DETERMINANTS OF SOVEREIGN BOND SPREADS IN EMERGING MARKETS: RECENT EMPIRICAL EVIDENCE

By

Aliaksei Khmurets

Submitted to

Central European University

Department of Economics

In partial fulfillment of the requirements for the degree of Master of Arts

Supervisor: Professor Alessia Campolmi

Budapest, Hungary

2008

Abstract

The thesis analyses the behavior of emerging market sovereign bond spreads over the period 1997-2008; in particular, the effect of the credit market crisis, which started in August 2007, is emphasized. For purposes of analysis the daily and quarterly data sets are used. Conventional panel data methods with a special attention to the time series properties of the variables are employed for the quarterly data set; panel error correction model is estimated using the daily data. The results suggest that controlling for the country-specific and market characteristics, the effect of the recent crisis was stronger than that of any crisis since 1997, contrary to the common opinion that emerging markets remained mostly unaffected by the credit crunch. The investment grade countries are shown to be both less susceptible to the short run market fluctuations and to have lower level of spreads in the long run, even after controlling for the credit rating.

Acknowledgements

I would like to thank my supervisor, Professor Alessia Campolmi, and Tom Rooney for the helpful comments and guidance in the process of writing this thesis. I am also grateful to the anonymous IMF economist, Emre Alper and Burcu Cigerli for kindly sharing research data with students and to all the people who supported me.

Table of Contents

Introduction

The fast growth of a number of Latin American, Eastern European, African and Asian countries, conventionally classified as "emerging economies" gave birth to large and volatile capital inflows, with the numbers of loans and bonds issues proliferating during recent years (Figure 1). Following almost a decade of debt restructuring in Latin America, emerging markets have gone through much turbulence since the mid-90s with a financial crisis happening virtually every second year on average.[1] Nevertheless, having recovered from the last crisis in Argentina, external investments in these countries showed tremendous growth, increasing by more than 200% during the last 5 years. Bonds and loans constitute the major part of these inflows: for a decade they counted for more than 80% of external financing, and only recently equity capital surpassed 20% (Figure 2). As a result, this area has been of a great interest for both academia and business.[2]

Until recently, the increasing capital inflow has been supported by investors' optimism about these countries. Indeed, some of them (e.g. Brazil or Russia) gained impressive results and received investment grade ratings from international rating agencies. Whether such an attitude of the international markets is sustainable in times of the global financial crisis is an open question though. Anecdotal evidence and several publications suggest that emerging markets have been "broadly resilient" to the turbulence, which started with the US housing market crash in August 2007 (IMF (2008)). For instance, Global Financial Stability Report of IMF (2008) notices, that

[1] Mexico (1994-1995), East Asia (1997-1999), Russia (1998), Turkey (2001), Argentina (2002).
[2] See, for example, research papers of JP Morgan Chase (1995) or Goldman Sachs (2000) in addition to academic papers discussed in the literature review section.

“improved fundamentals, abundant reserves, and strong growth have all helped to sustain flows into emerging market assets” during the recent liquidity crisis in international capital markets. But what about the risk premium required for sustaining these flows? Has the risk pricing of emerging market bonds changed since the defaults of Russia and Argentina? And are the strongest, investment grade emerging market countries better off in such circumstances? These are the questions, which I attempt to answer in this work.

Typically the yield spread on government bonds is assumed to reflect a country’s risk premium – the extra charge for financing, being paid by the safest national borrower (Rowland (2000)). It is defined as the difference in yields between an emerging market country’s bond and a risk-free debt instrument, usually US Treasury bond of a similar maturity. The previous research on this topic can be divided into two broad categories: studies based on economic fundamentals (such as GDP growth, inflation and balance of payments statistics) and those using pure market data and information available from credit rating agencies.

In this thesis I make use of both methods in order to build an empirical model of sovereign bond spread determinants and investigate the evolution of spreads behavior over the period 1997-2008. I use quarterly and daily panel data to implement this empirical framework. Specifically, I control for a broad range of macroeconomic fundamentals and market factors using the quarterly data set and take advantage of the high frequency data using the daily one. Since the time dimension is larger than the cross-sectional one in both cases, the special attention is paid to the time series properties of the data. A number of unit root tests were performed to determine the order of integration of the series. Then feasible GLS estimator was used for the quarterly data set and the panel error correction model was estimated on the daily data.

The thesis provides the results based on the most recent data. It is shown, that while the emerging markets may be said to have been resilient to the US crisis with respect to their real economies, their bond spreads increased substantially. Controlling for the fundamentals, ratings and market variables, this effect is stronger than that of the default of Russia in 1998. The investment grade countries have lower levels of spreads in the long run according to the daily data, which is not supported by the quarterly data estimates, however. They were also less responsive to the fluctuations of the global interest rates during the recent credit market turmoil, but more sensitive to the stock market, having better dynamics of the spreads in the short run on average. In sum, the emerging market risk premia are still susceptible to market fluctuations, the investment grade countries have lower bond spreads than the speculative ones even after controlling for the sovereign rating and this effect took place during the recent credit crisis.

The paper is organized as follows. Chapter 1 provides a review of existing literature on the topic, chapter 2 outlines the empirical framework used, chapter 3 gives a description of the data sources and variables, chapter 4 discusses the results and analyses the implications of the findings, and the last section summarizes the paper.

Chapter 1 – Literature Review

One of the first papers investigating the behavior of a country risk premium in international capital markets is the work of Edwards (1984). In this study the author, using a simple theoretical framework, presents the yield spread as a function of the probability of default of a particular country, which is in turn dependent on a range of fundamentals:

$$\log(spread)_{it} = \alpha_i + \sum_{j=1}^{J} \beta_j \mathrm{X}_{jit} + u_{it} \tag{1}$$

where X is a vector of *J* variables, including debt-to-output ratio, reserves-to-output ratio, propensity to invest, loan characteristics and other controls for each country *i* at time period *t*. This framework has been used by the majority of researchers on this topic since then. For example, Min (1998) uses a broad range of indicators, including liquidity and solvency variables, macroeconomic fundamentals, external shocks and dummies to explain the launch spreads of bonds issued by 11 emerging market countries. Following the framework developed in Edwards (1984), he compiles 18 independent variables and applies F-tests for joint significance in order to determine the final specification. The results of Min (1998) and the other studies discussed in this chapter are summarized in Table 1.

Since roughly a half of debt financing comes to emerging markets via loans (Figure 2), the distinction between the two instruments is worth mentioning. Edwards (1986) argues that there are important differences in the pricing of bonds and loans and provides empirical evidence that spreads on loans are lower than those of bonds. The bond issues traditionally have been considered a more risky investment than loans due to several institutional and economic reasons.

For example, bond ownership is more widespread and this makes it harder for the creditors to monitor financial conditions of the borrower. In addition, loans are extended by banks or bank syndicates, which have more expertise and willingness to exercise control, while the general public holding bonds is less coordinated and less efficient in protecting their creditor's rights. On the other hand, as Eichengreen and Mody (1998) suggest, bonds usually have legal seniority in case of default, while the status of loans is more variable. Kamin and Kleist (1999) investigate this issue and come to the conclusion that only the level of spreads on loans and bonds differs (i.e. the constant term), but the pricing behavior remains unchanged. Having this result in mind, I will abstract from this subtlety and concentrate on the risk-pricing behavior.

Another empirical issue, addressed by Eichengreen and Mody (1998) is the sample selection bias in studies which use launch spreads data.[3] As compared to the secondary market spreads, which continuously incorporate all the information available at the moment and rise during poor market conditions reflecting increased risks, initial spreads may actually decrease because the riskiest borrowers are rationed out of the market and only the most creditworthy, low-risk (and accordingly, low-spread) borrowers have access to financing. They argue that OLS estimates based on such data will be biased and inconsistent and suggest using the Heckman correction procedure to control for selectivity bias. However, this approach requires a sample of non-issued bonds, which is much harder to obtain. In their paper they use error correction model, estimating it by joint maximum likelihood and conventional two-step procedure. The results suggest that the selectivity bias is present in their data, especially in Latin American countries.

[3] Launch spread is the difference between the yield of a bond and the risk-free rate of a similar maturity at the time of issue. A secondary spread for this bond can be obtained in the same manner at any point of time, using the yield implied by the market price of the bond and prevailing risk-free rate at the moment.

An alternative way to model spread determinants, which allows to avoid the sample selection problem, is to use secondary market yield spreads. Researchers typically used either a number of bonds traded on the secondary market or a bond spread index, such as JP Morgan's EMBI (Emerging Markets Bond Index), which is calculated as a weighted average of the secondary market yield spreads on sovereign bonds of a particular country. This approach was used in Cantor and Packer (1996) and also in more recent studies, such as Goldman Sachs (2000) and Ferrucci (2003). The latter two papers employ cointegration technique and estimate dynamic error correction panel data models. In order to implement this econometric method, the researchers had to use interpolation to obtain monthly data, which raises questions of their results' reliability. They argue, however, that the stock variables, such as international reserves or external debt are not very volatile and the benefits of having artificial observations outweigh the costs, since the model has a superior forecasting ability as compared to conventional panel data methods. Both papers show that yield spreads convey the mean reverting behavior and converge towards the theoretical equilibrium implied by the fundamentals. On the other hand, a number of spreads in both samples diverged from the "fair" value, suggesting the important influence of external factors. Ferrucci (2003) estimates a half-life of spread misalignment to be in the range of 1.5 – 3.8 months.

A number of studies took a different approach in explaining the yield spread, abandoning fundamentals and using sovereign ratings of international rating agencies instead. These grades are based on a broad number of criteria, which include not only economic and market indicators, but also a wide range of additional factors, including political risks, financial variables and expert opinions.[4] Thus, the sovereign rating is presumably a more useful tool for explaining spreads, not to mention the fact that it is available in real time. An important milestone, which started this stream of research, is the early work of Cantor and Packer (1996). In this study they show that rating alone has a greater explanatory power than the range of fundamentals, and after including it in equation (1) the fundamentals become insignificant.[5] Their results suggest that a deterioration of rating by one notch (say from A- to BBB+) raises spread by 25%.[6] However, the authors note that "although ratings are clearly correlated with yields, it is far from obvious that ratings actually influence yields". In other words, the direction of causality remains an open question and the problem of endogeneity arises in this type of regressions. Rating agencies are often blamed for moving too slowly and changing their opinion after the markets have already adjusted themselves. This problem has rarely been addressed in the previous research though. Cantor and Packer (1996) and later Kaminsky and Schmukler (2002) employ event study methodology, using daily data for secondary spreads, and show that rating agencies' announcements do impact the markets. However, these impacts are relatively small compared to the extent of market adjustment during the days prior to the announcement. The approach of Eichengreen and Mody (1998) seems to be worth mentioning in this respect: they use credit rating in their analysis together with fundamentals and include not the rating itself, but the rating residuals, which are obtained from regressions of rating on those fundamentals in order to alleviate multicollinearity and simultaneity problems.

[4]For example, the methodology of Fitch-IBCA (2002) includes over 100 indicators.
[5] Sovereign rating in turn appears to be well-explained by a fairly narrow range of macroeconomic, including GDP per capita, inflation, GDP growth, fiscal balance, external balance, external debt, indicator of default history and an indicator of economic development variables (the R^2 is higher than 90%).
[6] Their estimated rating semi-elasticity of spread is 0.22, which results in the 25% effect after the transformation from logarithms.

Kamin and Kleist (1999) also show that there is a substantial heterogeneity in the evolution of spreads over time and countries: while there was a jump in spreads of speculative-grade bonds during the Mexican crisis (1994-1995), the bond spreads of high-rated countries continued to decline. They interpret this finding as “flight to quality”, the situation when investors get rid of the most risky assets in light of poor market conditions and spreads of strong emerging market borrowers decline, facing increased demand. Thus, it is possible that external shocks have the opposite effects on different country groups and if these differences are not controlled for, the results of regressions on the pooled data sample might hide important relationships. In addition, Kamin and Kleist (1999) show that there are some nonlinearities in the spread – rating relationship, namely for speculative grade bonds deterioration of rating leads to a larger increase in spread, reflecting the ever-increasing risks.[7]

In line with the previous paper, Eichengreen and Mody (1998) use a sample covering 1991-1997 and find that the US interest rates increase the spreads in Latin America, but decrease them in East Asia. They explain this finding as a “search for yield” phenomenon – the situation when investors in industrial countries, facing higher costs of financing and shrinking margins strive to increase their profitability and thus raise the demand for the emerging market bonds. Having in mind the Mexican crisis of 1994-1995 it is not surprising that investors preferred Asian bonds to Latin American, which resulted in increased demand for the former, decreased for the latter and ultimately, the opposite effects of the US interest rates for these two groups of countries.

The role of industrial countries’ interest rates, typically used as a proxy for global liquidity, is one of the most controversial results in the literature on this topic. It seems intuitive that as

[7]Ratings lower than BBB- on Moody’s or S&P scales are generally considered to be speculative ones.

interest rates in international financial markets rise it becomes more difficult for emerging countries to refinance their debt. This increases the probability of default and the yield spread. However, a number of papers (Min (1998), Kamin and Kleist (1999), Goldman Sachs (2000)) did not find any significant effect of the global interest rates. On the other hand, it seems that the evidence in favor of important influence of interest rates appears more frequently in the more recent sophisticated studies. Kaminsky and Schmukler (2002), using daily and weekly panel data of market indicators find significant positive effects of US interest rates on emerging bonds' spreads. In particular, the effect is 50% stronger for weaker economies and is more pronounced during the crisis periods. Rozada and Yeyati (2006) and Ferrucci (2003) also find significant effects of the US interest rates, using panel error correction models and similar data sets.

The previous research found the importance of both macroeconomic fundamentals and market factors in explaining the yield spreads of emerging market countries. GDP per capita, external debt and reserves, fiscal policy, trade balance and a number of other variables were shown to have an impact on the country risk premium. At the same time pure market characteristics, like bond issue size, maturity, investors' optimism and sovereign credit rating also play a role. There is a substantial heterogeneity in the effects of these variables across time and country groups, however, and the results concerning the global interest rates are quite mixed. These are the areas on which I will concentrate in my analysis.

Chapter 2 – Empirical Framework

In this paper I follow the general framework developed by Edwards (1984) and use panel data to estimate equation (1), which takes the form

$$\log(spread)_{it} = \alpha_i + \sum_{j=1}^{J} \beta_j X_{jit} + \sum_{k=1}^{K} \gamma_k Z_{kt} + u_{it} \qquad (2)$$

where X represents a set of J country-specific variables and Z is a set of K controls common for all the cross-sections. Both data sets have the number of time periods, which is larger than the number of cross-sections. This feature of the data complicates the estimation and requires additional attention towards the time series properties of the variables. For example, if the series used in regressions are integrated of order one, fixed effects or least squares dummy variable (LSDV) methods may result in a spurious regression (Wooldridge (2003)).

While using the quarterly data set, which contains 46 time observations for 14 unbalanced cross-sections, I follow the approach of Alper (2006). First, I explore the time series properties of the variables in order to determine their degree of integration. The series that do not change over the cross-sections (e.g. Nasdaq index, or LIBOR) are checked for integration with Augmented Dickey-Fuller and Phillips-Perron tests; for the country-specific series Im, Pesaran and Shin, ADF-Fisher and PP-Fisher panel unit root tests are used. The results suggest that generally the variables are integrated of order one (while some of them are not), but after first-differencing all of them become stationary.[8] The country-specific intercepts disappear and equation (2) becomes a conventional regression on the first-differenced variables, in which a set of dummies is included to control for the specific time period effects:

$$\Delta \log(spread)_{it} = \sum_{n=1}^{N} \phi_n dum_{nt} + \sum_{j=1}^{J} \beta_j \Delta X_{jit} + \sum_{k=1}^{K} \gamma_k \Delta Z_{kt} + \Delta u_{it} \qquad (3)$$

The variable *dum* indicates the time dummies, which control for the effects of several crisis periods: the Russian and Indonesian defaults and the recent US housing market crisis. In order to correct for heteroskedasticity the feasible GLS estimator is then used, together with White period standard errors, which are robust to arbitrary serial correlation.

The second data set contains more than 1300 time periods for 15 unbalanced panels and requires additional attention to the time series properties of the data and the issues associated with it. On the other hand, it has a sufficient number of observations to facilitate the use of panel error correction model (PECM) and analyse the behavior of the spread in different sub-periods. In order to exploit this data set I use the panel data cointegration technique described in Rozada and Yeyati (2006). First, I perform the unit root tests used previously in the quarterly data part. If the series are integrated of the same order, a meaningful relationship exists between them only if they are cointegrated. Then, following the Engle-Granger (1987) methodology, I estimate the long-run relationship equation (4) using least squares dummy variables (LSDV) method, and check the residuals for stationarity, using the panel unit root tests.

[8] The results of the unit root tests for the quarterly data set are available upon request.

$$\log(spread)_{it} = \alpha_i + \gamma_1 \log(3mLIBOR)_t + \gamma_2 \log(10yUST)_t +$$
$$+\gamma_3 \log(NASDAQ)_t + \beta_4 \log(rating)_{it} + u_{it} \qquad (4)$$

3mLIBOR, *10yUST*, *NASDAQ* and *rating* represent 3-month LIBOR interest rate, 10-year US Treasury interest rate, Nasdaq index and S&P foreign currency sovereign credit rating, respectively. Once the residuals (further denoted by $\hat{\varepsilon}_{i,t-1}$) are shown to be stationary, the variables in the long-run equation can be represented with a PECM, according to the Granger representation theorem. The second step of the Engle-Granger procedure involves estimation of the PECM, using $\hat{\varepsilon}_{i,t-1}$ in order to obtain the short-run dynamics. Since the lag structure of the PECM is unknown, I follow the general-to-specific approach and estimate equation (5) starting with 5 lags of all the variables.

$$\Delta \log(spread)_{it} = \varphi_i + \delta_1 \hat{\varepsilon}_{i,t-1} + \sum_{l=1}^{L} \delta_{2l} \Delta \log(spread)_{i,t-l} + \sum_{l=0}^{L} \lambda_{1l} \Delta \log(3mLIBOR)_{t-l} +$$
$$+\sum_{l=0}^{L} \lambda_{2l} \Delta \log(10yUST)_{t-l} + \sum_{l=0}^{L} \lambda_{3l} \Delta \log(NASDAQ)_{t-l} + \sum_{l=0}^{L} \delta_{3l} \Delta \log(rating)_{i,t-l} + \upsilon_{it} \qquad (5)$$

I estimate equation (5) by LSDV method. As Rozada and Yeyati (2006) note, this is not the most efficient approach, because the lagged dependent variable appears as a right-hand side variable. However, since the sample number of observations is big and the time-series dimension is much greater than the cross-sectional one, it can be assumed that "the time dimension is large and the estimation bias goes to zero".

Chapter 3 – Data Description

In order to implement the approach outlined in the previous chapter I use daily and quarterly data. Both data sets impose certain limits. Specifically, the first data set includes a broad range of macroeconomic fundamentals which allow to control for important determinants of the creditworthiness. However, the majority of these indicators are available only at quarterly frequency, which limits the length of the panel to 46 periods. The period of interest, the recent credit crisis, which started in August 2007, is represented by only 2-3 quarters and after first-differencing is reduced even further. Thus, in order to investigate the behavior of the spreads during the credit crisis period I use daily series. This approach comes at cost of having fewer controls, which are, basically, a few market variables, but the number of time periods becomes more than 1300 for each cross-section, on average.

In this paper I use JP Morgan's EMBI index as a proxy for spread. As it was previously mentioned, this index is based on the secondary market spreads and does not suffer from the sample selection problem associated with launch spreads. Two of these indexes were used in the analysis: EMBI Global (EMBIG) and EMBI+. Both are calculated as weighted averages of the secondary market spreads on the bonds with minimum issue size of US$500 million, at least 2.5 years until maturity at the time of initial entry and at least 1 year until maturity thereafter (JP Morgan (2004)). EMBI+ includes the sovereign bonds, which pass a liquidity test and their credit rating does not exceed BBB+ on the S&P scale. EMBI Global allows for quasi-sovereigns (i.e. guaranteed by government) and has less strict inclusion criteria.

Out of these two indexes only EMBI+ series were available at daily frequency over the period including the recent credit crisis, while EMBIG contained a larger number of countries. This imposes a trade-off between having EMBI+ in both data sets and having a greater number of observations in the quarterly one, using EMBIG instead. In Ferrucci (2003) the author extensively examines the two alternatives and concludes that EMBI+ and EMBIG "differ somewhat", but are "sufficiently strongly correlated" not to prevent him from pooling them. In my paper I do not splice the two indexes in order to avoid a potential structural brake problem and use EMBIG in the quarterly data set and EMBI+ in the daily one. In addition, the indexes are strongly correlated (the correlation coefficient is 0.999) and virtually identical for some countries. Thus, using EMBIG and EMBI+ in this fashion should not affect the results (both are denoted as *spread*).

3.1. Quarterly Data

This data set covers the period from the fourth quarter of 1997 until the first quarter of 2008 and contains a broad range of variables for the following countries: Brazil, Bulgaria, Chile, Colombia, Indonesia, Malaysia, Mexico, Peru, Philippines, Poland, Russia, South Africa, Turkey and Ukraine. The list of ratios and other variables, which are assumed to have an effect on the creditworthiness of a country and the probability of this country facing liquidity constraints in serving its debts (potential X-s from equation (2)), is provided below:

Liquidity/Solvency variables

External Debt-to-International Reserves, External Debt-to-Exports, International Reserves-to-Imports, Current Account-to-GDP, Current Account-to-Exports, Trade Balance-to-GDP, Budget

Deficit-to-GDP, Debt Service-to-Debt, Debt Service-to-Exports, Debt Service-to-International Reserves, Exports-to-GDP.

Macroeconomic Variables

GDP per capita, Growth Rate of GDP (imports, exports, investment), Investment-to-GDP, Inflation, Domestic Credit-to-GDP, Openness = (Exports+Imports)/GDP, Real Exchange Rate.

External debt statistics were obtained from World Bank's Quarterly External Debt Statistics, Macroeconomic variables – from the IMF's International Financial Statistics database. GDP per capita was converted into US dollars; international reserves include both gold and foreign currency reserves.

Global Market Factors

As a proxy for global liquidity I use 3-month LIBOR interest rate. It reflects the cost of funds for the large international banks and while being higher than, but quite close to the US Treasury 3-month bill rate, behaved differently during the 2007 credit crisis. Namely, when the crisis started in August 2007, the costs of borrowings increased due to the lack of funds in the market and unwillingness of the banks to lend to each other. On the other hand, the increased demand for the safe assets like US Treasuries pushed their price upwards, depressing the yields. Thus, LIBOR and US Treasury yields moved in the opposite directions during some time, although they move together in the long run. In these circumstances LIBOR better reflects the costs of funds in the capital markets and affects the probability of emerging countries defaulting due to the higher refinancing costs. Therefore, I use 3-month LIBOR as a short-term interest rate in my analysis.

A number of studies found significant effects of the long-term interest rates (see Table 1). LIBOR is not calculated for such maturity, but supposedly long-term rates are not as volatile as short-term ones, so I used the 10-year US Treasury yield as a long-term interest rate. Following the research of Rozada and Yeyati (2006) and Ferrucci (2003), I use the difference in yields on the bonds of Baa and Aaa US corporations (*Risk Appetite*). This measure reflects investors' optimism, which increases demand for riskier assets and narrows the spread between yields on the bonds of different credit quality. A similar intuition applies to Nasdaq Composite index. In addition, I use the real oil price (*oil*), which may affect the economic strength of several oil exporting countries, and the Standard & Poor's foreign currency sovereign credit rating. The credit rating was converted into numerical form according to Table 2, provided in Appendix B.

The interest rates and the corporate yields were obtained from the database of the Federal Reserve System, the credit ratings – from S&P's "Sovereign Ratings History Since 1975" and other Internet sources, the Nasdaq Composite series – from Yahoo Finance, the oil price – from the IMF's IFS database.

3.2. Daily Data

This data set covers the period from March 2002 to May 2008 and includes 15 countries: Brazil, Bulgaria, Colombia, Egypt, Indonesia, Mexico, Morocco, Panama, Peru, Philippines, Poland, Russia, South Korea, Turkey and Ukraine. The EMBI+ spreads are regressed on 3-month LIBOR, 10-year US Treasury yield, Nasdaq Composite index and the S&P credit rating.

In both data sets the observations for Russia and Indonesia during the default periods were excluded. The spreads during such periods are abnormally high and the relationship between them and explanatory variables obviously breaks down. The descriptive statistics of the variables used in the analysis are given in Tables 3 and 4, Appendix B.

Chapter 4 – Results and Analysis

4.1. Quarterly Data Set

This section presents the estimates of equation (3), based on the quarterly data. All the variables outlined in chapter 3, which potentially influence the yield spread, were included in the regression and their effect was analysed. The majority of them are strongly correlated with each other, which poses the problem of muticollinearity. The final specification was obtained on the grounds of both economic theory and statistical significance, following the general-to-specific approach. The FGLS estimates of equation (3) are presented in Table 5, Appendix C.

The first column reports the estimates of the basic equation. As can be seen, GDP per capita, credit rating, debt-to-reserves and domestic credit-to-GDP ratios are statistically significant and have expected signs. GDP per capita and domestic credit-to-GDP ratio reflect the level of economic development and have negative coefficients. The credit rating, based on a wide range of factors including political risks, the overall development of a country and many others, also decreases the spread. Debt-to-reserves ratio shows the effect of debt burden: higher indebtedness and lower reserves increase the risk premium the countries pay on their bonds. The effects of Nasdaq and risk appetite are negative and positive, respectively. While the former has the expected sign, reflecting the overall investors' optimism, the latter is somewhat surprising. Risk appetite is defined as the difference between the yields on the Baa- and Aaa-rated US corporate bonds. As one may expect, increased risk appetite of investors would decrease both corporate and sovereign bond spreads. On the other hand, the investors may demand higher premia on the US corporate bonds in light of worsened market conditions and at the same time try to diversify their global portfolios, increasing the demand for emerging market bonds and narrowing their yield spreads. In this hypothetical situation the two spreads would move in the opposite directions. In addition, risk appetite is correlated with Nasdaq, which may pick up some of its effect in the regression. The real oil price significantly decreases spreads, reflecting the presence of big oil and gas exporters among the countries in the sample.

Let us now take a closer look at the interest rates. Intuitively, higher interest rates increase the debt burden of a country, making refinancing more expensive and in this way affect the creditworthiness of the borrower. In addition, as discussed in Kamin and Kleist (1999), the spread may increase due to purely “mathematical” reasons. A simple framework, adopted from their paper, provides a good illustration. In presence of a non-zero probability of default the risk-free interest rate is assumed to be determined as follows:

$$(1+r^f)d = (1-p)(1+i)d + ps\,, \qquad (6)$$

$$0<p<1$$

where p is the probability of default, i – the interest rate of a specific borrower, r^f - the risk-free interest rate, d – the principal amount of debt, and s – the amount recovered in case of default. Rearranging equation (6) gives the expression for the spread:

$$spread = i - r^f = \frac{p}{1-p}\left(1+r^f-\frac{s}{d}\right) \qquad (7)$$

$$\frac{\partial spread}{\partial r^f} = \frac{p}{1-p} > 0\,, \quad \frac{\partial^2 spread}{\partial r^f \partial p} = \frac{1}{(1-p)^2} > 0$$

Clearly, an increase of the risk-free interest rate increases the spread. Furthermore, this effect is stronger for the lower quality borrowers (i.e. it increases in *p*). While the framework outlined above is overly simplistic (for example, it does not consider the interest rates of different maturities, which I investigate in the next section), it is useful as an illustration. As shown in Table 5, the effect of 3-month LIBOR in the baseline equation is positive, supporting the theory. The coefficient on the long-term interest rate is not significant.

A number of dummy variables included in the regressions also provide interesting insights. These variables are supposed to capture the effects of contagion from various financial crises: the Russian and two Indonesian defaults and the recent credit crunch, stemming from the mortgage crisis in the US.[9] The results suggest that during the Russian, first Indonesian and US crises the spreads were significantly higher than normal. Furthermore, the effect of the US crisis is about twice as large as that of the Russian default. This stands in contrast with the perception that the emerging markets were only slightly affected by the US crisis. Figure 3 casts even more doubts on this result, showing that the spreads during this period increased uniformly by 150-200 basis points, reaching 300 on average – a relatively modest effect, compared to the statistically insignificant second Indonesian default, when the spreads of some countries exceeded 1000 basis points. How could it happen?

Taking a closer look at the fundamentals, however, one can notice that the statements about the resilience of emerging markets to the credit crisis are still relevant, but with respect to the real economy. The GDP per capita grew at the same rates as before; the credit ratings remained

[9] Russian default (3rd quarter of 1997 – 1st quarter of 2001) is denoted as *Russia*; the first (2nd – 4th quarters of 2000) and the second (2nd quarter of 2002 – 2nd quarter of 2003) Indonesian defaults are denoted as *Indonesia1* and *Indonesia2;* the US crisis (3rd quarter of 2007 – 1st quarter of 2008) is denoted as *US*.

unchanged and improved for Mexico and Chile. During the previous crises these two variables generally deteriorated. For example, GPD of 10 out of 14 countries fell significantly within 2 quarters after the Russian default. While the spreads at that time reached the levels measured in thousands of basis points, they could be explained, at least in part, by worsened fundamentals. Now the economies of the emerging market countries remained sound and after controlling for these factors the effect of the recent credit crunch is greater than that of any other crisis in the sample.

Next, I check for a possible heterogeneity in behavior of spreads of investment and speculative grade countries. Kaminsky and Schmukler (2002) note that the issues of these two groups of countries may be priced differently.[10] This may happen because of the restrictions imposed on institutional investors, who are allowed to hold only investment grade securities or because of a shift in the perception of default risk once a country reaches a certain rating threshold. The second column in Table 5 contains the investment grade dummy (*InvGr*) and it's interaction with domestic credit-to-GDP ratio, the only significant interaction term. The dummy itself is insignificant, suggesting that there is no difference in levels of spreads between the two groups of countries after taking into account the other controls. The interaction term suggests that credit-to-GDP ratio lowers spreads only in investment grade countries, which supposedly have more developed financial systems. The results of estimation based on two country groups separately are provided in columns 3 and 4. In addition to the above mentioned difference, the debt-to-GDP ratio and credit rating become insignificant in case of investment grade countries. It may seem that they were also more affected by the US crisis. This result is, however, based on only 11

[10] Investment grade credit rating is usually meant to be equal to or higher than BBB- on the S&P scale.

observations which remained for this country group after first-differencing and should be taken with a degree of skepticism.

Overall, the number of fundamental and market variables have significant effects with expected signs on the yield spreads: GDP per capita, credit-to-GDP, Nasdaq, credit rating and real oil price decrease the country risk premium, while debt-to-reserves, risk appetite and short-term interest rate increase it. The emerging market countries may be said to have been resilient to the US crisis with respect to the shape of their economies, but their financial instruments remained sensitive to fluctuations in international capital markets. The effects of financial crises are positive and significant with the US dummy having the largest coefficient. The differences between investment and speculative grade countries are not big, with only the effect of credit-to-GDP ratio being significantly stronger in the former group.

4.2. Daily Data Set

Clearly, the quarterly data does not allow investigating the US crisis any further. In this section I estimate the panel error correction model, using daily data, which allows me to explore the short-run dynamics of the yield spread behavior. The daily observations were available for the time period from March 2002 to May 2008. Figure 3 plots the spread series. For the purposes of analysis I use the following notation for the 3 sub-periods: the second default of Indonesia in the beginning (called *Indonesia* in the output tables), the US crisis (*US*) in the end, and the interim period (*Interim*).[11]

[11] The dates are given in the previous section.

As it has been already mentioned, the daily data limits the number of controls to a few series. The same reasons for choosing the controls outlined in the quarterly data section apply here. 3-month LIBOR and 10-year US Treasury interest rate control for the global cost of capital, Nadaq index is used as a proxy for investors' optimism and growth prospects of economy, and S&P credit rating is used to control for the country-specific fundamentals. While it has been shown that the fundamentals have a significant effect even after the rating is controlled for, they are not observable at this frequency. This is the unavoidable cost of using the daily data.

It was mentioned in the previous section that most of the time series used in the analysis are not stationary. That is, a meaningful relationship between them exists only if they are cointegrated. It has been shown, however, that during the recent US crisis the regular relationship between the spread and credit rating broke down: while the ratings improved or stayed the same, the spreads increased. In addition, as can be seen from Figures 3 and 4, the short-term interest rates were higher than the long-term ones (i.e. the yield curve was negatively sloped) and both of them moved in the direction opposite to the spreads. Due to this abnormality of the US crisis period I divide the sample in two parts: the US crisis period and the rest (Pre-Us). I then estimate the PECM on these two sub-samples. Assuming the recent credit crisis does not make a very long-lasting impact on the variables in question, it would be, probably, possible not to split the data and estimate one long-run equation a few years from now, after the relationship between the series comes back to its long-run equilibrium. However, facing the data constraints at the present moment, I have chosen to treat the two periods separately.

Tables 6 and 7 contain the results of the unit root tests of the time series, which suggest that all the variables are integrated of order one. Next, I estimate the long-run relationship equation (4) for the Pre-US and US periods (columns 1 and 2, Table 8). The unit root tests of the residuals, reported in Table 6, suggest that they are stationary. Thus, the variables in equation (4) are cointegrated. Having obtained this result, I estimate the short-run equations, which will be discussed below.

It can be seen from the first two columns of Table 8 that the results for the two periods are different. While Nasdaq and credit rating both have the expected signs, the short-term interest rate increases the spreads during the US crisis and decrease them during the Pre-US period. The long-run rates have the opposite effects. Ferrucci (2003) uses both rates in his analysis and also obtains the opposite effect of the long- and short-term interest rates. He interprets it as the importance of the slope of the yield curve, not just separate rates. As shown in Figure 4, the short-term interest rates have been rising since 2004, reflecting the monetary policy of the FED. At the same time the spreads were decreasing up to the summer of 2007, taking the advantage of good market conditions. During the US crisis, however, the short-term rates reflected the lack of capital in international financial markets and the spreads widened due to the increased financial risks. That is, they moved in the same direction. On the other hand, the long-run rates, which possibly reflected the anticipated rate cuts by the FED in light of crisis, decreased during this period.

The next two columns contain the estimates of the regressions, which include the investment grade dummy. It shows that the investment grade countries indeed have lower spreads in normal circumstances, as suggested by several studies (the Pre-US column). It is insignificant during the US crisis period, however. In the last column I present the estimates of equation (4) on the entire sample, controlling for the different yield curve slope in the two periods, in order to check the results obtained earlier.[12] The effect of the US crisis dummy is large, positive and significant, while the second default in Indonesia did not bring increases in the spreads. The investment grade countries have significantly lower spreads in Pre-Us period, but this effect is offset by the interaction term *US*InvGr* in the US period. Figures 5 and 6 illustrate the point. During the US crisis the spreads of both country groups differed by level, but moved in line with each other. In contrast, the slope of the speculative grade countries' graph was steeper in the preceding period, suggesting the presence of the other factors not captured by the different levels of ratings.

Thus, the results obtained earlier on the quarterly data set are confirmed with respect to the crisis dummies. The quarterly data set was unable, however, to capture the effect of reaching the investment grade rating. First, this could be due to the small number observations and infrequent data. Second, the time span in the quarterly set is different. It includes Russian and first Indonesian defaults, which could mute the effect in the way similar to the US crisis.

The results of the short-run equations are given in Tables 9 and 10. I estimate equation (5) for *Indonesia*, *Interim* and *US* periods. The lagged residuals used in the latter are from the US long-run equation (column 2, Table 8), the residuals used in the first two are from the Pre-US long-run equation (column 1, Table 8). I start the estimation allowing for 5 lags of all the variables and then exclude the insignificant ones in order to obtain the final specifications.

[12] Although I chose to treat Pre-US and US periods separately in my analysis, I run this regression on the entire sample as another illustration and check of the previous results. The unit root test of the residuals showed that they were stationary.

Columns 1, 3 and 5 of Table 9 contain the basic specifications of equation (5) for the three periods. The results are not easily tractable because of the cumbersome lag structure. However, in the majority of cases the dominant effect can be identified. For example, Nasdaq clearly decreases the spreads in all the periods: its significant lags are all negative. In contrast, it can be seen that the credit rating behaves differently: it has the expected negative sign in the *Interim* period (thus, it decreases the spread in normal circumstances), but is positive during both Indonesian and US crises. The explanation of this result probably lies in the abnormally high spreads during these periods. The intuition here is similar to that discussed in the quarterly data section. During the US crisis both fundamentals and ratings of the emerging countries remained sound, but the market turmoil increased the risk aversion and risk-premia on their bonds. In this situation an improved rating would coincide with a widened spread, resulting in a positive coefficient in the regression. During the default of Indonesia these controls also did not deteriorate to the extent needed to explain the abnormal yield hikes.

The effect of 3-month LIBOR is in general positive, although it is somewhat inconclusive in case of *Indonesia* due to the significant negative fifth lag. The effect of the 10-year US Treasury interest rate is negative. Also, it can be noticed, that the magnitude of the coefficients on the interest rates and Nasdaq is greater during the US period, suggesting that the volatility was higher than normal.

In order to explore the potential differences in risk pricing of the investment and speculative grade issues I introduce *InvGr* dummies and interact them with the other explanatory variables.

The results, reported in columns 2, 4 and 6 of Table 9 suggest significant differences, which prompts me to run the regressions for each country group separately (Table 10). I then analyse both sets of estimates, test the ambiguous results, which contain lags with different signs for the presence of a significant joint positive/negative effects and summarize the outcomes in Exhibit 1 below, which provides a clearer picture of the findings.

First, the investment grade dummies are significant and negative in the *Interim* and *US* periods, with the effect stronger in case of *US*. This means that on average, the spreads of the investment grade countries react to changes in explanatory variables more favorably. For example, for a given hike in short-term interest rates they would increase by less and for a given increase in Nasdaq they would decrease by more. This finding is in line with the earlier result showing the lower level of spreads for these countries during the *Interim* period. During the *US* period the spreads are less volatile, but their overall level is not significantly lower.

Exhibit 1
Summary of the Short-Run Effects for Investment Grade Countries
Dependent Variable: $\Delta Log(spread)$

	Indonesia	**Interim**	**US**
InvGr		⬇	⬇
$\Delta Log(3mLIBOR)$	⇧		⇩
$\Delta Log(10yUST)$	⬇	⬆	⬆
$\Delta Log(NASDAQ)$			⬇
$\Delta Log(rating)$	⇧	⬇	⇧

Note: the white and shaded arrows denote positive and negative effects, respectively. A rising white (shaded) arrow denotes a significantly more positive (less negative) effect in comparison to the speculative country group and vice versa.

Next, there is a difference in the impacts of the interest rates. It can be seen from Exhibit 1 that during the *Indonesia* period the reaction of the investment grade countries to changes in the interest rates was more pronounced, while during the credit crisis the effect was smoothed. It appears that this country group was less responsive to the volatility of the interest rates recently. On the other hand, they reacted more to the changes in Nasdaq and the effect of the credit rating was more "positive". The reasons for the positive sign on the credit rating during the crises have already been discussed above. It can be added that during the US crisis period 4 out of 8 investment grade countries were upgraded and the rest stayed at the same level. The speculative grade countries' ratings remained at the same level, on average.

In sum, the daily data confirmed the earlier results and provided new insights. The levels of the emerging market bond spreads during the US crisis have been abnormally high. The effect of Nasdaq index, representing investors' optimism, is negative both in the long and short term. The credit rating decreases the spreads in the long run, but it has abnormal positive sign during the crisis periods. The short-term interest rates increase the spreads in the short run and the long-term rates have the opposite effect. In the long run the short-term rates have a negative effect and the long-term rates have a positive sign, resulting in the cumulative positive effect. This is not the case for the *US* crisis period, when increasing risks coincide with declining interest rates.

While there is a substantial heterogeneity in reaction of spreads to various factors across different country groups and time periods, the investment grade countries have both lower level of spreads and more favorable short-run dynamics in the *Interim* period (which can be referred as a "normal"); lower spreads during the Indonesian default and better short-run dynamics during the recent credit crisis. Thus, it appears that the “discount” in spread for the investment grade countries indeed exists.

Conclusions

In this paper I explore the behavior of emerging market bond spreads from 1997 to 2008, including the recent credit crisis period, which started in August 2007 with the US mortgage market crash. While the capital flows to emerging markets were very strong during the last several years and it is frequently noted that these countries have been resilient to the crisis so far, it appears that the financial instruments of these countries are still very sensitive to the fluctuations in international capital markets.

In order to investigate the reaction of emerging market bond spreads to the recent crisis the quarterly and daily data sets were used. Both sets have significantly larger time dimension than cross-sectional one, thus a special emphasis on the time series properties of the variables was made. Feasible GLS estimator on the first-differenced series was used in the analysis of the quarterly data, and the panel error correction model was estimated on the daily data.

The analysis of the quarterly data revealed the importance of a number of fundamental and market variables: GDP per capita, credit-to-GDP, Nasdaq, sovereign credit rating and the real oil price decrease the spread, while debt-to-reserves, risk appetite and short-term interest rates increase it. There is also a difference between the investment and speculative grade countries, although it is not big in this model. The effect of credit-to-GDP ratio is significantly stronger in the former group. The time period dummies suggest that during the US, Russian and Indonesian crises the spreads were abnormally high, with the effect of the US crisis being the largest.

The daily data confirmed these results and provided new insights. The effects of the time period dummies, Nasdaq Composite and credit rating are the same, although the later exhibits abnormal positive sign during the crisis periods. The short- and long-term interest rates have the opposite signs, suggesting the importance of the slope of the yield curve, not just separate rates. In the long run the coefficient on the short-term rates is negative and the one on the long-term rates is positive, resulting in a cumulative positive effect. This is not the case during the *US* crisis period, when increasing risks coincide with declining interest rates and unusual negatively sloped yield curve prevails. In the short run the short-term interest rates increase the spreads and the long-term rates have the opposite effect in all the periods. The investment grade countries are shown to have both lower level of spreads in the long run and more favorable short-run dynamics; they were less responsive to the fluctuations in the global financial markets during the recent credit market turmoil.

To summarize, this thesis provides the evidence that the emerging markets risk premia are still susceptible to market fluctuations. The investment grade countries are better off than the speculative grade ones, having lower bond spreads even after the sovereign ratings are controlled for. It appears that the emerging markets, being resilient to the recent credit crisis in terms of their fundamentals, are still perceived as risky borrowers and charged high yield premia in times of global financial instability.

Appendix A

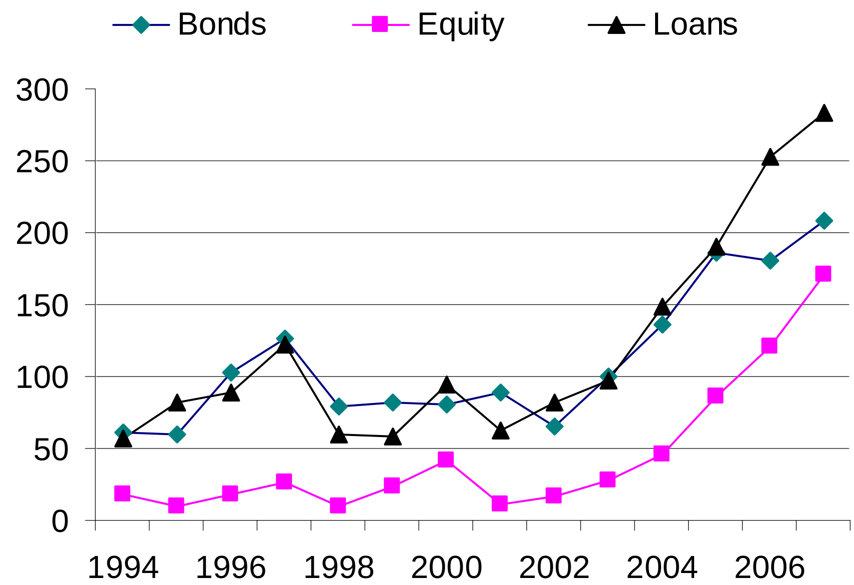

Figure 1. Emerging Market External Financing, by instrument (gross, $billions)
Source: IMF (1997-2007)

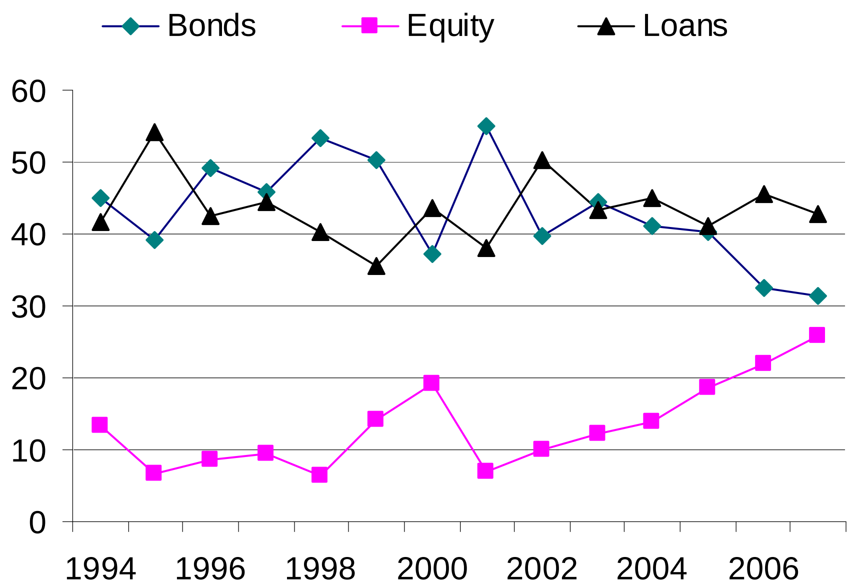

Figure 2. Emerging Market External Financing, by instrument (% of total value)
Source: IMF (1997-2007)

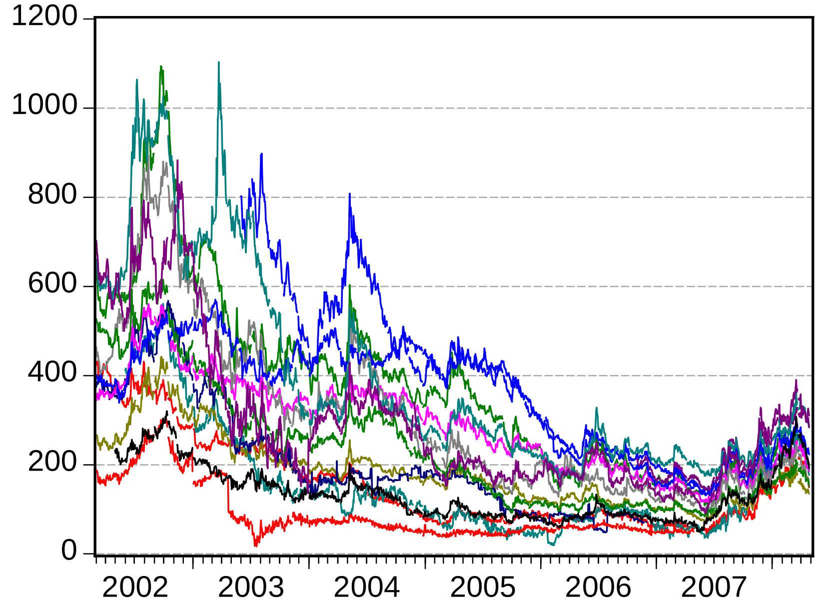

Figure 3. JP Morgan EMBI+ Spreads, basis pts (0.01%)
Source: JP Morgan

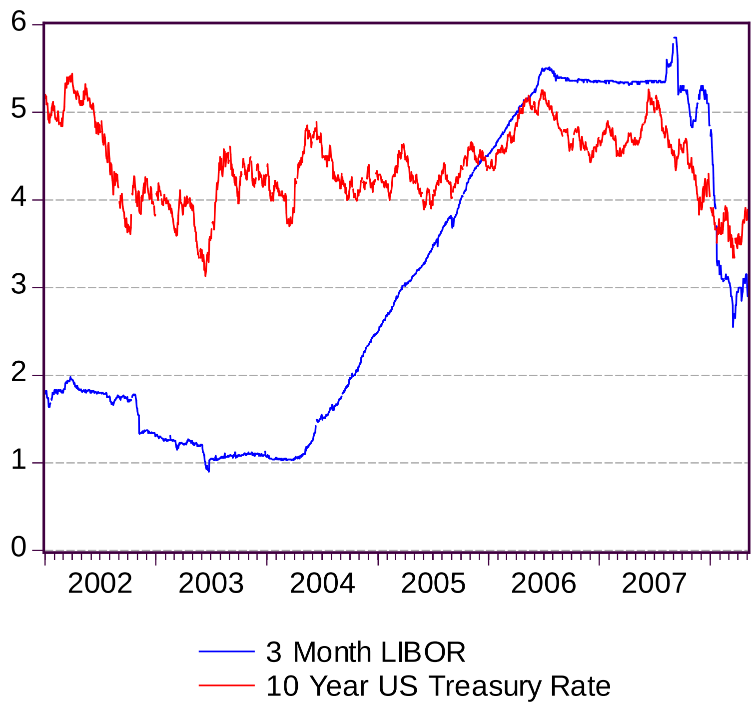

Figure 4. Global Interest Rates, %
Source: Federal Reserve Board Statistics

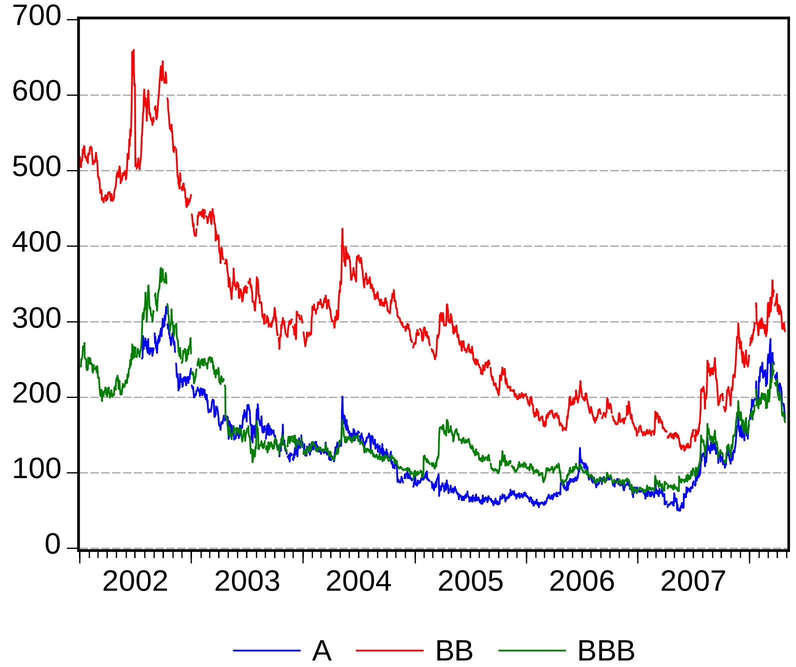

Figure 5. JP Morgan EMBI+ Spreads by Credit Rating, basis pts (group averages)
Source: JP Morgan

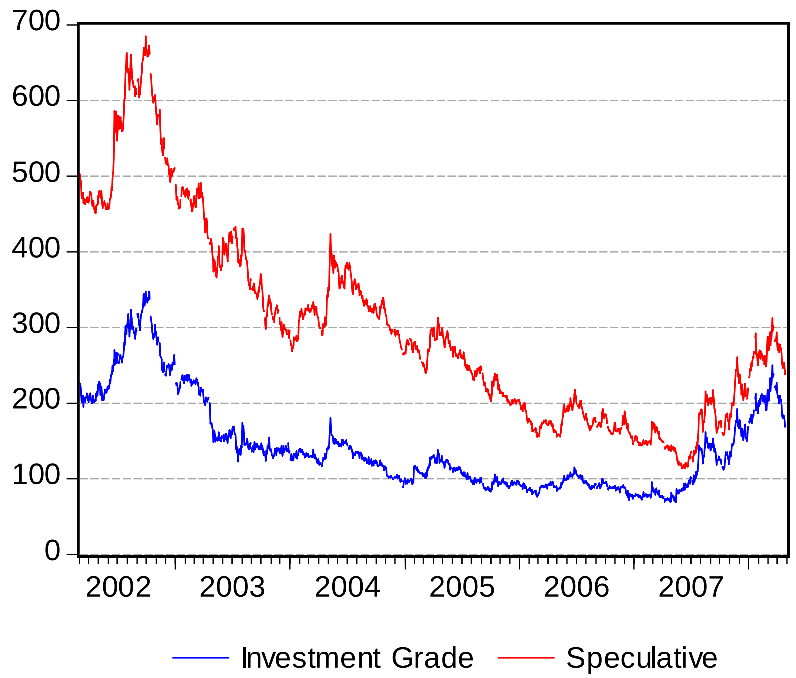

Figure 6. JP Morgan EMBI+ Spreads, Investment and Non-investment Grade Bonds (group averages). Source: JP Morgan

Appendix B

Table 1
Summary of the Previous Research

Study	Data	Estimation method	Significant variables
Edwards (1984)	727 public Eurodollar loans of 19 less developed countries, 1976-1980	Panel data technique, Random Effects	Debt/GNP (+) Debt Service/Exports (+) Reserves/GNP (-) Investment/GNP (-)
Cantor and Packer (1996)	35 (developed and emerging) countries' secondary yield spreads, 1995	OLS	Credit rating (-) or Economic Development (-) External Debt (+) Default History (+)
Min (1998)	Launch yield spreads of 505 bonds, issued by 11 emerging economies, 1991-1995	Pooled OLS	Private issue dummy (+) Debt/GDP (+) Reserves/GDP (+) Growth of Exports (-) Growth of Imports (+) Debt Service/Exports (+) Net Foreign Assets (-) Inflation (+) RER (+), ToT (-) Maturity (-)
Eichengreen and Mody (1998)	Launch yield spreads of 1300 developing-country bonds, 55 countries, issued in 1991-1997	Pooled OLS, correcting for selectivity bias	Private placement (+) US interest rate (+/-) Credit rating residual (-) Debt/GDP (+) Debt rescheduling dummy (+) Debt Service/Exports (+) Israel dummy (-) Latin America dummy (+) Public issuer (-) Private issuer (+)
Kamin and Kleist (1999)	Launch yield spreads on 304 bonds and 358 loans 1991-1997 10 countries	Pooled OLS	Credit rating (+) Issue characteristics Mexico dummy (+) Time dummies
Goldman Sachs (2000)	Eurobond yield spreads, 15 countries	Dynamic error correction panel data model	Real GDP Growth (-) Amortization/Reserves (-) Debt/GDP (+) Budget Balance (-) Openness of Economy (-) RER Misalignment (+) Long-run LIBOR (+) Restructure dummy (+)
Beck (2001)	9 countries' Eurobond spreads, 1998-2000	Panel data techniques	Real GDP Growth (-) Inflation (+) Current Account (+) LIBOR (3-month) (+)
Kaminsky and Schmukler (2002)	EMBI+ yield spreads, 1990-2000	Panel data methods, IV	1-month interbank US interest rate (+) Credit rating (-) Regional dummies
Ferrucci (2003)	EMBI+ and EMBI Global country spreads, 1992-2003	Dynamic error correction panel data model	Debt/GDP (+) (Imports+Exports)/GDP (-) Amortization/Reserves (+) Interest payments/Debt (+) Current Account/GDP (-) Short term Debt/GDP (-) 30-day US interest rate (+) 10-year US interest rate (-) US corporate bonds Spread (-) S&P 500 (-)
Rowland (2004)	EMBI Global composites, July 2003	Pooled OLS	GDP per capita (-) GDP Growth (-) Inflation (+)
Benczur and Ilut (2006)	757 syndicated bank loans, 46 countries, 1973-1981	Panel data methods, IV Structural-form estimation	Default History (+) 1-year $ LIBOR (-) Inflation (+)
Rozada and Yeyati (2006)	EMBI Global, 1993-2005	Panel ECM	High-yield corporate bonds spread (+) Credit rating (-) 10-year US interest rate (+) Time dummies

Table 2
Numerical equivalent of credit rating notches and outlooks

S&P	Numerical equivalent	Outlook/Watch Negative	Outlook/Watch Negative
AAA	22	+0.5	-0.5
AA+	21	+0.5	-0.5
AA	20	+0.5	-0.5
AA-	19	+0.5	-0.5
A+	18	+0.5	-0.5
A	17	+0.5	-0.5
A-	16	+0.5	-0.5
BBB+	15	+0.5	-0.5
BBB	14	+0.5	-0.5
BBB-	13	+0.5	-0.5
BB+	12	+0.5	-0.5
BB	11	+0.5	-0.5
BB-	10	+0.5	-0.5
B+	9	+0.5	-0.5
B	8	+0.5	-0.5
B-	7	+0.5	-0.5
CCC+	6	+0.5	-0.5
CCC	5	+0.5	-0.5
CCC-	4	+0.5	-0.5
CC	3	+0.5	-0.5
C	2	+0.5	-0.5
D/SD	1	+0.5	-0.5

Adopted from Meng and ap Gwilym (2007)

Table 3
Descriptive Statistics, Quarterly Data

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera (p-value)
438 Observations								
EMBI Global, basis pts	355.15	264.91	1905.53	47.58	272.34	1.57	6.80	0.00
GDP per capita, 000 $	1600.35	970.62	8251.94	206.73	1768.35	2.08	6.49	0.00
Debt-Reserves	3.04	2.82	8.60	0.54	1.30	0.89	4.36	0.00
Domestic Credit-GDP	1.74	1.47	6.22	0.34	1.26	1.63	5.66	0.00
Risk Appetite, %	-0.91	-0.89	-1.33	-0.56	0.20	-0.69	2.84	0.00
3-month LIBOR, %	3.33	3.44	6.20	0.93	1.75	0.01	1.51	0.00
10-year US Treasury Interest Rate, %	4.76	4.65	6.47	3.62	0.66	0.73	3.03	0.00
NASDAQ	2192.30	2053.39	4427.87	1309.96	657.32	1.63	5.90	0.00
Credit Rating	11.99	11.50	17.50	6.50	2.58	0.20	2.08	0.00
Real Oil Price, $	37.85	29.65	87.00	11.60	17.07	0.59	2.13	0.00

Data set covers 1997q4 – 2008q1 time period and includes 14 unbalanced cross-sections: Brazil, Bulgaria, Chile, Colombia, Indonesia, Malaysia, Mexico, Peru, Philippines, Poland, Russia, South Africa, Turkey, Ukraine

Table 4
Descriptive Statistics, Daily Data by Periods

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera (p-value)
Indonesia2								
2717 Observations								
EMBI+, basis pts	483.12	459.00	1103.00	152.00	202.22	0.67	2.98	0.00
3-month LIBOR, &	1.53	1.63	1.82	1.15	0.24	-0.11	1.20	0.00
10-year US Treasury Interest Rate, %	4.15	4.06	5.10	3.59	0.37	0.92	3.05	0.00
NASDAQ	1351.58	1348.31	1595.26	1114.11	87.96	0.01	3.37	0.00
Credit Rating	11.14	10.50	16.00	6.50	2.41	0.25	2.79	0.00
Interim								
14448 Observations								
EMBI+, basis pts	218.78	183.00	905.00	17.00	140.09	1.22	4.72	0.00
3-month LIBOR, &	3.20	3.16	5.51	0.90	1.74	0.02	1.36	0.00
10-year US Treasury Interest Rate, %	4.40	4.40	5.25	3.13	0.38	-0.36	3.52	0.00
NASDAQ	2086.63	2079.12	2604.52	1356.74	242.65	-0.34	3.19	0.00
Credit Rating	11.91	11.50	17.00	7.00	2.15	0.61	2.70	0.00
US								
2925 Observations								
EMBI+, basis pts	185.65	183.00	390.00	36.00	65.03	0.19	2.58	0.00
3-month LIBOR, &	4.57	5.20	5.85	2.55	1.05	-0.70	1.74	0.00
10-year US Treasury Interest Rate, %	4.26	4.28	5.26	3.34	0.54	0.12	1.74	0.00
NASDAQ	2537.62	2580.80	2859.12	2169.34	169.14	-0.31	1.99	0.00
Credit Rating	12.45	12.00	17.00	9.50	2.28	0.46	2.09	0.00

Data set covers March 2002 – May 2008 time period and includes 15 unbalanced cross-sections: Brazil, Bulgaria, Colombia, Egypt, Indonesia, Mexico, Morocco, Panama, Peru, Philippines, Poland, Russia, South Korea, Turkey, Ukraine

Appendix C

Table 5
FGLS Estimates
Dependent Variable: $Log(spread)$

White period robust t statistics are provided in parentheses. ***, **, * indicate statistical significance at 1%, 5% and 10% levels respectively.

	Entire Sample (1)	**Entire Sample (2)**	**InvGr =1 (3)**	**InvGr=0 (4)**
$Log(GDP)$	-0.68*** (-4.19)	-0.677*** (-4.379)	-0.86*** (-5.765)	-0.663*** (-2.614)
$Debt-Reserves$	0.058*** (3.763)	0.05*** (3.219)		0.06*** (3.969)
$Credit-GDP$	-0.22*** (-2.568)	-0.045 (-0.457)	-0.307*** (-2.986)	
$RiskAppetite$	0.133** (2.337)	0.129** (2.3)	0.11** (2.104)	0.166** (2.256)
$Log(3mLIBOR)$	0.173*** (5.736)	0.175*** (5.876)	0.167*** (3.485)	0.207*** (5.36)
$Log(10yUST)$	0.019 (0.188)			
$Log(NASDAQ)$	-0.643*** (-8.408)	-0.632*** (-9.447)	-0.636*** (-11.154)	-0.644*** (-6.878)
$Log(rating)$	-0.682*** (-3.941)	-0.694*** (-3.917)		-0.636*** (-3.16)
$Log(oil)$	-0.355*** (-5.612)	-0.358*** (-6.284)	-0.295*** (-3.885)	-0.362*** (-0.362)
$Russia$	0.140*** (9.297)	0.142*** (9.477)	0.171*** (13.922)	0.126*** (5.393)
$Indonesia\_1$	0.054** (2.245)	0.056** (2.393)		0.074*** (2.669)
US	0.4*** (5.387)	0.406*** (5.38)	0.397*** (6.844)	0.236*** (5.512)
$Constant$	-0.062*** (-10.957)	-0.067*** (6.299)	-0.038*** (-4.502)	-0.075*** (-8.757)
$InvGr$		0.007 (0.988)		
$Credit-GDP$ *$InvGr$		-0.293** (-2.248)		
Observations	421	421	179	243
Adjusted R-squared	0.474	0.48	0.424	0.512
Durbin-Watson Statistic	1.811	1.802	1.711	1.875

Table 6
Panel Unit Root Tests, Daily Data

	Im, Pesaran and Shin		ADF-Fisher		PP-Fisher	
	Test Statistic	p-value	Test Statistic	p-value	Test Statistic	p-value
Levels						
$Log(spread)$	-1.422	0.0775	38.687	0.133	38.713	0.132
$Log(rating)$	-0.527	0.299	34.517	0.261	34.81	0.25
Residuals (Pre-US)	-8.901	0	159.026	0	167.65	0
Residuals (US)	-4.958	0	76.551	0	89.914	0
1st Differences						
$Log(spread)$	-144.23	0	1398.42	0	1052.84	0
$Log(rating)$	-149.463	0	568.355	0	568.322	0

Residuals are from the long run equilibrium relationship equations for pre-US crisis and US crisis periods. Lags for the panel unit root tests were chosen according to Schwarz criterion.

Table 7
Unit Root Tests, Daily Data

	ADF				Phillips-Perron			
	Pre-US		US		Pre-US		US	
	Test Statistic	p-value	Test Statistic	p-value	Test Statistic	p-value	Test Statistic	p-value
Levels								
$Log(3mLIBOR)$	-2.11	0.54	-1.658	0.77	-1.945	0.63	-1.694	0.75
$Log(10yUST)$	-2.84	0.18	-32.89	0.07	-2.93	0.15	-3.11	0.11
$Log(NASDAQ)$	-2.98	0.14	-2.04	0.58	-2.82	0.19	-1.84	0.68
1st Differences								
$Log(3mLIBOR)$	-37.04	0	-15.44	0	-38.22	0	-15.38	0
$Log(10yUST)$	-25.24	0	-16.04	0	-34.13	0	-16.25	0
$Log(NASDAQ)$	-0.3642	0	-16.25	0	-0.3678	0	-16.5	0

Lags for the unit root tests were chosen according to Schwarz criterion.

Table 8
Long Run Relationships
Dependent Variable: $Log(spread)$

White period robust t statistics are provided in parentheses. ***, **, * indicate statistical significance at 1%, 5% and 10% levels respectively.

	Pre-US (1)	**US (2)**	**Pre-US (3)**	**US (4)**	**Entire Sample (5)**
$Log(3mLIBOR)$	-0.233*** (-8.072)	0.344*** (6.145)	-0.228*** (-10.05)	0.339** (6.32)	0.684*** (3.956)
$Log(10yUST)$	0.714*** (3.854)	-2.415*** (-8.89)	0.612*** (4.565)	-2.4*** (-8.502)	-0.241*** (-9.803)
$Log(NASDAQ)$	-1.749*** (-8.412)	-0.798*** (-3.618)	-1.54*** (-15.39)	-0.801*** (-3.592)	-1.566*** (-14.81)
$Log(rating)$	-1.147*** (-3.844)	-1.483*** (-93.265)	-1.13*** (-6.074)	-1.648*** (-15.80)	-0.981*** (-3.864)
Constant	20.954*** (21.324)	17.977*** (13.514)	19.484*** (34.903)	18.364*** (11.879)	19.182*** (38.618)
InvGr			-0.161*** (-2.941)	0.066 (1.464)	-0.239*** (-3.386)
US					3.609*** (6.055)
Indonesia_2					0.061 (0.952)
*US*InvGr*					0.251* (1.717)
*Indonesia*InvGr*					0.089 (0.531)
$Log(3mLIBOR)$ * *InvGr*					0.75*** (8.528)
$Log(10yUST)$ **InvGr*					-3.066*** (-7.809)
Observations	17893	2925	17893	2925	20818
Adjusted R-squared	0.9071	0.867	0.931	0.868	0.895

Note: country-specific intercepts were estimated, but not reported here.

Table 9
Short Run Relationships, by Periods
Dependent Variable: $\Delta Log(spread)$

White period robust t statistics are provided in parentheses. ***, **, * indicate statistical significance at 1%, 5% and 10% levels respectively.

	Lags	Indonesia2 (1)	Indonesia2 (2)	Interim (3)	Interim (4)	US (5)	US (6)
$\Delta Log(spread)$	1			-0.191***	-0.179***	-0.231***	-0.234***
				(-4.027)	(-4.142)	(-4.278)	(-4.444)
	2			-0.092**	-0.088***	-0.048	-0.053
				(-2.51)	(-2.835)	(-1.497)	(-1.539)
	3			-0.063**	-0.062**		
				(-1.977)	(-2.007)		
	4	-0.046**	-0.042**				
		(-2.106)	(-2.132)				
	5	0.041**	0.046**				
		(2.199)	(2.37)				
$\Delta Log(3mLIBOR)$		0.139***	0.089*	0.189***	0.199***	0.168***	0.153***
		(3.319)	(1.823)	(3.525)	(3.638)	(3.415)	(2.8)
	1					0.135***	0.144***
						(3.822)	(4.254)
	2					0.175***	0.164***
						(4.756)	(4.938)
	3				-0.068**	0.176***	0.201***
					(-2.261)	(5.059)	(4.619)
	4	0.104**	0.089**			0.328***	0.340***
		(2.32)	(1.975)			(18.497)	(16.461)
	5	-0.293***	-0.30***			-0.137***	-0.079***
		(-6.66)	(-7.272)			(-6.352)	(-2.605)
$\Delta Log(10yUST)$		-0.618***	-0.449**	-1.054***	-1.049***	-1.731***	-1.723***
		(-5.06)	(-4.422)	(-4.408)	(-4.384)	(-16.492)	(-16.766)
	1	0.181***	0.13**	0.34***	0.129**	-0.333***	-0.452***
		(3.187)	(2.409)	(4.376)	(2.012)	(-4.943)	(-5.251)
	2			0.147***			
				(3.101)			
	3	-0.096*	-0.093*				
		(-1.881)	(-1.806)				
	5			0.129***	0.084***	0.196***	0.217***
				(3.728)	(3.166)	(10.918)	(10.782)
$\Delta Log(NASDAQ)$		-0.094***	-0.095***	-0.287***	-0.287***	-0.454***	-0.456***
		(-3.943)	(-4.076)	(-5.402)	(-5.414)	(-6.294)	(-6.442)
	1	-0.182***	-0.178***	-0.262***	-0.256***	-0.501***	-0.374***
		(-4.84)	(-4.811)	(-3.604)	(-3.536)	(-7.06)	(-4.537)
	2			-0.165***	-0.146***	-0.416***	-0.431***
				(-5.542)	(-4.76)	(-6.33)	(-6.079)
	3			-0.09***	-0.087***	-0.125***	-0.182***
				(-3.016)	(-2.908)	(-5.21)	(-3.501)
	4	-0.063**	-0.059**			-0.23***	-0.223***
		(-2.446)	(-2.34)			(-7.806)	(-7.534)
	5	-0.089***	-0.106***			-0.34***	-0.293***
		(-3.594)	(-4.904)			(-10.48)	(-5.940)
$\Delta Log(rating)$			-0.332**	-0.279***	-0.284**		
			(-2.051)	(-2.624)	(-2.372)		

	Lags	**Indonesia2 (1)**	**Indonesia2 (2)**	**Interim (3)**	**Interim (4)**	**US (5)**	**US (6)**
	1			0.159*	0.164**	0.635**	0.638**
				(1.86)	(2.138)	(2.096)	(1.963)
	2	0.405*	0.217**				
		(1.757)	(1.89)				
	4				0.176***		
					(2.77)		
Residual	1	-0.003***	-0.003***	-0.019***	-0.02***	-0.036***	-0.035***
		(-3.951)	(-3.48)	(-5.648)	(-5.179)	(-7.761)	(-7.91)
Constant		0.0005	0.0004	-0.001***	0.0001	0.004***	0.004***
		(0.979)	(0.897)	(-3.799)	(0.435)	(13.891)	(13.057)
InvGr					-0.003***		-0.011***
					(-5.02)		(-13.613)
$\Delta Log(3mLIBOR)$ $*InvGr$			0.187***				
			(2.831)				
	3						-0.076**
							(-2.136)
	5						-0.129**
							(-2.481)
$\Delta Log(10yUST)$ $*InvGr$			-0.745***				
			(-4.056)				
	1		0.237**		0.806**		0.291***
			(2.292)		(2.523)		(3.416)
	2				0.411***		
					(2.995)		
	3						0.216**
							(2.385)
	5		0.215***		0.16***		
			(5.976)		(2.764)		
$\Delta Log(NASDAQ)$ $*InvGr$	1						-0.313***
							(-2.734)
	5						-0.126**
							(-1.91)
$\Delta Log(rating)$ $*InvGr$			0.522***				
			(3.251)				
	2		1.405***				2.122***
			(11.90)				(3.715)
	4				-0.626***		
					(-5.097)		
Observations		2012	2012	10839	10811	2132	2132
Adjusted R-squared		0.20	0.239	0.162	0.173	0.481	0.486

Note: country-specific intercepts were estimated, but not reported here.

Table 10
Short Run Relationships, by Periods and Country Groups
Dependent Variable: $\Delta Log(spread)$

White period robust t statistics are provided in parentheses. ***, **, * indicate statistical significance at 1%, 5% and 10% levels respectively.

	Lags	Indonesia2 InvGr=1 (1)	Indonesia2 InvGr=0 (2)	Interim InvGr=1 (3)	Interim InvGr=0 (4)	US InvGr=1 (5)	US InvGr=0 (6)
$\Delta Log(spread)$	1			-0.313***	-0.085**	-0.299***	-0.173***
				(-11.555)	(-2.205)	(-3.834)	(-3.879)
	2	-0.048**		-0.187***	-0.049**	-0.111**	
		(-2.176)		(-4.444)	(-2.456)	(-2.328)	
	3			-0.155***			
				(-3.417)			
	4		-0.035*				
			(-1.654)				
	5		0.052**				
			(2.377)				
$\Delta Log(3mLIBOR)$		0.296***		0.268***	0.169***		0.212***
		(3.694)		(2.516)	(2.885)		(3.324)
	1				0.075***	0.118***	0.155***
					(2.802)	(2.701)	(3.165)
	2					0.201***	0.115***
						(4.266)	(3.726)
	3			-0.22***		0.162***	0.179***
				(-2.987)		(3.78)	(4.914)
	4		0.128***			0.350***	0.334***
			(2.79)			(8.229)	(12.188)
	5		-0.131***	0.091**		-0.181***	-0.095***
			(-4.255)	(1.917)		(-4.507)	(-3.888)
$\Delta Log(10yUST)$		-1.201***	-0.468***	-1.78***	-0.77***	-1.863***	-1.585***
		(-6.121)	(-5.131)	(-3.672)	(-3.248)	(-11.175)	(-15.498)
	1	0.195**	0.162***	0.635***	0.215***	-0.247***	-0.365***
		(2.153)	(3.385)	(2.897)	(3.976)	(-2.492)	(-4.813)
	2			0.377***			0.077***
				(3.603)			(4.234)
	3			0.089**		0.284***	
				(2.442)		(2.964)	
	4			0.351**			
				(2.001)			
	5	0.065*		0.292***	0.062***	0.237***	0.215***
		(1.63)		(4.419)	(2.765)	(6.386)	(9.066)
$\Delta Log(NASDAQ)$		-0.103***	-0.091**	-0.254**	-0.297***	-0.388***	-0.522***
		(-2.748)	(-2.478)	(-2.291)	(-4.794)	(-3.863)	(-6.087)
	1		-0.175***		-0.282***	-0.68***	-0.363***
			(-4.241)		(-4.265)	(-8.206)	(-4.887)
	2			-0.108*	-0.154***	-0.544***	-0.371***
				(-1.602)	(-4.572)	(-5.483)	(-7.432)
	3			-0.119*	-0.044**	-0.337***	-0.08***
				(-1.905)	(-2.257)	(-4.375)	(-3.551)
	4		-0.084***	-0.182**		-0.212***	-0.229***
			(-3.284)	(-2.002)		(-5.425)	(-6.979)

	Lags	**Indonesia2 InvGr=1 (1)**	**Indonesia2 InvGr=0 (2)**	**Interim InvGr=1 (3)**	**Interim InvGr=0 (4)**	**US InvGr=1 (5)**	**US InvGr=0 (6)**
	5		-0.087*** (-3.955)			-0.395*** (-8.657)	-0.302*** (-5.477)
$\Delta Log(rating)$		0.27*** (12.393)	-0.301*** (-2.608)	-0.289* (-1.64)	-0.25** (-2.163)		
	1				0.146** (2.154)		
	2	1.682*** (117.19)	0.367** (2.078)			2.171*** (3.699)	
	3	0.224** (2.228)					
	4			-0.457*** (-4.26)	0.156** (2.188)		
$Residual$	1	-0.059*** (-3.85)	-0.003** (-2.203)	-0.026*** (-12.688)	-0.017*** (-3.688)	-0.038*** (-5.9)	-0.033*** (-6.964)
$Constant$		0 (0.099)	0.0001 (0.267)	-0.001** (-1.985)	-0.001*** (-3.396)	0.006*** (9.403)	0.005*** (5.507)
Observations		492	1637	3293	7578	963	1175
Adjusted R-squared		0.457	0.135	0.312	0.103	0.523	0.458

Note: country-specific intercepts were estimated, but not reported here.

Reference List

Alper E. (2006), "US Monetary Surprises and Emerging Markets Sovereign Spreads", 2007 American Economic Association Conference Papers (accessed at http://www.aeaweb.org/annual_mtg_papers/2007/0107_1300_0102.pdf).

Benczur P. and C. Ilut (2006), "Determinants of Spreads on Sovereign Bond Loans: The Role of Credit History", MNB WP 2006/1.

Cantor R. and F. Packer (1996), "Determinants and Impact of Sovereign Credit Ratings", Economic Policy Review 9, 153-174.

Edwards, S. (1984), "LDC's Foreign Borrowing and Default Risk: An Empirical Investigation 1976-1980", NBER WP1172.

Edwards, S. (1986), "The Pricing of Bonds and Bank Loans in International Markets", European Economic Review, No. 30, 565-589.

Eichengreen, B. and A. Mody (1998), "What Explains Changing Spreads on Emerging-Market Debt: Fundamentals or Market Sentiment?", NBER WP 6408.

Engle R.F. and C.W.J. Granger (1987), "Cointegration and Error Correction: Representation, Estimation and Testing", Econometrica 55: 251-276.

Ferrucci G. (2003), "Empirical Determinants of Emerging Market Economies' Sovereign Bond Spreads", Bank of England WP 205.

Fitch-IBCA (2002), "Fitch Sovereign Ratings. Rating Methodology", www.fitchratings.com

Goldman Sachs (2000), "A New Framework for Assessing Fair Value in Emerging Markets Hard-Currency Debt", Global Economics Paper No. 45.

IMF (2008), "Global Financial Stability Report", www.imf.org

JP Morgan (2004), "Emerging Markets Bond Index Plus (EMBI+). Rules and Methodology", www.morganmarkets.com

JP Morgan Chase (1995), "Improving Our Country-Risk Assessment Framework", JP Morgan Emerging Markets Research.

Kamin, S.B. and K. Kleist (1999), "The Evolution and Determinants of Emerging Market Credit Spreads in the 1990s", Board of Governance of the Federal Reserve System, International Finance Discussion Papers, #653.

Meng Lei and Owain ap Gwilym (2007), “The Determinants of CDS Bid-Ask Spread”, Research Paper 2006-2007, The University of Wales School of Management and Business.

Min, H.G. (1998), “Determinants of Emerging Market Bond Spread: Do Economic Fundamentals Matter?”, World Bank WP1899.

Kaminsky Graciela and Sergio L. Schmukler (2002), “Emerging Markets Instability: Do Sovereign Rating Affect Country Risk and Stock Returns?”, World Bank Policy Research WP 2678.

Rozada M.G. and E.L. Yeyati (2006), “Global Factors and Emerging Market Spreads”, Inter-American Development Bank WP 552.

Rowland, P (2000), “Determinants of Spread, Credit Ratings and Creditworthiness for Emerging Market Sovereign Debt: A Follow-Up Study Using Pooled Data Analysis”, Banco de la Republica WP (accessed at http://www.banrep.gov.co/docum/ftp/borra296.pdf).

Standard & Poor’s (2007), “Sovereign Rating History Since 1975”, www.standardpoors.com

Wooldridge M. Jeffrey (2003), “*Introductory Econometrics: A Modern Approach”*, second edition. Cincinnati, OH: South-Western College Publishing, 2003.