Determining Country Risk Premiums for Emerging Market Countries

A MODIFIED CONTINGENT CLAIM ANALYSIS MODEL

Master of Arts in Law and Diplomacy Thesis

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Abstract

When investing in developing economies, companies and investment banks often face a difficult choice in assigning country risk premiums for their investments. While there has been a consensus that risk can be measured as the spread between a sovereign's yield and that of an equivalent maturity US Treasury bond, this analysis assumes that markets are efficient. If such an assumption is true then it demands that at every moment in time, bonds should convey all the available information in the market and provide a fair risk/return ratio for the investor. The purpose of this paper is to question this assumption, and provide insight on an alternative method for calculating sovereign risk premiums.

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Determining Country Risk Premiums for Emerging Market Countries

When investing in developing economies, companies and investment banks often face a difficult choice in assigning country risk premiums for their investments. While there has been a consensus that risk can be measured as the spread between a sovereign's yield and that of an equivalent maturity US Treasury bond, this analysis assumes that markets are efficient. If such an assumption is true then it demands that at every moment in time, bonds should convey all the available information in the market and provide a fair risk/return ratio for the investor. The purpose of this paper is to question this assumption, and provide insight on an alternative method for calculating sovereign risk premiums.

Sovereign risk premium is the additional likelihood, over a risk-free investment, that a country will default on its foreign debt obligations and, therefore, halt any remittances of foreign exchange. A sovereign default entails substantial adverse future economic and political instability, followed by a lack of access to foreign markets and financing, for both public institutions and private enterprises. Different authors point to different reasons that lead a country to default; however, they all agree that there is a large cost in pursuing such policy, and that the country will only pursue such options if the perceived benefits outweigh the costs. More importantly, the authors acknowledge that when countries do default on their obligations, they generally do so because they are *unable* and/or *unwilling* to service the debt.

The *willingness* of a country to service its debt is mostly a qualitative question, and difficult to answer through a specific numerical model. It is generally assumed that the willingness to pay is a choice between the loss that comes from a default and the money saved on debt payment. This loss could come in the form of reputation, but also from the inability to pursue foreign exchange transactions and other factors. For instance, Bulow and Rogoff (1989) show that the penalties, rather than reputation, is what defines the ceiling for debt. They (Bullow and Rugoff, 1988) argue that the "reputation-for-payment models neglect a country's ability to bargain, [and] greatly overstate the ability of lenders to threaten to cut off an LDC from world capital markets. Thus they tend to overstate the empirical importance of capital markets cut off of an LDC relative to say, interference with the country's current account transactions."

However, although the willingness to pay poses limit on debt size, Grossman and Van Huyck (1985) show that the default has often been associated with specific shocks and adverse economic environment, and that countries are only able to default on their obligations if they have an economic reason for it, what they call an "excusable default". They show in their model that "excusable default does not preclude continued access to loans", and that, therefore, "although sovereigns sometimes excusably default, they always resist the temptation, which is greatest in the good state of the world, to repudiate their debts". From that, we conclude that countries will only de facto default if they are *unable* to pay their obligations.

This *ability* of a country to service foreign debt obligations is based mostly on its fundamentals, such as the relative size of its debt, its expected future revenues, its expected

GDP growth rates and many other variables including inflation, exchange rates and domestic interest rates. Therefore, implicit in our analysis is that fact that if a country is *able* to pay its obligations, it will be *willing* to do so.

Challenging Current Thinking

The principal problem in using the spread over the US Treasury as a measure of country risk for a developing economy is that such number is highly volatile. If the ability of a country to service its debt is based on its fundamentals, and using the spread is the correct method of analyzing country risk, then the logic would be that the fundamentals should be highly volatile as well. The reality, however, is that while these fundamentals vary, their changes are smooth and accrue over time. Brazil, during 2002, is a case in point. The country's sovereign risk, as measured by JP Morgan's EMBI index (an index of traded sovereign bonds), has varied from a low of less than 700 basis points in March of 2002, to a height of 2,390 basis points only five months later (just prior to the presidential election), to 1,050 basis points only three months after the investors worst fears materialized, namely the presidency of the opposition. Yet, simultaneously, the country's GDP growth forecasts increased, a US$30 billion IMF credit line was established, the expected fiscal surplus materialized and the trade surplus reached unprecedented levels. It is true that the sharp devaluation has increased the public debt, since large parts of it are dollar denominated. However, while there has been some change in fundamentals, the most striking feature is the sharp volatility of risk premiums. The question then becomes whether it is realistic that Brazil's ability to pay its debt, which defines the premium of its sovereign risk, has decreased so substantially in only six months, to be almost entirely restored in another six. It is important to note that at this

stage we are not making a claim that any specific risk level is correct; rather, that the sharp volatility implies that using the spread method is an imperfect measure of default risk.

Unlike emerging market debt, similar risk corporate bonds are not as volatile. Part of the reason is because there are widely accepted models on the correct pricing of these instruments. One of the theoretical foundations of pricing corporate bonds is Merton's (1974)[1] Contingent Claim Analysis (CCA) method, in which the value of a corporate bond is equal to the price of a risk-free bond and of a put option on the value of the firm, with a strike price equal to the total debt. That is, should a company's enterprise value fall below its total debt, bondholders take possession of the company (bankruptcy), meaning that equity holders have exercised their put option. This gives a clear framework for pricing the bond and, more importantly, for pricing the risk of default by the corporate. The spread between a risk-free bond and the corporate is equal to the risk of default, which in turn can be calculated by pricing the put option (See Note Below for a better understanding of CCA method)

Note 1.

A simplified example of Merton's Contingent Claim Analysis (CCA)

In order to better understand the modified Merton model presented in this paper, the risk premium of a fictitious distressed company will be priced according to the CCA method.

Almost Defaulted Inc., a distressed telecom provider in the United States, is a public company that has several outstanding publicly-traded bonds. Because of the dilapidated value of its investment in 3G licenses and the declining revenues from its extensive fiber-optic network, investors have sold its

[1] For simplified information on the Black Scholes model, Frank J. Fabozzi and Franco Modigliani's "Capital Markets – Institutions and Instruments" is a good source (p. 285-287 and 568-569)

stock aggressively with the fear of an imminent default. After touching a high of $78 per share in May of 2000, the stock is currently trading at $3.50 per share.

Almost Defaulted, Inc.		
Stock Price	$	3.50
# of Shares Outstanding		1,000,000
Market Capitalization	$	3,500,000
Total Value of Liabilities	$	25,000,000
Cash and Equivalents	$	1,500,000
Enterprise Value	**$**	**27,000,000**
Weighted Average Duration of Debt : 3.5 Years		
Implied Volatility on 3.5 Year Option: 52%		
YTM of 3.5 Year US Treasury Bond: 2.55%		

Fearing the collapse of the company, Mr. John Desperate, a bondholder of Almost Defaulted, is trying to determine what the correct price of his $10,000 investment in Almost Defaulted zero-coupon bonds is. His banker explained to him that the value of this distressed debt is equal to the price of a risk-free security and put option written on the value of the firm, and thus he could find the fair value of his debt by pricing the put option.

The mechanism through which the put option works is as follows: The value of the expected cash flows, discounted at the appropriate weighted average cost of capital, is the enterprise value of the firm. Because bondholders have priority of expected cash flows over stockholders, the market value of the firm's stock is found by subtracting the total liabilities from the enterprise value. Thus, if the Enterprise Value of the firm falls below the value of the total outstanding net liabilities, the company is bankrupt (meaning, there is no value left for stockholders). Declaring bankruptcy means that stockholders have exercised their put option.

More formally, the "stock price" of the option is the company's enterprise value, and the strike price is the value of its total outstanding net liabilities. The weighted average duration of its debt becomes the time to expiration of the option, and the volatility measure is the implied volatility of an option on the stock with the same maturity as the weighted average duration of the debt.

With the values on the table, Mr. John Desperate is able to price the value of the put option he implicitly wrote to stockholders when he initially purchased the bond. Using Black Scholes, the put option is worth $7,255,140. Since the weighted average duration of the liabilities is the same as the maturity of an equivalent zero-coupon bond, if we price the value of a zero coupon risk-free security of the same maturity, and subtract the price of the put option, we obtain the value of a zero-coupon Almost Defaulted bond on its total liabilities.

The present value of the zero-coupon risk-free security is $22,891,022, of which we subtract $7,255,140 from the put option, and come with a fair value of $15,635,882.

Price of the Put Option	$	7,255,140
(-) Price of Risk Free	$	22,891,022
Price of Bond	$	15,635,882
Face Value of 3.5 Year Zero-Coupon Security		62.54%
YTM of Bond		14.35%
Risk Premium		11.80%

From this we have that a 3.5 year, zero coupon security is worth 62.54% of face value, and therefore can easily determine the YTM (14.35%) or the present value of Mr. Desperate's bond ($6,254). The risk premium, if we define it as the yield over treasury, is then 11.80%. Effectively, this process has linked the stock price of the company (which affects its enterprise value) to its risk of default.

An Alternative Proposition

The alternative method for pricing sovereign risk suggested in this paper is based on this model. The reason why Merton's model does not directly apply to sovereigns is two-fold: firstly, should a country default, one cannot claim the "assets" of a country since a bankruptcy process does not exist for sovereigns. Secondly, this model requires one to value the equity of a country (so that the Enterprise Value can be found), something that is not priced by the market (unlike a publicly traded company, which can be found by using the market capitalization). For this reason, we must use an alternative concept of equity for this analysis and make a further assumption regarding bankruptcy of sovereigns.

As mentioned earlier, we are making an explicit statement that if a country is *able* to pay its debt, it will also be *willing* to do so. Therefore, from a borrower's perspective and much like in corporate debt, a sovereign debtor will only exercise its option of declaring default when it is indeed unable to pay its outstanding obligations. From the lender's perspective, the payout in the event of a default is also similar in the two examples. While the lender to a corporate

has the legal right to claim the assets of the company at time of default, generally when such an event is declared, these bonds are worth only between 20 and 30 cents on the dollar. Similarly, when a sovereign declares bankruptcy, the value of its bonds are also worth around 20 cents on the dollar. The difference is that for a sovereign, instead of exchanging the defaulted obligations for the assets of a country (which is very difficult, if not impossible, to do), the investor generally re-negotiates the debt and exchanges it for new liquid instruments. While the lender does not have the right to the assets, the country (unlike the corporate) will continue to exist regardless of the default, and will continue to generate revenues from tax collections. Therefore, while one does not have access to the "assets" *per se*, the payouts for both lenders and borrowers in the event of a default are similar enough to allow for the comparison.

The foundation of the model, and arguably the most difficult part of this analysis as well, is determining how to price the equity of a country. For this task, the proposed method is to value a country by its ability to generate future fiscal surpluses, discounted at the cost of obtaining these funds. This is very similar to the discounted cash flow method in corporate valuations, where the value of a company is its expected ability, discounted at the company's weighted average cost of capital, to generate future cash flows. In that method, a corporation's discounted future cash flows minus its net debt (total liabilities minus cash and equivalents) is the value of its equity. The net debt of a sovereign is divided into two components, namely the face value of all liabilities and the country's "cash". For the former, we define liabilities as the total outstanding federal liabilities (total face value of all public debt), including the pro-rata share of State-Owned-Enterprises' debt and discounting for inter-government loans. For the latter, "cash" will be defined as the amount of reserves held

at the Central Bank. Having defined broadly the process of the model, several questions remain as to how one should proceed in finding these values.

Discounting Future Cash Flows for a Sovereign

The first question in this process is determining which rate should be used to discount the expected primary surpluses. An argument could be made that it should be the Weighted Average Cost of Capital (WACC), much like in a corporation. However, the problem with using this methodology is that even though a theoretical calculation of the "cost of equity" of a country could be made using the Capital Asset Pricing Model, the country is unable to issue equity as a form of financing. Therefore, its true cost of financing is in reality only its cost of debt. Nonetheless, it is precisely the cost of debt that impedes us from using this analysis without a further assumption. If the Yield to Maturity (YTM) of currently traded foreign bonds is used, one will in fact be using, as the value of debt, the same value which this paper is trying to prove is incorrectly priced. Therefore, based on interest rate parity, it will be assumed that the yearly interest rate charged on domestic debt minus the expected inflation is the same as its USD marginal cost of debt, that is, the cash flows should be discounted at the local real interest rate. This is particularly relevant for a sovereign since inflation is directly linked to the government's ability to print money. In order to get a stronger measure, it is useful to compute the average of the expected real interest rates for future years, rather than only the current expected rate. Using the domestic interest rate makes further sense because domestic debt is the largest component of the stock of liabilities of the sovereign, and has a much better liquidity than foreign debt. Additionally, this rate is also linked to the growth rate of the economy, i.e., a higher real interest rate should slow the

economy and thus decrease the expected GDP growth. This relationship will then be reflected in the model through a higher discount rate of fiscal surpluses.

The second question in this process is determining how the leverage level of a sovereign affects its ability to pay its obligations. Aizenman and Marion (1999) show that the increased uncertainty about the size of an emerging market's external debt has a nonlinear and potentially large adverse effect on the supply of international credit offered to them, hindering a country's ability to service its obligations. In the proposed model, however, the size of the debt is relevant primarily for determining the strike price of the put option; it does not matter if a country is able to generate additional leverage to fund its future debt shortcomings (all else equal, generally the higher the leverage level of a country, the smaller its ability to borrow more funds). This is because the model measures the discounted future cash flows and compares it to the total debt load. Should the present cash flows increase due to additional leverage, the debt load will also increase by the same amount, thus unchanging its ability to fulfill its obligations. Leverage, moreover, also plays a significant role in determining the implied volatility of the put option, which will be discussed at a later point in this paper.

The third important question is how to determine the liabilities of a country. This is significantly more difficult than in a corporation, which publishes the data in its balance sheets. For one, there are dozens of different types of public debt. It is important to include *all* public debt, such as that of the states and municipalities, state-owned enterprises, and the central bank. A more difficult question, though, is whether one should consider the internal debt as part of the country's ability to pay its foreign liabilities. It may be argued that,

although highly undesirable, internal debt can be paid by printing additional local currency and consequently creating inflation, something that with foreign debt cannot be done. Nevertheless, while printing money is a possibility, we will make the argument that in today's environment defaulting on the debt is preferable than creating a hyper-inflationary environment, especially after the devastating effects of such policies in the 1980's. If one is to exclude domestic debt in the calculation, then a different model should be built in which the "equity" value of a country is based on its ability to generate "hard" currency and pursue consistent current account surpluses, rather than producing fiscal surpluses. However, this is not the intent of this paper.

Having the enterprise value of a country will then assist us in valuing the put option. While there are many ways in which to price a put option, the Black Scholes model will be used for this analysis. While the model in itself may not be the most accurate for valuing options, the important aspect is that the variables which will be used for it may be applied towards other option valuation models. Namely, these variables are the duration, strike price, stock price, risk-free rate and volatility.

According to Merton's CCA model, the stock price should be the company's enterprise value. Therefore, in this instance it will simply be the country's "equity" value plus its net debt, as described above. The strike price of the option will be the same as the net debt of the country. The maturity of the option will be the weighted average duration of the outstanding liabilities, and the risk-free rate will be determined by the equivalent duration measure of a similar maturity US treasury rate.

The volatility measure is decidedly the most challenging assumption of the option. It may be argued that the correct volatility is that of the country's stock market, since it is the closest tradable proxy for the likelihood of a potential default. That is, should a country declare bankruptcy it is very likely that its stock market will collapse along with it. However, there are several flaws with this rationale. For one, the historical volatility of the market needs to be unlevered based on the average indebtedness level of the components of the index. This volatility should then be re-levered again at the leverage level of the sovereign. However, the latter task is a stretch of the assumption of the equity value of a country, that is, to pursue this logic one would need to assume that the increase in volatility and risk due to leverage in a corporation will be similar to that of a sovereign. This is not believed that to be the case.

For this reason, it is believed that the foreign exchange market is a better proxy for volatility of the payment ability of sovereign debt, especially in the case of Brazil. This, however, is only applicable in countries that pursue a floating exchange rate regime, and even in our case study of Brazil, where this has been the policy of the government since 1999, it is not clear how large Central Bank interventions really are. Especially in recent years, this intervention has had limited effect on the volatility.

Within the currency market, there are several methods in which to extract the volatility. The first, using the historical volatility, is easily calculated. However, while it is convenient to look at historical rates, it may not necessarily be the best proxy for a model that is forward looking, especially since the expected and historical leverage of the country may differ (requiring one to "un-lever" and "re-lever" the volatility). The second method, which is much harder to obtain and not necessarily available, is to extract the implied volatilities in

reference currency call options, such as the US Dollar. Because most of these options are not traded on a public exchange but rather over the counter through large multinational banks, one must be able to obtain a "clean"[2] rate in order for it to be relevant; otherwise, calculating the one year historical volatility of the spot price of the reference currency may be the best option available. Ideally, one would want to obtain the implied volatility of an option with the same maturity as the weighted average duration of the country's liabilities; however it is rare to find relevant currency options with maturities beyond one year.

Having all these components, one then continues by pricing the put option and valuing the risk-free bond. The latter can be done by calculating the present value of a zero-coupon risk-free security of same face value and duration (which is its maturity, since it is a zero-coupon bond), and by subtracting the price of the put option. This way, we obtain the "fair" value of the debt. Once we have the fair value of the sovereign debt we can imply the Yield to Maturity of this bond, and subtract it from the risk-free yield to separate the sovereign risk. This will give the "fair" country risk premium for the sovereign, based on fundamentals rather than simply on market sentiment.

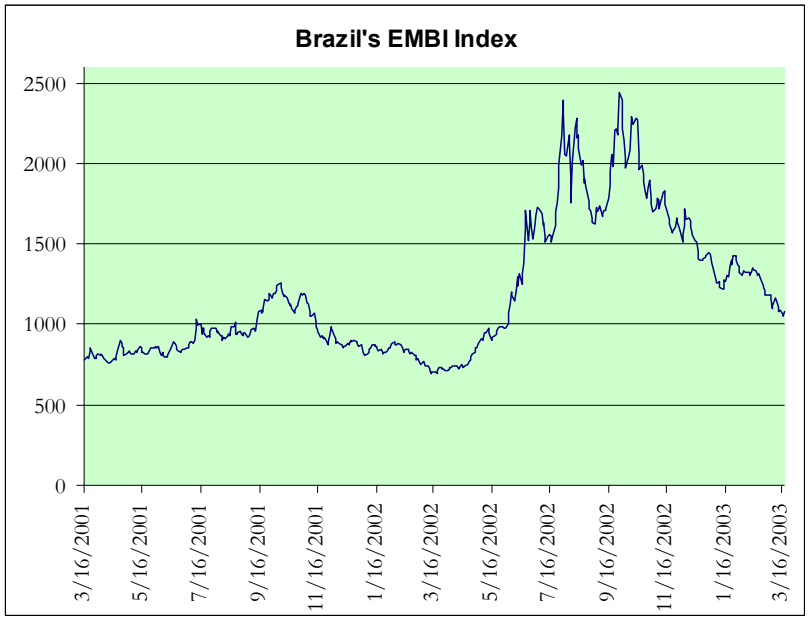
Table 1. Black Scholes Inputs

Input	Value
Option Strike Price	Local and foreign net government debt
Option Stock Value	Discounted fiscal surpluses
Option Volatility	Implied 1 year call options on reference currency
Option Maturity	Weighted Average Duration of the Debt
Option Risk Free Rate	Equivalent maturity US Treasury yield

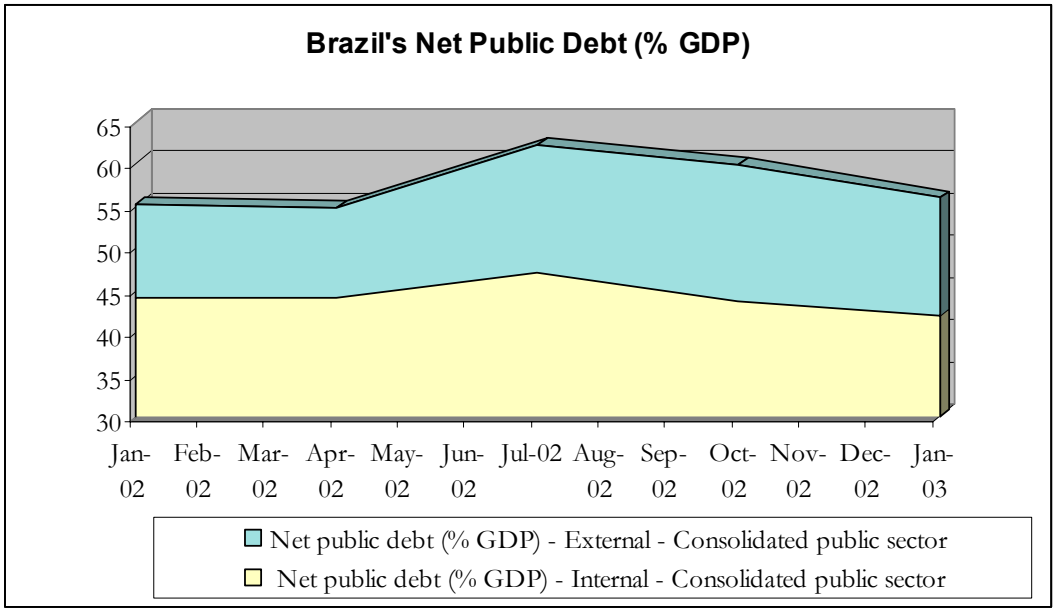
[2] A "clean" quote refers to a price given by a Bank which excludes the premium that the bank charges in offering such products. In highly competitive markets such as Brazil this should not be large; however, if there is only one major Bank as market maker skepticism should prevail in order to avoid an overstated implicit volatility measure.

Case Study

The paper now turns to a simplified case study of this model, based on Brazil. It should be noted that this model was developed specifically with Brazil in mind, thus applying it to a broader range of countries will require an understanding of the studied economy in order to adapt it to local circumstances.



Brazil's recent history is an interesting example for this study. The volatility of its bonds during 2002 made the task of estimating the country risk a daunting one, and many yearned for an alternative method of pricing sovereigns. Most of this volatility was blamed on the fears of the rise of the Worker's Party (PT) to the presidency, which materialized with Luis Inácio "Lula" da Silva's landslide victory in early November. However, unlike many feared, bond markets recovered after the victory, and the country's fundamentals started to improve significantly. Nonetheless, the sharp devaluation of the Real greatly increased the country's debt, large parts of it dollar-denominated, and created a sense of an imminent default.



More fundamentally, however, Brazil has come long ways in terms of governance and fiscal responsibility. From 1996 to 1999, the Brazilian government had not shown much discipline: the primary deficit averaged 0.2% of GDP and nominal deficit averaged 6.8% from 1995 to 1998. Considerable achievements were made after the introduction of the Fiscal Responsibility law, approved in the end of 1998. This program created a framework to generate sizable primary fiscal surpluses, creating an outlook for fiscal solvency in the medium term and stabilizing the net-debt/GDP ratio. From 1999 onwards, the primary surplus has always been higher than 3%, and currently the expectation is that of a 4.25% surplus. However, it is important to mention that interest expenses (often amplified by the effects of devaluations) have also grown slightly, keeping the nominal deficit still above 5% for the last few years.

Fiscal Balance	1995	1996	1997	1998	1999	2000	2001	2002 (E)
Nominal Deficit	-7.19%	-5.88%	-6.07%	-7.93%	-10.49%	-4.49%	-5.29%	-5.94%
Primary Deficit	0.36%	-0.09%	-0.91%	0.01%	3.28%	3.55%	3.75%	3.75%

Source: Banco Central do Brasil

While building the Brazilian model, most of the data was readily available through the Brazilian Central Bank, and all the specific dates, sources and inputs used may be found on Appendix 1. Of particular interest and which will be detailed later are the assumptions on the country's total liabilities and its duration, the rate at which to discount the forecasted surpluses, and the volatility measure used for the calculation of the Black Scholes put option.

Determining the appropriate debt stock for Brazil is not as straightforward as one may expect. In determining the external debt load, a number that is often cited is of USD205 billion, much higher than found in the model. However, this number is the gross private and public debt, and although it affects the *flow* of dollars to the economy, it does not relate to the ability of the *Government* to pay its obligations. The gross public sector registered debt (including all the state-owned enterprises, states, municipalities and other public institutions) amounts to only a little over USD100 billion. This number, however, is still not the correct *net* public debt. One must still subtract the government's foreign reserves and other assets. After this procedure one will arrive to the correct *net external public debt*, which is slightly over USD55 billion (January of 2003).

The internal liabilities, however, are of much more relevance and are what increases Brazil's debt load substantially. While the external debt only composes 14% of GDP, the net internal debt is above 41.9% of GDP. When calculating this number one must also be careful to measure the *net* internal debt, rather than the *total* internal debt. The difference here is that all the inter-government/agencies loans must bet netted; for instance, loans from a state-owned enterprise to a state government or from a municipality to the federal government must not

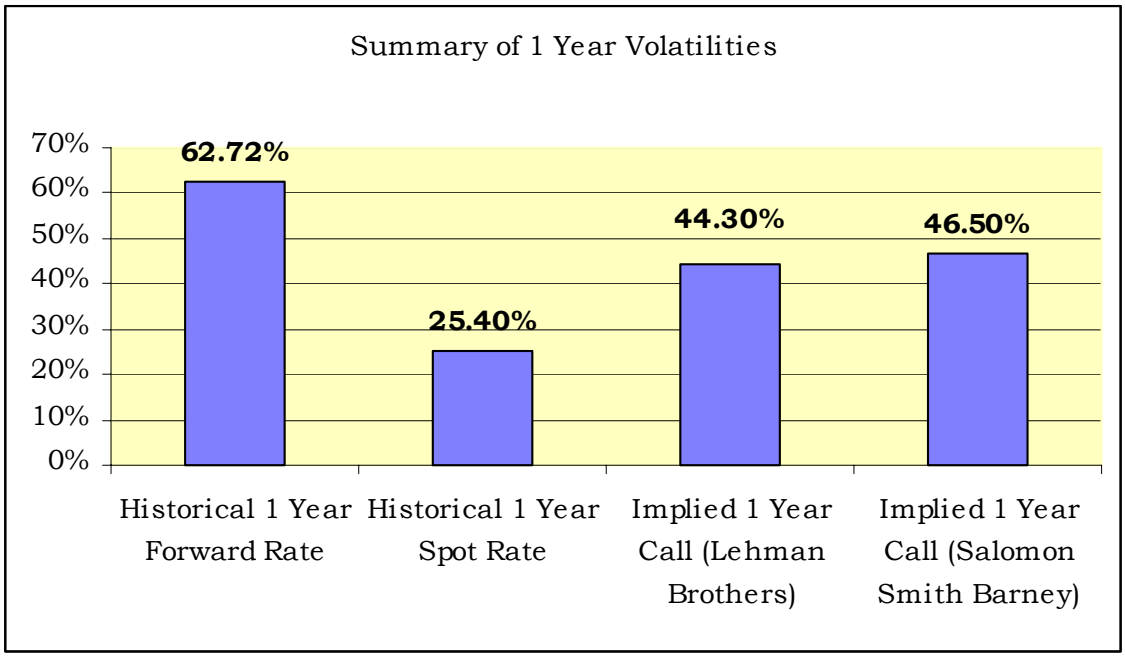
be counted. One of the reasons this number is so high is because of the so called "fiscal skeletons", which are contingent fiscal liabilities (past deficits and debts) that were recognized by the government (or may still be recognized in the future) and that were not previously included in the public debt calculation. As these deficits occurred in the past, they do not impact the financing requirement, but rather only the total debt stock[3]. There is no assurance that this number will not start to increase once again, and adversely contribute to the increase of the debt/GDP ratio. Nevertheless, this will not hamper the country's ability to service its debt.

While most of the foreign debt is of longer maturity, the internal debt is of a much shorter time-frame. Unfortunately the duration of the entire public debt is not readily available, and it would be a daunting task to find such number considering there are almost 30 states and 6,000 municipalities in Brazil. Nevertheless, since the federal government composes a large part of this measure, we assumed that the duration of this component was similar to that of the internal debt as a whole, which came to be 2.96 years. The same logic applied to the external debt, where the duration was only of the federal public debt, and was a much higher 6.13 years. The weighted average of the federal liabilities was then 3.82 years, which we assumed as the duration measure of Brazil's total debt stock.

Determining the rate at which to discount the future primary surplus came to be one of the most important assumptions in this work. As discussed in the theoretical explanation of the model, it is not possible to use the Yield to Maturity of currently traded bonds. The choice in using the forecasted inflation and domestic interest rates makes perfect sense, given that

[3] From 1996 until 2000 approximately R$ 57.7bn of fiscal skeletons were recognized by the government

Brazilian foreign bonds change constantly, and simple changes in this number can be quite substantial. The reason is that the discount rate greatly affects the terminal value of the discounted surpluses, which in turn is a large part of the "enterprise value" that is used for calculating the value of the put option.



The volatility measures were obtained through quotes with large banks in Brazil that make a market for these currencies. For comparison purposes, we also measured the one year historical volatility of 360-day forward rates, as well as the one year historical volatility of spot rates. It was surprising, however, that the implied volatility (the relevant measure for our model) quoted with both major banks were so similar; this led us to the conclusion that these numbers were highly relevant. In our model, we used as a volatility measure the average of these two quotes. For the complete sources and data set on volatilities refer to appendix 2.

Results and Conclusion

This modified CCA model yielded a country risk premium for Brazil of 11.29% (for 3.82 years of duration). However, this number is highly sensitive to variations in the discount rate and on the perpetuity growth rate of GDP, which largely impacts our terminal value. While the EMBI for Brazil on March 19, 2003 was a surprisingly similar 1075 basis point, we believe this to be a coincidence rather than a confirmation of the model. On Table 2 a sensitivity analysis is conducted on these two variables.

Table 2: Multiple Scenario Analysis

	Perpetutity Growth	3%	4%	5%
Discount Rate				
9%		9.54%	7.89%	6.09%
10.80%		12.70%	11.29%	9.72%
12%		14.61%	13.34%	11.94%

The significance of this work is not to present an exact measure of Brazil's default risk. Rather, it is to provide the basic foundations for an alternative method of calculating country-risk premium, based on fundamentals rather than market sentiment. It is expected, therefore, that with improvements in some of the calculations and modeling used, a more accurate number for sovereign risk may be derived and used for estimating the risk of investing in a developing economy. This is not only possible, but a desirable measure for these investments.

Appendix 1 - Sovereign DCF Calculation

Country Brazil
Date March, 2003

Assumptions and Inputs

GDP Growth Rates Consensus Forecast	3.19.03	
2003	2.01%	Central Bank of Brazil
2004	2.90%	Central Bank of Brazil
2005	3.56%	Central Bank of Brazil
2006	3.67%	Central Bank of Brazil
Perpetuity	4.00%	Assumption

Debt as a % of GDP	(January, 2003)	
Foreign *	14.0%	Central Bank
Internal	41.9%	Central Bank
Total	*55.9%*	

** Note that Foreign Debt is netted of foreign Reserves*

Local Currency Current GDP	$	1,356,267,946	Central Bank	2003 Forecast
Foreign Reservers (USD)	$	48,816,000	Central Bank	3.20.02

Forecasted Foreign Exchange (USD)		3.19.03	
Current	$	3.46	Bloomberg
Forecast EOY 2003	$	3.54	Central Bank of Brazil
Forecast EOY 2004	$	3.68	Central Bank of Brazil
Forecast EOY 2005	$	3.85	Central Bank of Brazil
Forecast EOY 2006	$	4.00	Central Bank of Brazil

Risk Free Rates (US Treasury)	3.20.03	Source: Bloomberg
1 Year	1.41%	
2 Year	1.66%	
4 Years	**2.59%**	
10 Years	3.98%	
30 Years	4.95%	

Consensus Local Interest Rates	3.19.03	
Current	2003	26.50%
Average	2003	23.69%
Average	2004	18.88%
Average	2005	16.78%
Source:	Brazi Central Bank	

Inflation Consensus Forecast	3.19.03	
2003	12.47%	Central Bank of Brazi
2004	8.14%	Central Bank of Brazi
2005	6.35%	Central Bank of Brazi
2006	5.56%	Central Bank of Brazi
Perpetuity	6.00%	Assumption

Real Brazilian Expected Interest Rates

	2003	11.22%
	2004	10.74%
	2005	10.43%
Average		10.80%

Primary Surplus Consensus Forecast	3.19.03	
2003	3.90%	Central Bank of Brazil
2004	3.75%	Central Bank of Brazil
2005	3.75%	Central Bank of Brazil
2006	3.50%	Central Bank of Brazil
Perpetuity	3.50%	Assumption

Back Scholes Inputs

Duration	3.82	Source: ING Barings
Volatility	44.3%	
Eq. Risk Free	2.59%	

DCF

	2003	2004	2005	2006	Perpetuity
GDP Growth	2.01%	2.90%	3.56%	3.67%	4.00%
Inflation	12.47%	8.14%	6.35%	5.56%	6.00%
GDP (in R$)	$ 1,356,267,946	$ 1,505,895,590	$ 1,655,093,009	$ 1,807,927,160	$ 1,988,719,876
(x) Exchange Rate	$ 3.54	$ 3.68	$ 3.85	$ 4.00	$ 4.24
(=) GDP (in US$)	$ 382,834,762	$ 409,343,461	$ 430,093,695	$ 451,990,830	$ 469,047,088
(x) Primary Surplus	3.90%	3.75%	3.75%	3.50%	3.50%
(=) Free Cash Flows (USD)	$ 14,930,556	$ 15,350,380	$ 16,128,514	$ 15,819,679	$ 16,416,648
Discounted at Cost of Debt					
10.80%	14,930,556	13,854,237	13,137,760	11,630,226	10,892,773

Kd= Local interest rate *minus* expected domestic inflation

MODEL

CASH

Level of Foreign Reserves (USD)	$	48,816,000
(=) Total Cash	**$**	**48,816,000**

ENTERPRISE VALUE

DCF from 2003 through 2005		38,622,223
(+) Perpetuity		160,207,386
(+) Cash	$	48,816,000
(=) Enterprise Value		**247,645,608**
Local Debt (US$)	$	164,241,696
Foreign Debt (US$)	$	103,772,291
TOTAL DEBT	**$**	**268,013,987**
Implied Equity	$	(20,368,378.68)

OUTPUT

Market Value of a Risk Free Security	$	243,088,273	(Zero Coupon)
(-) Black Scholes Price of Put	$	79,893,466	
(=) Fair Market Value of Brazilian Debt	$	163,194,807	
(=) Theoretical Yield to Maturity of Brazilian Debt		13.88%	
(-) Yield to Maturity of Risk Free Debt		2.59%	
(=) Brazil's country risk premium		**11.29%**	

Appendix 2 - Volatility Assumptions

(As of March 19. 2003)

Volatility of US Dollar and Brazilian Ral

Historical Volatility

	1 Year Forward Rate	Spot Rate
30 Day	16.46%	12.18%
50 Day	17.85%	16.41%
100 Day	22.11%	21.16%
360 Day	62.72%	25.40%

Implied Volatility on Call Options

Bank	Maturity	Strike	Premium	Spot (quote)	Risk Free Rate (annual)	Implied Volatility
Lehman Brothers	6 mos.	3.8	6.30%	3.468	1.20%	**36.80%**
Lehman Brothers	12 mos.	4.16	9.45%	3.468	1.41%	**44.30%**
Salomon Smith Barney	6 mos.	4	4.92%	3.4875	1.20%	**37.50%**
Salomon Smith Barney	12 mos.	4	11.90%	3.4875	1.41%	**46.50%**

Summary of 1 Year Volatilities

Historical 1 Year Forward Rate	**62.72%**
Historical 1 Year Spot Rate	**25.40%**
Implied 1 Year Call (Lehman Brothers)	**44.30%**
Implied 1 Year Call (Salomon Smith Barney)	**46.50%**

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