Determinants of the Implied Equity Risk Premium in Brazil

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Abstract

This paper tests determinants of the equity risk premium (ERP) in Brazil. We use implied ERP, based on the Elton (1999) critique. ERP for Brazil is calculated as a mean of large samples of individual stock prices in each month in the January, 1995 to November, 2010 period. As determinants of changes in the ERP we obtain, as significant, and in the expected direction: changes in the CDI rate; country debt risk spread; equity market volatility; and US market liquidity premium. The influence of the proposed determining factors is tested with the use of time series regression analysis.
1. Introduction

According to Pratt and Grabowsky (2008), the equity risk premium – ERP (or market risk premium), is defined as the additional compensation (above the expected return on risk-free assets) that investors demand for investing resources in a diversified portfolio. Estimating the ERP is one of the most important ingredients when one calculates the cost of capital for business firms. Its use is central to financial decisions. Investors need that piece of information in order to value stocks and assess the expected returns from investment portfolios. Chief financial officers need those rates in order to determine investment project feasibility, manage a firm from a value-creation perspective, and therefore identify the firm’s optimal capital structure.

In practice, there are three different approaches to ERP estimation. The first approach is to survey the expectations of investors and financial executives to find out how much they would be willing to pay for a certain amount of risk. The second approach is based on historically paid premiums for investments in stocks over risk-free securities. The third approach uses the premiums implicit in current prices, usually in the stock market. As it may be observed in Table 1, from a compilation by Damodaran (2011), the resulting values diverge and produce very different effects on the calculation of discount rates.

<table>
<thead>
<tr>
<th>Approach</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFO survey</td>
<td>3.07%</td>
</tr>
<tr>
<td>Global fund manager survey</td>
<td>3.86%</td>
</tr>
<tr>
<td>Historical</td>
<td>4.31%</td>
</tr>
<tr>
<td>Current implied premium</td>
<td>5.07%</td>
</tr>
</tbody>
</table>

Source: Damodaran (2011).

There are several reasons for the differences among the estimates and a lot of controversy concerning the various methodologies.

The estimation methods based on surveys fail because it is extremely difficult to define the group which would ideally represent the market as a whole. In addition, such opinions are affected by behavioral aspects and tend to place a heavier weight on recent historical data than on expectations themselves. According to Damodaran (2011), when markets are rising, investors tend to become more optimistic in such surveys and to forecast higher ERPs; when markets are falling, the opposite occurs and premiums are consistently lower. In addition, the responses depend on how the question is formulated: often, the subjects do not provide information on what premium they require, but rather on the forecast of future returns.

The methods based on historical returns are more commonly used, since they can be tested and are thus used as a basis for the reasoning underlying valuation and analysis reports. The major finance textbooks use such data as a starting point in the discussion of asset pricing models such as the CAPM and the APT. Major examples of this procedure include Brealey, Myers and Allen, (2011), and Ross, Westerfield and Jaffe (2009). In Brazil, the WACC (weighted-average-cost-of-capital) discount rate techniques usually adopted in public offers available at the CVM website and the determination of fair rates of return by public utility regulating agencies are based on averages of historical returns.
There are several problems with the use of historical returns in the computation of equity risk premiums. To begin with, that approach is based on the assumption that information surprises involving business firms tend to cancel each other over time, so that past behavior would become an unbiased estimator of future behavior. Elton (1999) questions this fact, demonstrating that, in practice, this has not occurred. Damodaran (2011) points out that this methodology puts us at a crossroad: if we use a very long historical period in order to have a representative sample (such as Ibbotson, 2010, whose series starts in 1926), we would have to assume that investors’ risk profiles and market fundamentals remained constant throughout that period. On the other hand, if we reduce the period to the last 40 or 20 years, say, high return volatility would produce unacceptably high standard errors. If that is the case for a mature and liquid market such as the United States, that effect is certainly amplified in emerging markets such as Brazil.

In addition, there is survivorship bias. Market histories are studied with the use of stock indices, and clear evidence for this bias in successful stock markets are presented and discussed in Brown, Goetzmann and Ross. (1995).

The use of an implied premium is predicated on the idea that valuation and analysis exercises must look forward in time and incorporate market expectations. Gebhardt, Lee and Swaminathan. (1999) use residual income models to estimate the implied cost of equity as the internal rate of return produced by forecasted earnings, and implicit in current stock prices. Claus and Thomas (1999) use the same idea in the aggregate. Damodaran (2011) calculates the implied premium for the American and Brazilian markets.

Since the ERP corresponds to a rate of return currently demanded by investors, several authors have attempted to associate macroeconomic variables as explanations for the level and fluctuations of market risk premiums. Damodaran (2011) estimates a regression equation of the US market premium against the US Treasury bond yield and shows that there is a strong correlation between the two variables. Ferreira (2011) presents evidence of an association between the implied risk premium in the Brazilian market and macroeconomic variables such as GDP, inflation, interest rates, money supply and output gap.

Still in macro terms, market analysts believe that risk premiums should rise over the next decade. Rokburgh, Lund, Dobbs, Manyika and Wu (2011) discuss the tendency for the emergence of an “equity gap”. There would be a sharp reduction in the relative demand for stocks, leading to an increase in the rates of return demand by investors in stocks, and therefore the ERP. The population of equity investors would decline for two reasons: (a) because investments from emerging countries are growing, and these have a tradition of lower investments in equities; (b) because developed-country investors are growing older and need to reallocate their funds increasingly to fixed income assets.

A methodology for estimating the implied equity risk premium for the Brazilian market is suggested in Minardi, Sanvicente, Montenegro, Donatelli and Bignotto (2007). They propose the use of business firm fundamentals, such as return on equity and payout ratio, as inputs to the Gordon formula. This is how the ERP for the Brazilian market will be measured in the present paper.

The present study analyzes the ERP as a rate of return implicit in current market prices using the data for the Brazilian market in the period of January, 1995 to November, 2010. We analyze the impact of market-determined variables, such as the Real/US dollar exchange rate, interest rates, domestic and international stock market indices, gold prices and credit risk premiums on the equity risk premium.
The typical application in Brazil uses, as a proxy for the ERP, historical averages of returns on U.S. market assets; these commonly involve the S&P500 stock index as a proxy for the market portfolio, and long-term U.S. Treasury securities as a proxy for the risk-free asset, instead of using (a) Brazilian market data, and (b) the current prices of both risk and time, as opposed to historical averages.

The typical application in Brazil also involves the addition, in the determination of required rates of return, of compensation for other systematic risk factors, such as country and currency risk, the appropriateness of which is not discussed in this paper, but see Sanvicente (2004) for evidence on the irrelevance of such additional factors.

The paper is organized as follows: section 2 reviews the literature, including previous uses and tests of determinants of the ERP; section 3 describes the methodology for the calculation of the ERP as implied by current stock prices; section 4 presents the methodology for the analysis of risk premium determinants, including both the model specification and the data used; the results are provided in section 5, and section 6 concludes and discusses both limitations and possible extensions.

2. Review of literature: implied equity risk premium and cost of equity

Claus and Thomas (1999) proposed a new approach to estimating the equity risk premium for the US market. This involved aggregating individual firm data and determining the equity risk premium implied in current stock prices for a number of firms, ranging from 1,559 in 1985 to 3,673 in 1998. Hence, they estimated a so-called “implied market risk premium”.

The implied equity risk premium was obtained as the internal rate of return (k), in the following equation:

\[
p_0 = bv_0 + \frac{ae_1}{(1+k)} + \frac{ae_2}{(1+k)^2} + \frac{ae_3}{(1+k)^3} + \frac{ae_4}{(1+k)^4} + \frac{ae_5}{(1+k)^5} + \left[ \frac{ae_5(1+g')}{(k-g')(1+k)^5} \right]
\] (1)

Where, for the end of each year (t = 0,..., 5):

- \(p_0\) = current stock market price;
- \(bv_0\) = book value of the firm’s equity, as disclosed in its financial statements;
- \(ae_t\) = abnormal earnings, equal to reported earnings minus a charge for the cost of equity, i.e., the product of beginning book value of equity and the implied rate of return; this means that projected earnings for year \(t\) are given by \(e_t = bv_{t-1} + 0.5 \times e_{t-1}\), where the \(e_t\) are analysts’ earnings forecasts; this is the so-called “clean surplus” approach, with the added assumption of a common 50% payout ratio for all firms;
- \(g''\) = the assumed constant growth rate in earnings in perpetuity, fixed at the real risk free rate, that is, the then current 10-year T-bond rate minus 3% p. a. This growth rate is applied to all earnings projected for \(t > 5\), so that the last term in the equation above represents what is usually referred to as the equity’s terminal value. In the calculation of abnormal earnings for \(t = 1\) to 5, the authors directly used analysts’ forecasts for years 1 and 2. For the remaining years \((t = 3\) to 5\), they used \(g'\), the implied growth rate in analysts’ forecast for long-term earnings, that is, the forecasted 5-year growth rate.
This approach produced estimates of the equity risk premium of approximately 3% p. a., with a low of 2.51% in 1997 and a high of 3.97% in 1995. This corresponds to around half of the usually obtained premium on the basis of historical returns.

In the calculation of the risk premium, the authors use the end-of-year 10-year Treasury bond yield. They also discuss why this is an appropriate benchmark rate:

There is some debate as to which maturity is appropriate when selecting the risk-free rate. The risk premium literature has used both shorter (30-day or 1-year) and longer (30-year) maturities for the risk-free rate. On the one hand, longer maturities exceed the true risk-free rate because they incorporate the uncertainty associated with intermediate variation in risk-free rates. On the other hand, short-term rates are likely to be below the true risk-free rate, since some portion of the observed upward sloping term structure could reflect increases in expected future short-term rates. Since the flows (dividends or abnormal earnings) being discounted extend beyond one year, it would not be appropriate to use the current short-term rate to discount flows that have been forecast based on rising interest rates. (Claus and Thomas, 1999, pp. 16-17)

In the appendix to their working paper, Claus and Thomas (1999) demonstrated that this “accounting-based valuation model” is equivalent to the dividend growth approach used in the present paper.

Claus and Thomas (1999) argue that, since earnings can be replaced by the corresponding dividends in the equation above, one might think that there would be no benefit in the use of earnings instead of dividends. Their contention, however, is: “the main problem with using the dividend growth model resides in the arbitrary choice of the assumed rate at which dividends grow in perpetuity” (Claus and Thomas, 1999, p. 9). This seems to be a strange argument, however, given their own need to propose a value and a rationale for their $g$ rate.

Their working paper also makes an interesting and relevant comment on the relationship between market efficiency and their approach to estimating an implied equity risk premium (and any other approach based on current market prices, for that matter):

Like other *ex ante* approaches, our approach assumes that the stock market efficiently incorporates analyst forecasts into prices, and that analysts make unbiased forecasts. There is however, a large body of research that has documented instances of mispricing relating to information available in analyst forecasts, and also evidence of various biases exhibited by analysts. Fortunately, the extent of mispricing documented is relatively small. Also, the evidence on mispricing suggests that some firms are underpriced and others are overpriced. **Therefore, some of that mispricing should cancel out at the market level, and be of less concern for our market-level study.** (Claus and Thomas, 1999, pp. 10-11) [Emphasis added, since this applies fully to our own approach in this paper.]

In several instances, Claus and Thomas (1999) refer to biases in analysts’ forecasts. This is a problem avoided in our approach, as described in section 3, since the only forecast we are required to make is the growth rate in perpetuity, from time $t = 0$ on, given our assumed earnings and dividends growth process. In addition, the existing coverage and availability of earnings forecasts by analysts for Brazilian firms is much more limited:
Turning to the issue of analysts making efficient forecasts, although some of the biases exhibited by analysts would similarly cancel out in the aggregate, there is evidence of a systematic optimism bias in analysts’ earnings forecasts. (Claus and Thomas, 1999, p. 11)

Very few firms had negative values for 2-year-ahead forecasts, even though quite a few firms reported losses in the current year. (Claus and Thomas, 1999, p. 13)

The contrast between our results and the traditional estimates of risk premium is even starker in light of the well-known optimism in analyst forecasts. (Claus and Thomas, 1999, p. 19)

They point out that a downward adjustment in the implied risk premium would be required to account for that optimism.

Finally, Claus and Thomas (1999) claim that their approach produces less variable estimates than the dividend growth approach, and they believe this is a desirable property, claiming that this is consistent with the view that the abnormal earnings approach provides more reliable estimates. This is based on a comparison of the resulting annual averages for k (the discount rate for projected abnormal earnings) and for k* (the discount rate for projected dividends).

However, a counterargument would be as follows: since the resulting differences in variability cannot be attributed to price variability, as the same prices are used in both cases, it would be possible to attribute the lower variability of the earnings approach to the management of disclosed earnings that they were not able to control for. In contrast, dividend payments, even when based on managed earnings, are still dependent on a decision, by a firm, that takes into account its capacity to make cash distributions to investors, rendering dividends a more informative or even reliable indication of the firm’s profitability prospects.

Gebhardt et al. (2001) use a similar approach to Claus and Thomas (1999): implied costs of equity are estimated as the internal rate of return on projected earnings. However, instead of making an attempt at estimating a market-wide average equity risk premium, they test for several determinants of individual firm equity risk premiums. Not surprisingly, proxies for risk (such as sector membership) and the magnitude of growth opportunities (book-to-market ratio and forecasted long-term growth rate) prove to be significant. Together with the dispersion in analyst earnings forecasts, they explain approximately 60% of the variation in the cross section of implied costs of capital.

At the time, this article was part of an effort to answer the call by Elton (1999) for the need for new approaches to risk premium estimation. Elton’s argument was as follows: “Our approach is distinct from most of the prior empirical work on asset pricing in that it does not rely on average realized returns.” (Elton, 1999, p. 2)

Operationally, they limit their earnings forecasting horizon to 3 years, instead of the 5-year horizon in Claus and Thomas (1999), due to the availability of analyst forecasts, thus circumventing the need for estimating the implied growth rate up to five years, as described in Claus and Thomas (1999). They then make projections of annual earnings up to 12 years. At t = 12 a terminal is value is computed. From t = 3 to t = 12, they make the assumption that each firm’s return on equity (ROE) declines linearly to the industry average. From t = 13 on, ROE is assumed to be equal to the cost of equity, implying that they make no positive net present value contribution. This assumption is used for all firms in their analysis, which range in number from 1,044 in 1979 to 1,333
in 1995. As in Claus and Thomas (1999), their proxy for the risk-free rate is also
derived from the 10-year Treasury bond yield.

Because of these small differences in approach to Claus and Thomas (1999),
they obtain an average 2.7% equity risk premium for the entire period. However, their
annual non-weighted mean for the equity risk premium ranges from a high of 5.2% in
1979 to a low of -0.2% in 1984. Note that these two years were not included in the
Claus and Thomas (1999) study which, as mentioned previously, covered the period
from 1985 to 1998. In their common coverage period (1985-1995), the two studies
reported very similar results, at least in terms of annual changes in the risk premium
level. The overall period averages in the common period are 3.44% p. a. (Claus
and Thomas, 1999) and 3.17% p. a. (Gebhardt et al., 2001). It should also be noted that the
Claus and Thomas (1999) “market-wide” premiums were computed as size-weighted
averages of individual firm estimates, not to mention the fact that the Claus and Thomas
(1999) study sample size was much larger, especially towards the end of the period they
analyzed.

As a result of the dissatisfaction with the use of historical returns in tests of asset
pricing models, Elton’s American Finance Presidential Address (1999) makes a plea for
the adoption of new approaches.

Initially, he reminds us that “almost all of the testing” (Elton, 1999, p. 1199)
involves the use of realized returns as a proxy for expected returns, with the crucial
reliance on the belief that information surprises tend to cancel each other out over a
study period, so that realized returns would be an unbiased estimate of expected returns.
As the reader perfectly knows, asset pricing models do not purport to explain the setting
of realized returns, but of equilibrium expected returns.

Elton (1999) goes on to highlight long periods during which the average of stock
market returns was lower than the risk-free rate (from 1973 to 1984 in the US), as well
as periods in which the returns on risky longer-term bonds were also lower than the
risk-free rate (1927 to 1981). As he describes it, “… 11 and over 50 years is an awfully
long time for such a weak condition [that a risky asset should earn more than the risk-
free asset] not to be satisfied.” (Elton, 1999, p. 1199)

His main argument is that the plausible explanation of such apparently
anomalous results is that realized returns are poor measures of expected returns, since

... information surprises highly influence a number of factors in our asset pricing
model. I believe that developing better measures of expected return and
alternative ways of testing asset pricing theories that do not require using
realized returns have a much higher payoff than any additional development of
statistical tests that continue to rely on realized returns as a proxy for expected
returns. (Elton, 1999, p. 1199-1200) [Emphasis added]

A simple, but useful formalization of Elton’s (1999) point is as follows. Realized
returns can be decomposed into expected and unexpected returns:

\[ R_t = E_{t-1}(R_t) + e_t \]  (2)

where \( R_t \) is return in period \( t \), \( E_{t-1}(R_t) \) is expected return at \( t \), conditional on
the information set available at time \( t - 1 \), and \( e_t \) is unexpected return.

In the discussion of stock market returns, the existing theories say that
unexpected return is caused by systematic factor shocks or unique firm specific events.
When one uses realized returns as a proxy for expected returns, the hope is that
unexpected returns are independent. This would mean that, over long observation intervals, such as that used as the basis for US market premiums (usually, from 1926 on), those unexpected returns tend to a mean of zero.

Elton’s argument, however, is that there tend to be information surprises which are very large, or that a sequence of such surprises is correlated. This would make their cumulative effect so large as to have a significant and permanent effect on the realized mean, and not disappear even as the observation interval becomes large.

The model he proposes is:

\[ R_t = E_{t-1}(R_t) + I_t + \varepsilon_t \]  \hspace{1cm} (3)

where \( I_t \) is a significant information event. For Elton (1999), \( I_t \) is often equal to zero, but occasionally a very large number (positive or negative). Hence, unexpected returns, \( \varepsilon_t = I_t + \varepsilon_t \) are in fact a mixture of two distributions, one with the usual properties (the \( \varepsilon_t \), independent and with zero mean), and a jump process for \( I_t \)

As a historical example of such a process, Elton (1999) mentions the “McDonald’s effect”. This had to do with the fact that, in the 1950’s and 1960’s, there tended to be positive earnings surprises for several years in succession. The series of high positive returns on McDonald’s stock, when efficient frontiers were constructed on the basis of realized returns tended to produce portfolios dominated by McDonalds, and these “were simply not credible”. (Elton, 1999, p. 1201)

Another example, and much closer to the present paper, is the effect of important market-wide crises, such as that in the latter part of 2008. The effect of such a shock on realized returns and their eventual use as the basis of estimates of risk premiums is illustrated in Sanvicente (2012), with a focus on the use of such estimates by regulatory agencies in Brazil.

Hsing, Phillips and Phillips (2011) applied the EGARCH model in the Brazilian stock index during 1997 until 2010 and find correlations with a few aggregate economic variables. The market seems to be positively affected by industrial production, the ratio of M2 money supply to GDP and the US stock market index. They also found a negative impact of the lending rate, currency depreciation and domestic inflation.

Camacho and Lemme (2004) compared a set of 22 Brazilian companies with investments abroad using two models: a Global CAPM and a Local CAPM to investigate whether the cost of equity capital of Brazilian companies employed on international investments should be greater than that used on national projects, assuming an integrated market. They concluded that it is not correct to add any risk premiums to the cost of domestic equity capital.

Ferreira (2011) observed the correlations between Brazilian macroeconomic variables and the implied risk premium calculated using monthly data on stocks traded on the Bovespa from January 2005 until December 2010. The results showed that the equity risk premium demanded by investors is positively affected by the unexpected inflation rate, the growth in money supply, the real interest rate, the output gap and it is negatively affected by GDP growth.

### 3. Calculation of ERP implicit in current Brazilian market prices

The starting point in our ERP estimation methodology is the so-called Gordon model, first proposed in Gordon (1959), which assumes that a stock’s dividends grow at the constant rate \( g \) per period. The stock’s intrinsic value corresponds to the present value of the stream of future dividends, discounted at \( k_e \), the firm’s opportunity cost of
equity. Given that dividends are assumed to grow at a constant rate, intrinsic value \( V_0 \) is the present value of a perpetual stream of cash flows, and is obtained as follows:

\[
V_0 = \frac{D_1}{k_e - g} \quad (4)
\]

where \( D_1 \) is the dividend per share to be paid at the end of the first period (year).

Under the assumption that observed prices \( P_0 \) are equal to intrinsic values, except for a random error, we can state that prices will contain information on the stock’s required return, so that required return could be estimated as follows, for each individual stock:

\[
k_e = \frac{D_1}{P_0} + g \quad (5)
\]

We then construct the required return on the market portfolio, assumed to be equal to the expected return, given the assumed equivalence of observed prices and intrinsic values, by computing an average of the required returns for a representative sample of individual stocks. In the tests run in this paper, we use a simple average, implying that the proxy for the market portfolio is an equally-weighted portfolio of the stocks included in the sample. Therefore, our assumed equality between observed prices and intrinsic values is being proposed, not on a security-by-security basis, but on average for the entire sample representing the market.

Prices \( P_0 \) are directly observed. Given that \( D_1 = D_0(1 + g) \), and \( D_0 \) (current dividend per share) is also observed, the remaining task is to estimate the so-called “sustainable” growth rate \( g \) (see Ross et al., 2009).

Without changing either financing or dividend policy, a firm can maintain the growth rate in both earnings and dividends through the following relationship:

\[
g = ROE \times b \quad (6)
\]

where \( ROE \) = return on equity, or net income after taxes/net worth, and \( b \) = earnings retention rate, or \( (1 - \text{payout}) \).

Since information on recent values of ROE, payout ratios and dividends per share are available from financial statements, and prices are directly and continuously observed, all the necessary data for estimating individual stock values for \( k_e \) and calculating their simple average are easily accessible.

In turn, the risk-free rate is obtained from current quotes of U.S. Treasury notes. Since these instruments pay their income in U.S. dollars, we convert the local market data using the Brazilian Real/U.S. dollar rate at each point in time.

The sample of individual stocks is processed as follows, for each month in the series:

a. Closing prices, 12-month net income, dividends and net worth per share are collected. Obviously, stocks not traded at the end of any month are excluded from the sample for that month. This still leaves a sample size, from January 1995 to November 2010, of at least 100 firms, using only one class of stock for each firm in the sample, not including financial institutions.
b. ROE and payout are computed as the ratios of net income/net worth, both on a per share basis, and dividends per share/income per share, respectively.
c. ROE and payout values are used for estimating $g$.
d. Equation (5) is then used in the estimation of $k_e$, given the estimated values of $D_1$ and $g$, and the observed prices $P_0$.
e. The simple average of the resulting individual values of $k_e$ is computed. This is the estimate for the expected (required) return on the market.
f. The last step to calculate the ERP is to subtract the expected return on the market ($E(r)$) from the risk-free rate, obtained from current quotes of U.S. Treasury notes.

The procedure outlined above resulted in the following monthly series for the Brazilian market’s ERP depicted in Figure 1.

**Figure 1: Implied ERP in Brazil, Jan. 1995 to Nov. 2010**

![Implied ERP in Brazil, Jan. 1995 to Nov. 2010](image)

Figure 1 demonstrates that the implied version of ERP for the Brazilian market is very sensitive to the occurrence of economic or financial crises. The equity risk premium increased during the second semester of 1998 and the first semester of 1999, a period marked first by the Russian crisis, immediately followed by Brazil’s change of exchange rate regime. We can also note sharp increases in the ERP in the second semester of 2001 (WTC 9/11 attacks); during the end of 2002 until the end of 2003 (Lula’s first presidential campaign and first year in office) and in the second semester of 2008 (Subprime Crisis and Lehman Brothers Default).

This sensitivity, in spite of being a drawback of the approach of estimating ERP with current market prices, is a distinct advantage. It makes the ERP estimate responsive to current market conditions.

When a crisis ensues, there is an increase in the overall market aversion to risky assets; investors require higher returns in order to hold such assets. This is equivalent to seeing investors discount future cash flows to those assets at higher rates, of which the ERP is a common component. This process produces lower market valuations. In our
approach, this is represented by lower values for $P_0$, and higher values for $k_e$, and hence, higher estimates for the ERP.

This sensitivity to changes in market conditions is a property that the historical ERP approach does not possess. A dramatic example of the failure of the historical ERP in this regard is provided in Sanvicente (2012), using data for the 2008 global financial crisis.

4. Methodology and data

We propose to explain the time series of implied ERP for Brazil using “market variables”. We believe they contain sufficient information about macroeconomic data and expectations, with the advantage of being observed more frequently and with no significant delays.

The basic specification we use proposes that the equity risk premium in Brazil is a function of the exchange rate, international capital flows to the stock market, the volatility of the Brazilian stock exchange, the volume traded in the local stock market, the basic domestic interest rate, the liquidity premium, country risk, the level of the stock exchange in the US, the price of gold, and the domestic credit risk premium:

$$ DERP = f(RPTAX, REXTFLOW, RVOLATIBOV, RVOLUMEIBOV, DCDI, DLIQPREM, RRISCKBR, RSP500, RGOLD, DCREDRISK) $$

Where:

DERP = first difference in the estimated value of the ERP

RPTAX = % change in the exchange rate of Reais to US$

REXTFLOW = % change in the capital flow from and to foreign investors in the Brazilian Stock Market

RVOLATIBOV = % change in Ibovespa volatility

RVOLUMEIBOV = % change in volume of trading, measured in Reais, in the Brazilian stock market

DCDI = first difference in domestic interest rates, proxied by the interbank market rate

DLIQPREM = first difference in the liquidity premium in international markets, measured by the difference between US TBond (30-year) and TNote (10-year) rates

RRISKB = % change in Brazil country risk spread, as measured by J. P. Morgan’s EMBI+

RSP500 = rate of return on the S&P 500 index

RGOLD = % change in gold prices
DCREDRISK = first difference in a measure of credit default risk in Brazil, represented by the spread between the average commercial bank lending rate to corporations and the CDI (Brazilian Interbank Rate) on an annual basis.

5. Results

Every individual variable listed above was checked for stationarity and unit roots, and transformed with the calculation of first differences or the computation of a rate-of-return format.

Initially, an analysis of partial correlation coefficients indicated, as prime candidates for explaining the time series of changes (first differences) in the estimated equity risk premium for Brazil in the 1995-2010 period:

(a) changes in the level of volatility in the local stock market (RVOLIBOV, partial correlation coefficient of 0.2608); (b) changes in the domestic market basic interest rate (DCDI, 0.2852); (c) changes in the liquidity premium (DLIQPREM, 0.3074); (d) changes in the country risk premium (RRISKBR, 0.3884); (e) returns on the international stock market, as proxied by the S&P500 (RSP500, -0.3412); (f) changes in the local market credit risk premium (DCREDRISK, 0.2045).

Since we are using monthly data for the January 1995 to November 2010 period, and given the computation of first differences or relative changes in several variables, this means the use of 190 observations.

All these variables, with the exception of the return on the international stock market, have positive partial correlations with the changes in the estimated ERP. Since they are all proxies for one type of risk or another, indications are that, when they rise, required returns on the local stock market also increase, as a response to higher risk levels. In the particular case of DCDI, the reason is more likely an increase in the risk-free rate that is part of the required rate at which expected cash flows to equities are discounted, resulting in lower stock prices and, given our method for estimating the ERP, resulting in higher ERP values.

The only variable for which a substantial negative partial correlation is found is RSP500. The result can be interpreted in the following manner: when stock prices rise in the US market, so that returns on the S&P500 are positive, we tend to observe higher prices in the local stock market, leading to lower estimated ERP values. There seems to be a strong positive association of the American market with local stock market prices, for which evidence is discussed in Sanvicente (2004).

In terms of partial correlations involving pairs of possible candidates as explanatory variables, and eventual sources of multicollinearity problems, the high positive correlations between changes in the exchange rate (RPTAX) and both the price of gold (RGOLD) and the country risk premium (RRISKBR) stand out, at 0.8080 and 0.4557, respectively, as well as the negative correlation (-0.6125) for the pair RRISKBR-RSP500. Cases such as these, however, are dealt with in the estimation of a reasonable model for explaining DERP, in what follows, through the use of variance-inflation factor (VIF) analysis.

Table 2 presents our regression estimation results for the full model, after the exclusion of RGOLD, due to its high correlation with RPTAX, as well as REXTFLOW and DCREDRISK, due to the low significance levels in a previous attempt at estimating the model with all possible candidate explanatory variables.
Table 2: Regression model results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient (standard error)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-0.0100</td>
</tr>
<tr>
<td></td>
<td>(0.0833)</td>
</tr>
<tr>
<td>RPTAX</td>
<td>-1.1320</td>
</tr>
<tr>
<td></td>
<td>(1.0860)</td>
</tr>
<tr>
<td>RVOLIBOV</td>
<td>(0.4081)</td>
</tr>
<tr>
<td></td>
<td>(0.3403)</td>
</tr>
<tr>
<td>RVOLUME</td>
<td>-0.8801</td>
</tr>
<tr>
<td></td>
<td>(0.6363)</td>
</tr>
<tr>
<td>DCDI</td>
<td>1.9590*</td>
</tr>
<tr>
<td></td>
<td>(0.6874)</td>
</tr>
<tr>
<td>DLIQPREM</td>
<td>7.0314*</td>
</tr>
<tr>
<td></td>
<td>(3.0042)</td>
</tr>
<tr>
<td>RRISKBR</td>
<td>1.8974</td>
</tr>
<tr>
<td></td>
<td>(1.0626)</td>
</tr>
<tr>
<td>RSP500</td>
<td>-3.6494</td>
</tr>
<tr>
<td></td>
<td>(2.8364)</td>
</tr>
<tr>
<td>Adj. R-squared</td>
<td>0.2897</td>
</tr>
<tr>
<td>F statistic</td>
<td>9.9132</td>
</tr>
<tr>
<td>Prob(F-statistic)</td>
<td>(0.0000)</td>
</tr>
<tr>
<td>DW statistic</td>
<td>1.8860</td>
</tr>
</tbody>
</table>

Note: The Newey-West procedure was used to adjust for heteroscedasticity, and a residual serial correlation test for ARCH effects was performed. The null hypothesis of the inexistence of an ARCH effect was not rejected at 5%.
* Significant at the 5% level. 190 observations are used.

Finally, the specification RESET test was implemented, and it was found that the fitted-square variable was highly significant. This led to the estimation of the full version of our original model with the results provided in Table 3, where squared values of both DCDI and RVOLIBOV were used as additional explanatory variables.

Table 3: Regression model results after RESET specification test

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient (standard error)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-0.1604</td>
</tr>
<tr>
<td></td>
<td>(0.0991)</td>
</tr>
<tr>
<td>RPTAX</td>
<td>-1.5581</td>
</tr>
<tr>
<td></td>
<td>(0.9322)</td>
</tr>
<tr>
<td>RVOLIBOV</td>
<td>-0.3063</td>
</tr>
<tr>
<td></td>
<td>(0.3147)</td>
</tr>
<tr>
<td>RVOLIBOV^2</td>
<td>0.7665*</td>
</tr>
<tr>
<td></td>
<td>(0.2064)</td>
</tr>
<tr>
<td>RVOLUME</td>
<td>-0.6531</td>
</tr>
<tr>
<td></td>
<td>(0.5404)</td>
</tr>
<tr>
<td>DCDI</td>
<td>1.8703*</td>
</tr>
<tr>
<td></td>
<td>(0.4586)</td>
</tr>
</tbody>
</table>
The results indicate that only four factors are influential in the explanation of changes in the estimated equity risk premium and, by construction, thanks to the methodology with which the ERP is estimated, in the explanation of stock market prices: market-wide volatility, in a non-linear fashion only, since only RVOLIBOV^2 is significant; changes in the basic interest rate (DCDI), in both its first order and the non-linear format; the country risk premium (RRISKBR); and the liquidity premium (DLIQPREM). The coefficients of all these variables have the expected sign (positive), since they either represent common sources of market risk, or correspond to the basic rate that would be used by the market to discount future cash flows to equities.

6. Conclusion

This paper has examined potential market variables that can explain the movements in the Brazilian Bovespa stock index. Monthly samples from January 1995 until November 2010 were used in empirical work to evaluate the implied equity risk premium of the Brazilian market. The authors believe that using the implied premium is a superior measure to the historic premiums because the market should be affected by expected changes of returns, not by the historic prices. Major findings are that the Brazilian market seems to be affected by three local variables: 1) the level of volatility of the Bovespa index; 2) increases in local interest rates; and 3) the country risk premium. And it is also affected by one international market variable: the liquidity premium. Other market variables like the exchange rate, gold prices, trading volume and the inflow of investors’ money to the Bovespa, credit default risk and the S&P500 were discarded as not being influential in the explanation of stock market prices.

In an attempt to model the Brazilian market one should look at those four variables for an explanation of our equity risk premium. Investors tend to demand higher rates of return to invest in equities in Brazil, than to invest in the U.S. One of the reasons is the level of risk associated with the volatility of our market, which is linked to the general explanation for the risk level. But to evaluate it properly, one should also look at our incredibly high interest rates, our country risk and the level of liquidity in the international markets. Those other explanations combined show why the Brazilian market is more complex and risky, inducing rational investors to require higher expected rates of return.
7. References


___________ (2012). Problemas de estimação de custo de capital de empresas concessionárias no Brasil: uma aplicação à regulamentação de concessões rodoviárias. *RAUSP, 47*(1), 81-95.