The Term-Structure of Sovereign Default Risk in an Emerging Economy

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Abstract

We study the time-varying structure of sovereign default risk in Colombia focusing on different time spans indicated by yield spreads of government bonds with different maturities. Cointegration regressions are performed to analyze whether the drivers of this risk change along its term structure. We show that although spreads are correlated across maturities, their relative behavior and determinants are not uniform. In fact, our results show that while short-run risk is driven by government indebtedness, economic activity and external sector indicators, in the longer-run only economic activity indicators prevail. For the longest available maturity, only investment significantly affects country default risk.

JEL Classification Numbers: F34; G15; F37.

Keywords: Sovereign default risk; term structure; emerging markets.

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I. Introduction

Country default risk, sometimes called sovereign risk, is a crucial issue in international lending, particularly in lending to emerging market economies. International investors worry about country default risk since a country's potential inability or unwillingness to repay affects their expected profit. Borrower countries worry about this risk as it excerpts influence over their ability and cost of obtaining funds in international financial markets. An adequate evaluation of country default risk is therefore crucial for the efficiency in international lending. Identifying the determinants of sovereign risk is useful to investors when evaluating the risks of a debt crisis in a particular economy in which they are interested in investing and may also be useful for governments when making decisions on implementing adjustment programs focusing on lowering their costs of borrowing abroad.

Analyzing the basic determinants of sovereign default risk is especially important for emerging market economies for which information is more opaque and lending is subject to more informational problems. As Krozner (2000) points-out, in emerging market economies factors such as the weak enforcement of property rights and limited information disclosure, as well as the history of defaults during episodes of debt crises, may imply significant risks for investors when taking investment decisions in these countries. Therefore, a thorough evaluation of the determinants of the risks of default is most important for both creditors and borrowers.

The determinants of country-default risk have been widely studied in the literature. See for instance Arora and Cerisola (2001), Sy (2002), Rowland and Torres (2004), Dalaimi et al. (2005), Baldacci et al. (2005), Longstaff et al (2005), Thuraisamy et al (2008), Hilscher and Nosbusch (2010), and Comelli (2012). Some of these studies focus on emerging market economies. We expand the literature on sovereign default risk in emerging market economies by studying the term structure of government-bond yield spreads in Colombia. Particularly relevant, we consider default risk corresponding to different time-spans in order to identify and distinguish between the determinants of short-run (liquidity) and long-run (solvency) risk.

In order to do so, we chose a set of variables, which have been extensively used in the literature, as determinants of government default risk for all maturities. This set of variables were compiled in a recent paper by Eichler and Maltritz (2013) who use them to study the term structure of sovereign default risk in European Monetary Union (EMU) member countries. Our indicator of country default risk is the spread of Colombia's government bonds with respect to the United States government bonds for different maturities. These yield spreads are observed on secondary capital markets and reflect the risk perceptions of market participants. Since both Colombian and United States bonds are traded with price discounts, in absence of exchange rate risk these spreads reflect the compensation that investors in bond markets bet for bearing the extra default risk that Colombian government bonds imply over United States bonds for different maturities.

The case of Colombia is a very interesting one to study. Unlike many other emerging market economies, Colombia has seldom defaulted on its debt obligations. Particularly, during the 1980s Colombia was the only Latin American country that completely avoided the debt crisis which lamed most of Latin America (Avella, 2006). Relative to other countries in the region the size of the state has been kept small and the government has never borrowed in unsustainable ways in debt markets. This is the first study of its kind for an emerging market economy.

Our results show that although spreads are correlated across maturities, their relative behavior and determinants are not uniform. In fact, our results show that while short-run risk is driven by government indebtedness, economic activity and external sector indicators, longer-run risk is driven only by economic activity indicators. Therefore, fiscal stance indicators do not affect long-run default risk.

Section 2 presents the variables used in our empirical analysis and the hypotheses on the relation existing between each explanatory variable and the risk spread. Section 3 presents the empirical analysis and discusses the results. Finally, section 4 concludes.

II. Variables included in the empirical analysis and hypothetical relations

Our interest relies on studying the term structure of sovereign default risk in Colombia. In particular, we are interested in finding whether the determinants of short–run (liquidity) and long–run (solvency) risk are different. To do so, we use the yield spread of Colombia's government bonds for different maturities with respect to the United States government bonds as our indicator for country default risk[1]. We collect information from secondary bond markets in both countries. Figure 2 shows that the evolution of our sovereign risk indicator for different maturities. Although these spreads are correlated across maturities, their relative behavior is not uniform through time. Particularly interesting, spreads are not always increasing in maturity. For example, the five-year yield spread is the highest during several periods, including at the end of the sample.

We follow the literature and include variables that have been identified as important determinants of sovereign default risk in earlier papers for all maturities. It is important to recall that our interest does not lie in identifying particular determinants of sovereign risk.

[1] Following a suggestion made by Josef Brada, and in sake of robustness, we also used German government bonds as the risk-free asset with which to compare Colombian government bond yields. As shown in Figure 1, US government bonds and German government bonds behave quite similarly over time. Therefore, not surprisingly, our results are qualitatively identical regardless of the risk-free interest rate we use.

Our main interest is in finding how a set of determinants influence this risk differently along the term structure.

We introduce variables reflecting both the government's debt situation and the state of the economy (including external sector variables).

Arguably the most important determinant of country default risk identified in the literature is the ratio of total government debt to GDP. All else constant, increases in government indebtedness reduce its payment capacity, increasing default risk. Additionally, highly indebted countries may face lower incentives to repay their outstanding debt.

Default risk may also be determined by the pace in which the government's debt is increasing. We follow previous studies and assume that a higher increase in indebtedness increases the risk of making default. A government whose debt is increasing faster is signaling that its earnings are not increasing at the pace they should to meet its current obligations, making it riskier for lenders. To proxy for the increase in the government's indebtedness we use the ratio of net borrowing to GDP. Net borrowing is positive (negative) when the country borrows (lends) more than it lends (borrows) in a period of time.

Higher interest rates on outstanding debt make it harder for a borrower to meet its repayment obligations. Thus, we use the implicit interest rate on outstanding debt as another important determinant of default risk. This interest rate is determined by the conditions in which new debt agreements are established. Therefore, it is different from interest rates in secondary debt markets. An increase in the implicit interest rate should increase sovereign default risk.

The overall state of the economy is an important determinant of sovereign default risk, as the ability of the government to finance through taxes depends on the economic performance of the country. Probably the most widely used indicator of the state of the economy is economic growth. We include the annual real growth rate of GDP as one of the determinants of country default risk. We expect that increases in this variable lead to a reduction in sovereign default risk, as economic growth increases the government's earnings.

In many related studies the external trade balance has also shown to be an important determinant of sovereign default risk. Hence, we include the ratio of trade balance to GDP in our empirical analysis. A positive trade balance helps to obtain funds that can be used to meet debt repayment obligations and is a signal of a competitive economy. Therefore, we expect increases in this variable to reduce default risk.

The composition of national income, between consumption and investment, may also influence the country's default risk. An economy in which the proportion of investment out of output is increasing will probably exhibit higher future economic growth which will make it easier to repay debt obligations. Therefore, we expect that increases in the ratio of capital accumulation to GDP will lead to a reduction in sovereign default risk.

We also include a proxy for the openness of the economy. Following previous studies, we use the ratio of the sum of imports and exports to GDP. The expected sign of the relationship between this variable and default risk is, however, ambiguous. A more open economy is expected to be more internationally financially integrated. On the one hand, this may imply the economy is perceived to be less risky for international investors, as it has access to multiple funding sources. It may also be a signal that the economy is credit – worthy. However, on the other hand, a more financially integrated economy is more exposed to international shocks, and therefore it is riskier for international investors.

Finally, the yield spread of Colombian bonds with respect to the United States bonds for a given maturity reflect both default risk and exchange rate risk. In order to control for exchange rate risk we use the average Colombian Peso / United States Dollar daily volatility. We use an E-GARCH model to calculate this volatility.

The variables described above have shown to be important in country and panel data studies of sovereign risk determinants (see, for instance, Hilscher and Nosbusch (2010)). However, our main interest does not rely on checking which subset of these variables is the best predictor of default risk in Colombia. Instead, we focus in identifying how the subset of important predictors changes over the term structure. For instance, we expect that, while in the short-run exchange rate volatility and government indebtedness indicators should matter, in the longer-run only more structural variables of economic activity should matter.

III. Empirical Analysis

We use cointegrating regressions to evaluate the effects of the previously described determinants on our sovereign risk measures for Colombia. In Table A1 of the appendix, we define and describe the sources of the Colombian data that we use in these estimations. These data are quarterly and span the period 2000q1 to 2011q3.

Sovereign default risk is measured for different future horizons using the spread between the zero-coupon yield of a Colombian government bond with a given maturity and the zero-coupon yield of an US Treasury bond with the same maturity. The implicit assumption is that the probability of government debt default in the US is negligible. Here we are following the approach described by Eichler and Maltritz (2013) to measure default risk and to identify the determinants of short-run versus those of long-run default risk.

Using unit-root tests we verify the non-stationarity of the sovereign default risk measures for Colombia and for most of the variables included in the empirical analysis. These results are summarized in Table 1. Therefore, a cointegration approach is the most appropriate framework in order to identify long-run relationships in our dataset. According to the Johansen's cointegration test, one cointegrating equation is identified under all different specifications (See Table 2). We use the Fully Modified Ordinary Least Squares (FM-OLS) method, originally developed by Phillips and Hansen (1990), to estimate the cointegration vectors that relate our sovereign risk measures with their potential determinants.

Consider the $n+1$ dimensional time series vector process $(S_t, X_t^{'})$, with cointegrating equation

$$S_t = X_t^{'}\theta + D_{1t}^{'}\delta_1 + \varepsilon_{1t} \tag{1}$$

where $D_t = (D_{1t}^{'}, D_{2t}^{'})'$ are deterministic trend regressors and the n stochastic regressors X_t are defined by the following system of equations:

$$X_t = \Lambda_{21}^{'} D_{1t} + \Lambda_{22}^{'} D_{2t} + u_{2t}$$

$$\Delta u_{2t} = \varepsilon_{2t} \tag{2}$$

The regressors in D_{1t} enter into both the cointegrating equation and the regressors equation, in contrast D_{2t} are deterministic trend regressors which are excluded from the cointegrating equation.

Following Phillips and Hansen (1990), we assume that the innovations $\varepsilon_t = (\varepsilon_{1t}, \varepsilon_{2t})$ are strictly stationary and ergodic with zero mean, contemporaneous covariance matrix Σ, one-sided long-run covariance matrix Γ, and non-singular long-run covariance matrix Ξ, each of which we partition in the following way:

$$\Sigma = E(\varepsilon_t \varepsilon_t') = \begin{pmatrix} \sigma_{11} & \sigma_{12} \\ \sigma_{21} & \Sigma_{22} \end{pmatrix}$$

$$\Gamma = \Sigma_{i=0}^{\infty} E(\varepsilon_t \varepsilon_{t-i}') = \begin{pmatrix} \lambda_{11} & \lambda_{12} \\ \lambda_{21} & \Gamma_{22} \end{pmatrix} \tag{3}$$

$$\Xi = \sum_{i=-\infty}^{\infty} E(\varepsilon_t \varepsilon_{t-i}') = \begin{pmatrix} \xi_{11} & \xi_{12} \\ \xi_{21} & \Xi_{22} \end{pmatrix} = \Gamma + \Gamma' - \Sigma$$

The assumptions in equations (1) – (3) imply that the elements of S_t and X_t are I(1) and cointegrated, but without multi-cointegration.

The FM-OLS estimator employs preliminary estimates of the symmetric and one-sided long-run covariance matrices of the residuals. Let $\hat{\varepsilon}_{1t}$ be the residuals obtained after estimating equation (1). The $\hat{\varepsilon}_{2t}$ may be obtained indirectly as $\hat{\varepsilon}_{2t} = \Delta\hat{u}_{2t}$, from the residuals of the regression in equation (2). Let $\hat{\Xi}$ and $\hat{\Gamma}$ be the long-run covariance matrices computed using the residuals $\hat{\varepsilon}_t = (\hat{\varepsilon}_{1t}, \hat{\varepsilon}_{2t})$. Then, we can modify the data in the following way:

$$\tilde{S}_t = S_t - \hat{\xi}_{12}\hat{\Xi}_{22}^{-1}\hat{\varepsilon}_2 \tag{4}$$

and an estimated term in order to perform a bias correction:

$$\tilde{\lambda}_{12} = \hat{\lambda}_{12}\hat{\xi}_{12}\hat{\Xi}_{22}^{-1}\hat{\Gamma}_{22} \tag{5}$$

The FM-OLS estimator can be defined as:

$$\hat{\beta} = \begin{bmatrix} \hat{\theta} \\ \hat{\delta}_1 \end{bmatrix} = (\Sigma_{t=1}^{T} Z_t Z_t')^{-1} \left(\Sigma_{t=1}^{T} Z_t \tilde{S}_t - T \begin{bmatrix} \tilde{\lambda}_{12}' \\ 0 \end{bmatrix} \right) \tag{6}$$

where $Z_t = (X_t', D'_t)$.

It is well known that the static OLS method allows estimating consistently the cointegration relationship[2]. However, these estimations are not useful to test hypotheses because their asymptotic distribution depends on nuisance parameters which are the result of the presence of serial correlation in the errors and the endogeneity of regressors. In this framework, the FM-OLS estimator applies semi-parametric corrections to the OLS method in order to obtain estimators whose asymptotic distributions are free of nuisance parameters.

Phillips and Hansen (1990) propose performing preliminary OLS estimations of the cointegration vector and of the contemporaneous relationship between regressors. The residuals from these regressions are used to compute the long run covariance matrices of the endogenous variables. These matrices are then employed to construct two types of corrections: a rescaling of the dependent variable and the inclusion of a bias correction term

[2] In fact these OLS estimates converge to their true values at a faster rate than in a stationary regression. However, simulation studies show that these OLS estimates do not have good finite-sample properties. See Campbell and Perron (1991).

in the OLS formula[3]. The resulting FM-OLS estimator is asymptotically unbiased and has fully efficient mixture normal asymptotics allowing for standard Wald tests.

The estimation of the long-run variance is a key feature of the FM-OLS method of estimating cointegrating relationships. We estimate this long-run variance through the non-parametric method described in Andrews (1991) which uses the Quadratic-Spectral kernel to allocate weights on different lags. It also computes a real-valued bandwidth using the Andrews' automatic bandwidth selection method.

Kurozumi and Hayakawa (2009) compare the finite-sample performance of alternative methods for the estimation of cointegrating regressions: FM-OLS, Canonical Regression (CCR) and Dynamic OLS (DOLS). Their findings show that the FM-OLS method, including the previous features for long-run variance estimation, makes a better bias correction than all the alternative methods.

The estimation results for each maturity are reported in Table 3. In parentheses, we report standard errors for each parameter. A first thing to note is that all models are globally significant at standard statistical levels according to the Wald test. Additionally, the model fit improves as maturities increase. For example, the adjusted R^2 for 1 year is 39.7% while for 10 years is 69.2%. This result may indicate that the variables included in the empirical model correspond to structural determinants of sovereign default risk in the long-run. The term structure of sovereign risk determinants is described below and shown in Figure 3 through 90% confidence intervals.

Government indebtedness indicators are important determinants of default risk for yield spreads of bonds with maturities shorter than 7 years. As expected, the coefficient corresponding to the ratio of government debt to GDP is positive and statistically significant at the 1% level indicating that increases in the stock of debt lead to a higher risk perception. According to Table 3, creditors require a higher compensation of between 3 (7-year maturity) and 7 (1-year maturity) basis points for a 1% increase in this ratio. For maturities over 7 years, this ratio has no effect on sovereign risk.

However, the sign of the coefficient corresponding to the ratio of net borrowing to GDP for maturities of up to 7 years resulted negative. This result indicates that investors require a lower compensation as the government increases its deficit. Even though we were expecting a positive relationship between these two variables, probably there is an intuitive explanation for our finding. In the case of emerging market economies for which international investors do not have perfect and complete information, access to external funds is a signal of creditworthiness. Therefore when investors observe that the Colombian government is able to obtain external financing, they perceive a lower risk in lending which

[3] The dependent variable in this cointegration regression is actually the normalized variable of the corresponding cointegration vector.

leads to lower risk premia. This result is quite different to the one obtained by Eichler and Maltritz (2013) for EMU countries, who find no significant effect of net borrowing on country default risk.

A related finding concerns the effect of the implicit interest rate on external debt on sovereign risk. This variable is computed as the ratio of quarterly interest payments to foreign creditors and total debt. Table 3 shows that the effect of this ratio on sovereign risk is negative on short-run horizons up to the seven-year maturity. For example, higher interest payments of 1% of GDP lead to a decline of the spread of around 34 basis points at the 3-year horizon. An intuitive explanation for this result is the positive perception that investors allocate on the fact that an emerging economy meets its commitments on interest payments on time. Therefore, a higher implicit interest rate is a good signal for investors that policy-makers in Colombia agree with meeting the country's external-debt obligations.

Our results also show that the indicators of economic activity are important determinants of sovereign risk at all horizons. The ratio of investment to GDP has a significant negative effect on sovereign risk. The longer the horizon of risk the stronger this effect becomes. For example, an increase of investment that is equivalent to 1% of GDP leads to a decrease in spreads of 41 basis points at the 1-year maturity but, at the 15-year maturity this effect amounts to a decrease of 100 basis points.

The effect of the annual rate of economic growth in Colombia is also consistently negative across maturities. Table 1 shows that a 1% increase of this growth rate implies around 33 basis points of lower spreads on the one-year horizon. It seems that this effect is slightly stronger at short-run than in long-run maturities and it becomes non-significant in the longest horizon (15 years). These estimated coefficients speak about how important economic-activity indicators are for the evaluation of sovereign risk at all horizons. Investment ratios seem to become more important for the evaluation of long-run risks than the rate of economic growth.

The variables related to the external economic relations are also found to be important to explain the dynamics of Colombian sovereign risk at different horizons. The ratio of trade balance to GDP is found to have a negative effect on default risk for short-run horizons up to the 7-year maturity. For example, an improvement of 1% of GDP in the trade balance is related to an improvement of 37 basis points in the spread for the 2-year maturity. Therefore, changes in this external account are not found to affect default risk at the very long-run horizons since economic activity indicators are already capturing the long-run performance of the country. This result contrasts with the finding in Eichler and Maltritz (2012) who found that the trade balance has only long-run effects on European default risk.

We construct an openness indicator as the ratio of the sum of exports and imports to GDP. This indicator is found to increase default risk for maturities of 5 years and longer. For example, an increase in 1% of GDP in this indicator leads to higher spreads of around 20 basis points at the 10-year maturity. This particular result was also found in Eichler and Maltritz (2013, p. 5) who interpret it as evidence for the hypothesis that further international integration leads to an increased vulnerability of the country to external shocks.

Finally, we also include as a determinant an estimation of the dynamics of exchange rate volatility in Colombia in order to control our results for exchange rate risk. Table 1 shows that this indicator of volatility has a positive effect on short-run sovereign risk on maturities up to 7-years. It is intuitive to think that exchange rate volatility is not important to explain this risk at very long-run horizons.

IV. Conclusions

This paper analyzes the term structure of sovereign default risk in an emerging economy, Colombia, using zero-coupon bond-yield spreads as risk indicators. We use spreads of distinct maturities as indicators of different time spans of risk. Therefore, we distinguish between the determinants of short-term (or liquidity) risk and those of long-term (or solvency) risk. We also identify a few determinants that significantly influence default risk at all horizons. We apply FM-OLS estimation of cointegration relationships on quarterly data for Colombia during the period 2000q1-2011q3.

Our results show that although spreads are correlated across maturities, their relative behavior and determinants are not uniform. In fact, we show that while short-run risk is driven by government indebtedness, economic activity and external sector indicators, longer-run risk is driven only by economic activity indicators. Therefore, fiscal stance indicators do not affect long-run default risk.

An indicator of openness is found to increase default risk at long-run horizons. This might be a consequence of the fact that more open economies are more prone to external shocks in times of crisis.

The following variables are found to have significant effects at short and medium-run horizons of default risk (maturities shorter than 7 years): net borrowing to GDP, implicit interest rate, trade balance and exchange rate volatility.

All these results provide new insights on the determination of sovereign default risk at different horizons in emerging market economies. Some of these findings support basic theories whereas other results are new and therefore deserve further exploration.

Acknowledgements

The opinions and findings in this document are those of the authors and do not necessarily represent those of the Banco de la Republica or its Board of Governors. We thank Josef Brada for specific comments and suggestions. We are grateful to the seminar participants at the 2012 Pacific Rim Conference held at Honolulu, the Central Bank of Colombia and Fedesarrollo for useful comments.

Appendix

Tables A1 and A2.

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Annex of Tables

Table 1: Unit Root Tests

Variable [1]	**Ng-Perron (Intercept)**	**Ng-Perron (Linear Trend)**	**ADF (Intercept)**	**ADF (linear trend)**	**Decision**
1-year Spread	-1.6436*	-2,0111	-1,8494	-1,9508	I(1)
2-year Spread	-1,4749	-1,9863	-1,9285	-1,9493	I(1)
3-year Spread	-1,4383	-2,0687	-2,0101	-2,0762	I(1)
5-year Spread	-1,3290	-2,2138	-1,9100	-2,3136	I(1)
7-year Spread	-1,2048	-2,2879	-1,6598	-2,5243	I(1)
10-year Spread	-0,8672	-2,1659	-1,215	-2,6139	I(1)
15-year Spread	-0,9779	-2,4412	-1,6959	-2,7887	I(1)
Debt to GDP	-0,8647	-0,6127	-2,4175	-3.5646**	I(1)
Net Borrowing to GDP	-3.2570***	-3.1338**	-0,9079	-2,4129	I(0)
Implicit Interest Rate	-3.5246***	-3.5247***	-1,1715	-1,5445	I(0)
Investment to GDP	2,4298	-2.6393*	-0,0851	-3.4188*	I(1)
Economic Growth	-1.6619*	-2,082	-2.7336*	-2,5243	I(0)
Trade Balance to GDP	-1.9753*	-3.4361***	-2.9450**	-5.6673***	I(0)
Openness	0,7703	-2.8415*	-0,9489	-3.6844**	I(1)
Exchange Rate Volatility	-2.6968***	-2.9709**	-3.2416**	-3.4747*	I(0)

Note: * Denotes significance at the 10% level, ** Denotes significance at the 5% level, *** Denotes significance at the 1% level, **1/** Unit root tests on the first difference of all variables (not shown on this table) reject the null hypotheses.

Table 2: Johansen's Cointegration Test (p-values)

Null Hypothesis	$r = 0$	$r \leq 1$	$r \leq 2$	$r \leq 3$
1-year Spread	0.006	0.232	0.636	0.196
2-year Spread	0.005	0.201	0.592	0.181
3-year Spread	0.003	0.166	0.563	0.201
5-year Spread	0.003	0.168	0.486	0.218
7-year Spread	0.004	0.245	0.415	0.238
10-year Spread	0.005	0.308	0.286	0.237
15-year Spread	0.005	0.234	0.280	0.301

Note: This table shows p-values for Johansen's unrestricted Cointegration Rank Test (Trace) on each system of I(1) variables. Every system of variables consists of a yield spread, debt to GDP, investment and openness. The number of co-integrating equations is denoted by r.

Table 3: Estimation Results for Each Maturity

Variable	1 year	2 years	3 years	5 years	7 years	10 years	15 years
Debt to GDP	0.0732*** (0.0147)	0.0511*** (0.0164)	0.0442** (0.0168)	0.0389** (0.0171)	0.0351* (0.0185)	-0.0051 (0.0435)	0.0038 (0.0648)
Net Borrowing to GDP	-0.5129*** (0.0837)	-0.5404*** (0.0933)	-0.5140*** (0.0954)	-0.4123*** (0.0974)	-0.3284*** (0.1055)	-0.2949 (0.2474)	-0.1038 (0.3685)
Implicit Interest Rate	-0.2353*** (0.0493)	-0.3181*** (0.0550)	-0.3418*** (0.0563)	-0.2940*** (0.0574)	-0.1902*** (0.0622)	-0.1352 (0.1459)	-0.1831 (0.2172)
Investment to GDP	-0.4088*** (0.0542)	-0.5709*** (0.0604)	-0.6701*** (0.0618)	-0.7979*** (0.0631)	-0.8797*** (0.0683)	-1.0021*** (0.1602)	-1.0045*** (0.2386)
Economic Growth	-0.3272*** (0.0367)	-0.2549*** (0.0409)	-0.2321*** (0.0419)	-0.2125*** (0.0428)	-0.2200*** (0.0622)	-0.3210*** (0.1086)	-0.1909 (0.1617)
Trade Balance to GDP	-0.3241*** (0.0646)	-0.3701*** (0.0720)	-0.3495*** (0.0737)	-0.2612*** (0.0752)	-0.1558* (0.0815)	-0.1029 (0.1911)	0.0637 (0.2846)
Openness	-0.0230 (0.0233)	0.0043 (0.0260)	0.0347 (0.0266)	0.0874*** (0.0271)	0.1358*** (0.0294)	0.1980*** (0.0689)	0.2071* (0.1026)
Exchange rate volatility	0.2139*** (0.0256)	0.2257*** (0.0286)	0.2099*** (0.0292)	0.1896*** (0.0298)	0.1751*** (0.0323)	0.0891 (0.0757)	0.1016 (0.1128)
Constant	15.334*** (0.9738)	19.4212*** (1.0857)	21.0540*** (1.1106)	21.6949*** (1.1340)	20.8443*** (1.228)	22.4566*** (2.8798)	21.0581*** (4.2891)
R^2 (Adjusted)	0.3975	0.4522	0.4965	0.5899	0.6488	0.6919	0.6703
F-Statistic	123.12***	119.77***	127.71***	140.40***	127.63***	26.30***	12.27***

Note: * Denotes significance at the 10% level, ** Denotes significance at the 5% level, *** Denotes significance at the 1% level

Table A1: Description and sources of the variables

Variable	Definition	Source
Yield spreads for different maturities	Spread between the zero-coupon yield of a Colombian government bond with a given maturity and the zero-coupon yield of an US Treasury bond with the same maturity.	Calculations of the staff of the Central Bank of Colombia with Datastream data
Debt to GDP	Total government debt (domestic and external) divided by Gross Domestic Product (GDP).	Central Bank of Colombia
Net Borrowing to GDP	Total government net financing as percentage of GDP	Central Bank of Colombia
Implicit Interest Rate	Interest payments on public external debt as percentage of the outstanding debt.	Authors' calculations with data from the Central Bank of Colombia
Investment to GDP	Gross fixed capital formation as percentage of GDP	Authors' calculations with data from DANE (Colombia's Statistics Office)
Economic Growth	Annual growth rate of GDP	Authors' calculations with data from DANE (Colombia's Statistics Office)
Trade Balance to GDP	Current account balance as percentage of GDP	Authors' calculations with data from the Central Bank of Colombia
Openness	Sum of exports and imports as percentage of GDP	Authors' calculations with data from the Central Bank of Colombia
Exchange Rate Volatility	Index (2000Q1=1) of the conditional variance of the Colombian Peso obtained using a GARCH (1,1).	Calculations of the staff of the Central Bank of Colombia with Datastream data

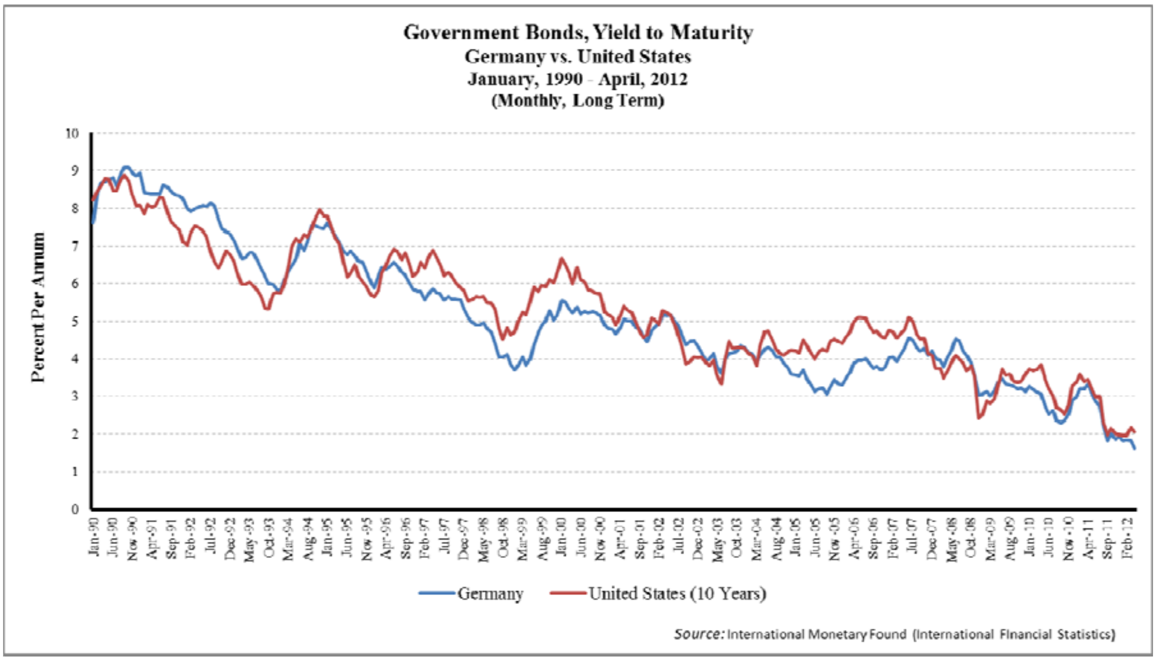
Table A2: Descriptive Statistics of the Variables

Variable	Mean	Standard Deviation	Maximum	Minimum
1-year Spread	6.33	2.59	10.28	1.34
2-year Spread	7.14	2.77	11.23	1.73
3-year Spread	7.63	2.84	12.2	2.10
5-year Spread	8.04	2.86	13.08	2.69
7-year Spread	8.07	2.84	13.53	3.03
10-year Spread	7.97	2.90	14.04	3.37
15-year Spread	7.28	2.90	13.97	3.31
Debt to GDP	38.87	4.83	47.83	27.42
Net Borrowing to GDP	1.03	0.83	2.99	-0.61
Implicit Interest Rate	7.79	1.28	11.5	5.99
Investment to GDP	20.34	4.30	27.66	13.34
Economic Growth	4.12	2.07	7.73	0.11
Trade Balance to GDP	-1.89	1.63	1.09	-6.14
Openness	42.68	9.86	61.63	24.01
Exchange Rate Volatility	2.58	3.07	14.86	0.29

Source: Author's calculations with quarterly data (2000Q1-2011Q3) for Colombia.

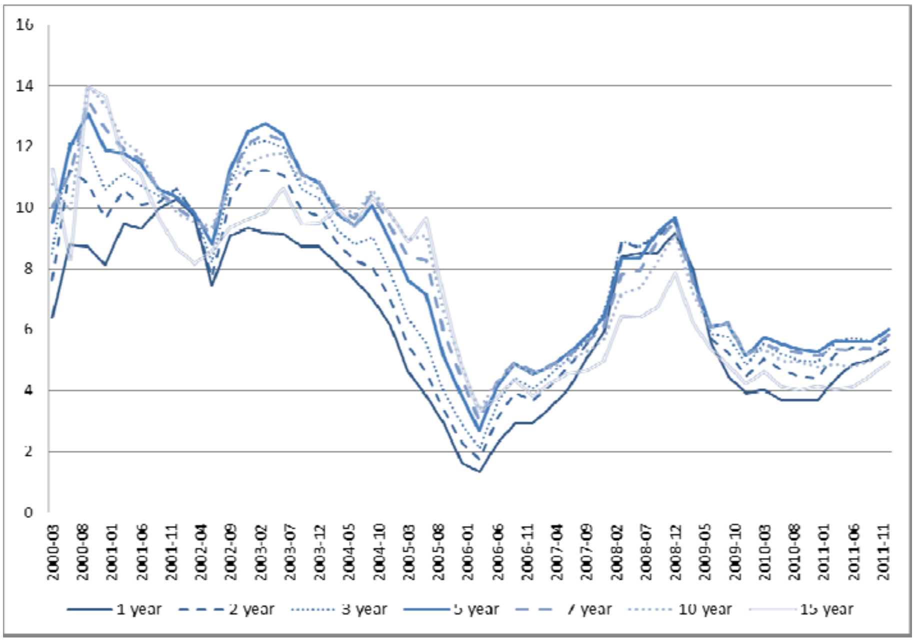
Annex of Figures:

Figure 1: Government Bonds: Yield to Maturity, Germany vs. United States



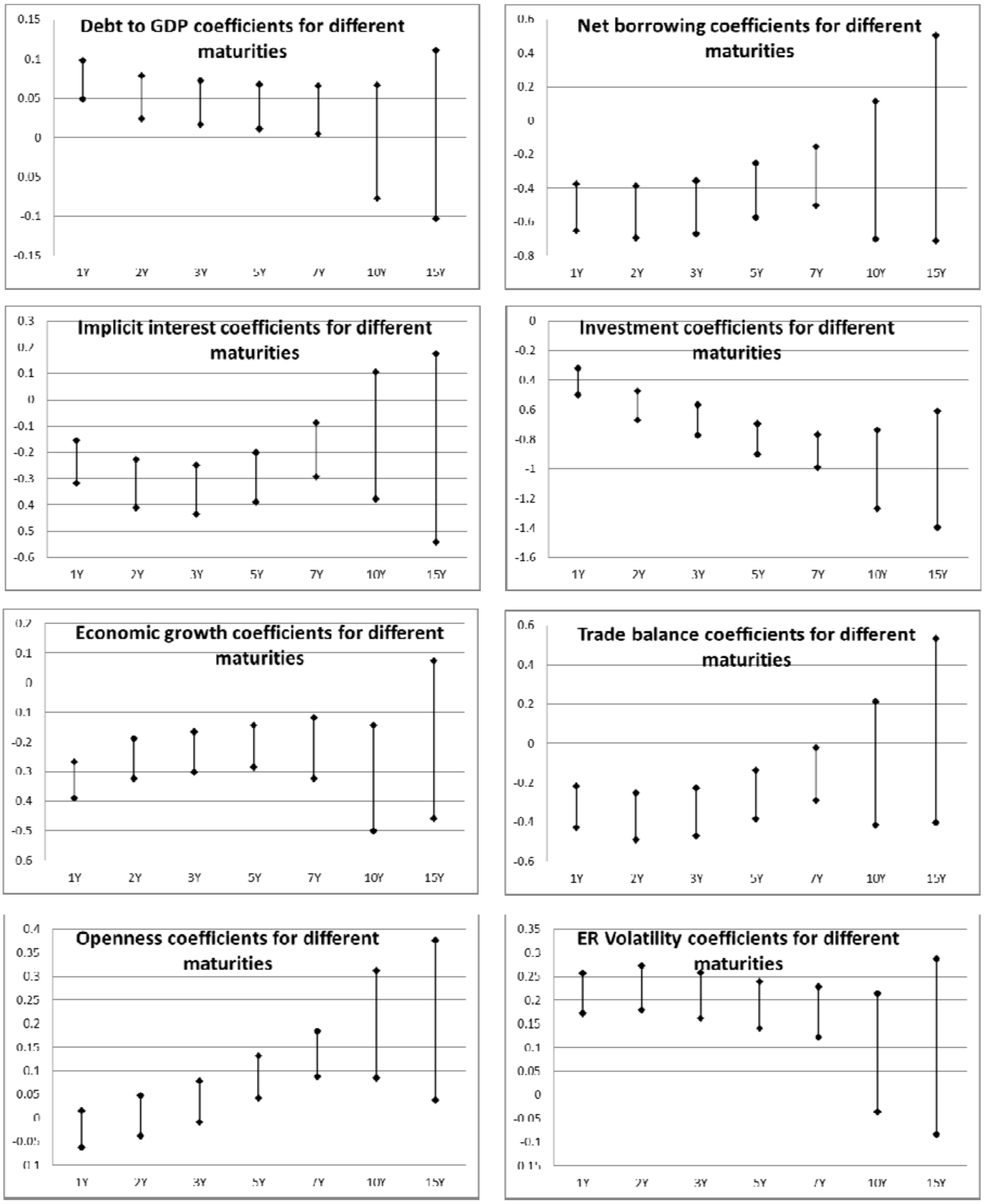
Source: International Monetary Fund (International Financial Statistics)

Figure 2: Spreads of Colombian Government Debt for Different Maturities



Source: Authors' calculations with data from the Central Bank of Colombia

Figure 3: The Term Structure of Sovereign Risk Determinants



Source: Authors' calculations