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Brady Bonds and Default Probabilities

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Abstract

This paper computes the default probabilities implicit in the prices of Brady bonds of seven developing countries and examines the factors that determine the high cross-correlation of the probability paths. The term structure of U.S. interest rates and the ratio of long-term foreign debt to GDP, together with a developing market index, explain more than 75 percent of the cross-sectional distribution of the default probabilities. The paper also demonstrates a new way to extract sovereign riskiness, implicit in traded bond prices. This allows the above results to be interpreted as explaining the cross-sectional distribution of sovereign riskiness as well.

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Keywords: Brady bonds, default probabilities, sovereign riskiness

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[1]I have received helpful comments and suggestions from Eduardo Borensztein, Arnab Das, Jose Luis Daza, Geert Rouwenhorst, and Chris Sims. All remaining errors are mine.

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SUMMARY

From the start of the Brady program, more than $50 billion dollars of emerging market debt has been converted into Brady bonds. Unlike Eurodollar securities issued by the same developing countries, the Brady bonds of these debtors have enjoyed an extremely liquid market. Nevertheless, the prices and yields on these instruments seem to move together, despite the countries' quite different economic fundamentals.

To analyze the issue, this paper computes the probabilities of default on seven discount Brady bonds, using data from the IMF SMPBASE for the period January 1994 - November 1996. The levels of the default probabilities obtained are consistent with the generally perceived riskiness of the issuers, judged either by Moody's ratings or from analysis of fundamentals. By using the Mexican and Argentinian par and discount bonds, the paper finds that the default probabilities extracted from discount bonds are uniformly higher than those of par bonds, due mainly to the different characteristics and durations of the issues.

The correlation between the paths of default probabilities are surprisingly high, well in excess of 80 percent. Simple regressions of the individual default probabilities series on face-value weighted indexes of developing countries' debt prices and the face-value weighted default probabilities index have coefficients of determination in excess of 50 percent except in the case of Bulgaria, where the coefficient of determination is much lower (below 15 percent). The subsequent analysis shows that more than 75 percent of the individual variation in default probabilities is explained by the spot U.S. interest rates (a proxy for the term structure of interest rates), a developing countries' index, and the ratio of the issuer's long-term foreign debt to GDP (a proxy of the country's ability to repay its foreign obligations).

I. INTRODUCTION

From the start of the Brady program, more than 50 billion dollars of emerging market debt has been converted into Brady bonds. Unlike Eurodollar securities issued by the same developing countries, the Brady bonds of these debtors have enjoyed an extremely liquid market. Nevertheless, the prices and yields on these issues seem to move together, despite the countries' quite different economic fundamentals. This paper examines whether investors differentiate between the different Brady bonds, i.e., whether news concerning a given country affects investor interest primarily in that particular country or whether there is evidence of an emerging markets factor which drives prices and yields on the Brady bond issues.

To analyze the problem, this paper computes the probabilities of default on seven discount Brady bonds, using data from the IMF SMPBASE for the period January 1994 - November 1996. To compute the default probabilities, the paper uses a version of the Bierman-Hass (1977) specification with the added complication of non-zero recovery in case of default. The analysis in case of default is facilitated by the presence of principal and rolling interest collaterals on the discount bonds. In essence, the method presented in this paper strips the bonds of the guarantees and estimates the pure country risk (the default probability).

The levels of the default probabilities obtained are consistent with the generally perceived riskiness of the issuers, judged either by Moody's ratings or from analysis of fundamentals. By using the Mexican and Argentinian par and discount bonds, the paper finds that the default probabilities extracted from discount bonds are uniformly higher than those of par bonds, due mainly to the different characteristics and durations of the issues.

The correlation between the paths of default probabilities are surprisingly high, well in excess of 80 percent. When Bulgaria is excluded, all correlations are in excess of 90 percent. Simple OLS regressions of the individual default probabilities series on face-value weighted indexes of developing countries debt prices and the face-value weighted default probabilities index have R^2's in excess of 50 percent except in the case of Bulgaria, where the coefficient of determination is much lower (below 15 percent). The subsequent analysis shows that more than 75 percent of the individual variation in default probabilities is explained by the spot U.S. interest rates, a developing countries' index, and the ratio of the issuer's long-term foreign debt to GDP.

The rest of the paper is organized as follows. Section II discusses the data used in the paper. Section III describes the computation of default probabilities, implicit in Brady bond prices and section IV presents and analyses the results. Section V proposes and implements a new measure of sovereign riskiness based on observed price data. Section VI compares the default probabilities extracted from discount and par Brady bonds, while section VII studies the determinants of the cross-sectional distribution of default probabilities. Section VIII suggests directions for future research and presents the conclusion.

II. DATA

The main computations in this paper use discount Brady bond prices. While section VI provides a comparison of the default probabilities obtained from both discount and par bonds, par bonds have additional features which complicate the calculations and make the results less reliable. For example, the Mexican par bonds have 17 series of Value Recovery Rights (VRR) which entitle the holder to additional payments linked to the price of oil. As there are no market instruments that would allow one to estimate the price of oil 10 or 15 years in the future, it would be better to judge investors' expectations by using discount Brady bonds.

From the beginning of the Brady program, nine countries have issued discounted Brady bonds, i.e., bonds whose principal is a reduced fraction of the original obligation (typically a 35 percent reduction) and that carry a floating interest rate (usually determined by the 6-month LIBOR on U.S. dollar deposits plus 0.1825 percent). The countries which have issued discount Brady bonds are Argentina, Brazil, Ecuador, Bulgaria, Mexico, Poland, Venezuela, Jordan, and the Dominican Republic.

For all those bonds the principal is fully collateralized by U.S. Treasury securities and, unlike corporate bonds, there is no possibility of collateral acceleration (i.e., seizure of principal collateral in case of default before the maturity date). The lack of acceleration is provided by the fact that the principal is secured by a series of discount U.S. Treasury bonds with the same date of maturity as the Brady bond. With the exception of Poland, whose bonds carry no interest collateral, the other issuers have either 12, 14, or 18 months of interest collateralized by highly liquid U.S. Treasury instruments. The issue amounts vary considerably, from 157 million for Jordan to 11.764 billion for Mexico. Table 1 summarizes the discount bond issues.

The SMPBASE, maintained by the IMF, has daily ask and bid price data on 7 of the issues: Argentina, Brazil, Ecuador, Bulgaria, Mexico, Poland, and Venezuela. Spreads between the bid and ask prices are relatively stable across time and have been typically declining since the time of issue which suggests that use of bid prices in the following analysis is appropriate.

Table 1. Summary of Discount Brady Bonds

Country	Issue date	Amount	Day	Month	Reduction
Argentina	31/03/1993	4.300	15	4	0.35
Brazil	15/04/1994	7.300	15	4	0.35
Ecuador	28/02/1995	1.435	15	4	0.45
Bulgaria	28/07/1994	1.850	28	1	0.50
Mexico	28/03/1990	11.764	30	3	0.35
Poland	27/10/1994	3.000	27	10	0.55
Venezuela	31/03/1990	1.226	18	4	0.30
Dominican republic	30/04/1994	0.329	30	5	0.35

Note: `Amount` is in billions U.S. dollars, `Issue date` is the date of issue of the bond in the format `dd/mm/yy`, `Day` is the day of the month on which the first semiannual coupons are paid, `Month` is the first coupon month, (the next is six months later), and `Reduction` is the reduction of the original face value.

Source: Merrill Lynch, *The 1995 Guide to Brady Bonds.*

All of the discount bonds have floating coupons, typically equal to the 6 months U.S. dollar LIBOR plus 0.1825 percent. To compute the expected coupons, the paper relies on weekly data on the swap curve, extracted from Bloomberg L.P. at maturities of 1, 3, and 6 months, and 1, 2, 3, 4, 5, 7, 10, 15, 20, and 30 years. Then the paper uses Bessel cubic spline interpolation to complete the swap structure across the remaining dates and maturities.[1]

To discount the future cash flows, the computations use either a flat term structure of interest rates (7 percent annual rate for all maturities) or the actual term structure, kindly provided by the Federal Reserve Bank of St Louis. In the latter case, the paper again relies on Bessel cubic spline interpolation to complete the term structure for the necessary maturities, starting from weekly data.

III. COMPUTING THE DEFAULT PROBABILITIES

Let the probability that the issuer would default on any coupon payment after time s, measured at time s, conditional on no prior default, be denoted by p_s. That is, it is assumed that the default probabilities for dates $t > s$ viewed from date s are constant. This is certainly a simplification which can be relaxed, albeit at the cost of much more intensive computations. The default probabilities are computed by using a version of the Bierman-Haas model.[2] To describe the derivation in more detail, let the forward rate from time a to b measured at time s be denoted by $f(s;a,b)$. The spot rate at time t from t to s is denoted by $r(t;t,s)$ or $r(t;s)$ for short. Further, the coupon owed at time s is denoted by c_s and the principal owed at maturity is denoted by F (and normalized by setting $F = 100$). Finally, let t denote the current period, and T be the time of maturity.

To construct the riskless yield curve, data on the U.S. Treasury yield curve, the collection $\{r(t;t+s)\}$ for $s = 1$ month, $\ldots$, 30 years$\}$ is obtained at weekly frequencies form Bloomberg L.P. The term structure for the necessary coupon dates is then constructed by using Bessel cubic spline interpolation. Further, using the spot rates, the entire structure of forward rates at t is computed in the standard fashion with discrete compounding:

$$f(t;a,b) = \frac{1 + r(t;b)}{1 + r(t;a)} - 1 \tag{1}$$

[1]Cubic splines are the preferred way to construct the complete term structure as they produce smooth and differentiable curves. The Matlab code is available upon request from the author.

[2]This is one of the methodologies by which one can compute the stripped yields on the Brady bonds.

The structure of forward rates is needed in order to compute the rolling interest collateral, an essential feature of the discount Brady bonds. With the exception of the Polish Brady bonds which have no interest collateral, all other Brady bonds have either 12, 14, or 18 months of interest collateralized by cash invested in either U.S. Treasury bonds or approved instruments (rated AA- or better). The rolling feature means that if the debtor makes a coupon payment, the collateral is "rolled over" to protect the next 12, 14, or 18 months of interest payments, all the way up to maturity or default. Therefore, denoting the value of the interest collateral at s by I_s, the expected value as of time t of I_s is:

$$\mathrm{E}_t\left[I_s\right] = \sum \frac{c_i}{[1+f(t;s,i)]^{i-s}} \tag{2}$$

where the summation is taken over the number of periods (2, 14/6, or 3) for which interest payments are collateralized.

To compute the present value of the principal collateral, P_t, recall that there is no possibility of acceleration of the principal collateral (seizure by the creditors in case of default). Therefore:

$$P_t = \frac{F}{[1+r(t;T)]^{T-t}} \tag{3}$$

or simply the price of a pure discount Treasury bond with remaining time to maturity of $T-t$ periods.

In order to compute the probability of default p_s, the observed Brady bond price B_s needs to be stripped of the interest and principal collateral. Clearly, the price B_t, less the value of the principal collateral P_t, should equal the present value of the expected stream of cash flows arising from the interest collateral and the coupon payments, discounted at the riskless rate. That is,

$$B_t - P_t = \sum_{s=t+1}^{T} \frac{\mathrm{E}[I_s]p_t(1-p_t)^{s-t-1} + \mathrm{E}[c_s](1-p_t)^{s-t}}{[1+r(t;s)]^{s-t}} \tag{4}$$

where the first term in the numerator of (4) denotes the value of the rolling interest collateral and the second measures the cash flows from coupons, all in expected value, adjusted by the probability of default. The probability of default obtained by this valuation can be called a *risk-neutral (martingale)* probability, as we have made the assumption of risk-neutrality by discounting at the riskless rate.

To obtain the probability of default p_t, the above equation is solved numerically using the Newton-Raphson algorithm. The results from the computations are presented and discussed in the following section.

IV. RESULTS

Table 2 presents selected statistics about the estimated default probabilities, computed from (4) using bid prices. Poland and Mexico are the countries with the lowest median semi-annual default probability, 2.23 percent and 2.91 percent, respectively, while Bulgaria has the highest one, 6.76 percent. Poland is also the country with the lowest variability of the computed probability of default implicit in the Brady bond prices (standard deviation 1.21 percent), while Venezuela is the one with the highest (2.17 percent).

Figures 1 and 2 plot the paths of the default probabilities computed for the different discount bonds from the first day data is available (as early as January 3, 1994) until November 21, 1996, a maximum of 760 data points using bid prices. The estimates using the ask prices are almost identical, as the spreads between the bids and the offers are virtually constant throughout the data period. Note the sharp uniform increase in default probabilities across the seven issuers starting at the end of November 1994 through April - May 1995, the period of the Mexican crisis. The percentage increases are the highest for Mexico (over 300 percent compared to pre-crisis levels) and the other Latin American countries (200-250 percent) and much lower for Bulgaria (170 percent) and Poland (less than 75 percent). Based on these casual observations, it appears that the market has viewed Poland as one of the least risky issuers (which could be judged by the lack of rolling interest collateral as well) and Bulgaria as the most risky.[3]

The computed paths exhibit serial persistence which is significantly different from zero. This suggests that the assumption of serially uncorrelated default probabilities, made in the analysis, is not entirely appropriate. As mentioned earlier, however, this assumption can be reduced only at the expense of much higher computational costs (see section VIII).

From the computed default probabilities, the paper proceeds with examination of the factors which determine the cross-sectional distribution of the default probabilities across the seven Brady bond issuers. Before presenting the results from the analysis, however, it is important to determine whether the estimated probabilities provide a realistic risk ranking of the countries compared to *ex-ante* Moody's ratings or

[3]News about the introduction of the currency board in Bulgaria and its actual implementation have changed this picture somewhat.

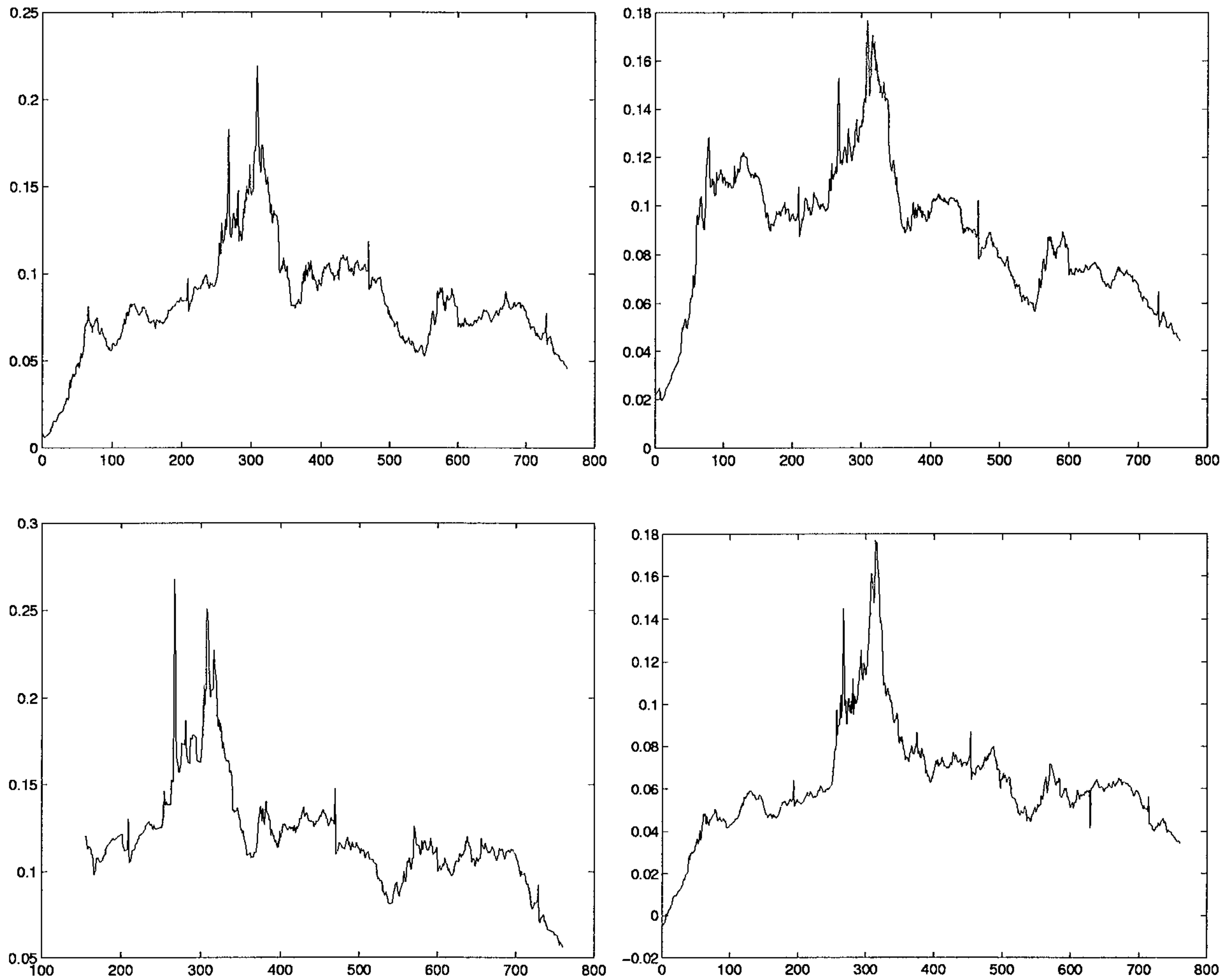
Table 2. Summary of the Computed Default Probabilities

Country	Min	Max	Mean	Median	Std	No. of obs.
Argentina	0.0028	0.1050	0.0407	0.0391	0.0146	760
Brazil	0.0096	0.0850	0.0435	0.0445	0.0137	760
Ecuador	0.0281	0.1343	0.0589	0.0566	0.0142	607
Mexico	0.0001	0.0835	0.0307	0.0291	0.0124	755
Venezuela	0.0094	0.1278	0.0614	0.0635	0.0217	760
Bulgaria	0.0416	0.1340	0.0714	0.0676	0.0151	612
Poland	0.0055	0.0616	0.0247	0.0228	0.0121	613

Note: The first column lists the issuing country, the second and the third columns, `Min` and `Max`, give the minimum and maximum of the default probability over the estimated path, `Mean` and `Median` compute the mean and median over the path, `Std` presents the standard deviation of the default probabilities, and the last column gives the number of consecutive price observations available and used in the computations. Results are computed from bid prices starting as early as January 3, 1994 up to November 26, 1996, a maximum of 760 tradings days.

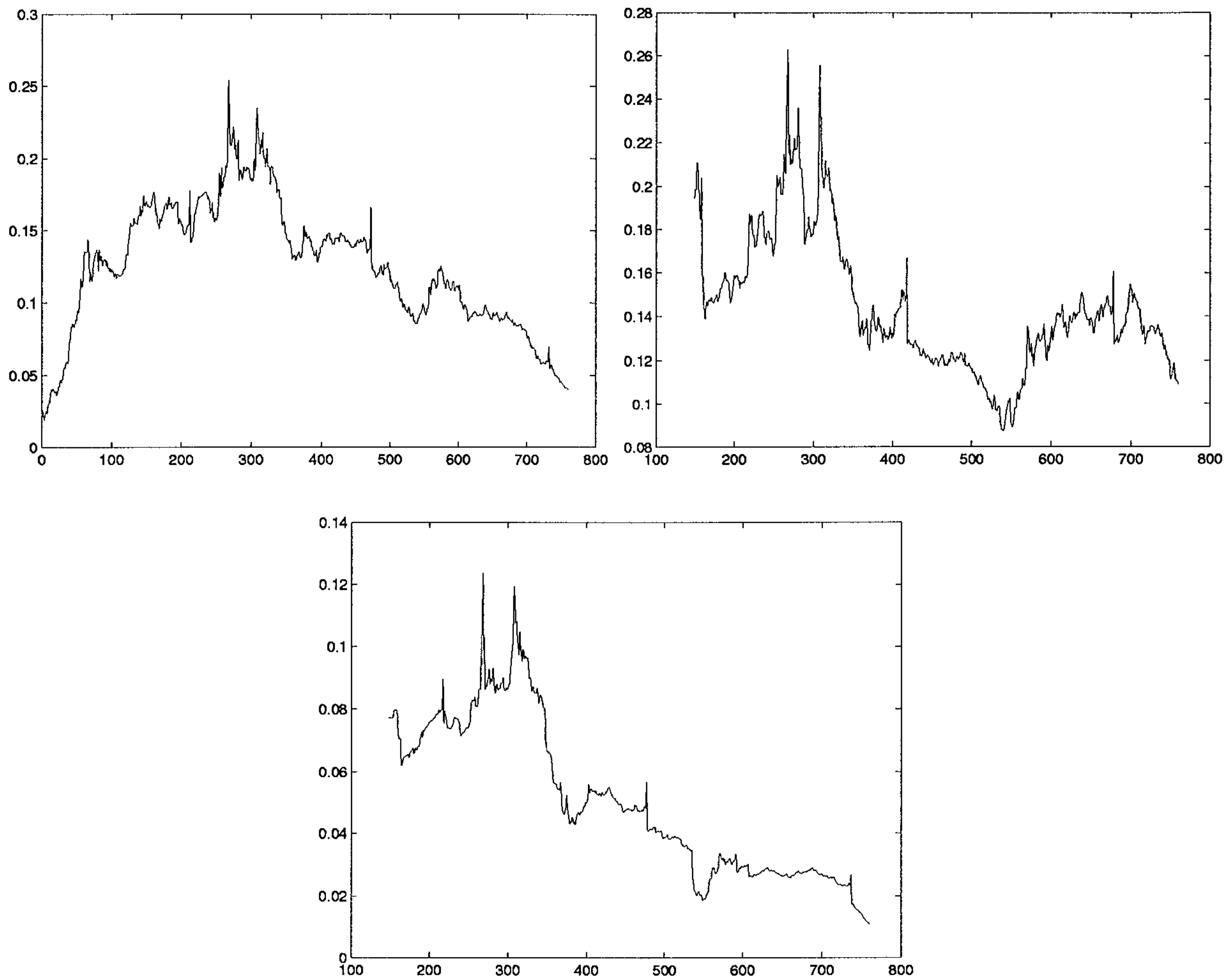
Source: the SMPBASE maintained by the Emerging Markets Division, Research Department, International Monetary Fund.

Figure 1. Estimated Risk-Neutral Probability of Default



Note: Estimated semi-annual probability of default using daily data, January 1994 - November 1996. Argentina and Brazil (top row), Ecuador and Mexico (bottom row).

Figure 2. Estimated Risk-Neutral Probability of Default



Note: Estimated semi-annual probability of default using daily data, January 1994 - November 1996. Venezuela and Bulgaria (top row), Poland (bottom row).

a sovereign riskiness rating obtained from the whole distribution of default probabilities, as discussed in the following section.

To obtain ratings of the countries using the estimated default probabilities, the probability density function of these estimates is computed nonparametrically. A normal kernel and an adaptive algorithm for the determination of the smoothing parameter is used to obtain the probability density functions (pdf's) plotted in figures 3 and 4. With the exception of Poland, all pdf's are unimodal with most of the probability mass concentrated around the mean. The next subsection constructs the empirical cumulative distribution function for each of these pdf's and uses it to obtain a relative market rating of the individual Brady bonds based on the concept of first-order stochastic dominance.

V. SOVEREIGN RISKINESS

One way to appraise the market's assessment of sovereign riskiness of the Brady bond issuers is to use the mean default probabilities, computed and presented in the previous section. While intuitive, this method utilizes only one moment of the distribution of the probability of default. This section introduces another possibility, based on the concept of stochastic dominance.

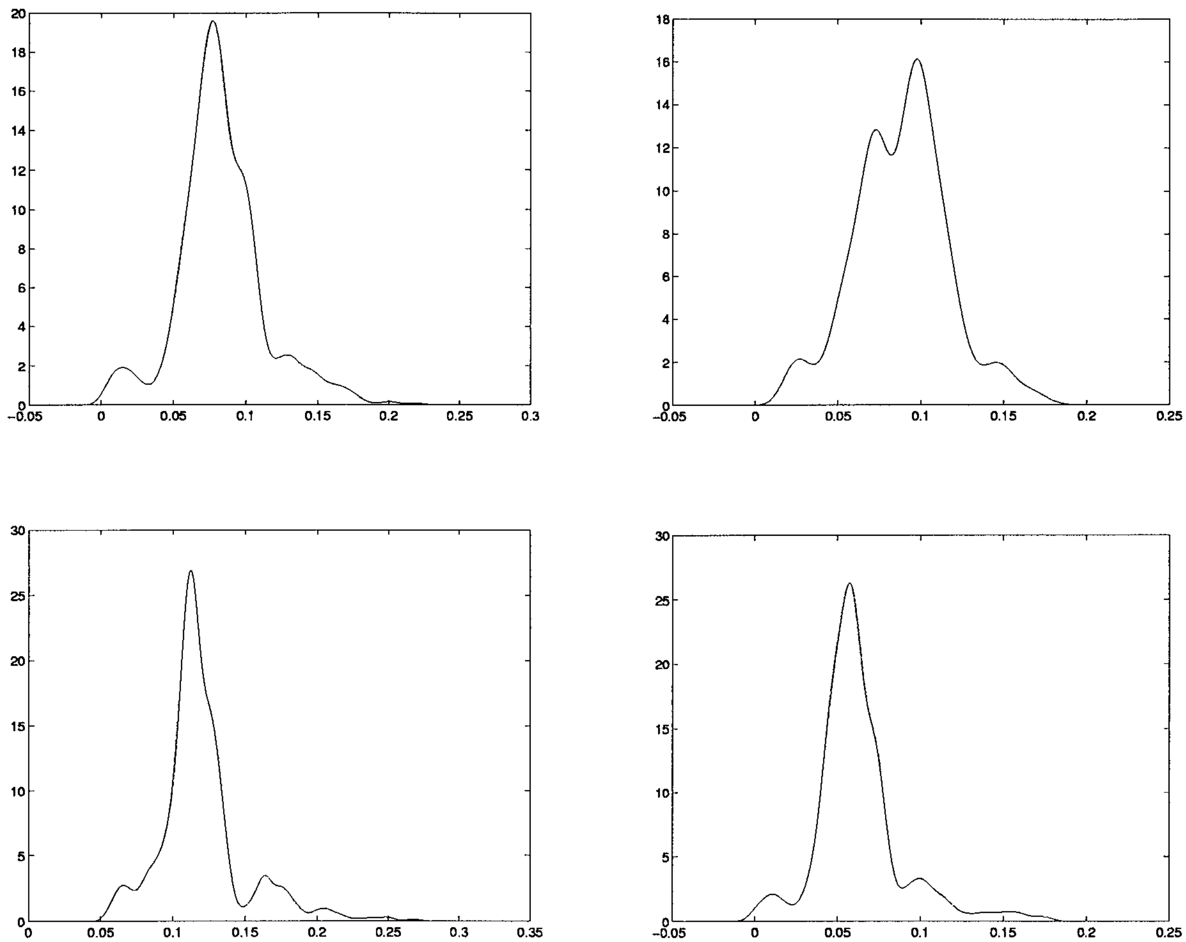
Recall from finance theory that given two (cumulative) distributions of asset returns A and B, distribution A is said to *first order stochastically dominate (FOSD)* distribution B (denoted by $A \succ B$) if the value of the cumulative distribution function (cdf) of A does not exceed that of B at any point on their support. Restricting the support of the cumulative distributions functions to $[0, 1]$ (very convenient for the analysis since default probabilities have such support), write this definition as:

$$A \succ B \equiv F_A(z) \leq F_B(z), \forall z \in [0, 1] \tag{5}$$

First order stochastic dominance means that all individuals with utility functions that are increasing in wealth prefer asset A to B or are indifferent between the two. To apply this concept to the cumulative distribution functions of default probabilities, we reverse the argument: A would be preferred to B if the cdf of B is exceeds that of A at every point of their support. Following this criterion, countries can be ranked according to their implied riskiness. Table 3 presents a country rating according to the simple mean of the estimated default probabilities (column 1), Moody's (column 2), and the first order stochastic dominance criterion, introduced above (column 3).

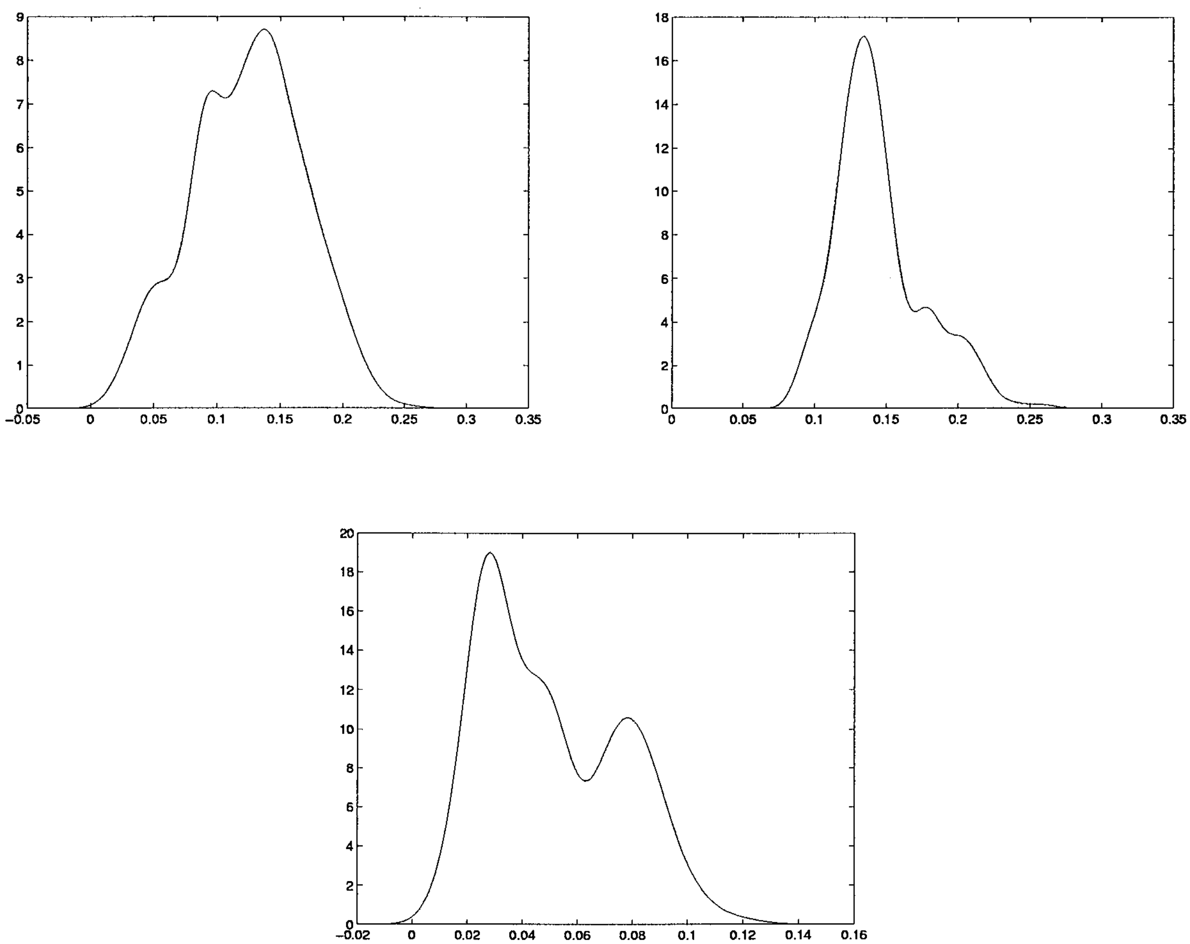
In figure 5 the cdf's of Mexico, Argentina, Brazil, and Ecuador clearly demonstrate why Mexico is the least risky and Ecuador the riskiest Brady bond issuer

Figure 3. Nonparametric Probability Density Function Estimate



Note: Nonparametric estimates of the density function of the probability of default for Argentina and Brazil (top row), and Ecuador and Mexico (bottom row). Results are obtained by using a normal kernel and an adaptive algorithm for determining the smoothing parameter.

Figure 4. Nonparametric Probability Density Function Estimate



Note: Nonparametric estimate of the density function of the probability of default for Venezuela and Bulgaria (top row), and Poland (bottom row). Results are obtained by using a normal kernel and an adaptive algorithm for determining the smoothing parameter.

in Latin America. While the results from that figure are unambiguous, first order stochastic dominance does not produce clear-cut results when comparing Mexico with Poland and Brazil with Venezuela because their cumulative distribution functions cross one another at points of their support. However, most of the mass of Poland's and Brazil's default probability is concentrated on the left, so that even though none of the cumulative distributions first order stochastically dominates the other, a reasonable approximation is certainly possible. Thus, the ratings presented in the table reflect some fine-tuning, which can be justified by invoking second-order stochastic dominance.[4]

Note that the mean probability of default and the first order stochastic dominance orderings are virtually identical. Thus, when comparing the market riskiness of discount Brady bonds, the first moments of the empirical pdf's seem to be sufficient statistics. Part of this result could be due to the assumption about the lack of serial correlation in the default probabilities. Moody's rankings are formally the same, except that Moody's does not rank all of the countries, while this paper assigns lower ratings for all non-rated countries.

The main implication of the results in this section is that the analysis that follows below explains not only the cross-sectional distribution of default probabilities, but also the cross-sectional distribution of sovereign country risk, as judged from the prices of Brady bonds.

VI. DISCOUNT BONDS AND PAR BONDS

It would be interesting to compare the default probabilities extracted from discount bonds, as presented in the previous section, and par Brady bonds. Recall that par bonds are issued at par for old debt but carry reduced, stepped up coupons for the first six or seven years. On bonds with identical characteristics, the computed default probabilities should be identical. Unfortunately, the par and discount bonds issued by developing countries do not have identical characteristics which explains the consistent differences among the computed probability series. For example, the coupon payments on Mexican par bonds are linked to the future price of oil and the oil revenues of the country via the so-called variable recovery rights (VRR).

The methodology for extracting the default probabilities from par bonds is similar to the one described for the discount bonds. The data are also available from the SMPBASE. Figure 6 plots the estimated default probabilities for discount and par Bradies for Argentina and Mexico. Even though the differences in levels of the

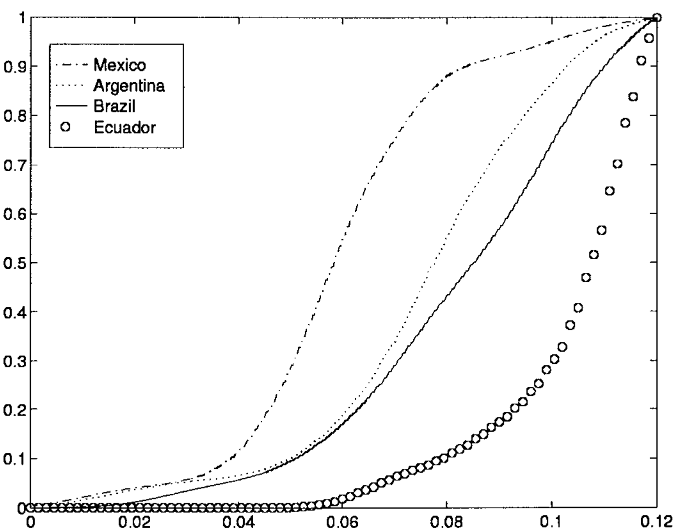
[4] A bit counterfactually, however, since the hypothesis of equal medians of the distributions for Poland and Mexico in one test, and Brazil and Venezuela, in another, is rejected.

Table 3. Estimated Sovereign Riskiness

Country	Mean of Def. Prob.	Moody's Rating	FOSD
Argentina	3	3	3
Brazil	4	5	4-5
Ecuador	5	6-7	6
Mexico	2	1-2	2-1
Venezuela	6	4	5-4
Bulgaria	7	6-7	7
Poland	1	1-2	1-2

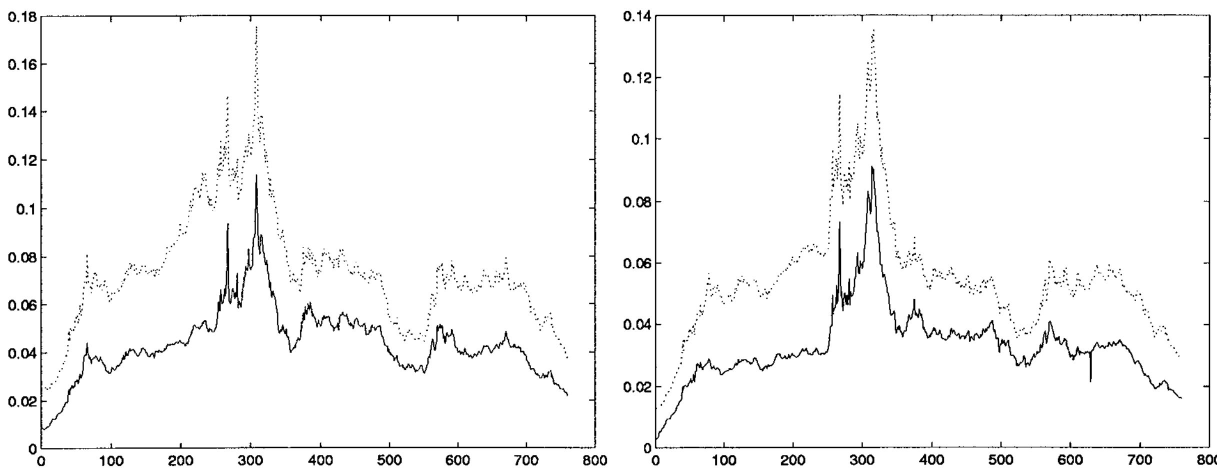
Note: The seven countries in the sample are ranked based on their sovereign riskiness according to three criteria ("1" is for the least risky, "7" is for the most risky). The first column uses the means of the computed probability distributions. Column 2 replicates Moody's ratings. Column 3 uses the First Order Stochastic Dominance (FOSD) concept, introduced earlier in this section.

Figure 5. Cumulative Distribution Function of Default Probabilities



Note: Cumulative distribution functions of the nonparametrically estimated density of the default probabilities for Argentina, Brazil, Ecuador, and Mexico. The figure clearly demonstrates why Mexico is viewed as the least risky issuer among these 4 countries.

Figure 6. Argentinian and Mexican Discount and Par Bonds.



Note: Inferred probability of default for discount (dotted line) and par (solid line) Brady bonds. Argentina is on the left panel, Mexico on the right.

individual series are statistically significant, they are highly and significantly correlated: the correlation coefficient is 91.74 percent for Argentina and 93.9 percent for Mexico.

VII. EXPLAINING THE DEFAULT PROBABILITIES

An initially striking feature of the estimated default probabilities is their high cross-correlation. Table 4 presents the correlation matrix of the estimated default probabilities paths of the seven countries. Although the lowest correlation coefficient is 72 percent (between Bulgaria and Venezuela), most of the coefficients are in excess of 90 percent.

Essentially the same results obtain when the individual probability series are regressed on a developing country index, which is either a Baker 15 index (an index of sovereign debt prices for 15 developing countries), an Eastern European index, or the face value weighted index of default probabilities (see Table 5). The absolute values of the t-statistics are statistically significant in all three cases which suggests a strong underlying "developing country" factor driving default probabilities.

Table 4. Correlation Matrix

Argentina	1.0000	0.9520	0.9605	0.9497	0.9139	0.8332	0.9247
Brazil		1.0000	0.9399	0.9550	0.9437	0.7870	0.9533
Ecuador			1.0000	0.9490	0.9194	0.8207	0.9125
Mexico				1.0000	0.8877	0.8087	0.9182
Venezuela					1.0000	0.7177	0.9495
Bulgaria						1.0000	0.8188
Poland							1.0000

Before proceeding, note that the *t*-statistic for Bulgaria is the lowest, in absolute value, for any of the three models. This suggests that the "developing country" factor is the least strong for Bulgaria, an observation which is confirmed by the relatively low correlation of the probability path for the Bulgarian Bradys with the other bonds, as presented in Table 4.

Since the default probabilities are computed using a bond pricing model, one may think that the influence of interest rates on default probabilities is accounted for and the remaining correlation is a sign of irrational herding or contagion. This, however, is not true. Table 6 presents OLS estimates of the model by using a constant, the Baker 15 index, the spot LIBOR for U.S. dollar deposits (results are virtually identical when a Treasury bill rate is used), and the ratio of long-term foreign debt to GDP as explanatory variables.

The spot LIBOR proxies for the level of the yield curve, one of the basic factors determining the term structure of interest rates.[5] The variable Debt/GDP proxies for the ability of the country to repay its foreign obligations. If debt is a burden, the expected sign on this variable is negative, while if debt levels have been increased under tighter investor scrutiny and allow for improved performance of the economy, the expected sign is negative.

The results are not surprising. The coefficients on the index do not change their signs or levels of significance for all countries in the sample except Bulgaria. For

[5]The slope of the term structure would be determined by a separate factor which we ignore in our model.

Table 5. Detailing the High Correlations: OLS Regressions Results

	Argentina	Brazil	Ecuador	Mexico	Venezuela	Bulgaria	Poland
			Using the Baker 15 Price Index				
Estimate	-0.132	-0.137	-0.150	-0.120	-0.234	-0.070	-0.120
t - stat.	-25.436	-32.321	-26.160	-27.973	-38.798	-8.597	-28.380
R^2	0.564	0.676	0.578	0.610	0.751	0.127	0.617
			Using an Eastern Europe Price Index				
Estimate	-0.078	-0.084	-0.092	-0.071	-0.149	-0.046	-0.074
t - stat.	-22.991	-31.218	-25.862	-24.493	-44.458	-9.130	-28.572
R^2	0.513	0.661	0.572	0.545	0.798	0.141	0.620
			Using a Default Probabilities Index				
Estimate	1.048	1.004	1.162	0.923	1.562	1.021	0.904
t-stat	104	124	88	124	61	35	78
R^2	0.955	0.968	0.939	0.968	0.879	0.712	0.923

Note: The dependent variable is the individual country probability of default. The explanatory variables include a constant and one of the three indices, described below. t-statistics are given for the index variable. The Baker 15 index is a face value weighted index of Brady bond offer prices. The Eastern Europe index is a face value weighted index of Bulgaria (discount bonds), Poland (par bonds), and Russia (clm bonds). The default probabilities index is a face value weighted index of the probabilities of default.

Data source: SMPBASE.

Bulgaria, the coefficient becomes positive with a t-statistic of 3.3168. On the other hand, the coefficients on the spot interest rate are strongly significant with t-statistics highest for Bulgaria and Poland.

The highly significant coefficients on the market index for all countries except Bulgaria can be interpreted as lack of a developing country factor in the determination of the probability levels for Bulgarian Brady bonds. On the other hand, U.S. spot interest rates have similar levels of significance for all countries in the sample. Note that it is not feasible to interpret the influence of spot rates on default probabilities solely, or even mainly, through the interest collateral as Poland has no interest collateral and yet, the t-statistic on its spot rate is the highest.

The coefficients on the variable Debt/GDP are positive and statistically significant for Argentina, Brazil, Bulgaria, and Ecuador and negative and statistically significant for Poland and Mexico, the least risky countries in the sample. The intuition is that these countries have been able to increase their debt levels because investors have adequate means of monitoring their performance (recall the lack of rolling interest collateral on the Polish Brady bonds).

In summary, spot U. S. interest rates, a developing market index, and the ability of the issuer to pay, as proxied by the ratio of long-term debt to GDP, explain most of the cross-sectional variation of the default probabilities perceived by market participants. The major caveat for these results is the assumption about the flat term-structure of the future default probabilities.

VIII. CONCLUSION

The paper computes the default probabilities implicit in the prices of Brady bonds for seven developing countries and examines the factors which determine the high cross-correlation of the probability paths. The term structure of U.S. interest rates and the ratio of long-term debt to GDP, together with a developing market index, explain more than 75 percent of the cross-sectional distribution of the default probabilities. The paper also demonstrates a new way to extract sovereign riskiness, implicit in traded bond prices. This allows the above results to be interpreted as explaining the cross-sectional distribution of sovereign riskiness as well.

Future research will focus on a more general form of the default probability, possibly estimating it nonparametrically. A broader array of instruments, including equity, could be used to examine the determinants of the cross-sectional distribution of risk across emerging markets.

Table 6. Explaining the Correlations

	Argentina	Brazil	Ecuador	Mexico	Venezuela	Bulgaria	Poland
Baker	-0.041	-0.048	-0.049	-0.043	-0.081	0.009	-0.034
t-stat	-22.174	-31.791	-21.588	-25.609	-37.160	3.317	-32.352
LIBOR	0.020	0.016	0.019	0.014	0.026	0.034	0.020
t-stat	27.777	28.121	22.660	21.806	31.907	34.243	49.388
Debt/GDP	0.003	0.008	0.011	-0.012	-0.002	0.024	-0.024
t-stat	1.710	6.808	20.052	-8.198	-0.661	21. 687	-14.9988
R^2	0.838	0.882	0.802	0.823	0.908	0.743	0.933

Note: The dependent variable is the individual country probability of default. The standard errors used to compute the *t*-statistics are heteroskedasticity corrected. The explanatory variables include a constant (estimates not reported), the Baker 15 index (an index of prices of developing countries' debt), the spot LIBOR (the level of the 6 months spot rate on dollar denominated deposits), and Debt/GDP, the ratio of the country's long-term debt to GDP.

Data Sources: SMPBASE and the World Development Finance Database.

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