5000 LE Tilburg
NETHERLANDS

Email: b.karatas@uvt.nl

For further Discussion Papers by this author see:
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I.   Introduction[1]

The ongoing Euro-zone sovereign debt crisis brings two inescapable questions: whether the problem of the countries defaulting on their sovereign debt is more related to their political environment compared to the macroeconomic problems, and whether there are indirect linkages from currency or banking crises to sovereign debt crises. From an historical perspective, debt crisis is more of an emerging economy problem since the advanced countries are closer to international financial markets and have better debt and currency managements. Therefore although recent developments show that there is no crisis prone country, the crisis episodes in emerging economies still attract more research compared to the advanced world.

A country's inability to rollover its debt is mostly signaled by solvency and liquidity measures. However, some countries experience prolonged episodes of high public debt to GDP ratios without experiencing a default. This leads to the question when do the sovereign financial problems turn into an action of default? As Reinhart and Rogoff (2009) put clearly in to words, "country default is often the result of a complex cost-benefit calculus involving political and social considerations, not just economic and financial ones"[2]. Nevertheless, this argument have rarely found itself in the empirical literature mainly because of the difficulty of empirically diagnosing the episode of sovereign default as well as the political indicators that play a role in the default decision.

Another recent attention in the crisis literature is the causal links from other financial crises to sovereign defaults. A currency or banking crisis increases the uncertainty of the foreign creditors regarding the government's ability to payback its debt and might lead to a default in the government's obligations. These contagions from one crisis to the other occur quite sudden which are mostly not captured in analyses applying low-frequency data.

In this study grounding from the recent sovereign debt crisis embracing Europe, the role of the political stability and the onset of currency and banking crises on the probability of sovereign default are investigated on a panel data binary choice model. The panel consists of 20 emerging economies with monthly observations between the years 1985 and 2007. In estimating the probability of an occurrence of sovereign debt crisis, along with macroeconomic variables well reputed in the literature, institutional variables and the previous incidences of banking and currency crises are included in the analyses. In exploring the triggers through banking or currency crises to sovereign defaults, interaction terms of these crisis events with international illiquidity of the country, appreciated real exchange rates and real

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[1] We thank Benedikt Goderis for his valuable comments and suggestions, and Galina Hale and Carlos Artera for sharing the data of their study "Sovereign debt crises and credit to the private sector".
[2] Reinhart and Rogoff (2009:51)

international interest rates are introduced. By doing so, the study tries to justify the theoretical linkages from currency to debt crises when the economy has high short-term external debt, appreciated real exchange rates and the tight international lending conditions; and from banking to debt crises if the country's short-term foreign debt is high. The results suggest that not only banking and currency crises are highly correlated with debt crisis, but also these crises have significant non-linear effects on the sovereign default probability.

The rest of this study is structured as follows: Section II presents the literature on sovereign debt defaults and on the possible links through banking and currency crisis to sovereign debt crisis, methodology and data of the analysis of this paper is presented in Section III preceding the results of the analyses in Section IV, Section V represents the robustness checks with conditional logit and system GMM estimations, and lastly the conclusion appears in Section VI.

II.   Literature Review

II.I. Causes of Debt Crises

The theoretical studies regarding sovereign risk and sovereign defaults mainly gather around two broad categories. The first ones study the cost and benefit analyses of the governments on the decision to continue servicing their debt; in these cases government chooses to default if the benefit of default exceeds the costs of the default, such as reputation loss or negative output effects. Pioneered by the classical paper of Eaton and Gersovitz (1981) this literature focuses on the willingness to pay of the debtors. The second category focuses on illiquidity or insolvency driving the country to a debt crisis since the government is unable to meet its debt obligations.

The theoretical model by Citron and Nickelsburg (1987) diverges from the other studies since its focus is on the political stability and its connection with debt crisis. They take into account economic and political factors in predicting the debt crisis. Their finding suggests that the political riskiness plays a major role in increasing the sovereign default probability.

Generally the empirical studies seeking the causes of the sovereign debt crises use the binary models having the occurrence of the sovereign default as the dependent variable and various macroeconomic variables, debt measures and liquidity indicators as independent variables. However there is no single definition for sovereign debt crisis in the empirical literature and it changes depending on the availability of information and the specific effects investigated in these studies.

Detragiache and Spilimbergo (2001) by analyzing 69 countries for the years 1971-1998 find that short-term debt, debt service, and foreign exchange reserves - the three measures of liquidity - play a role in explaining debt crisis. They also encounter endogeneity of the short-term debt, since it becomes harder for countries to borrow in longer terms on the eve of a debt crisis.

Manasse, Roubini and Schimmelpfenning (2003) ask which fundamentals in an economy are in imbalance prior to the sovereign debt crisis. They define debt crisis following Standard and Poor's default criteria in addition to high amount of IMF financing. Using a dataset consisting of yearly observations for 47 countries between 1970 and 2002 they estimate the probability of debt crisis with logit and binary recursive tree techniques. The authors control for the internal and external macroeconomic environment causing the debt crisis. Most of the debt crises periods are predicted correctly by the model. Mainly high levels of foreign debt, short term indebtedness, low growth rate of GDP, current account deficit, lower openness to international trade, tight interest rate policy of the G7 countries, high levels and volatility of inflation, election years, and high ratio of public debt to GDP precede the debt crisis for the economies in the sample.

Balkan (1992) uses a probit model for 33 developing countries for the years between 1970 and 1984 in testing the effect of political instability on the probability of sovereign debt rescheduling. He finds negative relationship between the democracy level of a country and rescheduling probability and positive relationship between political instability and the probability of debt rescheduling.

II.II. Links from Banking and Currency Crises to Debt Crises

Unlike the ample literature on the causal links between currency and banking crises, the connection of debt crisis with currency or banking crises is less sound. Debt, currency and banking crisis might happen simultaneously since there might be common economic problems resulting in triple crisis. On the other hand these crises can be contagious through worsening of macroeconomic environment caused by banking or currency crises triggering the default. One of the well-known links from currency to debt crisis is the "original sin" argument: currency devaluation leads to sovereign default if the majority of the debt is denominated in foreign currency which applies mostly to emerging economies[3]. The high amount of short-term foreign debt also works as a linkage from banking crisis to sovereign default. As discussed in Rosenberg et al. (2005) banking crisis spreads to government balance sheets if currency and maturity mismatch together with market risks in the economic system exist. Overvalued real exchange rates prior to

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[3] Eichengreen and Hausmann (1999, 2005) and Jeanne (2005)

domestic currency devaluation increase the default risk as evidenced by Jahjah and Montiel (2003) appears to be another cause of a possible spread from currency to debt crisis. Finally, the rise in the international interest rates trigger currency crisis leading to debt crisis since devaluation makes it difficult for the government to service its increased debt burden caused by high interest payments[4].

Reinhart (2002) analyzes among other things the interaction between currency and debt crises and finds that in emerging economies currency crises help in predicting debt crises in 85 percent of the cases but the converse is not true. Bordo and Meissner (2005) compare the 1880-1913 period to 1972-1997 in searching the role of foreign debt on different types of crises along with debt crises. The authors use currency and banking crises as indicators of sovereign debt crises and find evidence that high external debt and currency crisis experienced in the current or previous period increase the probability of debt crisis. Reinhart and Rogoff (2010) conduct an historical analysis dating back to 1800s for analyzing the relation between banking and debt crises applying multinomial logit estimation with two equation systems. The main finding of the study is that both banking and debt crises explain the occurrence of each other. The ratio of public debt to GDP also explains the occurrence of both crises types except the post World War II period debt crises episodes.

Based on the findings of the empirical literature and the focuses of the theoretical considerations the empirical focus of this study is going to be on the influence of currency and banking crises and the non-linear effects of these crises on sovereign debt defaults. In this respect, the role of political instability together with macroeconomic environment is going to be controlled. This study fills the gap in the literature of sovereign debt crises by using high-frequency data in analyzing the linkages.

III. Methodology and Data

III.I. Starting Dates of Sovereign Debt, Currency and Banking Crises

Almost all empirical studies investigating causes or linkages of financial crises rely on yearly data since especially for sovereign debt and banking crises, establishing the exact month of the onset of crisis is not easy. In this study, various sources which do careful analyses on determining the starting months of the sovereign debt, currency and banking crises are used.

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[4] Dreher et. al. (2006)

The staring months of the sovereign debt crises are taken from Artera and Hale (2008) who define the start of the sovereign debt crisis as the date when the renegotiation of the sovereign debt first mentioned in the English-language media prior to any restructuring agreement. They trace financial news in the Lexis-Nexis database in order to distinguish the default dates of sovereign debt. The onset of currency crises in the sample has been identified following Kraay (2003) and Eijffinger and Karataş (2012): A country is experiencing a currency crisis if the depreciation of domestic currency price per US dollar exceeds 5 percent for advanced and 10 percent for emerging economies in a given month following an episode of stable exchange rates (i.e. the average absolute percentage change should be lower than 1 percent for advanced and 2.5 percent for emerging economies for the 12 month-period prior to the large depreciation). Laeven and Valencia (2008) provides an updated, corrected, and expanded version of the banking crises database of Caprio and Klingebiel (1996) and Caprio, Klingebiel, Laeven, and Noguera (2005). In their database they require the banking crisis to be 'systemic' that they exclude banking system distress events that affected solely isolated banks. The work provides the starting months of the systemic banking crises, which indicates dispersion from the previous literature where the onsets of the banking crises were identified on an annual basis.

Accordingly, the starting months of sovereign debt, currency and banking crisis for the 20 emerging economies used in this study for the period between January 1985 and December 2007 can be found in Table I.1 in Appendix I.

III.II. The Model

In order to address the determinants of the sovereign debt crises, a pooled probit estimation is applied using the macroeconomic and institutional causes besides contemporaneous and three-month lagged moving averages of the currency and banking crises starting dates. The backward-looking moving averages are included to deal with the possible multicollinearity problem caused by including multiple lagged terms in the estimations. The probit model is defined by the following equation:

$$D_{i,t}^{*} = \beta_0 + \beta_1 X_{i,t-1} + \beta_2 Z_{i,t-1} + \beta_3 C_{i,t-1 \text{ to } t-3} + \beta_4 B_{i,t-1 \text{ to } t-3} + \beta_5 C_{i,t} + \beta_6 B_{i,t} + \beta_7 C_{i,t-1 \text{ to } t-3}{}' X_{i,t-1} \quad (1)$$
$$+ \beta_8 B_{i,t-1 \text{ to } t-3}{}' X_{i,t-1} + \mu_{i,t}$$

Where, $D_{i,t}^{*}$ is unobservable latent random variable for sovereign debt crisis. However, the discrete dependent variable $D_{i,t}$ is observable such that;

$$D_{i,t} = 1 \qquad \text{iff} \qquad D_{i,t}{}^{*} > 0 \text{ and } 0 \text{ otherwise}$$

The dependent variable $D_{i,t}$ takes the value of 1 if a sovereign debt crisis has started in country i in month t and zero otherwise[5]. The vectors $X_{i,t-1}$ and $Z_{i,t-1}$ include the set of macroeconomic and institutional variables, respectively, which play crucial role in influencing sovereign defaults. $C_{i,t}$ and $B_{i,t}$ represent the onset of currency and banking crises respectively, and $C_{i,t-1 to t-3}$ and $B_{i,t-1 to t-3}$ are the three month lagged moving averages of the two crises dummies. In order to capture the channels through which each crisis effect the sovereign debt crisis, the interaction terms of currency and banking crises with macroeconomic variables, $C_{i,t-1to t-3} {}'X_{i,t-1}$ and $B_{i,t-1 to t-3} {}'X_{i,t-1}$, are included in the regression equation.

III.III. Data[6]

The unbalanced sample included in the current analysis includes monthly observations starting from January 1985 until December 2007 for 20 emerging countries.

In predicting the onset of the sovereign debt crisis various studies[7] underline the set of macroeconomic variables which are typically used in the literature as the determinants of debt crises. In this study, following the results of the empirical literature on the sovereign debt crises, the determinants which have high predictive power are used as the macroeconomic indicators.

As a measure of the solvency of a sovereign, public debt of a country over its GDP is used. This data is compiled by Reinhart and Rogoff (2009) and defined as the gross (external plus internal) central government debt over GDP of a country. In order to capture whether or not a country is experiencing liquidity problems prior to a default, the ratio of short-term external debt service to foreign exchange reserves is included. High short term indebtedness creates maturity problems, and also currency mismatches if it is combined with currency crashes. This indicator is regarded as one of the best determinants of sovereign debt crises happened during 1990s.[8]

It has been proved in the empirical literature that current account deficit increases prior to debt crises and following the crisis the current account balance improves. In order to address the contribution of current

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[5] Throughout the study, only the starting months of crises are considered crisis events and the months following crises as non-crisis months in order to distinguish the onset of crisis from the continuation of the same crisis.
[6] The detailed explanation, construction and sources of all the data used in the analyses are presented in Appendix II.
[7] Manase et. al. (2003)
[8] Manase et. al. (2003)

account deficit to the probability of sovereign default, current account balance divided by the foreign exchange reserves is introduced as another macroeconomic determinant.

Apart from being the major indicator of the currency crisis, the overvaluation of the real exchange rates brings along the risk of default (Eaton and Gersovitz, 1981) because the external trade position and the general macroeconomic environment of the country become vulnerable. If the country has fixed exchange rate regime it becomes costly for the government to correct the misaligned exchange rates increasing the likelihood of the debt crisis. Therefore the overvaluation of the real exchange rates is included as another macroeconomic variable in predicting sovereign debt crisis.

The general domestic macroeconomic environment is also essential in signaling the vulnerability of the government in servicing its external debt. Therefore the key domestic indicators which are found to increase the likelihood of sovereign default; the monthly growth rate of the GDP as an indicator of government having enough resources to repay its debt, the percentage change in the real monetary policy interest rate since higher interest rates representing higher payments increasing the default risk, and the rate of inflation which captures the monetary mismanagement, are included in the estimations for controlling the domestic macroeconomic developments.

External developments which influence the borrowing costs are also important in determining emerging economies' debt management. Increased international interest rates may lead to lower capital flows to the emerging economies and therefore increase the vulnerability of the country's ability to rollover its debt. The percentage change in the real US federal funds rate is included in the analyses since it is concluded by various studies (as Arora and Cerisola, 2001) that the interest rate paid for external borrowings of emerging economies has a tendency to move in the same direction with US interest rates[9].

The institutional variables try to capture the effect of the change in the credibility of the policy implementation and the incentive of the government in following policies which guarantee the sustainability of its debt position. In this respect, the presidential and parliamentary elections bring along political uncertainty which plays important role in increasing the tensions of the political environment prior to crisis episodes. The parliamentary and presidential election dates included in the analyses are taken from the Consortium for Elections and Political Process Strengthening (CEPPS). Apart from election dates, stability of political system has been found[10] to have an influence on the willingness of a country's debt repayment. In order to address the riskiness of the political system of a country, the ratings

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[9] Hatchondo et. al. (2007).
[10] Citron and Nickelsburg (1987).

of the International Country Risk Guide (ICRG) provided by the Political Risk Services (PRS) Group are taken into account. Specifically in this study the focus is on the political stability that indicates the perception of the creditors on the riskiness of the government, and the financial quality which assesses the ability of the country in financing its obligations of official and commercial debt.

Finally, following the well announced results of the empirical literature[11] that there is a tendency of banking, currency and debt crises happening simultaneously, the dummy variables indicating whether or not a country is experiencing the onset of a currency or banking crises are included in the analyses as determinants of sovereign debt crises.

The summary statistics of the variables used in the analyses are given at Table 1. As can be observed from the table the occurrences of the sovereign default, currency and banking crises are rather rare in the sample due to the application of monthly data.

Table 1. Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Sovereign Default	3919	0.007	0.086	0	1
Currency Crisis	3919	0.005	0.068	0	1
Banking Crisis	3919	0.005	0.695	0	1
Public Debt	3919	47.921	27.075	4.2	154.9
Real International Interest Rate	3919	0.013	0.186	-0.529	1.276
Real Domestic Interest Rate	3919	0.069	0.827	-8.035	24
Exchange Rate Overvaluation	3919	0.143	1.624	-9.13	15.852
Current Account Position	3919	-0.028	0.181	-1.847	0.699
GDP Growth	3919	0.350	0.370	-1.277	1.543
Short Term External Debt	3919	1.145	1.501	0.060	32.926
Inflation	3919	0.023	0.058	-0.041	1.145
Election	3919	0.031	0.173	0	1
Political Stability	3919	62.731	9.151	30	83
Financial Quality	3919	34.261	7.094	8	48

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[11] Some leading studies are Herz and Tong (2008), and Reinhart and Rogoff (2010).

In order to minimize the concerns of endogeneity in the estimations all regressors are lagged by one month unless otherwise stated. Another econometric concern is the non-stationarity of the variables because the unbalanced sample includes 276 monthly observations per country. Im-Pesaran-Shin (2003) test which allows for heterogeneity in unbalanced panels is conducted for each variable in the dataset. The results suggest that for all variables, except public debt over GDP, the null of non-stationarity is rejected. Following the failure of rejecting the null of the existence of unit root for public debt over GDP, the variable is transformed into first differences. Lastly, the existence of statistical dependence within country observations are controlled by using robust standard errors clustered for each country.

IV. Results

Model (1) is estimated by applying pooled probit model and the results are presented in Table 2. In probit models the estimated coefficients do not give the measure of the change in the conditional mean of the dependent variable given a change in each regressor. Therefore in addition to estimated coefficients and z-statistics, the marginal effects of the probability of the debt crisis with respect to each independent variable are calculated and reported for every column. In presenting the goodness of fit of the estimations, each column contains the log-likelihood, pseudo R-squared and the percentage of correctly classified crisis and non-crisis observations. In calculating the correctly classified observations a low threshold of predicted probability– greater than 1% - is used to classify a country experiencing debt crisis. The reason for this low cut-off point is the rareness of the debt crises onsets in the total sample.

The estimations in Table 2 are conducted by using macroeconomic, institutional variables, and the starting months of currency and banking crises as independent variables. Column 1 represents the results with macroeconomic and institutional variables leaving out the crises indicators. The rest of the table adds the currency and banking crises indicators on top of the other determinants of sovereign defaults. In column 2 the three-month backward looking moving average of currency crisis is included, column 3 includes the moving average for the banking crisis, column 4 includes both moving averages of the lagged banking and currency crises, and finally the effect of the banking and currency crises occurring at the same period with sovereign debt crisis is questioned in column 5.

Table 2. Pooled Probit Estimation Results of Sovereign Debt Crisis

Variables	(1) Estimates (z-stats) Elasticity	(2) Estimates (z-stats) Elasticity	(3) Estimates (z-stats) Elasticity	(4) Estimates (z-stats) Elasticity	(5) Estimates (z-stats) Elasticity
ΔPublic Debt$_{t-1}$	0.098** (2.20) 0.002	0.098** (2.18) 0.001	0.094** (2.25) 0.001	0.094** (2.24) 0.001	0.087** (2.04) 0.0001
Real International Interest Rate$_{t-1}$	0.422 (1.23) 0.006	0.439 (1.29) 0.007	0.419 (1.21) 0.006	0.435 (1.27) 0.006	0.490 (1.39) 0.006
Real Domestic Interest Rate$_{t-1}$	-0.055 (-0.85) -0.001	-0.058 (-0.92) -0.001	-0.054 (-0.85) -0.001	-0.056 (-0.91) -0.001	-0.061 (-0.45) -0.001
Exchange Rate Overvaluation$_{t-1}$	-0.104*** (-3.26) -0.002	-0.113*** (-3.33) -0.002	-0.104*** (-3.16) -0.002	-0.113*** (-3.23) -0.002	-0.109*** (-2.79) -0.001
Current Account Position$_{t-1}$	-0.010 (-0.05) -0.0002	-0.025 (-0.12) -0.0004	0.018 (0.08) 0.0003	-0.001 (-0.00) -0.00001	-0.004 (-0.02) -0.0001
GDP Growth$_{t-1}$	-0.243 (-1.27) -0.004	-0.246 (-1.29) -0.004	-0.233 (-1.20) -0.004	-0.238 (-1.22) -0.004	-0.178 (-0.92) -0.002
Short-Term External Debt$_{t-1}$	0.019 (1.35) 0.0003	0.018 (1.38) 0.0003	0.018 (1.40) 0.0003	0.018 (1.45) 0.0002	0.014 (1.07) 0.0002
Inflation$_{t-1}$	0.491 (0.73) 0.007	0.489 (0.71) 0.007	0.335 (0.43) 0.005	0.352 (0.44) 0.005	0.320 (0.39) 0.004
Currency Crisis$_t$					1.155*** (2.92) 0.067
Banking Crisis$_t$					1.316*** (2.74) 0.091
Currency Crisis$_{t-1 \text{ to } t-3}$		1.397 (1.06) 0.021		1.260 (0.88) 0.019	1.104 (1.11) 0.018
Banking Crisis$_{t-1 \text{ to } t-3}$			1.140 (0.70) 0.017	0.968 (0.57) 0.014	0.279 (0.18) 0.004
Election$_{t-1}$	0.019 (0.05) 0.0003	0.021 (0.06) 0.0003	0.022 (0.06) 0.0003	0.024 (0.06) 0.0004	-0.240 (-0.68) -0.002
Political Stability$_{t-1}$	-0.010* (-1.84) -0.0002	-0.010* (-1.79) -0.0002	-0.010** (-1.99) -0.0002	-0.010* (-1.94) -0.0002	-0.012** (-2.13) -0.0002
Financial Quality$_{t-1}$	-0.020** (-2.41) -0.0003	-0.020** (-2.32) -0.0003	-0.021** (-2.36) -0.0003	-0.021** (-2.33) -0.0003	-0.025*** (-2.58) -0.0003
Log-Likelihood	-159.323	-158.834	-158.991	-158.594	-151.471
% of crises correctly predicted	55.17	51.72	51.72	51.72	58.62
% of non-crises correctly predicted	79.90	82.08	81.72	81.62	83.60
Pseudo-R^2	0.069	0.072	0.071	0.074	0.115
Number of Observations	3919	3919	3919	3919	3919

*Notes: Robust standard errors are clustered by country. The significance level of the variables are indicated by * (10%), ** (5%) and *** (1%). The marginal effects are evaluated at the sample mean for continuous variables and for change from zero to one for dummy variables holding all other variables at their mean. In classifying the percentage of correctly predicted crisis and non-crisis observations 1% cut-off point is used.*

The results show that growth of public debt to GDP ratio enters highly significant with a positive coefficient indicating that increased public debt signals the probability of sovereign debt crisis one month

prior to the onset of the crisis. Additionally the significant coefficient of real exchange rate overvaluation variable shows that exchange rate misalignment precedes the onset of a debt crisis confirming the theoretical findings of Eaton and Gersovitz (1981). Political stability has significant and negative coefficient confirming the findings of Citron and Nickelsburg (1987) and Balkan (1992) that political riskiness of a country increases the probability of sovereign default. The coefficient of financial quality indicates that the negative assessment of a country's ability in servicing its debt increases the debt crisis probability. The currency crisis and banking crisis occurring in the three month period preceding sovereign default, however, do not have any significant influence on the probability of sovereign default, evidenced in columns 2 to 5. This result indicates that there is no direct spread from currency and banking crisis to debt crisis through time. However, currency crisis and banking crisis occurring in the same month with sovereign default are highly correlated with the probability of debt crisis which is evidenced in column 5. With regards to the relation between currency and debt crisis, the results confirm Dreher et. al. (2006) that the contemporaneous correlation between currency and debt crisis is stronger than their lagged relationship. The performance of the model is indicated at the bottom part of Table 2. The pseudo R-squared is relatively low throughout different specifications. The model predicts 51 - 58% of the actual crisis episodes and 80 - 84% of the actual non-crisis episodes correctly, depending on the specification. This suggests that the model is relatively more successful in predicting non-crises episodes.

The findings of Table 2 confirms the previous literature on the sovereign debt crises that solvency as well as misaligned exchange rates increase the probability of sovereign default. Apart from these results, the political and institutional environment, and the contemporaneous occurrence of currency and banking crises are also among the significant determinants of debt crisis. Other possible determinants, like the illiquidity of a country proxied by the ratio of short-term foreign debt to international reserves, and the lagged currency and banking crisis onsets are not found to have a direct effect on the probability of sovereign default. Nevertheless, the incidences of currency or banking crisis possibly increase the probability of sovereign debt crisis in the presence of economic fragilities. Therefore in order to analyze the indirect links from prior banking crisis and currency crisis to the sovereign debt crisis, the interaction effects of the three-month backward looking moving averages of these crises with macroeconomic variables, including the illiquidity measure, external volatility and misaligned exchange rates are introduced into the estimations. Table 3 presents the results with the interaction terms using the specification in column 4 of Table 2[12]. Each column in Table 3 includes one interaction term for reducing the risk of multicollinearity in the estimations.

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[12] The contemporaneous occurrence of banking and currency crises are not included in these estimations since simultaneity might lead to biased results of the estimations.

Table 3. Pooled Probit Estimation Results of Sovereign Debt Crises with Interactions

Variables	(1) Estimates (z-stats)	(2) Estimates (z-stats)	(4) Estimates (z-stats)	(3) Estimates (z-stats)
ΔPublic Debt$_{t-1}$	0.095**	0.098**	0.095**	0.094**
	(2.26)	(2.29)	(2.24)	(2.25)
	0.001	0.001	0.001	0.001
Real International Interest Rate$_{t-1}$	0.430	0.431	0.427	0.436
	(1.24)	(1.26)	(1.25)	(1.27)
	0.006	0.006	0.006	0.006
Real Domestic Interest Rate$_{t-1}$	-0.057	-0.061	-0.056	-0.056
	(-0.91)	(-1.04)	(-0.59)	(-0.91)
	-0.001	-0.001	-0.001	-0.001
Exchange Rate Overvaluation$_{t-1}$	-0.113***	-0.108***	-0.113***	-0.113***
	(-3.24)	(-3.20)	(-2.39)	(-3.23)
	-0.002	-0.002	-0.002	-0.002
Current Account Position$_{t-1}$	0.001	0.001	0.020	-0.001
	(0.01)	(0.00)	(0.09)	(-0.00)
	0.00002	0.00001	0.0003	-0.00001
GDP Growth$_{t-1}$	-0.244	-0.232	-0.241	-0.238
	(-1.25)	(-1.18)	(-1.24)	(-1.22)
	-0.004	-0.003	-0.004	-0.004
Short-Term External Debt$_{t-1}$	0.017	0.017	0.015	0.018
	(1.41)	(1.37)	(1.25)	(1.43)
	0.0003	0.00003	0.0002	0.0003
Inflation$_{t-1}$	0.344	0.340	0.250	0.350
	(0.43)	(0.43)	(0.30)	(0.44)
	0.005	0.005	0.004	0.005
Currency Crisis$_{t-1 \text{ to } t-3}$	1.392	2.665	1.155	1.626
	(1.00)	(1.70)	(0.74)	(1.11)
	0.021	0.039	0.017	0.024
Banking Crisis$_{t-1 \text{ to } t-3}$	1.001	1.124	-0.098	0.985
	(0.59)	(0.67)	(-0.05)	(0.57)
	0.015	0.017	-0.001	0.015
Election$_{t-1}$	0.024	0.029	0.027	0.023
	(0.06)	(0.07)	(0.07)	(0.06)
	0.0004	0.0004	0.0004	0.0004
Political Stability$_{t-1}$	-0.010**	-0.010*	-0.011**	-0.010**
	(-1.97)	(-1.91)	(-2.01)	(-1.98)
	-0.0002	-0.0002	-0.0002	-0.0002
Financial Quality$_{t-1}$	-0.021**	-0.021**	-0.021**	-0.020**
	(-2.32)	(-2.45)	(-2.36)	(-2.29)
	-0.0003	-0.0003	-0.0003	-0.0003
Currency Crisis$_{t-1 \text{ to } t-3}$ X Real International Interest Rates$_{t-1}$	7.432			
	(1.53)			
Currency Crisis$_{t-1 \text{ to } t-3}$ X Exchange Rate Overvaluation$_{t-1}$		-0.629**		
		(2.36)		
Banking Crisis$_{t-1 \text{ to } t-3}$ X Short-term External Debt$_{t-1}$			0.475**	
			(2.20)	
Currency Crisis$_{t-1 \text{ to } t-3}$ X Short-term External Debt$_{t-1}$				-0.210
				(-0.86)
Log-Likelihood	-158.525	-158.301	-158.360	-158.567
% of crises correctly predicted	51.72	55.17	55.17	51.72
% of non-crises correctly predicted	81.54	81.62	81.80	81.52
Pseudo-R^2	0.074	0.075	0.075	0.074
Number of Observations	3919	3919	3919	3919

*Notes: Robust standard errors are clustered by country. The significance level of the variables are indicated by * (10%), ** (5%) and *** (1%) The marginal effects are evaluated at the sample mean for continuous variables and for change from zero to one for dummy variables holding all other variables at their mean. In classifying the percentage of correctly predicted crisis and non-crisis observations 1% cut-off point is used.*

The interpretation of the interaction terms are different compared to the other regressors in the estimations. The magnitude and the significance of the term change for each observation. Therefore the marginal effect and z-statistics of each interaction term included in the estimations are calculated at the mean, minimum and maximum levels and presented in Table 4.

Table 4. Marginal Effects of the Interaction Terms

Interaction Terms	Mean (z-stats)	Min (z-stats)	Max (z-stats)
Currency Crisis$_{t-1 \text{ to } t-3}$ X Real International Interest Rates$_{t-1}$	0.179 (1.74)	0.001 (0.16)	2.063 (3.08)
Currency Crisis$_{t-1 \text{ to } t-3}$ X Exchange Rate Overvaluation$_{t-1}$	-0.025 (-1.69)	-0.290 (-2.49)	0.021 (1.32)
Banking Crisis$_{t-1 \text{ to } t-3}$ X Short-term External Debt$_{t-1}$	0.010 (1.87)	0.000 (0.15)	0.272 (3.04)
Currency Crisis$_{t-1 \text{ to } t-3}$ X Short-term External Debt$_{t-1}$	-0.003 (-0.64)	-0.066 (-0.90)	-0.000 (-0.14)

Notes: The marginal effects of the interactions terms are calculated with the "inteff" command in STATA 11.

Following a currency crisis it becomes difficult for the government to borrow from abroad, especially for the emerging economies, since they experience downgrades in their credit ratings (Reinhart, 2002). Coupling with tight lending conditions of the international markets the currency crisis is more likely in increasing the default probability. The interaction between real international interest rates proxied by the percentage change in the real US federal funds rate and the onset of the currency crisis seeks the effect of the currency devaluation coupled with tight international markets on the probability of sovereign default. The term does not enter significant in the estimations in column 1 of Table 3. Table 4 indicates that the mean interaction effect is positive as well and varies from 0.001 to 2.063. It is also significant for some of the observations suggesting that tight international lending conditions increase the probability of default if the country experiences a currency crisis.

Besides the direct influence of the appreciated real exchange rates, the indirect effect of this indicator is emphasized in the literature. Jahjah and Montiel (2003) showed in a multiple equilibria model that appreciated real exchange rates increase the probability of a default in case of a currency crisis. Interaction between currency crisis and overvalued real exchange rates investigates this effect in column 2 of Table 3. The term enters significant which shows that currency crisis preceded by appreciated real exchange rates heighten the sovereign debt crisis probability and proves the theoretical results regarding this indirect link between currency and debt crisis. Table 4 indicates that for some observations the interaction effect is positive, although their marginal effects are insignificant.

High short term foreign debt compared to foreign exchange reserves indicate that the country have international illiquidity problems which lead to bank run according to Diamond and Dybvig (1983). The historical graphical observations done by Reinhart and Rogoff (2010) link this finding to debt crisis by showing that short-term foreign debt levels aggravate in the phase of a banking crisis and are immediately followed by sovereign debt crises. Since illiquidity of the country spreads the vulnerability of the banking system to the government with costly bail-out funds it is expected that in a country facing illiquidity, an occurrence of a banking crisis leads to a sovereign default. The interaction term of banking crisis with short-term external debt over foreign exchange reserves seeks this relation. The results in column 3 of Table 3 point out that the term is significant and positive indicating that the probability of a sovereign debt crisis increases if international illiquidity of the country is accompanied by a banking crisis prior to a default.

In emerging economies the governments have to convince the international creditors that they are going to raise enough resources to service their debt when they are issuing new debt. The devaluation of the domestic currency by increasing the costs of rolling over the maturing debt may lead to sovereign default because finding enough resources to cover their obligations becomes much more difficult for the governments. Therefore international illiquidity may also indirectly increase the default probability in the phase of a currency crisis. This effect is represented with the interaction term short-term foreign debt divided by foreign exchange reserves with currency crisis dummy and results are shown at the last column of Table 3. The term, however, does not enter significantly in the estimations which can also be seen from the marginal effects of the term from Table 4. The goodness of fit measures show that the model has rather low pseudo R-squared values. 51 - 55% of the actual crisis months and 81% of the actual non-crisis months are correctly predicted by the model indicating that once again the model has relatively higher probability of predicting non-crises months.

V.   Robustness Checks: Fixed - Effects Logit and System GMM Estimations

The macroeconomic and institutional variables included in the analyses may not control all the country-specific characteristics exist in the models estimated. These unobservable country effects might lead to biased results of the pooled probit estimations. The fixed-effects model assumes that the individual characteristics of each country are correlated with the regressors and eliminates the time-invariant characteristics from the predictor variables. Since fixed-effects probit model cannot be consistently estimated, the above specifications in Tables 2 and 3 are re-estimated with applying conditional logit

estimations[13] (Chamberlain, 1980) taking into account the fixed country effects[14]. The time invariant observations are excluded from the estimations decreasing the number of observations to 2848. The results of the re-estimation of the specifications in Table 2 by conditional logit model are presented in Table 5.

Table 5. Conditional (Fixed - Effects) Logit Estimation Results of Sovereign Debt Crisis

Variables	(1) Estimates (z-stats) Elasticity	(2) Estimates (z-stats) Elasticity	(3) Estimates (z-stats) Elasticity	(4) Estimates (z-stats) Elasticity	(5) Estimates (z-stats) Elasticity
ΔPublic Debt$_{t-1}$	0.202*	0.202*	0.197*	0.196*	0.164
	(1.87)	(1.88)	(1.85)	(1.87)	(1.44)
Real International Interest Rate$_{t-1}$	0.979	1.005	0.956	0.985	1.079
	(1.01)	(1.04)	(0.99)	(1.02)	(1.08)
Real Domestic Interest Rate$_{t-1}$	-0.123	-0.126	-0.113	-0.118	-0.127
	(-0.79)	(-0.82)	(-0.71)	(-0.73)	(-0.71)
Exchange Rate Overvaluation$_{t-1}$	-0.205***	-0.225***	-0.204***	-0.223***	-0.208*
	(-2.78)	(-2.75)	(-2.65)	(-2.62)	(-2.79)
Current Account Position$_{t-1}$	0.028	0.002	0.114	0.079	0.445
	(0.02)	(0.00)	(0.09)	(0.06)	(0.39)
GDP Growth$_{t-1}$	-0.262	-0.257	-0.222	-0.224	-0.114
	(-0.55)	(-0.54)	(-0.43)	(-0.44)	(-0.23)
Short-Term External Debt$_{t-1}$	0.024	0.025	0.025	0.025	0.028
	(0.77)	(0.80)	(0.79)	(0.83)	(1.03)
Inflation$_{t-1}$	1.313	1.292	0.663	0.737	-0.322
	(1.17)	(1.13)	(0.33)	(0.36)	(-0.16)
Currency Crisis$_t$					2.481***
					(2.81)
Banking Crisis$_t$					3.306***
					(3.00)
Currency Crisis$_{t-1 \text{ to } t-3}$		2.956		2.640	2.646
		(0.89)		(0.73)	(0.85)
Banking Crisis$_{t-1 \text{ to } t-3}$			2.627	2.198	2.278
			(0.54)	(0.44)	(0.57)
Election$_{t-1}$	0.121	0.117	0.123	0.121	-0.311
	(0.12)	(0.11)	(0.12)	(0.12)	(-0.39)
Political Stability$_{t-1}$	-0.021	-0.022	-0.023	-0.023	-0.037
	(-0.76)	(-0.79)	(-0.83)	(-0.83)	(-1.37)
Financial Quality$_{t-1}$	-0.069**	-0.068**	-0.069**	-0.069**	-0.066*
	(-2.14)	(-2.10)	(-2.11)	(-2.08)	(-1.73)
Log-Likelihood	-134.869	-134.546	-134.546	-134.383	-127.569
Pseudo-R^2	0.056	0.058	0.057	0.059	0.107
Number of Observations	2848	2848	2848	2848	2848

*Notes: The time in-variant 1071 observations are dropped from the estimations. Robust standard errors are clustered by country. The significance level of the variables are indicated by * (10%), ** (5%) and *** (1%).*

The results in Table 5 do not diverge considerably from the probit results presented in Table 2. Public debt and political stability has lower significance. The significance of appreciated real exchange rates and

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[13] The conditional logit is the probability which is conditional on the number of the matched set. The intercept is different for each set and is not estimated by the model. Therefore, the predicted probabilities cannot be estimated making the reader to rely on the marginal effects and the percent of correct predictions resulting from pooled probit estimations.

[14] The joint significance of the fixed time effects are also tested resulting in a failure in rejecting the null that all month coefficients are jointly equal to zero. Therefore they are not included in the specifications.

financial quality together with the contemporaneous banking and currency crisis dummies are similar to previous results.

The conditional logit estimations of the specifications with interaction terms are represented in Table 6. In these specifications only the interaction of the currency crisis with overvalued exchange rates enters as the significant interaction term. Once more the public debt, overvalued exchange rates and the financial riskiness appear significant confirming the findings of the pooled probit regressions.

Table 6. Conditional (Fixed - Effects) Logit Estimation Results of Sovereign Debt Crisis with Interactions

Variables	(1) Estimates (z-stats)	(2) Estimates (z-stats)	(3) Estimates (z-stats)	(4) Estimates (z-stats)
ΔPublic Debt$_{t-1}$	0.197*	0.203*	0.196*	0.196*
	(1.85)	(1.87)	(1.86)	(1.85)
Real International Interest Rate$_{t-1}$	0.975	0.979	0.986	0.964
	(1.00)	(1.02)	(1.02)	(1.01)
Real Domestic Interest Rate$_{t-1}$	-0.119	-0.121	-0.119	-0.113
	(-0.74)	(-0.78)	(-0.74)	(-0.73)
Exchange Rate Overvaluation$_{t-1}$	-0.224***	-0.210***	-0.223***	-0.223***
	(-2.63)	(-2.56)	(-2.63)	(-2.60)
Current Account Position$_{t-1}$	0.090	0.049	0.086	0.136
	(0.07)	(0.04)	(0.07)	(0.11)
GDP Growth$_{t-1}$	-0.234	-0.204	-0.226	-0.232
	(-0.45)	(-0.40)	(-0.44)	(-0.46)
Short-Term External Debt$_{t-1}$	0.025	0.025	0.025	0.022
	(0.82)	(0.80)	(0.77)	(0.75)
Inflation$_{t-1}$	0.705	0.633	0.754	0.437
	(0.34)	(0.31)	(0.36)	(0.20)
Currency Crisis$_{t-1 \text{ to } t-3}$	2.757	5.309	2.221	2.437
	(0.77)	(1.48)	(0.61)	(0.62)
Banking Crisis$_{t-1 \text{ to } t-3}$	2.277	2.664	2.121	0.237
	(0.45)	(0.54)	(0.40)	(0.04)
Election$_{t-1}$	0.120	0.129	0.123	0.130
	(0.11)	(0.12)	(0.12)	(0.12)
Political Stability$_{t-1}$	-0.024	-0.023	-0.023	-0.024
	(-0.85)	(-0.83)	(-0.83)	(-0.84)
Financial Quality$_{t-1}$	-0.069**	-0.071**	-0.069**	-0.070**
	(-2.05)	(-2.15)	(-2.08)	(-2.08)
Currency Crisis$_{t-1 \text{ to } t-3}$ X Real International Interest Rates$_{t-1}$	7.371			
	(0.69)			
Currency Crisis$_{t-1 \text{ to } t-3}$ X Exchange Rate Overvaluation$_{t-1}$		-1.176*		
		(-1.86)		
Banking Crisis$_{t-1 \text{ to } t-3}$ X Short-term External Debt$_{t-1}$			0.858	
			(1.63)	
Currency Crisis$_{t-1 \text{ to } t-3}$ X Short-term External Debt$_{t-1}$				0.282
				(0.26)
Log-Likelihood	-134.367	-134.170	-134.375	-134.256
Pseudo-R^2	0.059	0.061	0.059	0.060
Number of Observations	2848	2848	2848	2848

*Notes: The time in-variant 1071 observations are dropped from the estimations. Robust standard errors are clustered by country. The significance level of the variables are indicated by * (10%), ** (5%) and *** (1%).*

So far the possibility of the endogeneity of macroeconomic and political variables, and the simultaneity bias resulting from the contemporaneous currency and banking crisis dummies have not been addressed. In the absence of strictly exogenous instruments, this issue is taken into account by implementing system GMM estimation technique developed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). The system GMM estimator is proved to have better finite sample properties and increase the efficiency of GMM estimator. Difference GMM estimator's performance becomes weaker with the higher persistence of the series since in that case the lagged levels of the regressors become weak instruments of the current first-differences. System GMM estimator overcomes this problem by including another equation in levels by using first-differences as instruments.

Table 7 presents the results of the System GMM estimations with applying the specifications of Table 2. For each estimation, the regressors are instrumented by using their first lags as instruments and only one instrument is created for every variable and lag distance. In the presence of unbalanced samples forward orthogonal deviation transformation preserves the sample size in the first differenced equation as well as removing the fixed-effects. Therefore in the differences equation instead of first-differencing, forward orthogonal deviations transformation has been used. This does not change the first-differenced instruments in the levels equation. The exogeneity of the instruments are tested with Sargan test of over identifying restrictions for each column. Lastly, for the models to be well specified, Arellano-Bond serial correlation test is expected to reject the null of no autocorrelation of the first-order and not to reject the null for the second-order correlation in the first differences. The tests are computed for each specification and presented in Table 7.

The results presented in Table 7, do not differ extensively from the pooled probit results in Table 2. Once more the main indicators of sovereign debt crisis are the change in public sector indebtedness, the overvalued real exchange rates and the riskiness of the financial position of the country. The main difference from the previous results is the insignificance of the contemporaneous currency and banking crisis dummies[15] and the political instability indicator. Sargan test of over identifying restrictions suggest that the population moment conditions are valid represented by the p-value being above 0.05. The Arellano-Bond test for the first order serial correlation rejects the null of no autocorrelation in the differenced residuals. This result is usually expected and does not lead to the conclusion that the model is misspecified. The second order correlation test does not detect any correlation in the levels equation. Therefore it can be concluded that the model is well specified.

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[15] The unpublished pooled OLS estimations suggest that this divergence in the significance of crisis dummies is due to the change in the estimation method from non-linear techniques to the linear probability model.

Table 7. System GMM Estimation Results of Sovereign Debt Crises

Variables	(1) Estimates (z-stats)	(2) Estimates (z-stats)	(3) Estimates (z-stats)	(4) Estimates (z-stats)	(5) Estimates (z-stats)
ΔPublic Debt$_{t-1}$	0.003**	0.003**	0.002**	0.003**	0.002*
	(2.07)	(2.08)	(2.10)	(2.12)	(1.84)
Real International Interest Rate$_{t-1}$	0.008	0.008	0.008	0.008	0.009
	(0.81)	(0.84)	(0.81)	(0.84)	(0.89)
Real Domestic Interest Rate$_{t-1}$	-0.001	-0.001	-0.001	-0.001	-0.001
	(-0.84)	(-0.86)	(-0.82)	(-0.83)	(-0.81)
Exchange Rate Overvaluation$_{t-1}$	-0.003***	-0.003***	-0.003**	-0.003***	-0.003***
	(-2.69)	(-2.66)	(-2.55)	(-2.59)	(-2.61)
Current Account Position$_{t-1}$	0.011	0.010	0.011	0.011	0.009
	(0.64)	(0.63)	(0.66)	(0.65)	(0.65)
GDP Growth$_{t-1}$	-0.003	-0.004	-0.003	-0.004	-0.004
	(-0.44)	(-0.58)	(-0.44)	(-0.58)	(-0.58)
Short-Term External Debt$_{t-1}$	0.002	0.002	0.002	0.002	0.001
	(1.28)	(0.88)	(1.14)	(0.81)	(0.35)
Inflation$_{t-1}$	0.010	0.010	0.008	0.008	0.006
	(0.41)	(0.40)	(0.31)	(0.31)	(0.21)
Currency Crisis$_t$					0.095
					(1.37)
Banking Crisis$_t$					0.095
					(1.28)
Currency Crisis$_{t-1 \text{ to } t-3}$		0.036		0.032	0.014
		(0.68)		(0.59)	(0.24)
Banking Crisis$_{t-1 \text{ to } t-3}$			0.030	0.028	0.034
			(0.45)	(0.42)	(0.68)
Election$_{t-1}$	0.001	0.001	0.001	0.001	-0.002
	(0.10)	(0.06)	(0.09)	(0.06)	(-0.30)
Political Stability$_{t-1}$	0.000	-0.000	0.000	-0.000	-0.001
	(0.10)	(-0.11)	(0.05)	(-0.14)	(-0.41)
Financial Quality$_{t-1}$	-0.001**	-0.001**	-0.001**	-0.001**	-0.001**
	(-2.18)	(-2.09)	(-2.16)	(-2.07)	(-1.99)
Number of Observations	3919	3919	3919	3919	3919
Number of Instruments	23	25	25	27	31
Sargan Test P-value	0.689	0.589	0.754	0.659	0.455
AR (1)	-3.21***	-3.21***	-3.21***	-3.21***	-3.22***
AR (2)	-1.35	-0.87	-1.18	-0.93	0.13

*Notes: Robust standard errors are clustered by country. The significance level of the variables are indicated by * (10%), ** (5%) and *** (1%). One-step system GMM estimator is calculated. Forward orthogonal deviations transformation is implemented in differences equation. Both in levels and differences equations the variables are instrumented with using their first lags and the instrument set is collapsed in order to generate one instrument for every variable and lag distance.*

The pooled probit specifications of Table 3 with the interactions of lagged banking and currency crises with macroeconomic indicators are estimated with system GMM technique and the results are presented in Table 8. The results confirm the direct effects of the public debt, overvalued exchange rates and financial riskiness on the probability of sovereign debt. The interaction terms do not appear significant in the estimations although the magnitudes and signs of the coefficients do not diverge from the marginal effects

resulting from the pooled probit estimations presented in Table 4. Once more the insignificant p-value of the Sargan tests suggests that the instruments are valid. The existence of first order serial correlation and the failure of rejecting the null of no second order serial correlation in first differences indicate that the models are not misspecified.

Table 8. System GMM Estimation Results of Sovereign Debt Crises with Interactions

Variables	(1) Estimates (z-stats)	(2) Estimates (z-stats)	(3) Estimates (z-stats)	(4) Estimates (z-stats)
ΔPublic Debt$_{t-1}$	0.003**	0.003**	0.003**	0.003**
	(2.15)	(2.19)	(2.12)	(2.18)
Real International Interest Rate$_{t-1}$	0.008	0.008	0.008	0.008
	(0.82)	(0.83)	(0.84)	(0.82)
Real Domestic Interest Rate$_{t-1}$	-0.001	-0.001	-0.001	-0.001
	(-0.83)	(-0.91)	(-0.83)	(-0.80)
Exchange Rate Overvaluation$_{t-1}$	-0.003***	-0.003***	-0.003***	-0.003***
	(-2.59)	(-2.60)	(-2.61)	(-2.65)
Current Account Position$_{t-1}$	0.011	0.011	0.011	0.011
	(0.67)	(0.63)	(0.66)	(0.69)
GDP Growth$_{t-1}$	-0.004	-0.004	-0.004	-0.005
	(-0.52)	(-0.51)	(-0.58)	(-0.60)
Short-Term External Debt$_{t-1}$	0.002	0.002	0.002	0.002
	(0.95)	(0.92)	(0.87)	(0.71)
Inflation$_{t-1}$	0.009	0.008	0.008	0.003
	(0.33)	(0.32)	(0.30)	(0.12)
Currency Crisis$_{t-1\ to\ t-3}$	0.036	0.071	0.043	0.028
	(0.63)	(0.73)	(0.74)	(0.49)
Banking Crisis$_{t-1\ to\ t-3}$	0.027	0.029	0.029	-0.015
	(0.41)	(0.42)	(0.42)	(-0.41)
Election$_{t-1}$	0.001	0.001	0.001	0.001
	(0.07)	(0.07)	(0.06)	(0.07)
Political Stability$_{t-1}$	-0.000	-0.000	-0.000	-0.000
	(-0.07)	(-0.07)	(-0.13)	(-0.14)
Financial Quality$_{t-1}$	-0.001**	-0.001**	-0.001**	-0.001**
	(-2.07)	(-2.07)	(-2.06)	(-2.10)
Currency Crisis$_{t-1 to\ t-3}$ X Real International Interest Rates$_{t-1}$	0.168			
	(1.06)			
Currency Crisis$_{t-1\ to\ t-3}$ X Exchange Rate Overvaluation$_{t-1}$		-0.014		
		(-0.85)		
Banking Crisis$_{t-1to\ t-3}$ X Short-term External Debt$_{t-1}$			0.026	
			(1.42)	
Currency Crisis$_{t-1to\ t-3}$ X Short-term External Debt$_{t-1}$				-0.006
				(-0.57)
Number of Observations	3919	3919	3919	3919
Number of Instruments	29	29	29	29
Sargan Test P-value	0.703	0.550	0.720	0.694
AR (1)	-3.21***	-3.21***	-3.21***	-3.21***
AR (2)	-0.72	-0.49	-0.92	-0.81

*Notes: Robust standard errors are clustered by country. The significance level of the variables are indicated by * (10%), ** (5%) and *** (1%). One-step system GMM estimator is calculated. Forward orthogonal deviations transformation is implemented in differences equation. Both in levels and differences equations the variables are instrumented with using their first lags and the instrument set is collapsed in order to generate one instrument for every variable and lag distance.*

The results from this section point out that main conclusion do not differ substantially with changes in estimation methods. The increase in the change of public debt and appreciated real exchange rates increase the probability of the sovereign default besides the inability of the country in servicing its commercial and official debt. Except the system GMM results, the currency and banking crises tend to accompany sovereign debt crisis. The political risk does not enter significantly in explaining the probability of sovereign debt in this section. The indirect linkages from currency and banking crisis are less realized in the robustness checks, although the magnitudes and signs of the effects are robust to changes in estimation techniques.

VI.   Conclusion

Inspired by the recent exposure of the advanced economies to financial crises and consequently sovereign debt repayment problems, this study explores the explanatory powers of banking and currency crises on sovereign defaults while controlling for the political and macroeconomic factors by applying monthly data. In uncovering the non-linear linkages from banking and currency crises to sovereign defaults, the interactions of international illiquidity with banking and currency crisis, overvalued exchange rates and real international interest rates with currency crises are included. The results indicate that banking, currency and debt crises have a tendency to occur simultaneously; an increase in the indebtedness of the public sector, overvalued exchange rates and financial as well as political riskiness of a country plays a role in predicting sovereign default. Currency crisis increases the debt crisis probability through appreciated real exchange rates, and for some observations through tight international lending, and international illiquidity indirectly increases default probability if a banking crisis happens in three month-time prior to a sovereign default. International illiquidity coupled with currency crisis does not have any significance on the probability of a debt crisis.

The study contributes to the existing literature with the application of high-frequency data in estimations having monthly starting dates of sovereign debt crises and introducing non-linear effects of the currency and banking crises on sovereign defaults. The role of political disunity is clearly present in the analysis increasing the uncertainty of the sovereign actions and leading to a rise in the probability of default.

APPENDIX I: Crises Dates

Table I.1.Debt, Banking and Currency Crisis Dates between 1985 and 2007

Country	Debt Crisis	Currency Crisis	Banking Crisis
Argentina	September 1986 January 2001	January 2002	December 1989 November 1995 December 2001
Bolivia	September 1985 July 1987 April 1993 April 1997 February 2000		September 1986 November 1994
Brazil	September 1989 January 1993 December 1996	January 1999 October 2002	February 1990 December 1994
Chile	December 1985 January 1988		
China		January 1994	November 1998
Colombia	July 1987 March 1990 June 1999		June 1998
Dominican Republic	February 1987 March 1990 November 1993 February 2005	June 1987 April 1990	April 2003
Ecuador	February 1987 September 1992 April 1999	December 1985 September 1992	August 1998
India		July 1991	September 1993[16]
Indonesia	October 1997 April 2000 April 2002	September 1986 August 1997	November 1997
Jamaica	August 1986 April 1988 April 1992		December 1996
Korea	August 1997	December 1997	August 1997
Malaysia		December 1997	July 1997
Mexico	June 1985 December 1994	December 1994 September 1998	November 1994
Paraguay	May 1986	March 1989	December 1986

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[16] The starting month is taken from Khan (2011) as the forced merger between New Bank of India and Punjab National Bank due to increased problems of New Bank of India.

	February 2003	June 2002	May 1995
Philippines	February 1985 October 1986 April 1987 June 1988 July 1990	September 1997	July 1997
Russia	January 1991 January 1992 August 1998	September 1998	August 1998
Thailand		July 1997	July 1997
Turkey	July 1998	February 2001	November 2000
Uruguay	September 1985 May 2003		January 2002
Venezuela	January 1986 March 1988 December 1988 January 1994 January 2005	December 1986 February 2002	January 1994

APPENDIX II: Data Descriptions

Macroeconomic Variables:

1. Public Debt over GDP: Yearly ratios of the gross central government debt over GDP taken from Reinhart and Rogoff (2009), linear interpolation, lagged one month, levels. Source: The data is extracted from the website: http://www.carmenreinhart.com/data/browse-by-topic/topics/9/

2. Short-term External Debt Position: Yearly ratios of short-term external debt of a country to non-gold reserves, converted into monthly observations by linear interpolation, lagged by one month, levels. Source: World Bank, World Development Indicators (WDI) (short-term external debt) and IMF, International Financial Statistics (IFS), line 1.L.D (non-gold reserves).

3. Current Account Position: The monthly difference between a country's exports and imports, converted into dollars and divided by non-gold reserves, lagged by one month, levels. Source: IFS, lines 70.D, 71.D, RF and 1LD.

4. Exchange Rate Overvaluation: The average of the real exchange rate change for the 12 months before the crisis onset. Source: IFS, lines RF and 64.

5. The Growth Rate of GDP: The monthly growth rate of the Nominal GDP of a country in constant local currency, linear interpolation, lagged by one month. Source: WDI.

6. Real Domestic Interest Rates: Monthly Money market interest rates subtracted from inflation rate expressed in percentage changes, lagged by one month. Source: IFS, lines 60B and 64.

7. Inflation Rate: The percentage change in the consumer price index, lagged by one month. Source: IFS, line 64.

8. Real International Interest Rates: US Federal Funds Rates subtracted from inflation rate of US taken in percentage changes, lagged by one month. Source: IFS, line 60B.

Institutional and Political Variables:

1. The parliamentary and presidential election dates are taken from Election Guide website of the Consortium for Elections and Political Process Strengthening (CEPPS): http://www.electionguide.org/

2. Financial Risk Rating is an assessment of a country's ability to pay its way by financing its official, commercial and trade debt obligations. The components of this rating includes foreign debt as a percentage of GDP, foreign debt service as a percentage of exports of goods and services, current account as a percentage of exports of goods and services, net international liquidity as months of import cover and exchange rate stability. Risk ratings range from 50 (lowest risk) to 0 (highest risk). Taken from ICRG of Political Risk Services (PRS) Group.

3. Political Risk Rating is a measure of the political stability by assessing risk points for each of the component factors of government stability, socioeconomic conditions, investment profile, internal conflict, external conflict, corruption, military in politics, religious tensions, law and order, ethnic tensions, democratic accountability, and bureaucracy quality. The rating ranges from 100 (lowest risk) to 0 (highest risk). Taken from ICRG of PRS Group.

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