

Do International and Domestic Pricing Models Lead to Different Cost of Equity Estimates for Petrobras ?

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Abstract

This article assesses to what extent international and domestic asset pricing models imply a different cost of equity estimate for Petrobras under the assumption of perfect capital markets integration. Our approach distinguishes from Koedijk, et. al (2002) by dealing with a multifactor Solnik-Sercu International-CAPM (ICAPM) including beyond the global market portfolio and exchange rate risk premia an instrument associated with the country risk premia. In contrast with Koedijk's main result, our findings suggests that traditional domestic CAPM yields a significantly different estimate of the cost of equity from the multifactor ICAPM. In particular, when the US investor's point of view is taken into account, both the global market index, exchange rate and country risk premiums are statistically relevant to price domestic assets internationally. Our results could be attributed to the fact that although Petrobras is subjected to strong specific Brazilian factors, the company's results are somewhat related to the oil price movements in the international market which makes global factors relevant to price assets.

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1 Introduction

Although economic theory suggests the use of International CAPM (ICAPM) to calculate the cost of equity in a financially integrated world, the practice has shown a wide variety of asset pricing models that ignore the international dimension in computing the cost of equity (Keck et al. (1998)). Even though the ICAPM can be preferable, the use of domestic CAPM can lead to the same cost of equity estimate as the ICAPM if the local stock market portfolio contains all the information that is relevant in order to price domestic assets internationally.

This paper aims at verifying empirically whether international and domestic pricing models lead to different cost of equity estimates for Petrobras. Stulz (1995b) was the first to address this problem. He derived an expression for the difference in firm's beta when estimated by the domestic CAPM and the ICAPM of Grauer et al.(1976). This difference was called by him as pricing error test which is linearly related to the cost of equity differential. He went further and found a substantial pricing error using data for the Swiss multinational Nestlé.

Koedijk, et. al (2002) extended the Stulz analysis in some ways: first by dealing with the Solnik (1983) and Sercu (1980) multifactor ICAPM including both the global market portfolio and exchange rate risk premia, second by deriving statistical a test for the pricing error significance and third, by applying the pricing error test for broad sample of 3293 stocks for nine different developed countries.

This paper applies the tests developed by Koedijk, et. al (2002) for Petrobras using however a extended version of Solnik-Sercu model wich includes a country risk premium. We aslo dealt with a new aspect not yet considered in the previous work associated to the fact that several multinational companies such as Petrobras have stocks negociated in many international stock markets.⁴ Therefore we implemented the pricing error tests for Petrobras according to its Brazilian and american investors. These two investors' points of view are characterized by which stock the returns were collected (ordinary stock at IBOVESPA and ADR at NY) and by which local market index were used (IBOVESPA and S&P 500). The country risk premiums reflect the risks run by Petrobras over its offshore operations in Latin America countries (particulary at Argentina, Chile and Colombia).

For the Brazilian investor's point of view our results stand in line with those obtained by Koedijk, et. al (2002) in wich the cost of equity estimations differ only marginaly when estimated by either the domestic CAPM and the Solni-Sercu multifactor ICAPM. More specifically, they found that for about only 5% of all firms in their sample the domestic CAPM yielded a significant cost of equity estimate as the multifactor ICAPM at a 95% confidence level. Sanvicente (2004) also found similar results for a sample of 112 companies and four countries: Argentina, Brazil, Chile and Mexico. Our results indicate that both exchange rate and country risks are relevant for the cost

⁴Petrobras has stocks negociated at IBOVESPA in Brazil and at NYSE in the US.

of equity assessment, although it seems that the domestic portfolio is enough to price the assets internationally. In other words, the local market portfolio contains all the information needed to diversify the exchange rate and country risks.

However, when a country risk instrument is added to the ICAPM specification, while keeping the Brazilian investor's look, the pricing error test suggests that the two models are not equivalent. Moreover, both exchange rate and country risks are relevant to explain Petrobras stock returns.

Although we agree that Petrobras stock returns are strongly subjected to country's industrial structure and company specific factors such as its capital structure, it seems that its increasingly degree of internalization and exposure to oil price movements become exchange and country risks relevant for the cost of equity estimation. In this case, domestic and international CAPM can lead to a different cost of equity prediction.

Similar results were found for pricing error test applied to the Petrobras stock US investor's point of view. For this case we also found that the global stock market index is also relevant to explain the company returns.

Our findings can be interpreted as an evidence of real capital markets integration although it is valid for only one company. In any case our results stand in sharp contrast to those present in this literature.

The paper is organized as follow: next section reviews the pricing error test developed by Koedijk, et. al (2002) in a slightly different context of ICAPM with country risk premium; sections 3 presents the data and empirical strategy. Sections 4 and 5, respectively, present the tests results and variance decomposition calculation; section 6 finally concludes the paper.

2 Modelling the International and Domestic CAPM Equivalence Test

In this section we will present the tests developed by Koedijk, et. al (2002) to assess whether the domestic CAPM leads to a different cost of equity estimate from the multifactor international CAPM (ICAPM).

We begin by a slight modification of Solnik-Sercu version of ICAPM. Assuming a market with $2n + 1$ risk factors: n exchange, rates, n country risk premiums and the global market portfolio.⁵ More precisely, our model can be expressed as:⁶

$$E[R_{PB} - r_0] = E[R_G - r_0]d_1 + E[S + r - \iota r_0]'d_2 + E[C_R]'d_3 \quad (1)$$

⁵The asset pricing models of Solnik (1974,1983), Grauer et. al (1976), Sercu (1980) and Adler and Dumas (1983) essentially differ by its assumptions regarding the role of exchange rates factors and inflation differentials. For an overview of this literature see Stulz (1995).

⁶For the equation (1) derivation see Sercu and Uppal (1995).

where R_{PB} and R_G are, respectively, the continuously compound return of Petrobras ordinary stock and the global market index MSCI expressed in numeraire currency, i.e the currency 0 of Petrobras stock⁷. S denotes the vector of nominal exchange rate continuously compound returns of the other $l = 1, \dots, n$ countries in relation to currency 0 (Real or US dollars) and C_R are the the continuously compound return of the Emerging Markets Bond Index (EMBI) for the same countries. The vector r represents the nominal continuously compound return of risk-free asset in country $l = 1, \dots, n$. r is the risk-free rate in the numeraire (home) country and ι is a vector of ones. The global market, exchange rate and country risk betas are defined, respectively, as the regression coefficients d_1 , d_2 and d_3 in the following equation:

$$R_{PB} = \alpha_1 + R_G d_1 + S' d_2 + C'_R d_3 + \mu = \alpha_1 + Z' d + \mu \quad (2)$$

where $Z' = [R_G \ S' \ C'_R]$ and $\alpha_1 = r_0(1 - d_1) + (r - r_0)' d_2$ is a constant. The specific risk μ is orthogonal to Z . This version of the ICAPM will be kept as the supported hypotheses along this paper.

In order to estimate d we will assume that the regression parameters are constant along the sample period although the global risk premia may vary. Our econometric tests will be stated in terms of the coefficients d of Petrobras stock relative to the global market index, exchange rate risk and country premia.

Following Stulz (1995b) we consider the domestic CAPM as an alternative model:

$$E[R_{PB}] = r_0 + E[R_L - r_0]b \quad (3)$$

where R_L is the return of the local market index expressed in the numerarie currency 0. The beta of the domestic CAPM is then defined as the coefficient b in the following regression:

$$R_{PB} = \alpha_2 + R_L b + \epsilon \quad (4)$$

The domestic CAPM states a different formulation of the systematic and specific risk rather than the ICAPM. In order to compare the two models, one needs to relate R_L to the global factors Z .

More specifically, as eq. 2 applies to Petrobras Stock we can also apply it to the local market portfolio, getting hence to:

$$R_L = \alpha_L + Z' d_L + \xi \quad (5)$$

where ξ_i is orthogonal to Z . Replacing eq.(4) into eq.(5) results:

$$R_{PB} = \alpha_3 + Z' d_L b + \xi b + \epsilon \quad (6)$$

⁷The Petrobras Stock was denominated in Reais on the first and in US dollars on the second and third implementation. The detailed description of these implementations will be provided on section 2

where, $\alpha_3 = \alpha_2 + b\alpha_L$. Equations (2) and (6) imply the same decomposition of systematic and specific risk if the local specific risk ϵ in eq. (4) is orthogonal to Z . In this case, the composite specific risk term $\xi b + \epsilon$ is also orthogonal to Z implying that equations (2) and (6) are identical. Therefore the parameters in these two equations must be the same, resulting in:

$$d = d_L b \quad (7)$$

If restrictions in (7) hold, no pricing error results from the adoption of the domestic CAPM instead of ICAPM. Following Koedijk et al. (2002) we call a test for this null-hypotheses a "Pricing Error Test". More precisely, it will be tested the orthogonality between the global factors Z and the residuals from the domestic CAPM regression (4).

To perform this test one needs to include the global instruments Z in the domestic CAPM regression:

$$R_{PB} = \alpha_4 + R_L \beta + Z' \delta + \nu \quad (8)$$

and test the null-hypotheses $H_0 : \delta = 0$. If the restrictions in (7) hold, then no pricing error exists and the risk that is diversifiable domestically is also diversifiable internationally. In other words, the domestic market portfolio contains all the information that is relevant to price the assets. On the other hand, if the risk that is diversifiable domestically includes the risk that is systematic in the global market, then the domestic CAPM incorrectly joins such risks. In this case, the ICAPM will require a risk premium leading to a different cost of equity from domestic CAPM.

(7) can be rejected by at least one of the three conditions: beta of global market portfolio ($d_1 = d_{L1}b$), the exchange rate betas ($d_2 = d_{L2}b$) and the country risk betas ($d_3 = d_{L3}b$). Koedijk et al. (2002) showed that eq.(8) can be reparametrized in such way that the pricing errors $p = d - d_L b$ result directly as the parameters of the regression model below:

$$R_{PB} = \alpha_4 + R_L \beta + Z'_\perp p + \nu \quad (9)$$

where $Z'_\perp = Z - \xi_L \gamma_L$ and γ_L is a vector of parameters such that Z_\perp is orthogonal to R_L by construction. We test the null hypotheses that the first element of p is zero. According to Koedijk et al. (2002) we call this test as "Global Beta Test". If the null is not accepted, then the direct ICAPM beta d_1 will differ significantly from the indirect beta $d_{L1}b$. Even if the exchange rate and country risks are not priced, the pricing error test still uses regression (8) without exchange rates and EMBI. Karolyi and Stulz (2002) derive a similar orthogonality condition for the single factor ICAPM in a market with instantaneous purchasing power parity. In their specification the instruments Z only contain the return of the global market portfolio R_G . Our model simplifies to their formulation if all the currencies betas (d_2 coordinates) and country risks betas (d_3 coordinates) are equal to zero. Following Koedijk et al. (2002) we call a test of this null as "Currency and

Country Betas Test". More specifically, it tests the null hypotheses that $d_2 = 0$ and $d_3 = 0$ in regression (2). As a final test, Koedijk et al. (2002) suggested the null $H_0 : d_1 = 0$, conditional on first setting $d_2 = 0$. This is a test of pricing error between the domestic CAPM and the single factor ICAPM. Table 1 below summarizes the hypotheses underlying the pricing tests.

Table 1: Summary of econometric tests, regression models and null-hypotheses

Test	Regression model	H_0	Issue
Pricing Error	$R_{PB} = \alpha_4 + R_L\beta + Z'_1 p + \nu$	$p = 0$	Pricing error of domestic CAPM versus multifactor ICAPM
Global Beta	$R_{PB} = \alpha_4 + R_L\beta + Z'_1 p + \nu$	first element of $p = 0$	Beta versus domestic CAPM
Pricing Error Single Factor ICAPM	$R_{PB} = \alpha_5 + R_L\varphi + R_G\phi + \omega$	$\phi = 0$	Pricing error of domestic CAPM versus ICAPM
Exposure	$R_{PB} = \gamma_0 + R_L\gamma_1 + S'\gamma_2 + \epsilon$	$\gamma_2 = 0$	Exposure controlled for local market return
Total Exposure	$R_G = c_1 + S'f_{GS} + \eta_G$ $R_L = c_2 + R_Gf_{LG} + S'f_{LS} + \eta_L$ $R_{PB} = c_0 + S'c_1 + \eta_Gc_2 + \eta_Lc_3 + v$	$c_1 = 0$	Exposure controlled for orthogonalized local and global market return
Currency and Country Risks Betas	$R_{PB} = \alpha_1 + R_Gd_1 + S'd_2 + C'_Rd_3 + u$	$d_2=0$ and $d_3=0$	Exposure controlled for global market return

Our investigation concerns the possible differences between expected returns implied by ICAPM and those generated by domestic betas. The hypotheses about the cross section of α 's will not be tested.⁸Our results might be understood as an assessment of the question if international risk factors could be used to explain the asset pricing anomalies of the domestic CAPM.

3 Empirical Strategy and Data

We performed the pricing error test, suggested on table 1, according three investors' points of view. On the first implementation, we focused on the Brazilian investor's point of view. More specifically, we used the following variables: Petrobras ordinary stock negotiated at Ibovespa, exchange rates relative to Real, Morgan Stanley Capital International Index (MSCI) as global market return and Ibovespa index. We obtained exchange rate returns for Argentina, Brazil, Chile and Colombia. We tried to expand the set of exchange rates in the sample to all Latin American countries where Petrobras does business but, unfortunately, due to multicollinearity among exchange rate returns of Equator, Mexico, Peru and Venezuela these countries were taken out of the sample.

On the second implementation, we still kept the Brazilian investor's point of view but now adding an instrument related to the country risk. As a measure of such variable we used the Emerging Markets Bond Index (EMBI) for the countries on the sample.⁹

⁸As Koedijk et al. (2002) observer for the domestic CAPM it has been well recorded tha betas cannot explain the cross-section of expected returns and that α_i statistically differs from zero for portfolios chosen on market capitalization size or book-to-market ratio. Fama and French (1998) show that these empirical results hold for many countries.

⁹That remain the same as the in first implementation.

The third implementation, aimed at the US investor's using Petrobras ADR return negotiated at NYSE, exchange rates returns relative to Dolar, MSCI, S&P 500 and country risk measured by EMBI. The countries remained the same.

The theoretical model and the econometric tests performed on the first implementation are exactly the as those developed by Koedijk et al. (2002). More specifically, the instruments Z in equation (2) do not contain the country risk returns. As consequence, any of the pricing error tests deal with d_3 . However, for the other implementations, the theoretical specification and econometric test are exactly the ones presented on section 2.

In our empirical analysis we considered sample period from 13.feb.2002 to 18.oct.2006 amounting to 1220 daily observations after missing values exclusions.

4 Results

Tables 2,3 and 4 bellow show the p-values for the pricing errors test for each of the three implementations mentioned on section 2. Also for each investor's point of view we calculate Petrobras direct and indirect beta (tables 2A, 3A and 4A). The direct beta was obtained from multifactor ICAPM d_1 and are equal to the OLS estimate of d_1 in the regression $R_{PB} = \alpha_1 + R_G d_1 + S' d_2 + u$. The indirect beta was calculated as the product of b from the domestic CAPM $R_{PB} = \alpha_2 + R_L b + \epsilon$ and the estimate of d_{L1} of the domestic market portfolio priced with the multifactor ICAPM, $R_L = \alpha_L + R_G d_{L1} + S' d_{L2} + u_L$.

As it can be seen in table 2 below, on the first implementation the PE test indicates an insignificant difference between domestic and international CAPM estimates. In particular, the PESF test suggests that global market index does not seem to accomplish new information regarding risk diversification as those contained in the local market index. The same happens with the exchange rate variations as pointed out in the exposure (E) test. However, it is clear from the TE test that exchange rate matters to explain the stock returns. The same is obtained when CB test is performed.

Table 2: First Implementation Results - Brazilian Investor Point of View

	Pricing Error Test (PE)	Global Beta (GB)	Pricing Error Single Factor ICAPM (PESF)	Exposure (E)	Total Exposure (TE)	Currency Betas (CB)
H_0	$p = 0$	first element of $p = 0$	$\phi = 0$	$\gamma_2 = 0$	$c_1 = 0$	$d_2 = 0$
P-values	0.5330* 0.5328**	0.8550* 0.8550**	0.1281* 0.1278**	0.7721* 0.7721**	0.0000* 0.0000**	0.0000* 0.0000**

* Associated with a F -statistic;

** Associated with a chi-square statistic.

Table 2A
Direct Beta vs Indirect Beta

	Direct Beta d_1 of the ICAPM	Indirect Beta: $d_{L1} * b^{(A)}$
Petrobras	0.441171	0.4347984

(A) d_{L1} is the first element of d_L that is the global beta of local market.

Yet regarding the Brazilian investor's point of view, but now adding country risk instruments, the equivalence between CAPM and ICAPM is rejected as indicated by the PE test. Again the global market index did not bring any relevant information regarding risk diversification as suggested by the GB and PESF tests. As in the first implementation, the Exposure test indicates that exchange rate risk seems to be diversified in the local market index although it is relevant according to the TE test. Moreover, as result of CCB test, country risks is relevant in explaining the stock returns. These tests results are presented in table 3 below.

Table 3: Second Implementation Results - Brazilian Investor Point of View

	Pricing Error Test (PE)	Global Beta (GB)	Pricing Error Single Factor ICAPM (PESF)	Exposure (E)	Total Exposure (TE)	Currency and Country Betas (CCB)
H_0	$p = 0$	first element of $p = 0$	$\phi = 0$	$\gamma_2 = 0$	$c_1 = 0$	$d_2 = 0$ and $d_3 = 0$
P-values	0.0000* 0.0000**	0.6483* 0.6482**	0.1281* 0.1278**	0.3912* 0.3908**	0.0000* 0.0000**	0.0000* 0.0000**

* Associated with a F -statistic;

** Associated with a chi-square statistic.

Table 3A
Direct Beta vs Indirect Beta

	Direct Beta d_1 of the ICAPM	Indirect Beta: $d_{L1} * b^{(A)}$
Petrobras	0.438374	0.0233914

(A) d_{L1} is the first element of d_L that is the global beta of local market.

When the look was changed and the US investor's point of view is considered, the PE test once again indicated that the cost of equity estimated from domestic and international pricing models are different. Moreover, all global factors seem to be relevant to explain the company's stock returns. These results suggest that international pricing models should be used in estimating the cost of equity for Petrobras. The results are presented in table 4 below.

**Table 4: Third Implementation Results - US Investor Point of View
with Country Risk**

	Pricing Error Test (PE)	Global Beta (GB)	Pricing Error Single Factor ICAPM (PESF)	Exposure (E)	Total Exposure (TE)	Currency and Country Betas (CCB)
H_0	$p = 0$	first element of $p = 0$	$\phi = 0$	$\gamma_2 = 0$	$c_1 = 0$	$d_2 = 0$ and $d_3 = 0$
P-values	0.0000* 0.0000**	0.0000* 0.0000**	0.0000* 0.0000**	0.0000* 0.0000**	0.0000* 0.0000**	0.0000* 0.0000**

* Associated with a F -statistic;

** Associated with a chi-square statistic.

**Table 4A
Direct Beta vs Indirect Beta**

	Direct Beta d_1 of the ICAPM	Indirect Beta: $d_{L1} * b^{(A)}$
Petrobras	0.675551	0.8883844

(A) d_{L1} is the first element of d_L that is the global beta of local market.

5 Variance Decomposition: local, global, currency and country risk

This section further explores our pricing error tests results. We now decompose the variance of Petrobras Stock returns to assess the contributions of systematic local market risk, global risk and specific risk to this metric.

Our starting point is the following regression model:

$$R_{PB} = \alpha_4 + R_L\beta + Z'_\perp p + \nu \quad (10)$$

with local market index R_L and the orthogonalized global factors Z'_\perp . Koedijk et al. (2002) showed that by taking the variance of both sides of eq. 9, the volatility of Petrobras Stock Returns can be expressed as:

$$Var[R_{PB}] = b^2 Var[R_L] + p'(\Omega + (\Omega d_L d'_L \Omega) / \sigma_L^2) p + \sigma^2 \quad (11)$$

In eq. 11 the total variance of Petrobras Stock returns ($Var[R_{PB}]$) is decomposed into systematic local market risk ($b^2 Var[R_L]$) additional global risk in Z (exchange rate risk and country risk, related to the covariance matrix Ω of Z and specific risk σ^2). Observe that under our null hypotheses that both CAPM and ICAPM models are equivalent, that is $p = 0$, then the contribution of the

global factors should be zero. Tables 5 to 7 below show the variance decomposition for each implementation performed.

Note that in the first implementation, according to models equivalence indicated by the pricing error test in which $H_0 : p = 0$, the contribution of the global factors to the total variance of Petrobras Stock is almost zero (= 0.86%). In the second implementation however, where the pricing error test did not indicate the models equivalence, global factors had a strong influence over the total variance (44.28%). Moreover the local factors did not exert any influence over the volatility of Petrobras returns. On the the third implementation local factors backed to show strong influence over the total variance.

Summing up, according to the international investor point of view (third implementation) although it seems that global factors are relevant to price Petrobras stocks, the volatility of its returns were strongly influenced by local factors. Moreover, in all implementations the contribution of specific factors were quite large.

A tentative explanation of this findings is related to what De M enil (1999) calls lack of *real* capital markets integration. According to his results, both cyclical, structural and institutional country specific factors significantly contribute to explain differences in return on equity for large non-financial firms. In particular, he found important effects for the regulatory environment where he pointed to labor market regulation and product market regulation as significant determinants of firms performance.

In short, with a lack of real capital market integration and substantial cross-country's difference in market regulation (specially in Brazil) a country's fortune and the fortunes of the firms operating in this country are closely tied together. Although increasing in the harmonization of regulatory policies as is happening in the EU will reduce these structural differences, substantial differences remain between Brazil (where Petrobras gets most of its revenue) and the develop countries. Therefore these differences have been used by individual investors for the purpose of pricing assets. Note that the lack of real integration is separate from the issue of financial integration. The assumption that the ICAPM is the null implies that we are assuming financial integration. Consequently, our results have no implication for the global financial markets integration. Rather, these markets should be used for diversification purposes.

**Table 5: Decomposition of Variance: local, global and currency factor
First Implementation - Brazilian Investor's Point of View**

Total Variance	Systematic Local Market Risk	Global Risk and Exchange Rate Risk	Specific Risk
$Var[R_{PB}]^{(A)}$	$b^2 Var[R_L]^{(B)}$	$p'(\Omega + (\Omega d_L d_L' \Omega) / \sigma_L^2) p$	$\sigma^2^{(C)}$
	53.14 %	0.86 %	46.00 %

^(A) $Var[R_{PB}]$ is the variance of Petrobras return;

^(B) $Var[R_L]$ is the variance of local market return;

^(C) σ^2 is the variance of residuals μ_L in equation $R_L = a_L + Z' d_L + \mu_L$

**Table 6: Decomposition of Variance: local, global and currency factor
Second Implementation - Brazilian Investor's Point of View with Country Risk**

Total Variance	Systematic Local Market Risk	Global Risk, Exchange Rate Risk and Country Risk	Specific Risk
$Var[R_{PB}]^{(A)}$	$b^2 Var[R_L]^{(B)}$	$p'(\Omega + (\Omega d_L d_L' \Omega) / \sigma_L^2) p$	$\sigma^2^{(C)}$
	0 %	44.28 %	55.72 %

^(A) $Var[R_{PB}]$ is the variance of Petrobras return;

^(B) $Var[R_L]$ is the variance of local market return;

^(C) σ^2 is the variance of residuals μ_L in equation $R_L = a_L + Z' d_L + \mu_L$

**Table 7: Variance Decomposition: local, global, currency factor and country risk
Third Implementation - US Investor's Point of View**

Total Variance	Systematic Local Market Risk	Global Risk, Exchange Rate Risk and Country Risk	Specific Risk
$Var[R_{PB}]^{(A)}$	$b^2 Var[R_L]^{(B)}$	$p'(\Omega + (\Omega d_L d_L' \Omega) / \sigma_L^2) p$	$\sigma^2^{(C)}$
	44.07 %	2.44 %	53.49 %

^(A) $Var[R_{PB}]$ is the variance of Petrobras return;

^(B) $Var[R_L]$ is the variance of local market return;

^(C) σ^2 is the variance of residuals μ_L in equation $R_L = a_L + Z' d_L + \mu_L$

6 Conclusion

While economic theory suggests the use of an ICAPM to price assets in integrated capital markets, domestic CAPM does not yield an incorrect estimate of the cost of equity (Koedijk, et. al (2002)).

Although we assessed the models equivalence for only one company, we may say that our results stand in sharp contrast with those presented in the literature. More specifically, two out of three

PE tests indicated that international and domestic CAPM does not yield the same cost of equity estimation for Petrobras.

Moreover, in line with the evidence available about the theme, we also found that exchange rate and country risks variations are relevant to price domestic assets internationally.

Equally interesting is that, although the general evidence about the equivalence between domestic and international CAPM for Petrobras, suggests the relevance of global factors for the asset pricing, the specific country circumstances together with Petrobras particular capital structure (a state owned company), are the main sources of the returns volatility (see the third implementation variance decomposition).

Further research is required however, in order to quantify the cost of equity differential implied by both pricing models. Some assessment is also needed to examine the specific contribution of each global factor on the stock return.

7 References

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