

Determinants of the implied equity risk premium in Brazil

Antonio Zoratto Sanvicente[†]

Mauricio R. A. Carvalho[‡]

Abstract This paper proposes and tests market determinants of the equity risk premium (ERP) in Brazil. We use implied ERP, based on the Elton (1999) critique. We demonstrate that calculating implied, as opposed to historical, ERP makes sense, because it varies, in the expected direction, with changes in fundamental market indicators. The ERP for Brazil is calculated as a mean of large samples of individual stock prices in each month of the January, 1995 to December, 2019 period, using the “implied risk premium” approach. We obtain the following determinants of changes in the ERP, which are significant, and in the expected direction: changes in CDI rate, country debt risk spread, U.S. market liquidity premium, and level of the S&P500. The influence of the proposed determining factors is tested, using time series regression analysis. The possibility of a change in that relationship with the 2008 global financial and the 2015 Brazilian economic crises is also tested. Results indicate that neither crisis had a significant impact on the nature of the relationship between the implied ERP and its determining factors. For comparison, we also consider the same variables as determinants of the ERP calculated with average historical returns, as is common in professional practice. First, the constructed series does not exhibit any relationship to known market events. Second, the variables found to be significantly associated with historical ERP do not exhibit any intuitive relationship with compensation for market risk.

Keywords: Equity risk premium; Discounted dividend model; Capital asset pricing model

JEL Code: E44, G12, G14, G31, G32.

1. Introduction

Any stock’s risk premium, or “equity risk premium” (ERP), is given by the difference between the expected return on the market portfolio and the rate of return on the market’s risk-free asset. From one stock to another, the actual risk premium varies with the particular stock’s beta, or sensitivity to returns on the market portfolio.

In many important applications, estimates of the market risk premium are made using averages of historical differences between returns on a stock

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[†]Sao Paulo School of Economics – FGV, Brazil: antonio.sanvicente@fgv.br

[‡]Condere Consultoria de Negócios (M&A e Valuation), Brazil: mauricio@condere.com.br

market index, such as the Standard & Poor's 500 (S&P500) and a return on a riskless asset, such as U.S. Treasury notes or bonds.

In Brazil, those important applications include (a) the determination of discount rates in order to value stocks of firms in acquisition and/or going-private offers (OPAs); (b) the setting of so-called “regulatory internal rates of return” for companies in regulated sectors, such as electric power generation and distribution, highways, and natural gas distribution, among others. Internally, firms may need to calculate their cost of equity capital as part of variable compensation schemes, or in the computation of their weighted-average cost of capital when valuing new investment opportunities. This is done because the Sharpe (1964), Lintner (1965), and Mossin (1966) version of the capital asset pricing model (CAPM) is used in the construction of the relevant security market line for estimating the appropriate *opportunity* cost of equity.

Two main issues stand out. First, the already-mentioned use of historical return averages, as opposed to current levels of the market portfolio's expected return, is in stark conflict with the concept of an opportunity cost. For an individual or a firm that needs to make an investment decision, the relevant cost should be that prevailing at the moment the decision must be made, and not an average of what occurred in the past.¹ Second, since the available history for the Brazilian stock market is considered “short,” when compared to that of the U.S. market, for example, it is claimed that one should use a U.S. market index as a proxy for the market portfolio, and not Brazilian stock prices and returns, even when calculating an equity risk premium for the Brazilian market.

In the present paper, we explain how to get around using historical averages as a basis of estimating expected returns on the market portfolio, by describing a straightforward procedure for obtaining the required expectation from current stock market prices. This is known as an “implied” equity risk premium. We then present the resulting series for the January 1995-December 2019 period, pointing out special situations, or “crises” in which the expected

¹In previous discussions, the authors have met with the contention that, if one uses historical averages of very long periods, such as those available for the U.S. stock market, then the resulting estimate would be “representative.” Against this position we simply offer the argument that, putting weak market efficiency considerations aside, this would be equivalent to saying that the distribution of rates of return is stable throughout the historical period used, and that the “law of large numbers” applies, which simply does not make sense in the case of financial asset prices and returns. It is much more plausible to admit that the distribution of rates of return changes frequently and that one would do better by using an approach that does not rely on assuming that the law of large numbers applies. Obviously, a historical average does not change very frequently, but only with the slow addition of new observations as time passes.

market portfolio return spiked, as would be natural, as compensation for sharp increases in the general level of risk perceived in the market.

We also test the significance and direction of the relationship between easily-observed market fundamentals and our estimate for the market portfolio's return, and show that the results are significant for certain fundamentals, and in the appropriate direction.

An alternative manner in which one can point out problems with the use of historical returns in the computation of equity risk premiums is to mention that the 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 idea, 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 (as does Ibbotson (2010), whose series starts in 1926), we would have to assume that investors' risk profiles and/or market fundamentals remained constant throughout that period. On the other hand, if we reduce the period to the last 20 or 40 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 would certainly be amplified in emerging markets such as Brazil. In addition, there is survivorship bias. Market histories are studied using stock indices, and clear evidence for this bias in successful stock markets is presented and discussed by Brown et al. (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 et al. (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 & Thomas (1999) use the same idea in the aggregate. Damodaran (2011) calculates the implied premium for the American and Brazilian markets.

The fact that implied risk premium and cost of equity calculations are gaining relevance at the expense of the historical return approach is emphasized by Nekrasov & Ogneva (2011), who enumerate some of the following applications: shedding light on the equity premium puzzle (Claus & Thomas, 2001; Easton et al., 2002); the market's perception of equity risk (Gebhardt et al., 2001); risk associated with accounting restatements (Hribar & Jenkins, 2004); legal institutions and regulatory regimes (Hail & Leuz, 2006); and tests of the inter-temporal CAPM (Pastor et al., 2008), among others.

More recently, the cost of equity estimated with an implied risk premium has been used as a dependent variable in corporate finance research. For ex-

ample, Javakhadze et al. (2016) see the influence of managerial social capital. That is, capital constructed by developing managers' networks benefits a firm by reducing its cost of equity. The cost of equity was estimated using the dividend discount model, with data for 729 firms on all continents. Lima & Sanvicente (2013) present evidence that better governance reduces the cost of equity in the Brazilian market.

Hsing et al. (2011) apply the EGARCH model to the Brazilian stock index from 1997 to 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 U.S. stock market index. They also find a negative impact of the lending rate, currency depreciation and domestic inflation.

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

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

Ferreira (2017) uses an implied risk premium for the Brazilian market as part of an investigation into whether publicly-owned firms had created shareholder value in the 2008-2015 period. The equity risk premium was calculated in the determination of a firm's cost of equity, itself a component of the firm's weighted-average cost of capital (WACC). The sample involved 134 listed firms, and for approximately 75% of such firms the author concludes that there had been value creation for their respective shareholders.

A methodology for estimating the implied equity risk premium for the Brazilian market is suggested by Minardi et al. (2007). The proposal is to use 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 is measured in the present paper.

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; results are provided in Section 5; and Section 6 concludes and discusses both limitations and possible extensions.

2. Literature review: implied equity risk premium and cost of equity

Claus & Thomas (1999) propose a new approach to estimating the equity risk premium for the U.S. market. This involves 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 estimate a so-called “implied market risk premium.” The implied equity risk premium is obtained as the internal rate of return (k), in the following equation:

$$p_0 = bv_0 + \sum_{t=1}^5 \frac{ae_t}{(1+k)^t} + \left(\frac{ae_5(1+g'')}{(k-g'')(1+k)^5} \right) \quad (1)$$

where, for the end of each year ($t = 0, \dots, 5$):

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 $e_t = bv_{t-1} + 0.5 \cdot e_{t-1}$, 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 calculating abnormal earnings for $t = 1, \dots, 5$, the authors directly use analysts’ forecasts for years 1 and 2. For the remaining years ($t = 3, \dots, 5$), they use g' , the implied growth rate in analysts’ forecast for long-term earnings, that is, the forecasted 5-year growth rate.

This approach produces 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 premium usually obtained based on

historical returns, that apparently high level being the source of the so-called “equity premium puzzle” (Mehra & Prescott, 1985).

In calculating 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 & Thomas, 1999, p. 16-17).²

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

Claus & 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 to using 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 & 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):

²In our methodology, we also use the yield to maturity currently quoted for 10-year U.S. Treasury bonds. For one thing, as in Ferreira (2017), the similar local security would not be a risk-free asset. However, for the decision to use an international security, we must assume that the local market is sufficiently integrated into the international market, and for evidence of the sufficient degree of the Brazilian market integration, see Sanvicente et al. (2017), using 2004-2014 data.

*“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 & Thomas, 1999, pp. 10-11). [Emphasis added, since this applies fully to our own approach in this paper.]*

In several instances, Claus & 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 are 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 & 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 & 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 & 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 & 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 & Thomas (1999): implied costs of equity are estimated as the internal rate of return on projected earnings. However, instead of attempting to estimate a market-wide average equity risk premium, they test for several determinants of individual firm equity risk premiums. Unsurprisingly, 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, that article was part of an effort to answer the call by Elton (1999) 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 of Claus & Thomas (1999), due to the availability of analyst forecasts, thus circumventing the need to estimate the implied growth rate up to five years, as described by Claus & Thomas (1999). They then make projections of annual earnings up to 12 years. At $t = 12$ a terminal 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 there is 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. Like Claus & Thomas (1999), their proxy for the risk-free rate is also the 10-year Treasury bond yield.

Because of these small differences in approach to Claus & 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 & 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 & Thomas, 1999) and 3.17% p. a. (Gebhardt et al., 2001). It should also be noted that the Claus & Thomas (1999) “market-wide” premiums were computed as size-weighted averages of individual firm estimates, not to mention that the sample size of Claus & Thomas (1999) was much larger, especially towards the end of the period 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 U.S.), 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:

$$R_t = \mathbf{E}_{t-1}(R_t) + e_t, \quad (2)$$

where R_t is return in period t , $\mathbf{E}_{t-1}(R_t)$ 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, 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 U.S. 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 would not disappear even as the observation interval becomes large.

The model he proposes is:

$$R_t = \mathbf{E}_{t-1}(R_t) + I_t + \varepsilon_t, \quad (3)$$

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

Elton (1999) mentions the "McDonald's effect" as an example of such a process. This had to do with the fact that, in the 1950's and 1960's, there tended to be positive earnings surprises for that company 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 McDonald's, and these "*were simply not credible*" (Elton, 1999, p. 1201).

Another example, 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 by Sanvicente (2012), with a focus on the use of such estimates by regulatory agencies in Brazil.

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 by 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, after a simple rearrangement of Equation (4):

$$k_e = \frac{D_1}{P_0} + g. \quad (5)$$

We then construct the required return on the market portfolio, which would be equal to the expected return under market equilibrium, 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. Dividend per share D_0 is also observed. Given that, the remaining task is to estimate the so-called "sustainable" growth rate g (see Ross et al., 2012). Without changing either financing or dividend policy, a firm can maintain the growth rate in both earnings and dividends through the following relationship:

$$g = \text{ROE} \times b, \quad (6)$$

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 10-year U.S. Treasury bonds. 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.

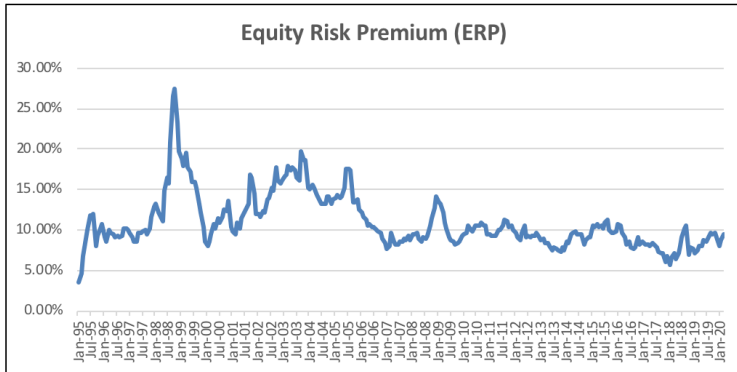
The sample of individual stocks is processed as follows, for each month in the series:

- 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 December 2019, of at least 90 firms in each month, using only one class of stock for each firm in the sample, which does not include investment funds or financial institutions.
- b. ROE and payout are computed as the ratios of after-tax net income to net worth, both on a per share basis, and dividends per share to after-tax net income per share, respectively.
- c. ROE and payout values are used for estimating g , according to Equation (6).
- 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, from the expected return on the market ($\mathbf{E}(r)$), the risk-free rate, obtained from current quotes of 10-year U.S. Treasury bonds.

The procedure outlined above results in the following monthly series for the Brazilian market's ERP, depicted in Figure 1.

Figure 1 demonstrates that the implied version of the ERP for the Brazilian market is very sensitive to the occurrence of economic or financial crises, as it should be. The equity risk premium increased rapidly and substantially 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

Figure 1
Implied ERP (% p. a.) in Brazil, Jan. 1995 to Dec. 2019



of exchange rate regime. We can also note sharp increases in the ERP in the second semester of 2001 (WTC 9/11 attacks); from the end of 2002 to the end of 2003 (Lula's first presidential campaign and first year in office), in the second semester of 2008 (the subprime crisis and Lehman Brothers default), and a 100-basis-point jump in January, 2015, marking the onset of the Brazilian economic crisis as President Dilma Rousseff began her second presidential term.

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, and hence a substantially more representative “price” of risk than the estimates based on historical returns.

When a crisis ensues, there is an increase in the overall market aversion to risky assets; investors demand 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 , 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 by 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, or “fundamentals.” 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 proposes that the equity risk premium in Brazil is a function of the exchange rate, the volatility of the Brazilian stock market, the volume traded in the local stock market, the basic domestic interest rate, the U.S. liquidity premium, Brazil’s country risk, the level of stock market prices in the U.S., the price of gold, and the domestic credit risk premium:

$$\text{DERP} = f(\text{RPTAX}, \text{DVOLATIBOV}, \text{RVOLUMEIBOV}, \text{DCDI}, \text{DLIQPREM}, \text{DRISKBR}, \text{RSP500}, \text{RGOLD}, \text{DCREDRISK}), \quad (7)$$

where

DERP = first difference for the estimated value of the ERP

RPTAX = % change in the exchange rate of Reais to U.S.\$

DVOLATIBOV = first difference for historical Ibovespa volatility

RVOLUMEIBOV = % change in volume of trading 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 30-year and 10-year U.S. T-bond yields

DRISKBR = first difference for the 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, that is, a log return format, as indicated in their definitions.

Initially, an analysis of partial correlation coefficients revealed several prime candidates to explain the time series of changes (first differences) in the estimated equity risk premium for Brazil in the 1995-2019 period. These candidates include (a) changes in the level of volatility in the local stock market (DVOLATIBOV, partial correlation coefficient of 0.1999); (b) changes in the domestic market basic interest rate (DCDI, 0.2934); (c) changes in the liquidity premium (DLIQPREM, 0.2173); (d) changes in the country risk premium (RRISKBR, 0.3182); and (e) returns on the international stock market, as proxied by the S&P500 (RSP500, -0.2916). Since we use monthly data for the period from January 1995 to December 2019, and given the computation of first differences or relative changes in several variables, this gives 299 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, or compensations for risk, 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 in higher ERP values, given our method of estimating the ERP.

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 U.S. market, returns on the S&P500 are positive. Since this is seen as good news, we tend to observe higher prices in the local stock market, leading to lower estimated ERP values.

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 (DRISKBR) stand out, at 0.6977 and 0.5318, respectively, as well as the negative correlation (-0.4807) for the pair DRISKBR-RSP500. Cases such as these, however, are dealt with in the estimation of a reasonable model for explaining DERP, in what follows, after performing variance-inflation factor (VIF) analysis. This

Table 1
Regression model results for the January 1995 to December 2019 period

variable	coefficient	(standard error)
intercept	0.0008	(0.0006)
RPTAX	-0.0040	(0.0200)
DVOLATIBOV	0.0181	(0.0391)
RVOLUMEIBOV	-0.0070	(0.0036)
DCDI	0.1100**	(0.0281)
DLIQPREM	1.7695**	(0.5603)
DRISKBR	0.2162*	(0.1092)
RSP500	-0.0438*	(0.0187)
RGOLD	0.0040	(0.8428)
DCREDRISK	0.0125	(0.0179)
	value	p-value
adj. R-squared	0.2243	
F statistic	10.5761	0.0000
DW statistic	1.8063	

Dependent variable is DERP = first difference of estimated equity risk premium (ERP). 299 observations. Note: The Newey-West procedure was used to adjust for heteroskedasticity. A residual serial correlation test for ARCH effects was performed, using up to 03 lags, but the null hypothesis of inexistence of an ARCH effect was not rejected at 5%. **, * indicate significance at the 1% and 5% levels, respectively.

analysis reveals the highest factor value of 2.1098 for DRISKBR. Since the rule of thumb is to consider excluding a variable for which VIF > 10, no variable is excluded. The full model is then estimated and the results are displayed in Table 1.

The specification Ramsay RESET test was implemented. The fitted-square variable was not significant, obviating the need for using non-linear forms of explanatory variables and including additional variables, since this procedure is often used to test for relevant variable omission. In particular, it can be argued that the impact of possibly relevant macroeconomic variables is subsumed in the behavior of basic market variables.

Next, in order to check for the impact of the 2008 global financial crisis and the 2015 Brazilian economic crisis on the estimated relationship between changes in the ERP and the proposed determining factors, a stability (“breaking point”) test was performed, assuming that the breaks had occurred in September 2008 and January 2015.³ The resulting F statistic for the joint

³In the software (EViews, version 10) manual, the test is referred to as the “breakpoint Chow test,” and is included in the group of “stability diagnostics.” The manual’s description follows: “The idea of the breakpoint Chow test is to fit the equation separately for each subsample and to see whether there are significant differences in the estimated equations. A significant difference indicates a structural change in the relationship. For example, you can use this test to examine whether the demand function for energy was the same before and after the oil shock. The test

test, that is, considering the two shocks together, was equal to 0.6730, with a p-value equal to 0.8516. The numerator and denominator degrees of freedom were, respectively, equal to 20 and 269. Hence, it is apparent that there was no significant change in the relationship between changes in ERP and their determinants.

Results indicate that four of the proposed 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. The first three of these factors include changes in the basic interest rate (DCDI); changes in the country risk premium (DRISKBR); and changes in the liquidity premium (DLIQPREM). The coefficients of all these variables have the expected positive sign, 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. The fourth empirically relevant variable (RSP500) has a negative coefficient. How it affects the value of ERP in the Brazilian market was previously explained, seeing that prices in various national equity markets tend to co-vary in the same direction.

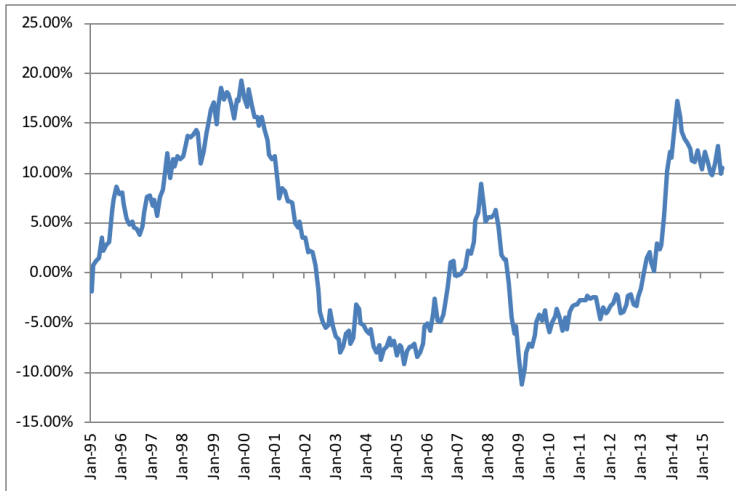
To compare with the results from the procedure commonly used to estimate the equity risk premium, we also consider testing for the significance and direction of the relationship between current fundamentals and the historical average constructed as the difference between past returns on the S&P500 and U.S. T-note rates. The averages were constructed over 60-month moving periods, as usually proposed in this approach. The resulting ERP series is displayed in Figure 2.

The highest levels for historical ERP occur in 1999, but almost one full year after the currency crisis in Brazil, and the other crises that more directly affected the U.S. market, in Sept. 2001 and Sept. 2008, would have involved ERP values of only 5.03% and -0.95% (!) p. a., respectively. Furthermore, the correlation coefficient between the ERP series, estimated with current prices and with historical prices, is not even positive, being equal to -0.0412 over the entire period.

In a deliberate effort to belabor the point, we also used the historical ERP series as dependent variable in our proposed equation, regressing it against current values of fundamentals for the Brazilian market (with the exclusion of

may be used with least squares and two-stage least squares regressions; equations estimated using GMM offer a related test. *The Chow breakpoint test tests whether there is a structural change in all of the equation parameters*” (our emphasis), indicating that we are testing whether there were changes in the estimated parameter set, including the intercept, and not only a single or a few parameters. For an explanation of this test, you can also see Kennedy, 2003.

Figure 2
Equity risk premium estimate for the usual applications in the Brazilian market



The proxy for the market portfolio is the S&P500 index. The risk premium is calculated using 60 previous monthly returns for that index, and the risk-free rate is the yield on the 10-year U.S. Treasury Note.

RSP500). The equation's adjusted R^2 is equal to 0.0133, and three variables are significant at the 5% level: DCREDRISK and RGOLD (with negative coefficients), and RPTAX, with a positive coefficient. Intuitively, only the last result makes any sense: when the exchange rate increases, so does the required return on the market portfolio.

6. Conclusion

This paper examines potential market variables that can explain the movements in the Brazilian market equity risk premium and, therefore, stock market prices. Monthly samples from January 1995 to December 2019 were used to construct the implied equity risk premium for the Brazilian market. The authors believe that the implied premium is a superior measure to the commonly-used historic premiums because the market should be affected by expected changes of returns, not by historic prices. Major findings are that the Brazilian market seems to be affected by two local variables: 1) changes in local interest rates; and 2) economic conditions that determine the country risk premium. It is also affected by two international market variables:

the U.S. liquidity premium and the level of U.S. equity prices. Other market variables like the Real/U.S. dollar exchange rate, gold prices, stock market trading volume and credit default risk were discarded as not being influential in the explanation of stock market prices, possibly because the underlying economic factors are already represented by the significant variables.

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. The reasons for this include higher local interest rates and the higher sovereign risk. Those explanations combined show why the Brazilian market is more complex and risky, leading rational investors to require higher expected rates of return.

Finally, the paper presents evidence of how inadequate historically-based premiums are for representing the market compensation for risk. This raises important questions about the reasonableness of their use in so many practical applications.

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