Credit Spread Arbitrage in Emerging Eurobond Markets

Caio Ibsen Rodrigues de Almeida [*,a]
Antonio Marcos Duarte, Jr. [**]
Cristiano Augusto Coelho Fernandes [***]

Abstract

Simulating the movements of term structures of interest rates plays an important role when optimally allocating portfolios in fixed income markets. These movements allow the generation of scenarios that provide the assets' sensitivity to the fluctuation of interest rates. The problem becomes even more interesting when the portfolio is international. In this case, there is a need to synchronize the different scenarios for the movements of the interest rate curves in each country. An important factor to consider, in this context, is credit risk. For instance, in the corporate Emerging Eurobond fixed income market there are two main sources of credit risk: sovereign risk and the relative credit among the companies issuers of the eurobonds. This article presents a model to estimate, in a one step procedure, both the term structure of interest rates and the credit spread function of a diversified international portfolio of eurobonds, with different credit ratings. The estimated term structures can be used to analyze credit spread arbitrage opportunities in Eurobond markets. Numerical examples taken from the Argentinean, Brazilian and Mexican Eurobond markets are presented to illustrate the practical use of the methodology.

Please address all correspondence to:
Antonio Marcos Duarte, Jr., Director
Risk Management
Unibanco S.A.
Av. Eusébio Matoso, 891 / 5 andar
05423-901 São Paulo, SP, Brazil
Phone: 55-11-30971668 Fax: 55-11-30974276

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[*] Pontifícia Universidade Católica do Rio de Janeiro, Brazil. E-mail: caio@ele.puc-rio.br
[**] Unibanco S.A., Brazil. E-mail: antonio.duarte@unibanco.com.br
[***] Pontifícia Universidade Católica do Rio de Janeiro, Brazil. E-mail: cris@ele.puc-rio.br

1. Introduction

The prices of fixed income assets depend on three components (Litterman and Iben [1988]): the risk free term structure of interest rates, embedded options values and credit risk. Optimally allocating portfolios in fixed income markets demands a detailed analysis of each of these components.

Several authors have already considered the risk free term structure estimation problem. For example, Vasicek and Fong [1982] suggest a statistical model based on exponential splines. Litterman and Scheinkman [1991] verified that there are three orthogonal factors which explain the majority of the movements of the US term structure of interest rates. These three factors form the basis for many fixed income pricing and hedging applications. For instance, these factors are used in Singh [1997] to suggest optimal hedges.

Some bonds present embedded options. In general, the price of an embedded option is a nonlinear function of its underlying bond price on all dates before the option maturity date. An embedded option depends not only on the actual term structure of interest rates, but also on the evolution of this term structure during the life of the option. Several models have been proposed for the evolution of the term structure of interest rates. These models are classified in two major groups (Heath et al. [1992]): equilibrium models (Cox et al. [1985], among others) and arbitrage free models (Heath et al. [1992], Ho and Lee [1986], Vasicek [1977], among others). At this point in time, the pricing of embedded options using arbitrage free models is perceived as the most appropriate because the parameters can be chosen to be consistent with the actual term structure of interest rates and, consequently, to the actual prices of bonds (Heath et al. [1992]). The process modeled can be the short-term interest rate, the whole term structure of interest rates, or the forward rates curve. No matter what the process is, when it is Markovian, it is usually implemented using binomial trees (Black et al. [1990]) or trinomial trees (Hull and White [1993]).

Almeida et al. [1998] presented a model to decompose the credit risk of term structures of interest rates using orthogonal factors, such as Legendre polynomials (Sansone [1959]). In this model, the term structure of interest rates is decomposed in two curves: a benchmark curve and a credit spread function. The last one is modeled using a linear combination of Legendre polynomials.

In this article we present a model to estimate, in a single step, both the term structure of interest rates and the credit spread function of an international portfolio of bonds with different credit ratings. This model extends the approach proposed in Almeida et al [1998]. It allows the joint estimation of the credit spread function of any international portfolio with different credit ratings. This extension is crucial when analyzing credit spread arbitrage opportunities in fixed income markets. For the purpose of illustration, we concentrate on the Emerging Corporate Eurobond market, studying the three most important in Latin America: Argentina, Brazil and Mexico. However, the methodology is quite general, and can be applied to any fixed income portfolio composed by bonds with different credit ratings.

This article is organized as follows. Section 2 explains the model. Section 3 presents the estimation process for its parameters. Section 4 explains the methodology used for optimally allocating portfolios using the model. Section 5 presents three practical examples of detection and exploitation of arbitrage opportunities in the Latin American Eurobond market. Section 6 presents a summary of the article, and the conclusions.

2. The Model

Suppose we want to analyze a portfolio in the Emerging Eurobond market. Assets with the same cash flow and embedded option structures, but different credit ratings, ought to have different prices. For this reason, when structuring fixed income portfolios, it is fundamental to estimate and simulate the movements of different term structures of interest rates, one for each credit rating in the portfolio. One possibility would be to estimate a term structure, for each credit rating. There is a statistical problem with the amount of data available when relying on this approach: in the emerging eurobond market there are usually very few liquid bonds for each credit rating. A joint estimation procedure is thus necessary.

An interesting possibility is to capture the difference in risk between credit ratings using different credit spread functions. Using this approach, it is possible to estimate in a single step the term structures for different credit ratings.

The equation that describes the term structure of an Emerging Eurobond market (that is, fixed income instruments of one country, issued in a same currency, with the same credit rating) can be written as

$$R(t) = B(t) + \sum_{n \geq 0} c_n P_n \left(\frac{2t}{\lambda} - 1\right), \forall t \in [0, \lambda]. \qquad (1)$$

where t denotes time, $B(t)$ is a benchmark (for example, the US term structure), P_n is the Legendre polynomial of degree n, c_n is a parameter to be estimated, and λ is the largest maturity of a bond in the Emerging Eurobond market under consideration.

The price of a bond (P_A) is related to the term structure of interest rates as

$$P_A = \sum_{i=1}^{n_A} C_i \exp(-t_i R(t_i)) \qquad (2)$$

where C_i denotes the i^{th} cash flow paid by the bond at time t_i, and n_A denotes the total number of cash flows paid by the bond.

Setting up the notation, variables $r_j, j = 1,...,J$, denote different credit ratings. For instance, a credit rating such as AAA may be associated with r_1, a credit rating such as AA may be associated with r_2, and so on.

An extension of (1) is to consider the spread function depending on the different credit ratings, such as

$$R(t, r_1,..., r_J) = B(t) + C(t, r_1,..., r_J), \forall t \in [0, \lambda]. \qquad (3)$$

If the spread function $C(t, r_1,..., r_J)$ is modeled as a linear combination of orthogonal polynomials (in order to exploit the modeling and estimation advantages illustrated in Almeida et al. [1998]) (1) will be obtained.

An example of (3) that captures the difference in risk between credit ratings using only a translation factor is given by

$$R^{(j)}(t) = B(t) + \sum_{i=1}^{j} S_i + \sum_{n \geq 1} c_n P_n \left(\frac{2t}{\lambda} - 1\right), \forall t \in [0, \lambda], \forall j = 1,2,...J. \qquad (4)$$

where S_i is a nonnegative spread variable (that is, $S_i \geq 0\ \forall i = 1,2,..., j$) that measures the difference in risk between the $(i-1)^{th}$ and the i^{th} credit ratings, and J represents the total number of credit ratings.

A limitation of (4) is that all J estimated term structures are parallel. Although very limited, (4) captures the fact that bonds with "better" ratings ought to have smaller prices (everything else being equal). In other words: the "better" the rating, the higher the interest rates used to price bonds with that particular rating. Exhibit 1 depicts a possible output for (4).

It is possible to exhibit more general models than that given in (4) (that is, a model which allows the term structures obtained for different credit ratings to differ not only by a translation factor). Exhibit 2 presents a schematic drawing of possibles term structures of interest rates for different credit ratings, in a more general model.

3. Joint Estimation of Term Structures

Let us consider the simplest case first (that is, (4)). The objective is to estimate the variables $S_i, i = 1,..., J$ and the coefficients $c_1, c_2, c_3,...$. The final results of this estimation process are J different term structures of interest rates, each related to a different rating.

Let us define the discount function $D^{(j)}(t)$ for rating r_j to be

$$D^{(j)}(t) = \exp\left(-R^{(j)}(t)t\right), \forall t \in [0,\lambda], j = 1,..., J \tag{5}$$

We assume that m eurobonds are available to estimate the coefficients. We assume that m_j eurobonds possess a rating r_j. The residual term e_k of the statistical fit obtained for the price of the k^{th} eurobond satisfies

$$p_k + a_k + 1_k^{put} o^p - 1_k^{call} o^c = \sum_{l=1}^{f_k} u_{kl} D^{(j_k)}(t_{kl}) + e_k, \forall k = 1,2,..., m \tag{6}$$

where p_k denotes the price of the k^{th} eurobond, a_k denotes the accrued interest of the k^{th} eurobond, 1_k^{put} and 1_k^{call} are dummy variables (Draper and Smith [1966]) indicating the existence of embedded put and call options in the eurobond, o^p and o^c are unknown parameters related to the prices of the embedded put and call options, f_k denotes the number of remaining cash flows of the k^{th} eurobond, t_{kl} the time remaining for payment of the l^{th} cash flow u_{kl} of the k^{th} eurobond, and j_k denotes the rating of the k^{th} eurobond (for instance, if the rating of the k^{th} eurobond is r_3, then $j_k = 3$).

The estimation process is based in a two step procedure:

1. Identify influential observations (Rousseeuw and Leroy [1987]) using an extension of Cook's statistics (Atkinson [1988]). This first step is important because in the Emerging Eurobond market there are many illiquid or "badly" priced bonds. If these bonds are not appropriately handled during the estimation phase, they may distort the term structures estimated.
2. Use a duration weighted estimation process after removing all the influential observations detected in the first step. The estimation should preferably use robust techniques, such as the Least Sum of Absolute Deviation or the Least Median of Squares (Rousseeuw and Leroy [1987]). The use of duration weights incorporates heteroskedasticity in the nonlinear regression model by allowing the volatility of the eurobond prices to be proportional to its duration (as suggested in Vasicek and Fong [1982]).

A numerical example illustrating the practical use of this methodology is presented next.

4. A Numerical Example of the Estimation Process

Let us consider the joint estimation of Brazilian and Mexican eurobonds term structures using (4). Fifty-two eurobonds are used: twenty-five Brazilian; twenty-seven Mexican. The eurobonds are classified in seven different credit ratings (by Bloomberg Agency): BB1, BB2, BB3, B1, B2, B3 and NR (Not Rated). Exhibit 3 presents the main characteristics of the fifty-two eurobonds. Prices were collected on June 3, 1998.

Three leverage points were detected in the first step of the estimation process: one Brazilian (Iochpe); two Mexican (Bufete and Grupo Minero). Exhibit 4 presents the parameters estimated for both the Brazilian and the Mexican eurobond term structures. Exhibit 5 displays four estimated term structures: two related to the credit rating B1; two related to the credit rating B3.

Note that for the Brazilian term structures, the translation factor varies just a few basis points when different ratings are compared: for instance, the difference between the B1 and the B3 translation factors is only 34 basis points (= 475 – 441; in Exhibit 4). On the other hand there is a difference of 130 basis points between the B1 and B3 Mexican translation factors (= 509 – 379). This is a first indication that those Brazilian companies (in Exhibit 3) issuing eurobonds presented more homogeneous price values than the price of Mexican companies.

The next sections illustrate how the term structures in Exhibit 5 can be used to exploit arbitrage in the Emerging Eurobond market.

5. Detection and Exploitation of Arbitrage Opportunities

The following five steps are proposed to detect and exploit arbitrage opportunities in Latin American Eurobond markets:

1. Choose a set of eurobonds with a common rating.
2. Estimate the term structures of interest rates for each country.
3. Based on the estimated term structures, consider possible future scenarios for their relative movement.
4. Analyze the sensitivity of different eurobond portfolios to the scenarios generated.
5. Obtain a portfolio that better adjusts to the scenarios expected.

Two numerical examples are presented to illustrate the practical use of these five steps. These examples consider the following data[4]:

1. Brazil and Mexico: B1 Eurobonds.
2. Argentina and Mexico: BB2 Eurobonds.

5.1 Brazil and Mexico: B1 Eurobonds

Exhibit 5 depicts the Brazilian and the Mexican B1 term structures. The Mexican term structure lies below the Brazilian term structure, indicating that the Brazilian B1 eurobonds are “cheaper” when compared to Mexican B1 eurobonds.

The large difference between the translation, rotation and torsion factors of the two term structures (see Exhibit 4) suggests as a probable future scenario one where the curves converge to each other. That is, if there are no economic conditions leading these two countries to behave radically different, we could expect their term structures (with the same rating) to converge.

Exhibit 6 depicts a scenario for the convergence of the two term structures. The arrows indicate the direction of the movements that would be observed for each term structure in this situation. These scenarios could be associated with a decrease in the external long term emerging markets borrowing rate. For the sake of illustration, we consider as possible future scenarios only those where the Brazilian translation factor and the Mexican rotation factor change their values.

A set of scenarios for each term structure is generated. The prices of the eurobonds for each of these scenarios are calculated. Exhibit 7 depicts possible scenarios for the Brazilian and the Mexican term structures. Exhibit 8 presents the prices of the Mexican B1 eurobonds for six scenarios. Exhibit 9 presents the prices of the Brazilian B1 eurobonds for six scenarios.

We note that a nine-year maturity is the largest in the Brazilian and Mexican B1 eurobond market. We concentrate our analyses of the term structures in two regions: region I, with maturities less than 4.5 years; and region II, with maturities greater than 4.5 years. Exhibit 8 and Exhibit 9 show that in this situation, all Brazilian B1 bonds would increase their values, short-term Mexican bonds (maturing in region I; ICA 2001 and Vicap 2002) would decrease their values, and long-term Mexican bonds (maturing in region II; Azteca 2004, Azteca 2007 and Vicap 2007) would increase their values. A good strategy would be to buy Brazilian bonds and long-term Mexican bonds, and to sell short-term Mexican bonds.

Exhibit 10 presents the percent variation of a proposed portfolio long Azteca 2004, Azteca 2007, Vicap 2007, Votorantin 2005 and RBS 2007, US$ 10 million each, and short ICA 2001 and Vicap 2002, US$ 25 million each. In the most favorable scenario — the Mexican rotation factor decreasing by 94 basis points and the Brazilian translation factor decreasing by 132 basis points — the portfolio provides a gain of 3.55%.

Exhibit 11 presents the portfolio sensitivity to the Brazilian translation factor and the Mexican rotation factor. The plots in Exhibit 11 are interesting decision making tools, providing an order of magnitude of possible gains/losses. Obviously, the use of detailed risk management reports are strongly recommended to better analyze the market risks involved in case the expected scenarios (in Exhibit 7) do not materialize.

5.2 Argentina and Mexico: BB2 Eurobonds

In this second example we consider the Argentinean and Mexican eurobond markets. The eurobonds used for the joint estimation of term structures are given in Exhibit 12. An example of the term structures estimated is given in Exhibit 13: Argentinean and Mexican BB2 term structures. The parameters estimated for the two BB2 term structures are given in Exhibit 14.

Let us suppose that a fixed income manager is positioned on a portfolio composed by the eurobonds listed in Exhibit 15. Suppose as a probable scenario in the near future is for a substantial reduction on long-term Mexican BB2 rates, a small increase on short-term Mexican BB2 rates, and also a substantial reduction on Argentinean BB2 rates. This scenario can be obtained by decreasing the Argentinean translation factor to get the effect of reducing Argentinean interest rates, and a combination of changes in the Mexican rotation and torsion factors. Exhibit 16 depicts several scenarios incorporating these expectations. For example, in the most extreme scenario considered, the Mexican term structure experiences a reduction of approximately 90 basis points on long-term rates, an increase around 30 basis points on medium-term rates, and an increase around 10 basis points on the short-term interest rates.

Exhibit 17 presents the prices for the Argentinean eurobonds in the manager’s portfolio for nine scenarios. Exhibit 18 presents the prices for the Mexican eurobonds for nine scenarios. The manager’s portfolio is composed by a long position in Multicanal 2007, Perez 2007 and Televisa 2006, US$ 5 million, and a short position Cemex 2006, US$ 15 million. Exhibit 19 presents the portfolio percent variation for each scenario depicted in Exhibit 16. We observe that the best performance of the portfolio (for the scenarios displayed in Exhibit 19) provides a gain of 1.24%.

Finally, Exhibit 20 depicts the portfolio sensitivity to parallel changes in the Argentinean term structure, and the rotational and torsional changes in the Mexican term structures.

6. Conclusion

This article presents a methodology for the joint estimation of term structures of interest rates of bonds with different credit ratings. The model is based on an optimization procedure which assumes that the term structures movements are driven by orthogonal factors. The estimated curves are useful for risk analysis, derivatives pricing and portfolio selection. The methodology is efficient from the computational point of view and is particularly useful when analyzing markets with few liquid bonds, such as Emerging Eurobond markets. The methodology is completely compatible with scenario analysis models for portfolio optimization and asset-liability management.

Latin America Eurobond markets are used to illustrate the practical use of the methodology. We explore some simple examples of arbitrage between international term structures with the same rating, using scenario analysis to select portfolios. Although the joint estimations realized in the article involve just pairs of countries (Brazil versus Mexico and Argentina versus Mexico) the joint estimation process could involve several countries.

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Exhibit 1. Term Structures for Different Ratings: Simple Model

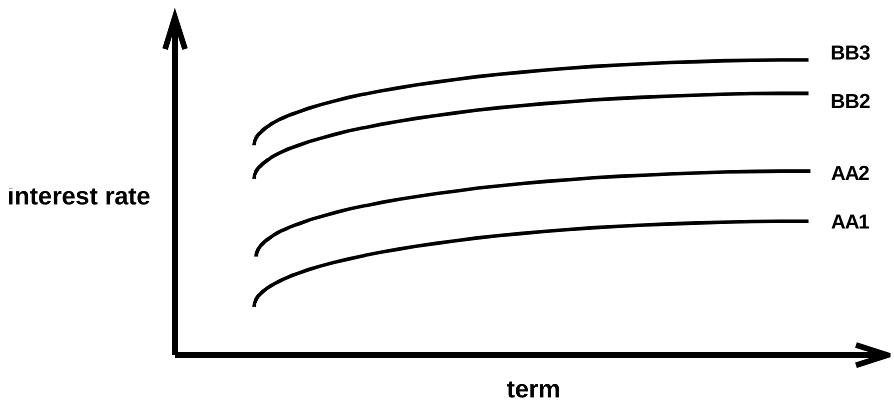


Exhibit 2. Term Structures for Different Ratings: General Model

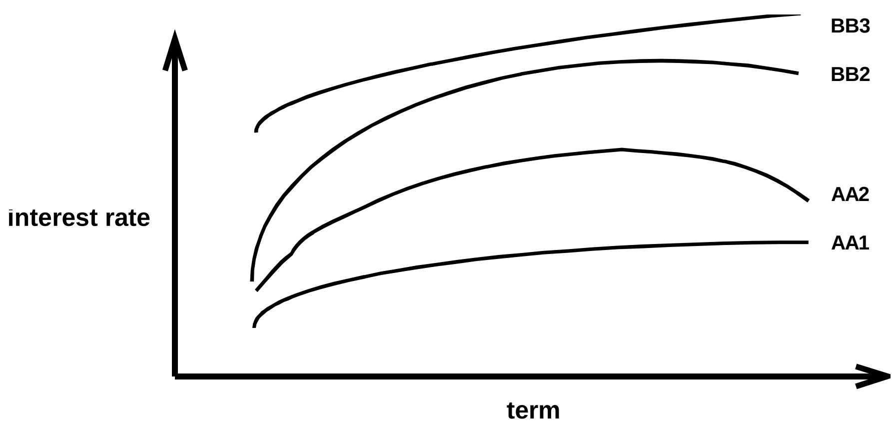


Exhibit 3. Eurobonds Used to Illustrate the Estimation Process

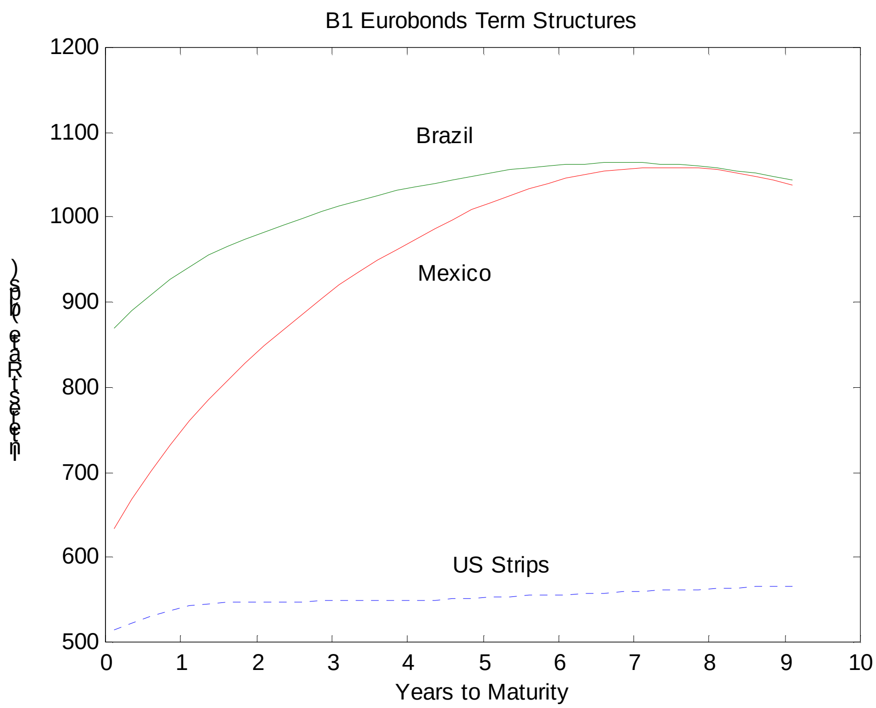
Eurobond	Rating	Country	Coupon (%)	Maturity
Bco Bradeco	B2	Brazil	8.000	28-Jan-2000
Bco Excel	B2	Brazil	10.750	08-Nov-2004
Bco Itau	B2	Brazil	7.500	11-Jul-2000
Bco Safra	B2	Brazil	8.125	10-Nov-2000
Bco Safra	B2	Brazil	8.750	28-Oct-2002
Bco Safra	B2	Brazil	10.375	28-Oct-2002
CEMIG	NR	Brazil	9.125	18-Nov-2004
CESP (*)	NR	Brazil	9.125	28-Jun-2007
Copel	NR	Brazil	9.750	02-May-2005
CSN Iron	B2	Brazil	9.125	01-Jun-2007
CVRD	NR	Brazil	10.000	02-Apr-2004
Ford	B2	Brazil	9.250	22-Jan-2007
Ford Ltd	B2	Brazil	9.125	08-Nov-2004
Gerdau	NR	Brazil	11.125	24-May-2004
Iochpe	NR	Brazil	12.375	08-Nov-2002
Ipiranga (*)	NR	Brazil	10.625	25-Feb-2002
Klabin	NR	Brazil	10.000	20-Dec-2001
Klabin (*)	NR	Brazil	12.750	28-Dec-2002
Lojas	NR	Brazil	11.000	04-Jun-2004
Minas X WR-A	B3	Brazil	7.875	10-Feb-1999
Minas X WR-B	B3	Brazil	8.250	10-Feb-2002
Parmalat (*)	NR	Brazil	9.125	02-Jan-2005
RBS	B1	Brazil	11.000	01-Apr-2007
Unibanco	B2	Brazil	8.000	06-Mar-2000
Votorantim	B1	Brazil	8.500	27-Jun-2005
Altos Hornos	B2	Mexico	11.375	30-Apr-2002
Altos Hornos	B2	Mexico	11.875	30-Apr-2004
Azteca	B1	Mexico	10.125	15-Feb-2004
Azteca	B1	Mexico	10.500	15-Feb-2007
Banamex	BB2	Mexico	9.125	06-Apr-2000
Bufete	B3	Mexico	11.375	15-Jul-1999
Cemex	BB2	Mexico	8.500	31-Aug-2000
Cemex	BB2	Mexico	9.500	20-Sep-2001
Cemex	BB2	Mexico	10.000	05-Nov-1999
Cemex	BB2	Mexico	10.750	15-Jul-2000
Cemex	BB2	Mexico	12.750	15-Jul-2006
Coke FEMSA	BB2	Mexico	8.950	01-Nov-2006
Cydsa	NR	Mexico	9.375	25-Jun-2002
DESC	BB3	Mexico	8.750	15-Oct-2007
ELM	NR	Mexico	11.375	25-Jan-1999
Empresas ICA	B1	Mexico	11.875	30-May-2001
Gruma	BB1	Mexico	7.625	15-Oct-2007
Grupo IMSA	BB2	Mexico	8.930	30-Sep-2004
Grupo Minero	BB1	Mexico	8.250	01-Apr-2008
Hylsa	BB3	Mexico	9.250	15-Sep-2007
Pepsi-Gemex	BB3	Mexico	9.750	30-Mar-2004
Televisa	BB2	Mexico	0	15-May-2008
Televisa	BB2	Mexico	11.375	15-May-2003
Televisa	BB2	Mexico	11.875	15-May-2006
Tolmex	BB2	Mexico	8.375	01-Nov-2003
Vicap	B1	Mexico	10.250	15-May-2002
Vicap	B1	Mexico	11.375	15-May-2007

* This is a "step-up bond." For each of these bonds the coupons shown are those prevalent on June 3, 1998.

Exhibit 4. Values of Factors for the Brazilian and Mexican Term Structures for Different Ratings

Factor	Value (bps)
Brazilian B1 Translation	441
Brazilian B2 Translation	451
Brazilian B3 Translation	475
Brazilian NR Translation	485
Brazilian Rotation	57
Brazilian Torsion	-56
Mexican BB1 Translation	249
Mexican BB2 Translation	322
Mexican BB3 Translation	322
Mexican B1 Translation	379
Mexican B2 Translation	509
Mexican B3 Translation	509
Mexican NR Translation	532
Mexican Rotation	156
Mexican Torsion	-114

Exhibit 5. A Comparison of Mexican and Brazilian Term Structures of Interest Rates for Different Credit Ratings



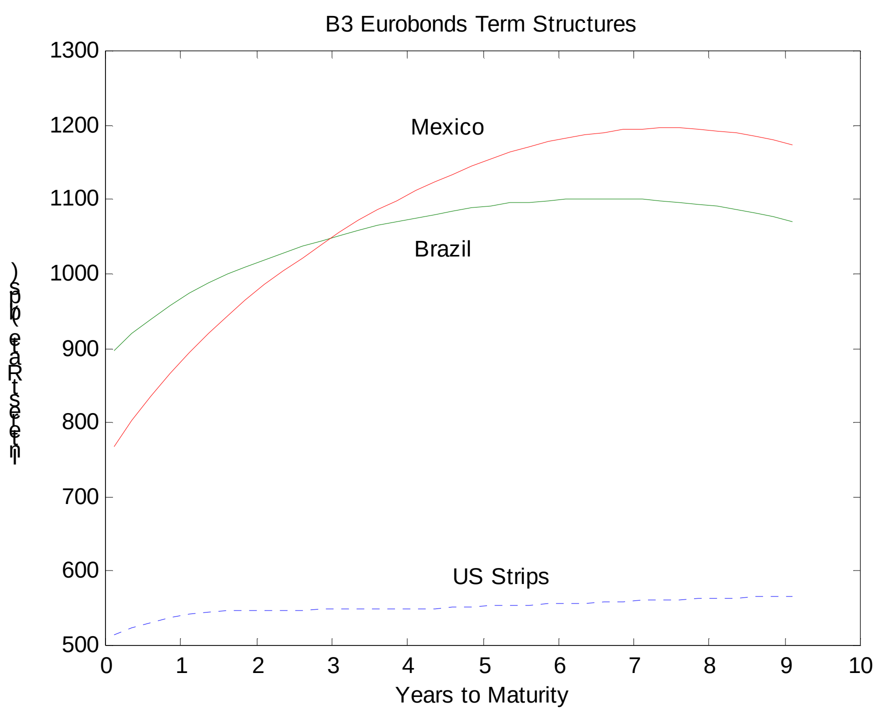


Exhibit 6. Possible Convergence Scenario

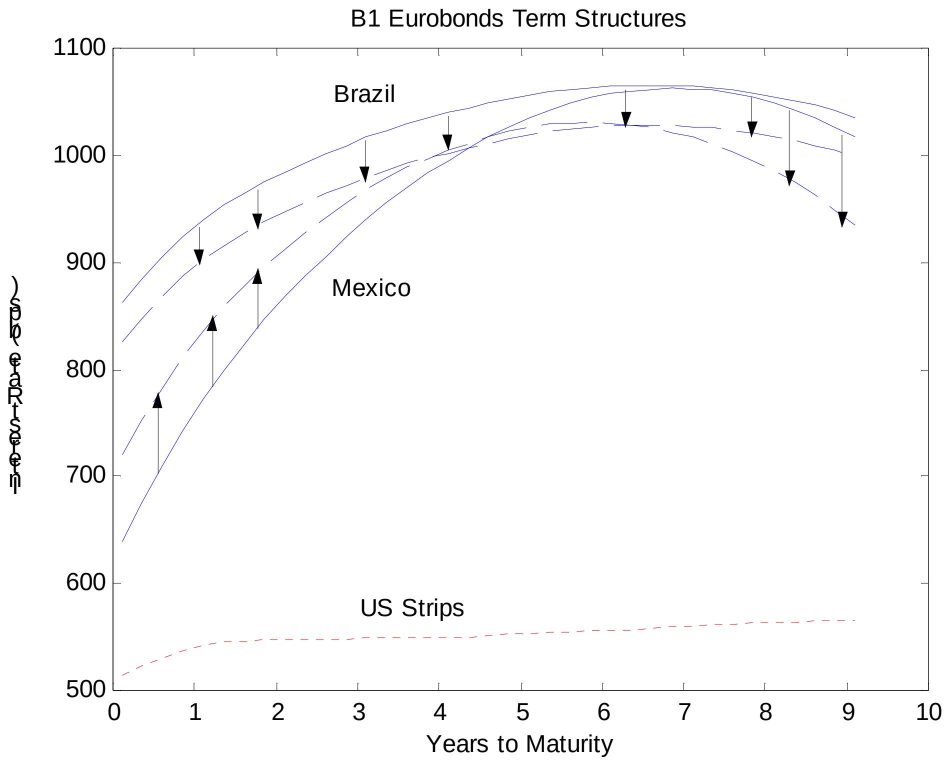
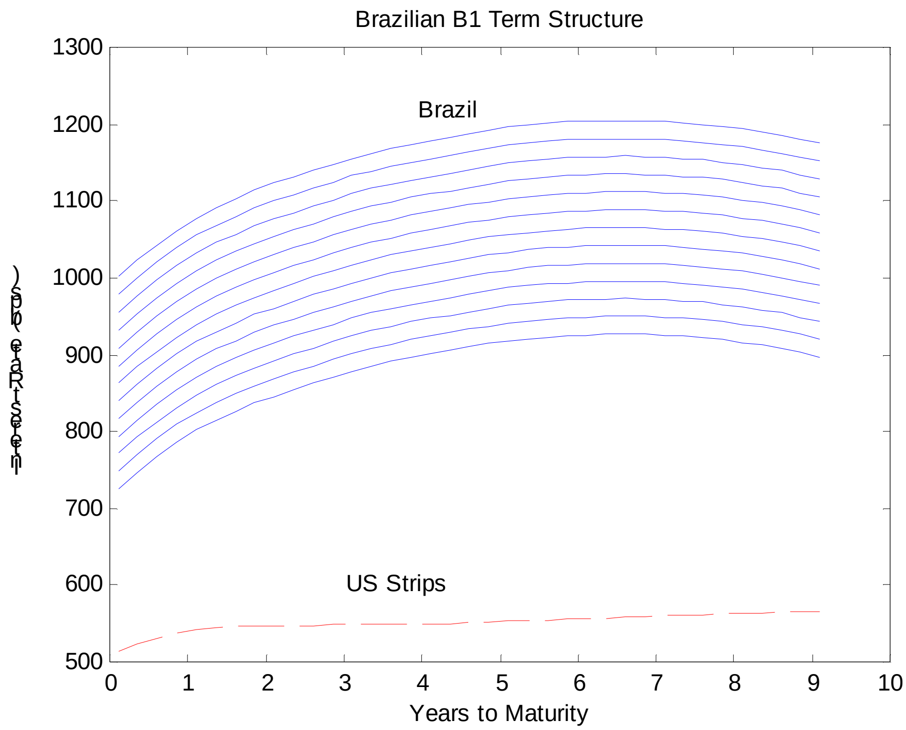


Exhibit 7. Different Scenarios for the B1 Term Structures



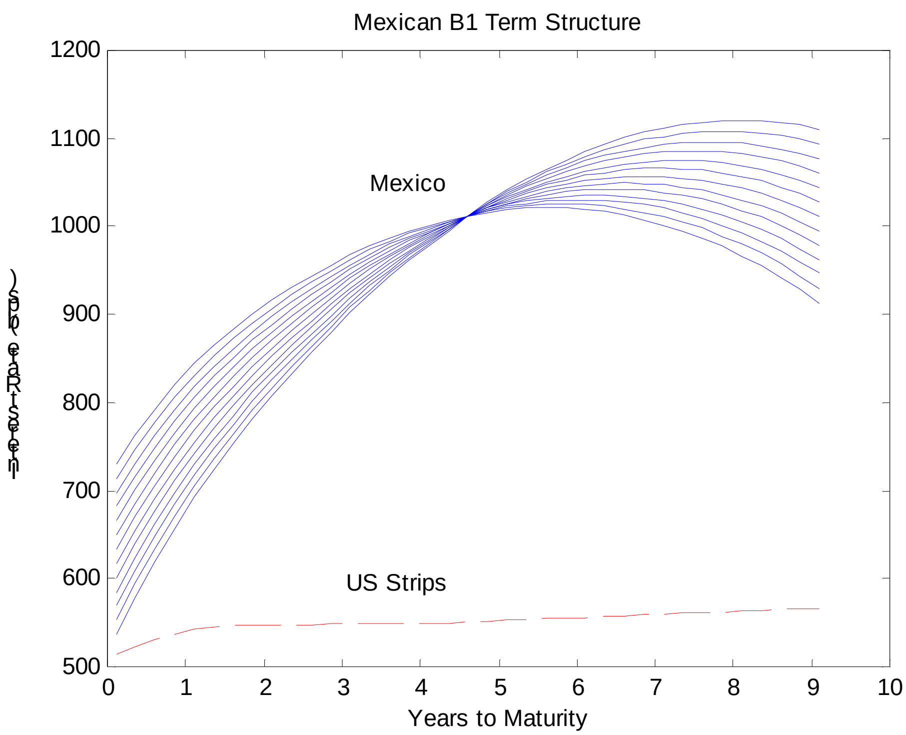


Exhibit 8. Price* of Mexican B1 Eurobonds for Different Scenarios

Rotation Factor (variation in bps)	**ICA 2001 (US$)**	**Vicap 2002 (US$)**	**Azteca 2004 (US$)**	**Azteca 2007 (US$)**	**Vicap 2007 (US$)**
0	107.5396	102.9799	103.3919	105.2489	108.0515
-16	107.3530	102.5176	103.4772	106.1557	110.2376
-31	107.1668	102.1876	103.5465	106.9832	111.6975
-47	106.9809	101.9613	103.6011	107.7264	112.6066
-62	106.7953	101.8140	103.6425	108.3804	113.1286
-78	106.6101	101.7247	103.6724	108.9411	113.3996
-94	106.4252	101.6756	103.6925	109.4048	113.5225

* Computed using the Mexican B1 estimated eurobond term structure.

Exhibit 9. Price* of Brazilian B1 Eurobonds for Different Scenarios

Translation Factor (variation in bps)	**Votorantin 2005 (US$)**	**RBS 2007 (US$)**
0	94.2236	106.1714
-22	96.3265	107.5414
-44	98.3751	108.9342
-66	100.3624	110.3502
-88	102.2811	111.7899
-110	104.1245	113.2537
-132	105.8856	114.7419

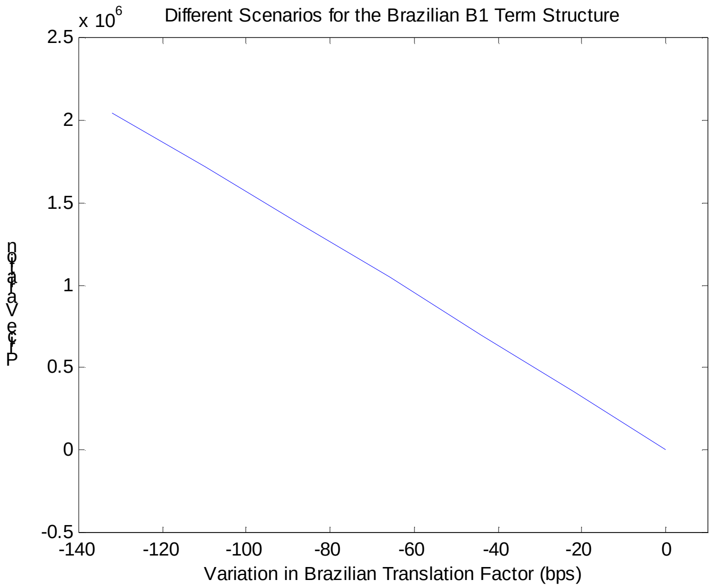
* Computed using the Brazilian B1 estimated term structure.

Exhibit 10. Percent Variation on the B1 Portfolio Value for Different Scenarios for the Mexican and Brazilian Term Structures

	0	**-16**	**-31**	**-47**	**-62**	**-78**	**-94**
0	0.00	0.45	0.80	1.05	1.25	1.39	1.51
-22	0.35	0.80	1.15	1.41	1.60	1.75	1.86
-44	0.70	1.15	1.50	1.76	1.95	2.09	2.21
-66	1.05	1.50	1.84	2.10	2.29	2.44	2.55
-88	1.38	1.84	2.18	2.44	2.63	2.78	2.89
-110	1.72	2.17	2.51	2.77	2.97	3.11	3.22
-132	2.04	2.50	2.84	3.10	3.29	3.44	3.55

Horizontal - Changes in the Mexican Rotation Factor in Basis Points
Vertical - Changes in the Brazilian Translation Factor in Basis Points

Exhibit 11. Portfolio Sensitivity for Different Scenarios



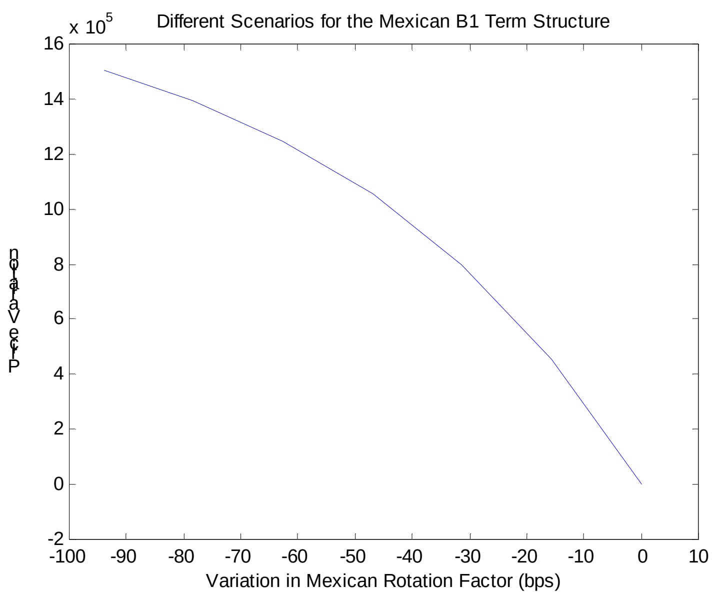


Exhibit 12. Argentinean and Mexican Eurobonds Used in an Example

Eurobond	Rating	Country	Coupon (%)	Maturity
Banco de Credito	BB3	Argentina	9.500	24-Apr-2000
Banco Galicia	BB3	Argentina	7.875	26_Aug-2002
Banco Galicia	BB3	Argentina	9.000	01-Nov-2003
Cia Intl. Telecom	BB2	Argentina	8.850	01-Aug-2004
Edenor	NR	Argentina	9.750	04-Dec-2001
Multicanal	BB2	Argentina	9.250	01-Feb-2002
Multicanal	BB2	Argentina	10.500	01-Feb-2007
Perez	BB2	Argentina	8.125	15-Jul-2007
Perez	BB2	Argentina	9.000	30-Jan-2004
Rio Plata	BB2	Argentina	8.750	15-Dec-2003
Supermercados	BB3	Argentina	10.875	09-Feb-2004
Telecom	BB2	Argentina	8.375	18-Oct-2000
Telefonica	BB3	Argentina	8.375	01-Oct-2000
Telefonica	BB2	Argentina	11.875	01-Nov-2004
TGS	BB2	Argentina	10.250	25-Apr-2001
Transener	NR	Argentina	9.625	15-Jul-1999
YPF	BB2	Argentina	7.250	15-Mar-2003
YPF	BB2	Argentina	7.750	27-Aug-2007
YPF	BB2	Argentina	8.000	15-Feb-2004
Altos Hornos	B2	Mexico	11.375	30-Apr-2002
Altos Hornos	B2	Mexico	11.875	30-Apr-2004
Azteca	B1	Mexico	10.125	15-Feb-2004
Azteca	B1	Mexico	10.500	15-Feb-2007
Banamex	BB2	Mexico	9.125	06-Apr-2000
Bufete	B3	Mexico	11.375	15-Jul-1999
Cemex	BB2	Mexico	8.500	31-Aug-2000
Cemex	BB2	Mexico	9.500	20-Sep-2001
Cemex	BB2	Mexico	10.000	05-Nov-1999
Cemex	BB2	Mexico	10.750	15-Jul-2000
Cemex	BB2	Mexico	12.750	15-Jul-2006
Coke FEMSA	BB2	Mexico	8.950	01-Nov-2006
Cydsa	NR	Mexico	9.375	25-Jun-2002
DESC	BB3	Mexico	8.750	15-Oct-2007
ELM	NR	Mexico	11.375	25-Jan-1999
Empresas ICA	B1	Mexico	11.875	30-May-2001
Gruma	BB1	Mexico	7.625	15-Oct-2007
Grupo IMSA	BB2	Mexico	8.930	30-Sep-2004
Grupo Minero	BB1	Mexico	8.250	01-Apr-2008
Hylsa	BB3	Mexico	9.250	15-Sep-2007
Pepsi-Gemex	BB3	Mexico	9.750	30-Mar-2004
Televisa	BB2	Mexico	0	15-May-2008
Televisa	BB2	Mexico	11.375	15-May-2003
Televisa	BB2	Mexico	11.875	15-May-2006
Tolmex	BB2	Mexico	8.375	01-Nov-2003
Vicap	B1	Mexico	10.250	15-May-2002
Vicap	B1	Mexico	11.375	15-May-2007

Exhibit 13. Detecting Arbitrage Opportunities in the BB2 Argentinean and Mexican Eurobond Markets

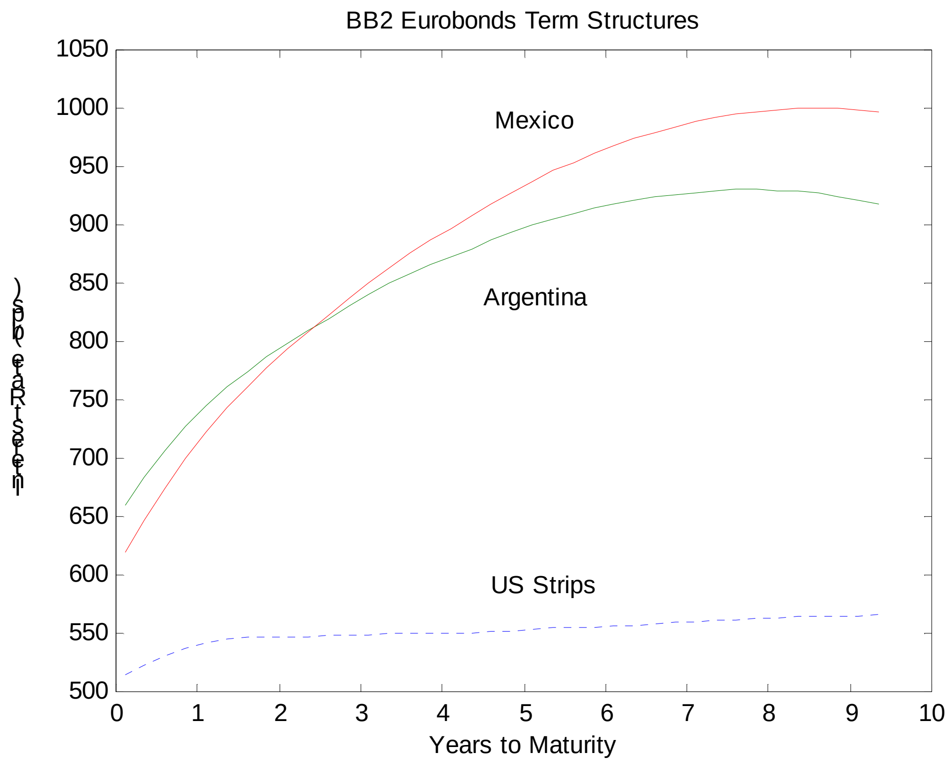


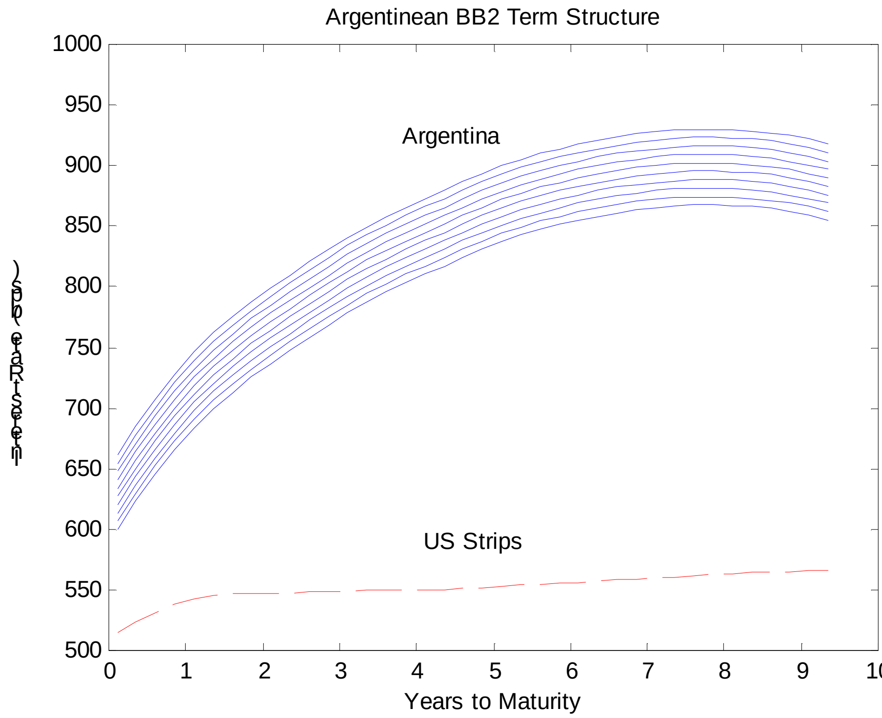
Exhibit 14. Parameters Estimated for the
Argentinean and Mexican BB2 Term Structures

Factor	**Value (bps)**
Argentinean Translation	291
Argentinean Rotation	98
Argentinean Torsion	-57
Mexican Translation	322
Mexican Rotation	153
Mexican Torsion	-74

Exhibit 15. BB2 Eurobond Portfolio: Argentina and Mexico

Eurobond	Country	Coupon (%)	Maturity
Multicanal	Argentina	10.500	01-Feb-2007
Perez	Argentina	8.125	15-Jul-2007
Cemex	Mexico	12.750	15-Jul-2006
Televisa	Mexico	11.875	15-May-2006

Exhibit 16. Different Scenarios for the BB2 Term Structures



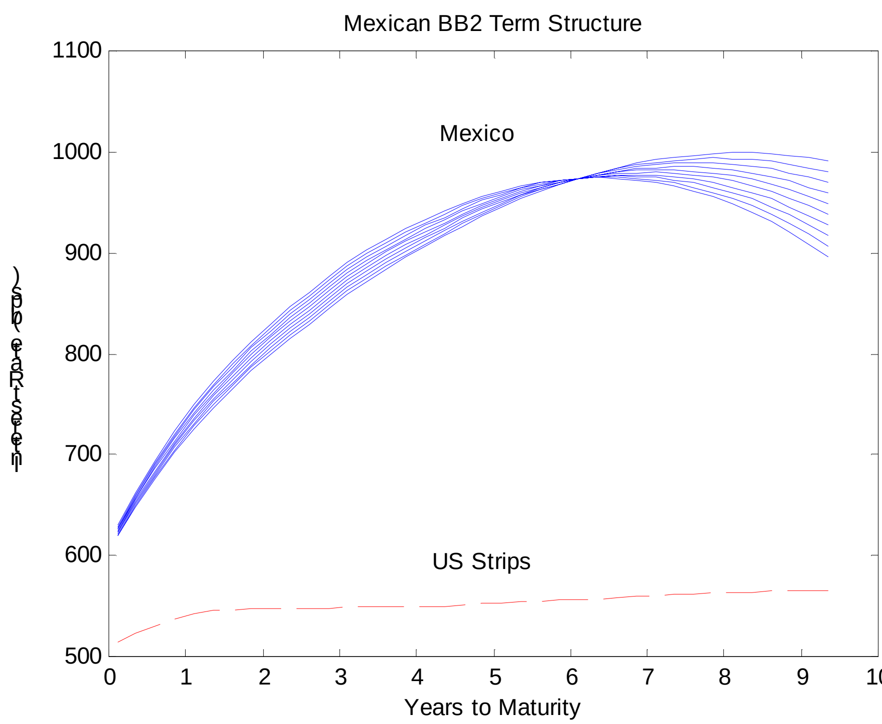


Exhibit 17. Price* of Argentinean BB2 Eurobonds for Different Scenarios

Translation Factor (variation in bps)	**Multicanal 2007 (US$)**	**Perez 2007 (US$)**
0	**112.5599**	**97.9793**
-7	112.9957	98.3912
-13	113.4337	98.8054
-20	113.8739	99.2217
-27	114.3163	99.6403
-33	114.7608	100.0612
-40	115.2076	100.4842
-47	115.6566	100.9096
-53	116.1079	101.3372
-60	116.5614	101.7670

* Computed using the Argentinean BB2 estimated term structure

Exhibit 18. Price* of Mexican BB2 Eurobonds for Different Scenarios

Rotation Factor (variation in bps)	**Torsion Factor (variation in bps)**	**Televisa 2006 (US$)**	**Cemex 2006 (US$)**
0	**0**	**113.4530**	**122.8172**
-6	**-4**	113.5656	122.9501
-11	**-9**	113.6788	123.0836
-17	**-13**	113.7924	123.2177
-22	**-18**	113.9065	123.3524
-28	**-22**	114.0210	123.4877
-33	**-27**	114.1360	123.6236
-39	**-31**	114.2515	123.7602
-44	**-36**	114.3675	123.8974
-50	**-40**	114.4840	124.0352

* Computed using the Mexican BB2 estimated term structure

Exhibit 19. Percent Variation on the Portfolio for Different Scenarios

Rotation	Torsion	0	-7	-13	-20	-27	-33	-40	-47	-53	-60
0	**0**	0.00	0.13	0.27	0.41	0.54	0.68	0.82	0.96	1.10	1.24
-6	**-4**	-0.04	0.10	0.23	0.37	0.51	0.64	0.78	0.92	1.06	1.20
-11	**-9**	-0.08	0.06	0.19	0.33	0.47	0.60	0.74	0.88	1.02	1.16
-17	**-13**	-0.11	0.02	0.16	0.29	0.43	0.57	0.70	0.84	0.98	1.12
-22	**-18**	-0.15	-0.02	0.12	0.25	0.39	0.53	0.67	0.81	0.95	1.09
-28	**-22**	-0.19	-0.05	0.08	0.22	0.35	0.49	0.63	0.77	0.91	1.05
-33	**-27**	-0.23	-0.09	0.04	0.18	0.31	0.45	0.59	0.73	0.87	1.01
-39	**-31**	-0.27	-0.13	0.00	0.14	0.28	0.41	0.55	0.69	0.83	0.97
-44	**-36**	-0.31	-0.17	-0.04	0.10	0.24	0.37	0.51	0.65	0.79	0.93
-50	**-40**	-0.34	-0.21	-0.07	0.06	0.20	0.34	0.47	0.61	0.75	0.89

Horizontal - Changes in the Argentinean Translation Factor in Basis Points
Vertical – Changes in the Mexican Rotation and Torsion Factors in Basis Points

Exhibit 20. Portfolio Sensitivity for Different Scenarios