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Present value model between prices and dividends with constant and time-varying expected returns: enterprise-level Brazilian stock market evidence from non-stationary panels

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ABSTRACT

The Present Value Model (PVM) – in which current security prices depend upon the present value of future discounted dividends, where the discount rate is equivalent to the required rate of return – is one of the long-standing principles of Finance Theory. The objective of this work is to analyze the validity of the PVM between prices and dividends at the firm level from panel techniques applied to non-stationary and potentially cointegrated processes for the Brazilian stock market. Considering the Present Value Model with Constant and Time-Varying Expected Returns, the evidence that real (log) prices and real (log) dividends are non-stationary I(1) and (log) price-dividend ratio is I(0) cannot be rejected. Regarding FMOLS and DOLS estimators for panel cointegration models, stock prices are found to be overvalued under either constant or time-varying expected returns assumption.

Keywords: Present value model; unit root; cointegration; non-stationary panels.

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1. INTRODUCTION

Testing expectations and rationality in financial markets, the Present Value Model (PVM) states that current security prices equals the summed discounted value of future dividends, where the discount rate is equivalent to the required rate of return. Scholars have displayed considerable interest in the underlying model due to macroeconomic events (historical collapses in stock prices) in which prices possibly deviated from their fundamental values (low dividends payouts and record high stock prices suggested stock price overvaluation); a theoretical and statistical debate on the possibility to forecast security prices (random walk, martingale properties); estimation and inference in the presence of nonstationarity (stochastic trend), particularly in the panel data framework.

Previous empirical analysis of the PVM and of the long-run relationship between prices and dividends is predominantly based upon two cointegration approaches. First, as in Campbell and Shiller (1987), real prices and real dividends should cointegrate, i.e. exhibit a stable long-run relationship. In this case, the cointegrating parameter provides an estimate of the inverse discount rate. Second, as in Campbell and Shiller (1988a,b), allowing for a time-varying discount rate, the difference between log dividends and log prices must exhibit $I(0)$ stationarity. Although cointegration tests do not reveal the existence of bubbles directly, the presence of cointegration can be explained by stock price deviation in vis-a-vis its fundamentals, which enables the indirect inference towards the existence of bubbles.

Assuming rational expectations (RE), the underlying model for stock prices has been tested since the decade of 1980 for U.S. data and many studies indicate that stock prices were more volatile than the PVM theoretically implied. Shiller (1981) developed a seminal work on the model assessment employing variance bounds tests, from which a theoretical and quantitative discussion has emerged, notably through the works of Grossman and Shiller (1981), LeRoy e Porter (1981), Marsh and Merton (1986), Shiller (1989), Scott (1990), Mankiw, Romer e Shapiro (1985, 1991), Gilles e LeRoy (1992), LeRoy and Parke (1992) as well as important statistical criticism in relation to small sample bias and finite sample considerations from Flavin (1983) and Kleidon (1986).

As stock prices assumed higher values due to the rapid development of the stock market throughout the decade of 1990, scholars and market analysts questioned the PVM validity and the effects of interest rates on the stock price-dividend relation. General consensus is that fundamentals have basically remained unchanged throughout the period considering the large rise in stock prices at the end of last century and their subsequent fall, which implies that the market became significantly overvalued and fundamentals subsequently reasserted themselves. Among the most prominent proponents of this view is Campbell and Shiller (2001). Nevertheless, an alternative view stated that stock prices reflected investors' permanently revised expectations of higher future earnings and dividends due to productivity gains originating from technological change.

Evidence for I(0) stationarity of the log price-dividend ratio is scarce. Campbell and Shiller (1987), Diba and Grossman (1988) Brooks and Katsaris (2003), Kapetanios, Shin and Snell (2006) obtain different results from cointegration tests between prices and dividends. Froot and Obstfeld (1991), Lamont (1998), Balke and Wohar (2002) observe I(1) non-stationarity of the price-dividend ratio. Cecchetti, Lam and Mark (1990), Timmermann (1995), Kim, Morley and Nelson (2001), Dupuis and Tessier (2003), Manzan (2004), Su, Chang and Chen (2007) obtain results that might vary upon the econometric approach adopted, sample size and the degree of volatility encountered in specific intervals.

The examination of individual firms is unusual, since most time-series studies adopt the S&P 500 index as the analysis benchmark. Thus, Campbell and Shiller (1987, 1988), Lee (1995), Sung and Urrutia (1995), Timmermann (1995), and Crowder and Wohar (1998) estimate the present value relation on aggregate level over a significant length of time, in accordance to the concept stated by Stoja and Tucker (2004) that the power of unit root and cointegration tests is based on the length of time period rather than the number of observations.

Meanwhile, it is recognized that the application of firm-level data allows for observation of patterns and relationships that may not be evidenced through stock market index analysis, since an index application may smooth noise or volatility from individual firms. Cohen, Polk and Vuolteenaho (2001), Vuolteenaho (2002) and Jung and Shiller (2005) suggest a greater likelihood for the PVM to be validated at the firm level rather than at the aggregate level (stock market index). As Jung and Shiller (2005) analyze, although information about cash flows and future prospects of individual companies are well understood by investors, the same degree of clarity may not apply to the market with respect to changes in the pattern of aggregate dividends or earnings flow in a country's stock market.

Recent works examining the validity of the PVM at the aggregate stock market index level are those of Campbell and Shiller (1987), Campbell and Shiller (1988a,b), Fama and French (1988), Cecchetti, Lam and Mark (1990), Timmermann (1995), Kim, Morley and Nelson (2001), Dupuis and Tessier (2003), Manzan (2004), Su, Chang and Chen (2007). Some Brazilian stock market empirical findings applying similar methodology as Campbell e Shiller (1987, 1988a,b) were obtained by Anchite and Issler (2001) and Morales (2006). Considering these latter authors, whereas the PVM with time-varying returns is not statistically rejected, evidence points either towards a rejection or failure to reject the model, though with weaker statistical significance.

Concerning the few empirical works testing the validity of the PVM at the firm level, Nasseh and Strauss (2004), Goddard, McMillan and Wilson (2008) employ U.S. and U.K. data, respectively, in order to assess the underlying model under time-varying returns, and point out that panel methods are particularly useful when the available time period is relatively short, providing a gain in power precision and avoiding structural shifts in the data that occur over longer time periods. These authors found that the examination of the rational valuation formula at the firm level appears to be somewhat more supportive of the present value model than previous studies based on aggregated stock price and dividend index data.

Thus, the following research question is posed in this paper: In Brazil, is there a stable long-run relationship between the present value of an asset (real prices) and its respective discounted earnings (real dividends), at the microeconomic level (firm level), in order to validate the Present Value Model and, therefore, expectations and rationality of economic agents in the financial market, through first generation unit root and cointegration tests as well as dynamic panel techniques?

The remainder of the paper is structured as follows. In Section 2, the Present Value Model is briefly discussed. Section 3 provides technical details of the panel unit roots and cointegration tests adopted. Section 4 reports and interprets the results of these tests. Section 5 summarizes and concludes.

2. THE PRESENT VALUE MODEL

The PVM relates the present value of expected dividends and the stock price under the implied condition of RE as follows:

$$P_t = \sum_{i=1}^{\alpha} \delta^1 E_t D_{t+i} \quad (1)$$

Campbell and Shiller (1987) demonstrated that, under the transversality condition, there will be only one possible price in order to exclude the presence of bubbles and, therefore, the possibility of many solutions to the price equation above. Assuming the validity of the model under this assumption, Campbell and Shiller (1987), showed that prices and real dividends are cointegrated and the cointegration vector equals to $(1, R^{-1})$, as the following equation below:

$$P_t - R^{-1} = R^{-1} E_t \sum_{i=1}^{\propto} (1+R)^{-1} \Delta D_{t+1+i} \quad (2)$$

The methodology employed by Campbell and Shiller (1988), in order to circumvent the nonstationarity of the price and dividends series and hence admit the possibility of time-varying discount rates, suggests the logarithmic transformation of the variables $[d = \ln(D)\,; p = \ln(P)\,; r = \ln(1+R)]$ as follows:

$$p_t = \left[\frac{k}{1-\rho}\right] + E_t[(1-\rho) \sum_{i=1}^{\infty} \rho^i d_{t+i+1} - \sum_{i=0}^{\infty} \rho^i r_{t+i+1}] \quad (3)$$

where $k = -\ln(\rho) + (1-\rho)\ln(\rho - 1)$ and $\rho = 1/[\exp(d-p)]$. Again, under the transversality condition, the above equation can be rewritten as:

$$p_t - d_t = -k(1-\rho)^{-1} + E_t\left[\sum_{i=1}^{\infty} \rho^i (\Delta d_{t+i+1} - r_{t+i+1})\right] \quad (4)$$

If the variation in the dividend and discount rate is stationary, the spread ($h = \ln(P_t/D_t) = p_t - d_t$) will be stationary and therefore the logarithms of prices and dividends will be cointegrated with the vector equal to $(1, -1)$. Therefore, it would be sufficient to prove that the spread is $I(0)$ in order to validate the present value model. The spread and variation in dividends can be modeled with an Autoregressive Vector, with the restriction that returns are unpredictable $E(h_{1,t+1}/h_{t,}\Delta d_t) = 0$. As a result, the spread should Granger cause the dividends.

Basically, three types of criticism can be inferred regarding the procedure above. First, as Froot and Obstfeld (1991) note, it would be to oppose empirical evidence contrary to the results above; second, according to Evans (1991), it would be to examine the assumptions of the model and verify, for instance, the existence of bubbles; and the third, as Gil-Alana (1999) and Caporale and Cerrato (2004) observe, would be the adequacy of the tests in relation to facts such as mean reversion.

Long processes of mean reversion and persistent shocks imply fraction order of cointegration, making traditional test results inconclusive, although it remains a long-term equilibrium relationship between prices and dividends. It is worth stating that the present value model is not incompatible with the existence of bubbles and mean reversion. Hence, the econometric approach should be modified to consider these facts.

3. NON-STATIONARY PANEL ECONOMETRIC PROCEDURES

Until recently, panel data investigation did not have available the crucial stationarity (ADF and Phillips-Perron) and cointegration (Engle-Granger and Johansen) tests, which has been motivated by the growing involvement of macroeconomic applications in the panel data tradition, whose focus has shifted towards examining the asymptotics of macro panels with large T (length of the time series) and N (number of cross-sections). The adoption of similar tests as available in the time series framework on panel data is yet in progress.

The major differences between time-series and panel unit root and cointegration tests can be summarized as follows: observation of patterns and relationships in the data that may not be detectable at the stock market aggregate level due to data smoothing caused by aggregation; consideration of different degrees of heterogeneity among individuals; in panel data analysis, the validity of rejecting a unit root may be subject of discussion; the power of panel unit root tests increases as N increases, with increased robustness in relation to the standard low-power DF and ADF tests applied to small samples; additional cross-sectional components incorporated in panel data models provide better properties of panel unit root tests; panel cointegration tests have increased power especially for small T, commonly encountered when data is limited to the post war period.

Testing for unit roots in panels is not a common practice as it is testing for unit roots in time series studies. The statistical methods applied in this paper relate to the works by Levin and Lin (1993), Levin, Lin and Chu (2002), Im, Pesaran and Shin (2003), Breitung (2000), Fisher-ADF and Fisher-PP proposed by Maddala and Wu (1999) and Choi (2001) and Hadri (2000). Recent panel cointegration tests applied are those developed by Kao (1999), Pedroni (2000, 2004) and Maddala and Wu (1999).

The Levin, Lin and Chu (LLC) model is an extension of the Dickey-Fuller (DF) unit root test. The null hypothesis concerns a common unit root process. This model allows for two-way fixed effects – fixed effects specific to units a_i and time trends specific to units θ_t: $\Delta Y_{i,t} = a_i + \rho Y_{i,t-1} + \sum_{k=1}^{n} \emptyset_k \Delta Y_{i,t-k} + \delta_i t + \theta_t + u_{it}$.

Im, Pesaran and Shin (IPS) test is an extension of the LLC model. Its null hypothesis is that all series are non-stationary ($\rho_i = 1$ for all i) under the alternative that a fraction of the panel series are stationary ($\rho < 1$ for at least one i). It is a sharp contrast with the LLC model, which presumes that all series are stationary under the alternative hypothesis. LLC restricts ρ to be homogeneous across all i and IPS allows for heterogeneity in the equation: $Y_{i,t-1}$: $\Delta Y_{i,t} = a_i + \rho_i Y_{i,t} + \sum_{k=1}^{n} \phi\, \Delta Y_{i,t-k} + \delta_i t + u_{it}$.

Breitung (2000) studies the local power of LLC and IPS tests statistics against a sequence of local alternatives. Breitung finds that the LLC and IPS tests suffer from a dramatic loss of power if individual specific trends are included, which is due to the bias correction that also removes the mean under the sequence of local alternatives. Breitung suggests a test that does not employ a bias adjustment whose power is substantially higher than that of LLC and the IPS tests using Monte Carlo experiments. Its construction is similar to the LLC test using forward orthogonalization transformation employed by Arellano and Bover (1995).

Fisher-ADF and Fisher-PP tests use Fisher's (1932) results to derive tests that combine the *p*-values from individual unit root tests. Defining π_i as the *p*-value from any individual unit root test for cross-section i, then under the null of unit root for all *N* cross-sections, we have the asymptotic result that: $-2\sum_{i-1}^{N} \log(\pi_i) \to \chi^2_{2N}$. Thus, the χ^2 statistic and the standard normal statistic are employed using the individual ADF and Phillips-Perron unit root statistics. The null and alternative hypotheses are the same as the IPS test.

The Hadri test is a Lagrange Multiplier (LM) test based on the residuals. It is a generalization of the KPSS from time series to panel data. Its null hypothesis indicates no unit root in any of the series in the panel. Its alternative hypothesis is that at least one unit root in the panel exists. The traditional and alternative (allows for heteroskedasticity $\sigma^2_{\varepsilon i}$ across i) LM statistics is given as: $LM_1 = \frac{1}{N}(\sum_{i=1}^{N} \frac{1}{T^2} \sum_{t=1}^{T} S_{it}^2)/\hat{\sigma}_{\varepsilon}^2$ and $LM_2 = \frac{1}{N}(\sum_{i=1}^{N} (\frac{1}{T^2} \sum_{t=1}^{T} S_{it}^2/\hat{\sigma}_{\varepsilon i}^2))$.

The purpose of testing for cointegration is primarily related with the investigation of spurious regression, which occurs only in the presence of nonstationarity. Following the same logic as the panel unit root tests, panel cointegration tests can be motivated by the search for more powerful tests than those obtained by applying individual time-series cointegration tests. The latter models have low power especially for short T and short span of the data which is often limited to post-war annual data.

Kao tests are residual-based DF and ADF tests for cointegration in panel data. The null hypothesis is that of no cointegration. This test imposes homogeneous cointegrating vectors and AR coefficients. However, it does not allow for multiple exogenous variables on the cointegrating vector nor does it identify the cases where more than one cointegrating vector exists. Considering $y_{it} = x_{it}'\beta + z_{it}'\gamma + e_{it}$, the ADF test can be constructed as

$ADF = t_{ADF} + \sqrt{6N}\hat{\sigma}_v/(2\hat{\rho}_{0v})/\sqrt{\hat{\sigma}_{0v}^2/(2\hat{\sigma}_v^2) + 3\hat{\sigma}_v^2/(10\hat{\sigma}_{0v}^2)}$ where t_{ADF} is the t statistic for ρ in $\hat{e}_{it} = \rho\hat{e}_{it-1} + \sum_{j=1}^{p}\vartheta_j\Delta\hat{e}_{it-j} + v_{itp}$.

Pedroni multiple tests differ from the previous approach in assuming trends for the cross-sections and in considering the null that of no cointegration. The panel regression model has the following form: $Y_{i,t} = a_i + \delta_t + \sum_{m=1}^{M}\beta_{mi}X_{mi,t} + u_{i,t}$. They allow for multiple regressors, for the cointegration vector to vary across different panel sections, and also for heterogeneity in the error across cross-sectional units. Seven different cointegration statistics are proposed to capture the within and between effects in the panel.

In the Johansen-Fisher panel test, Maddala and Wu (1999) uses Fisher's (1932) combined test to propose an alternative approach to test cointegration in panel data by the combination of tests from individual cross-sections to obtain the test statistics for the entire panel. If π_i is the p-value of an individual cointegration test for the cross-section i, then under the null hypothesis for the panel: $-2\sum_{i=1}^{N}\log(\pi_i) \rightarrow \chi^2 2N$. The χ^2 reported is based on the p-values of MacKinnon-Haug-Michelis (1999) for Johansen's cointegration trace and maximum eigenvalue test.

In panel cointegrated regression models, the asymptotic properties of the estimators of the regression coefficients and the associated statistical tests differ from those of the time series cointegration regression models. A long run relationship commonly observed in macroeconomic and financial data is often predicted by economic theory. It is thus significant to estimate regression coefficients and test whether restrictions established are empirically satisfied such as a one-for-one cointegrating equilibrium between prices and dividends, which also implies that the price-dividend ratio is stationary.

Standard regression of price on dividends indicate that current price is a function of past dividend innovations as lag values are likely to be significant, but dividend innovations are subject to a moving average (MA) process or entail a relatively large temporary component relative to stock prices, leading to an underestimation of the coefficient related to dividends. Regressing dividends on price avoid these implications and, since price incorporate all current innovations on dividends and is forward-looking, past lags should be insignificant.

Pedroni's (2000, 2001) FMOLS (Fully Modified Ordinary Least Squares) and DOLS (Dynamic Ordinary Least Squares) are employed to regress dividends on prices. The basic idea of these estimators is to correct for endogeneity bias and serial correlation, allowing for standard normal inference. Both estimators start from: $y_{1,i,t} = \mu_i + \beta_i' y_{2,i,t} +$

$u_{i,t}$, in which the scalar $y_{1,i,t}$ and the $(p-1) \times 1$ vector $y_{2,i,t}$ are firm specific variables, $i = 1, \dots, N$ and $t = 1, \dots, T$.

The FMOLS estimator applies a non-parametric correction employing $\hat{u}_{i,t}$ and $\Delta y_{2,i,t}$. The DOLS estimator applies a parametric correction for the endogeneity by augmenting the underlying starting equation with leads and lags of $\Delta y_{2,i,i}$: $y_{1,i,t} = \mu_i + \beta_i' y_{2,i,t} + \sum_{s=-s_i}^{s_i} \tau_{i,s}' \Delta y_{2,i,t-s} + v_{i,t}$. Information on the cointegratimg vectors is then pooled to generate a more precise estimation and more powerful tests in relation to single equation methods. The hypothesis $H_0: \beta_i = 1, \forall i$ is tested versus $H_1: \beta_i \neq 1$ using the *t*-statistics.

4. RESULTS

In order to assess the present value model at the firm level for the Brazilian stock market, datasets on prices and dividends have been used at an annual frequency for the period of January 1987 to December 2008. The initial period is based on the availability of data platform, considering that the power of unit root and cointegration tests focuses both on cross sections (*N*) and, more remarkably, on the extension of the time period considered (*T*), as evidenced by Shiller and Perron (1985) and Hakkio and Rush (1991). Stock prices are adjusted for dividends, bonuses, and stock splits. Following the assumptions of the present value model, the annual series of dividends per share correspond to 12 months and the annual series of prices correspond to the end of the frequency. All monetary values have been collected from the Economatica consulting platform and deflated by the IGP-DI index of July 31st, 2009. Thus, real terms converted by price inflation index (rpi_t) have been used and no distortion is generated by any inflationary effect.

The sample selection criteria established for Brazilian stocks are: i) to belong or to have belonged to the theoretical portfolio over the period of 1986 to 2009, ii) to have observations comprising the initial and final sampling period adopted, assuming that the present value model can be more effective when applied to companies in a stage of maturity in their life cycle. The IBOVESPA is the most important indicator of the average performance of stocks for the Brazilian stock market, having not suffered any modifications since its inception in 1968. This index is the current value, in actual cash, of a theoretical portfolio of shares constituted on January 2nd, 1968 (basis value: 100 points) from a hypothetical application. The assumption is based on no additional investments since then, considering only adjustments made to the distribution of dividends by the issuing companies.

The following IBOVESPA companies presented in Table 1 have been analyzed for the evaluation of the present value model with constant and time-varying expected returns from unit root and cointegration techniques for non-stationary panels. Stock quotes have been updated to changes due to financial events such as M&A.

Table 1 – Companies by Class, Code and Sector

COMPANY	CLASS	CODE	SECTOR	COMPANY	CLASS	CODE	SECTOR
Alpargatas	ON	ALPA3	Textile Industrial	Itausa	PN	ITSA4	Business Services
Alpargatas	PN	ALPA4	Textile Industrial	ItauUnibanco	ON	ITUB3	Financial
Ambev	PN	AMBV4	Beverages	ItauUnibanco	PN	ITUB4	Financial
Aracruz	PNB	ARCZ6	Paper & Paper Products	Klabin S/A	ON	KLBN3	Paper & Paper Products
Brasil	ON	BBAS3	Financial	Klabin S/A	PN	KLBN4	Paper & Paper Products
Bradesco	ON	BBDC3	Financial	Lojas Americ	ON	LAME3	Department Stores
Bradesco	PN	BBDC4	Financial	Lojas Americ	PN	LAME4	Department Stores
Bardella	PN	BDLL4	Farm & Construction Machinery	Metal Leve	PN	LEVE4	Auto Parts
Alfa Consorc	PNF	BRGE12	Business Services	Light S/A	ON	LIGT3	Electric Utilities
Alfa Invest	ON	BRIV3	Financial	Mangels Indl	PN	MGEL4	Steel & Iron
Alfa Invest	PN	BRIV4	Financial	Petrobras	ON	PETR3	Oil & Gas Drilling & Exploration
Braskem	PNA	BRKM5	Chemicals	Petrobras	PN	PETR4	Oil & Gas Drilling & Exploration
Cesp	PNA	CESP5	Electric Utilities	Paranapanema	PN	PMAM4	Metal Fabrication
Grazziotin	PN	CGRA4	Department Stores	Pro Metalurg	PNB	PMET6	Auto Parts
Cacique	PN	CIQU4	Food & Beverages	Alfa Holding	PNB	RPAD6	Business Services
Cemig	PN	CMIG4	Electric Utilities	Sadia S/A	PN	SDIA4	Meat Products
Confab	PN	CNFB4	Steel & Iron	Suzano Papel	PNA	SUZB5	Paper & Paper Products
Souza Cruz	ON	CRUZ3	Cigarettes	Telesp	ON	TLPP3	Telecom Services
Duratex-Old	PN	DURA4	Lumber, Wood Production	Telesp	PN	TLPP4	Telecom Services
Eluma	PN	ELUM4	Metal Fabrication	Tupy	PN	TUPY4	Auto Parts
Estrela	PN	ESTR4	Toy & Hobby Stores	Unibanco	ON	UBBR3	Financial
Eucatex	PN	EUCA4	Lumber, Wood Production	Unibanco	PN	UBBR4	Financial
Ferbasa	PN	FESA4	Steel & Iron	Savarg	PN	VAGV4	Air Services
Forjas Taurus	PN	FJTA4	Steel & Iron	Vale	ON	VALE3	Steel & Iron
Gerdau Met	PN	GOAU4	Steel & Iron	Vale	PNA	VALE5	Steel & Iron
Guararapes	ON	GUAR3	Textile Industrial	Fibria	PN	VCPA4	Paper & Paper Products
Yara Brasil	PN	ILMD4	Agricultural Chemicals				

Source: Elaborated by the authors.

4.1 PRESENT VALUE MODEL: CONSTANT EXPECTED RETURNS

To verify whether the real prices and real dividends series are $I(1)$ non-stationary, we apply unit root tests to the restricted model (no exogenous variable), also allowing for individual effects (individual intercept), individual effects and individual linear trends (intercept and trend). The sensitivity of the results is verified in the presence of individual effects and individual linear trends, as well as for *P* specific lags in orders from 0 to 4, as presented in Tables 2 and 3.

Considering all tests for the presence of a unit root in the real price series of the companies composing the panel, they reveal sensitivity to the presence of individual effects and individual linear trends as well as to the lag order, as expected and verified in Goddard *et al*. (2008). Reverting the null hypothesis in order to test for stationarity in all companies using the Hadri test along with the Heterocedastic Consistent Z-stat, in both individual models with intercept and intercept and trend, the null hypothesis of no unit root is rejected at the 1% level, not confirming that $p_{it}/rpi_t \sim I(0)$, noting that real prices as stationary processes present no theoretical support. Hence, we cannot reject the hypothesis that the real price series of the companies surveyed have a unit root for the entire panel or for most companies analyzed, considering the different null and alternative hypotheses tested.

Table 2 – Panel Unit Root Tests: p_{it}/rpi_t

Model	Restricted		Individual Intercept		Intercept and Trend	
	Automatic Lag Length Selection (AIC): 0 to 4					
Método	*Stat.*	Prob.	*Stat.*	Prob.	*Stat.*	Prob.
Ho: Unit Root (common unit root process)						
Levin-Lin-Chu *t**	-2,2832	[0.0112]**	18,5787	1.0000	15.2497	1,0000
Breitung *t*-stat	-	-	-	-	3.39507	0,9997
Ho: Unit Root (individual unit root process)						
Im-Pesaran-Shin *W*-stat	-	-	2.07979	0,9812	-6,05231	[0.0000]***
Fisher-ADF Chi-Square	173.188	[0.0000]***	175.762	[0.0000]***	270.642	[0.0000]***
Choi-ADF Z-stat	1.70995	0.9564	2.61528	0.9955	-4,64084	[0.0000]***
Fixed Lags						
Method	*Stat.*	Prob.	*Stat.*	Prob.	*Stat.*	Prob.
Ho: Unit Root (common unit root process)						
Levin-Lin-Chu *t**						
0	-3,1526	[0.0008]***	-2,8701	[0.0021]***	-6,88928	[0.0000]***
1	-3,2934	[0.0005]***	-1,62736	[0.0518]*	-5,80197	[0.0000]***
2	-40,677	[0.0000]***	-84,909	[0.0000]***	-92,9979	[0.0000]***
3	1.15754	0,8765	22.4429	1,0000	23,6944	1,0000
4	-2,7979	[0.0026]***	28.2651	1,0000	38.5565	1,0000
Breitung *t*-stat						
0	-	-	-	-	2.66591	0.9962
1	-	-	-	-	3,7066	0,9999
2	-	-	-	-	3,27428	0,9995
3	-	-	-	-	3.03404	0.9988
4	-	-	-	-	3,50573	0.9998
Ho: Unit Root (individual unit root process)						
Im-Pesaran-Shin *W*-stat						
0	-	-	-1,21187	0,1128	-4,44501	[0.0000]***
1	-	-	1.12969	0,8707	-2,52375	0.0058
2	-	-	-15,5425	[0.0000]***	-18,1787	[0.0000]***
3	-	-	5.83310	1.0000	2.08716	0.9816
4	-	-	2.96120	0.9985	-0,11022	0,4561
Im-Pesaran-Shin *t*-bar						

0	-	-	-1,6744	-	[-2.69762]***	-
Fisher-ADF Chi-Square						
0	155.645	[0.0012]***	128.116	[0.0708]*	164.667	[0.0002]***
1	198,022	[0.0000]***	170.933	[0.0001]***	198.728	[0.0000]***
2	146,951	[0.0052]***	622.184	[0.0000]***	167,685	[0.0001]***
3	72,7228	0.9944	61.0590	0,9999	88,0442	0,8969
4	110,494	0,3631	118.111	0.1984	122,531	0.1300
Choi-ADF Z-stat						
0	-2,9011	[0.0019]***	-1,18919	0.1172	-4,47871	[0.0000]***
1	-0,5485	0,2917	1,15898	0,8768	-1,92918	[0.0269]**
2	2,22608	0,987	1.40693	0,9203	1,18908	0.8828
3	4,80871	1,0000	6,86059	1.0000	3,36174	0.9996
4	3.43865	0.9997	5.42836	1.0000	2.85895	0,9979
Fisher-PP Chi-Square	157.507	[0.0009]***	129.710	[0.0587]*	199.409	[0.0000]***
Choi-PP Z-stat	-2,3468	[0.0095]***	-0,87072	0.1920	-4,85371	[0.0000]***
Ho: Stationarity (common unit root process)						
Hadri Z-stat	-	-	18.1880	[0.0000]***	12.9798	[0.0000]***
Heterocedastic Consistent Z-stat	-	-	14.1587	[0.0000]***	14.2305	[0.0000]***

Note: ***, **, * represent test statistics significant to the 1%, 5%, and 10% levels, respectively. Probabilities for Fisher tests are computed using an asymptotic chi-square distribution. All other tests assume asymptotic normality. LLC, Fisher-PP and Hadri: Newey-West bandwidth selection using Bartlett kernel. Critical *t*-bar values obtained from original Im, Pesaran e Shin (2003) paper. In Hadri test, high correlation leads to severe size distortion, leading to over-rejection of the null.
Source: Elaborated by the authors.

Regarding the panel unit root tests applied to the dependent variable of the PVM, they also reveal sensitivity to the presence of individual effects and individual linear trends and the lag order. Using the Hadri test along with the Heterocedastic Consistent Z-stat, in both individual models with intercept and intercept and trend, the null hypothesis of no unit root is rejected at the 1% level, not confirming that $d_{it}/rpi_t \sim I(0)$, noting that real dividends as stationary processes present no theoretical support. Thus, we cannot reject the hypothesis that the real dividends series of the companies surveyed are integrated of order one for the entire panel or for most sample companies.

Table 3 – Panel Unit Root Tests: d_{it}/rpi_t

Model	Restricted		Individual Intercept		Intercept and Trend	
	Automatic Lag Length Selection (AIC): 0 to 4					
Method	*Stat.*	Prob.	*Stat.*	Prob.	*Stat.*	Prob.
Ho: Unit Root (common unit root process)						
Levin-Lin-Chu *t**	-4,6888	[0.0000]***	-3,3710	[0.0004]***	4.89877	1.0000
Breitung *t*-stat	-	-	-	-	1,4064	0,9202
Ho: Unit Root (individual unit root process)						
Im-Pesaran-Shin *W*-stat	-	-	-5,7001	[0.0000]***	-8,0994	[0.0000]***
Fisher-ADF Chi-Square	241.778	[0.0000]***	470.940	[0.0000]***	435.803	[0.0000]***
Choi-ADF Z-stat	-2,7398	[0.0031]***	-4,2926	[0.0000]***	-6,8387	[0.0000]***
Fixed Lags						
Method	*Stat.*	Prob.	*Stat.*	Prob.	*Stat.*	Prob.
Ho: Unit Root (common unit root process)						
Levin-Lin-Chu *t**						
0	-25,0438	[0.0000]***	-32,2061	[0.0000]***	-32,5282	[0.0000]***

1	-8,0673	[0.0000]***	-0,4760	0.3170	0.88223	0,8112
2	-40,3807	[0.0000]***	-63,1416	[0.0000]***	-74,7506	[0.0000]***
3	-1,0754	0.1411	33.4245	1,0000	40,7919	1,0000
4	0.37535	0.6463	57.9524	1,0000	76.3102	1,0000
Breitung *t*-stat						
0	-	-	-	-	-0,5127	0.3041
1	-	-	-	-	-0,1918	0,4239
2	-	-	-	-	1,5247	0,9363
3	-	-	-	-	2,1342	0.9836
4	-	-	-	-	5.36374	1.0000
Ho: Unit Root (individual unit root process)						
Im-Pesaran-Shin *W*-stat						
0	-	-	-12,5074	[0.0000]***	-14,5772	[0.0000]***
1	-	-	-2,9645	[0.0015]***	-4,4421	[0.0000]***
2	-	-	-11,7258	[0.0000]***	-1,80E+16	[0.0000]***
3	-	-	0.65700	0.7444	-2,3310	[0.0099]***
4	-	-	1,8240	0.9659	-1,5334	[0.0626]*
Im-Pesaran-Shin *t*-bar						
0	-	-	[-.09863]***	-	[-3.90533]***	-
Fisher-ADF Chi-Square						
0	280,0190	[0.0000]***	729.654	[0.0000]***	707,1940	[0.0000]***
1	250.812	[0.0000]***	216,1470	[0.0000]***	191,5430	[0.0000]***
2	188,2920	[0.0000]***	551,1020	[0.0000]***	191.766	[0.0000]***
3	138.618	[0.0132]**	182,3680	[0.0000]***	124.286	0.0854
4	103,6260	0.4919	83,0211	0.9356	102.511	0.5229
Choi-ADF Z-stat						
0	-6,4754	[0.0000]***	-8,3971	[0.0000]***	-10,3793	[0.0000]***
1	-3,8159	[0.0001]***	-2,2270	[0.0130]**	-4,0754	[0.0000]***
2	-1,3397	[0.0902]*	-2,4336	[0.0075]***	NA	-
3	0.64932	0.7419	2.14441	0.9840	-0,3380	0.3677
4	2.43557	0.9926	3.96827	1.0000	0,7964	0.7871
Fisher-PP Chi-Square	275.028	[0.0000]***	779.714	[0.0000]***	797.972	[0.0000]***
Choi-PP Z-stat	-4,9376	[0.0000]***	-8,3378	[0.0000]***	-11,5246	[0.0000]***
Ho: Stationarity (common unit root process)						
Hadri Z-stat	-	-	4.64082	[0.0000]***	9.70268	[0.0000]***
Heterocedastic Consistent Z-stat	-	-	12.9789	[0.0000]***	10.9717	[0.0000]***

Note: ***, **, * represent test statistics significant to the 1%, 5%, and 10% levels, respectively. Probabilities for Fisher tests are computed using an asymptotic chi-square distribution. All other tests assume asymptotic normality. LLC, Fisher-PP and Hadri: Newey-West bandwidth selection using Bartlett kernel. Critical *t*-bar values obtained from original Im, Pesaran e Shin (2003) paper. In Hadri test, high correlation leads to severe size distortion, leading to over-rejection of the null.
Source: Elaborated by the authors.

The results for panel cointegration tests are presented in Tables 4, 5 and 6. We apply the residual Kao (1999) tests and multiple Pedroni (2000, 2004) tests, both based on Engle-Granger. Regarding the Kao (1999) residual tests, under the model with individual intercept, we reject the hypothesis of no cointegration by the automatic lag selection criterion. Analyzing the sensitivity of the results, we reject the hypothesis of no cointegration for all lag orders.

Table 4 – Residual-Based Kao Tests: d_{it}/rpi_t and p_{it}/rpi_t

Ho: No Cointegration								
Model with Individual Intercept								
Automatic Selection: 2 Lags based on AIC								
	ADF	Residual Variance	HAC Variance	RESID(-1)	D(RESID(-1))	D(RESID(-2))	D(RESID(-3))	D(RESID(-4))
t	-9,0846	16.22261	11.39772	-17,7954	4,3092	0,0638	-	-
Prob.	[0.0000]***	-	-	[0.0000]***	[0.0000]***	0,0270	-	-
Coeff.	-	-	-	-0,6437	0,1413	2,3615	-	-
Std. Error	-	-	-	0,0362	0,0328	[0.0184]**	-	-
	R-squared	0,29669		Adjusted R-squared	0,295289		DW stat	1,98638
Fixed Lag: 1								
	ADF	Residual Variance	HAC Variance	RESID(-1)	D(RESID(-1))	D(RESID(-2))	D(RESID(-3))	D(RESID(-4))
t	-11,7603	16.22261	11.39772	-20,1559	3,2073	-	-	-
Prob.	[0.0000]***	-	-	[0.0000]***	[0.0014]***	-	-	-
Coeff.	-	-	-	-0,6329	0,0883	-	-	-
Std. Error	-	-	-	0,0314	0,0275	-	-	-
	R-squared	0,308906		Adjusted R-squared	0,308253		DW stat	1,907819
Fixed Lag: 2								
	ADF	Residual Variance	HAC Variance	RESID(-1)	D(RESID(-1))	D(RESID(-2))	D(RESID(-3))	D(RESID(-4))
t	-9,0846	16.22261	11.39772	-17,7954	4,3092	0,0638	-	-
Prob.	[0.0000]***	-	-	[0.0000]***	[0.0000]***	0,0270	-	-
Coeff.	-	-	-	-0,6437	0,1413	2,3615	-	-
Std. Error	-	-	-	0,0362	0,0328	[0.0184]**	-	-
	R-squared	0,29669		Adjusted R-squared	0,295289		DW stat	1,98638
Fixed Lag: 3								
	ADF	Residual Variance	HAC Variance	RESID(-1)	D(RESID(-1))	D(RESID(-2))	D(RESID(-3))	D(RESID(-4))
t	-6,9656	16.22261	11.39772	-15,9261	5,4298	2,2780	1,9357	-
Prob.	[0.0000]***	-	-	[0.0000]***	[0.0000]***	[0.0230]**	[0.0532]*	-
Coeff.	-	-	-	-0,6727	0,2100	0,0765	0,0530	-
Std. Error	-	-	-	0,0422	0,0387	0,0336	0,0274	-
	R-squared	0,288156		Adjusted R-squared	0,285908		DW stat	2,111568
Fixed Lag: 4								
	ADF	Residual Variance	HAC Variance	RESID(-1)	D(RESID(-1))	D(RESID(-2))	D(RESID(-3))	D(RESID(-4))
t	-6,0687	16.22261	11.39772	-15,1347	6,0761	3,1180	3,1311	2,2518
Prob.	[0.0000]***	-	-	[0.0000]***	[0.0000]***	[0.0019]***	[0.0018]***	[0.0246]**
Coeff.	-	-	-	-0,7428	0,2735	0,1262	0,1082	0,0633
Std. Error	-	-	-	0,0491	0,0450	0,0405	0,0346	0,0281
	R-squared	0,296736		Adjusted R-squared	0,293597		DW stat	2,123853

Note: ***, **, * represent test statistics significant to the 1%, 5%, and 10% levels, respectively. Newey-West bandwidth selection using Bartlett kernel.
Source: Elaborated by the authors.

Concerning the Pedroni (2000, 2004) tests, although they display residual sensitivity to the inclusion of linear trends and the lag order established, the prevalence is evident in relation to the rejection of the null hypothesis of no cointegration between prices and dividends considering the companies examined, hence validating the PVM with constant expected returns.

Table 5 – Pedroni Multiple Tests: d_{it}/rpi_t and p_{it}/rpi_t

	Ho: No Cointegration						
	Panel Tests				Group Tests		
	v-Statistic	rho-Statistic	PP-statistic	ADF-statistic	rho-Statistic	PP-Statistic	ADF-Statistic
	T1	T2	T3	T4	T5	T6	T7
	Ha: Common AR coefficients (*within-dimension*)				Ha: Individual AR coefficients (*between-dimension*)		
	Automatic Lag Length: Max Lag of 4 based on AIC						
	Restricted Model						
S1	14.38529	-18,8584	-17,4167	-17,3132	14,3853	-18,8584	-17,4167
Prob.	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***
S2	2.879485	-12,0592	-10,7620	-9,1541	-	-	-
Prob.	[0.0063]***	[0.0000]***	[0.0000]***	[0.0000]***	-	-	-
	Model with Individual Intercept						
S1	6.130905	-13,7506	-17,0284	-16,9181	-8,3048	-15,0771	-14,1739
Prob.	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***
S2	1.205090	-11,9568	-13,1104	-12,4344	-	-	-
Prob.	0.1930	[0.0000]***	[0.0000]***	[0.0000]***	-	-	-
	Model with Intercept and Trend						
S1	-1,3393	-7,6167	-15,3008	-15,1543	-3,6954	-15,2276	-10,9516
Prob.	0.1627	[0.0000]***	[0.0000]***	[0.0000]***	[0.0004]***	[0.0000]***	[0.0000]***
S2	-3,6644	-7,4270	-14,4561	-14,3098	-	-	-
Prob.	[0.0005]***	[0.0000]***	[0.0000]***	[0.0000]***	-	-	-
	Fixed Lag: 1						
	Restricted Model						
S1	14.38529	-18,8584	-17,4167	-13,2967	-10,1090	-20,3044	-13,7822
Prob.	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***
S2	2.879485	-12,0592	-10,7620	-7,4407	-	-	-
Prob.	[0.0063]***	[0.0000]***	[0.0000]***	[0.0000]***	-	-	-
	Model with Individual Intercept						
S1	6.130905	-13,7506	-17,0284	-12,4387	-8,3048	-15,0771	-9,7771
Prob.	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***
S2	1.205090	-11,9568	-13,1104	-8,8961	-	-	-
Prob.	0.1930	[0.0000]***	[0.0000]***	[0.0000]***	-	-	-
	Model with Intercept and Trend						
S1	-1,3393	-7,6167	-15,3008	-10,7284	-3,6954	-15,2276	-7,8414
Prob.	0.1627	[0.0000]***	[0.0000]***	[0.0000]***	[0.0004]***	[0.0000]***	[0.0000]***
S2	-3,6644	-7,4270	-14,4561	-9,1609	-	-	-
Prob.	[0.0005]***	[0.0000]***	[0.0000]***	[0.0000]***	-	-	-
	Fixed Lag: 2						
	Restricted Model						
S1	14.38529	-18,8584	-17,4167	-9,1231	-10,1090	-20,3044	-11,1728
Prob.	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***
S2	2.879485	-12,0592	-10,7620	-4,8865	-	-	-
Prob.	[0.0063]***	[0.0000]***	[0.0000]***	[0.0000]***	-	-	-
	Model with Individual Intercept						
S1	6.130905	-13,7506	-17,0284	-7,2586	-8,3048	-15,0771	-11,0159
Prob.	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***
S2	1.205090	-11,9568	-13,1104	-3,9426	-	-	-
Prob.	0.1930	[0.0000]***	[0.0000]***	[0.0002]***	-	-	-

Model with Intercept and Trend							
S1	-1,3393	-7,6167	-15,3008	-4,5457	-3,6954	-15,2276	-5,3517
Prob.	0.1627	[0.0000]***	[0.0000]***	[0.0000]***	[0.0004]***	[0.0000]***	[0.0000]***
S2	-3,6644	-7,4270	-14,4561	-3,3787	-	-	-
Prob.	[0.0005]***	[0.0000]***	[0.0000]***	[0.0013]***	-	-	-
Fixed Lag: 3							
Restricted Model							
S1	14.38529	-18,8584	-17,4167	-8,3171	-10,1090	-20,3044	-4,4068
Prob.	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***
S2	2.879485	-12,0592	-10,7620	-3,5993	-	-	-
Prob.	[0.0063]***	[0.0000]***	[0.0000]***	[0.0006]***	-	-	-
Model with Individual Intercept							
S1	6.130905	-13,7506	-17,0284	-6,3291	-8,3048	-15,0771	-0,6857
Prob.	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	0.3154
S2	1.205090	-11,9568	-13,1104	-1,6541	-	-	-
Prob.	0.1930	[0.0000]***	[0.0000]***	0.1016	-	-	-
Model with Intercept and Trend							
S1	-1,3393	-7,6167	-15,3008	-4,0621	-3,6954	-15,2276	0.872635
Prob.	0.1627	0.0000	[0.0000]***	[0.0001]***	[0.0004]***	[0.0000]***	0.2726
S2	-3,6644	-7,4270	-14,4561	-0,8348	-	-	-
Prob.	[0.0005]***	[0.0000]***	[0.0000]***	0.2816	-	-	-
Fixed Lag: 4							
Restricted Model							
S1	14.38529	-18,8584	-17,4167	-5,8145	-10,1090	-20,3044	-2,8177
Prob.	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0075]***
S2	2.879485	-12,0592	-10,7620	-2,0921	-	-	-
Prob.	[0.0063]***	[0.0000]***	[0.0000]***	[0.0447]**	-	-	-
Model with Individual Intercept							
S1	6.130905	-13,7506	-17,0284	-3,6216	-8,3048	-15,0771	0.391604
Prob.	[0.0000]***	[0.0000]***	[0.0000]***	[0.0006]***	[0.0000]***	[0.0000]***	0.3695
S2	1.205090	-11,9568	-13,1104	-0,7975	-	-	-
Prob.	0.1930	[0.0000]***	[0.0000]***	0.2903	-	-	-
Model with Intercept and Trend							
S1	-1,3393	-7,6167	-15,3008	-1,1543	-3,6954	-15,2276	2.419183
Prob.	0.1627	[0.0000]***	[0.0000]***	0.2049	[0.0004]***	[0.0000]***	[0.0214]**
S2	-3,6644	-7,4270	-14,4561	0.403012	-	-	-
Prob.	[0.0005]***	[0.0000]***	[0.0000]***	0.3678	-	-	-

Note: ***, **, * represent test statistics significant to the 1%, 5%, and 10% levels, respectively. S1 represents the statistics, and S2 denotes the weighted statistics. Newey-West bandwidth selection using Bartlett kernel.
Source: Elaborated by the authors.

Regarding the trace test and maximum eigenvalue of Johansen-Fisher panel data, in the absence of trend in data, the model with intercept (no trend) in CE and VAR – particularly suitable for the PVM analysis – rejects the hypothesis of zero cointegrating relationship in both statistical tests based on the trace and maximum eigenvalue at the 1% level; concerning the hypothesis of at most 1 cointegrating vector, it is also rejected in both trace and maximum eigenvalue statistics at the 1% level. This is in line with the hypothesis that real prices and real dividends exhibit a stationary relationship.

Table 6 – Panel Johansen-Fisher Test: d_{it}/rpi_t and p_{it}/rpi_t

Deterministic Trend Specification: No Trend in Data				
No Intercept or trend in CE or VAR				
Hypothesized No. of CE(s)	Fisher Stat.* (from *trace test*)	Prob.	Fisher Stat.* (from *max-eigen test*)	Prob.
None	430.4	[0.0000]***	408.0	[0.0000]***
At most 1	174.9	[0.0000]***	174.9	[0.0000]***
Intercept (no trend) in CE – no intercept in VAR				
Hypothesized No. of CE(s)	Fisher Stat.* (from *trace test*)	Prob.	Fisher Stat.* (from *max-eigen test*)	Prob.
None	372.7	[0.0000]***	386.5	[0.0000]***
At most 1	115.5	0.2488	115.5	0.2488
Deterministic Trend Specification: Linear Trend in Data				
Intercept (no trend) in CE and VAR				
Hypothesized No. of CE(s)	Fisher Stat.* (from *trace test*)	Prob.	Fisher Stat.* (from *max-eigen test*)	Prob.
None	427.3	[0.0000]***	406.5	[0.0000]***
At most 1	237.9	[0.0000]***	237.9	[0.0000]***
Intercept and trend in CE - no trend in VAR				
Hypothesized No. of CE(s)	Fisher Stat.* (from *trace test*)	Prob.	Fisher Stat.* (from *max-eigen test*)	Prob.
None	909.2	[0.0000]***	362.5	[0.0000]***
At most 1	118.8	0.1869	118.8	0.1869
Deterministic Trend Specification: Quadratic Trend in Data				
Intercept and trend in CE – linear trend in VAR				
Hypothesized No. of CE(s)	Fisher Stat.* (from *trace test*)	Prob.	Fisher Stat.* (from *max-eigen test*)	Prob.
None	451.8	[0.0000]***	413.7	[0.0000]***
At most 1	398.7	[0.0000]***	398.7	[0.0000]***

Note: ***, **, * represent test statistics significant to the 1%, 5%, and 10% levels, respectively. Lags interval (in first differences): 1 1. Probabilities are computed using asymptotic χ^2 distribution.
Source: Elaborated by the authors.

Individual FMOLS and DOLS estimates and *t*-statistics are reported for $H_0: \beta_i = 0{,}05$. In Table 7, results are reported for panel estimators in the presence and absence of time dummies. Assuming a constant discount rate of 5%, the results from both individual tests and panel tests reject the null hypothesis at the 1% level. Concerning tests applied to individual companies, 45 out of 53 companies produce rejections in DOLS and/or FMOLS tests. For panel tests, all 6 reported results reject the null at the 1% level. Discount rate estimates are below the value of 5% per year for most series. Thus, results indicate that stock prices overstate dividend movements throughout the sample period. Panel values obtained demonstrate a relatively accurate representation of the average long-term relationship between real prices and real dividends in the PVM under constant expected returns.

Table 7 – Panel Cointegration Estimates: Constant Returns

$$\boldsymbol{\frac{d_{it}}{rpi_t} = \alpha_i + \beta_i \frac{p_{it}}{rpi_t} + \mu_{it}}$$

Firm	FMOLS	*t*-stat	DOLS	*t*-stat	FMOLS	*t*-stat	DOLS	*t*-stat
	Dynamic Lags = 0				*Dynamic Lags* = 1			
	Lags = 0				Lags = 1			
ALPA3	0,0224	[-3.3861]**	0,0227	[-3.9488]**	0,0221	[-3.6122]**	0,0377	-1,0484
ALPA4	0,0233	[-2.5495]*	0,0232	[-3.1482]**	0,0229	[-2.7870]**	0,0284	-1,0037
AMBV4	0,0333	[-3.6487]**	0,0319	[-2.9639]**	0,0328	[-3.5077]**	0,0266	[-3.3076]**
ARCZ6	0,0532	0,4234	0,0560	0,8633	0,0547	0,5700	0,0591	1,1756
BBAS3	0,0771	0,2245	0,0881	0,4263	0,0780	0,2765	0,1875	1,3684
BBDC3	0,0205	[-4.0496]**	0,0178	[-4.5422]**	0,0181	[-4.4288]**	0,0420	-0,4380
BBDC4	0,0207	[-5.4902]**	0,0206	[-7.4430]**	0,0205	[-6.2854]**	0,0305	[-1.6694]*
BDLL4	0,1010	0,7823	0,1199	1,4197	0,1070	1,0605	0,1797	[1.7606]*
BRGE12	0,0263	-1,0147	0,0352	-0,9175	0,0314	-0,9343	0,0333	-0,8817
BRIV3	0,0370	-0,9631	0,0382	-1,0746	0,0383	-0,9683	0,0360	-0,7645
BRIV4	0,0427	-0,3530	0,0461	-0,2607	0,0460	-0,2179	0,0276	-0,9777
BRKM5	-0,0454	[-3.4354]**	-0,0156	[-2.4764]*	-0,0357	[-3.0442]**	-0,0618	[-3.8037]**
CESP5	0,0862	0,9019	0,0852	0,8702	0,0815	0,8689	0,0928	0,7471
CGRA4	0,0259	[-2.9474]**	0,0223	[-3.7062]**	0,0233	[-3.3480]**	0,0903	1,1403
CIQU4	0,0156	[-1.9493]*	0,0100	[-3.2441]**	0,0135	[-2.4498]*	-0,0023	[-2.1362]*
CMIG4	0,0852	[2.4827]*	0,0935	[2.7679]**	0,0896	[2.4324]*	0,1070	[2.7045]**
CNFB4	0,0272	[-2.0469]*	0,0260	[-2.5553]*	0,0265	[-2.4519]*	0,0182	-0,8994
CRUZ3	0,0325	-0,4706	0,0330	-0,6982	0,0327	-0,5892	-0,0071	-0,9648
DURA4	0,0160	[-6.5739]**	0,0214	[-5.7101]**	0,0167	[-6.1155]**	0,0138	[-3.0427]**
ELUM4	0,0218	[-9.8799]**	0,0211	[-9.8381]**	0,0234	[-9.8001]**	0,0066	[-6.7888]**
ESTR4	0,0142	[-2.1986]**	0,0144	[-43.4016]**	0,0152	[-34.0188]**	0,0012	[-1.4884]**
EUCA4	0,0065	[-1.0626]**	0,0072	[-12.3620]**	0,0072	[-12.5017]**	0,0119	[-1.3127]**
FESA4	0,0633	[1.9392]*	0,0709	[2.8449]**	0,0663	[2.1305]*	0,0555	0,6637
FJTA4	0,2096	1,0334	0,2626	[2.1027]*	0,2499	1,4805	0,3519	[5.1510]**
GOAU4	0,0456	-0,8116	0,0454	-0,9881	0,0454	-0,9192	0,0265	[-1.8104]*
GUAR3	0,0053	[-9.7628]**	0,0054	[-31.5773]**	0,0054	[-22.9544]**	0,0108	[-9.5412]**
ILMD4	0,0688	0,2087	0,3263	[3.7723]**	0,1355	0,8443	0,3686	[5.9974]**
ITSA4	0,0329	[-3.0462]**	0,0319	[-4.1667]**	0,0324	[-3.4372]**	0,0658	1,3125
ITUB3	0,0339	[-4.3536]**	0,0341	[-6.2169]**	0,0338	[-3.7098]**	0,0343	[-2.9640]**
ITUB4	0,0297	[-6.1577]**	0,0298	[-8.5246]**	0,0297	[-5.2947]**	0,0323	[-3.5804]**
KLBN3	0,0222	[-3.5857]**	0,0246	[-3.3626]**	0,0220	[-3.6931]**	0,0058	[-2.0344]*
KLBN4	0,0693	[2.6487]**	0,0751	[3.2236]**	0,0696	[2.4078]*	0,0638	[1.7888]*
LAME3	0,0087	[-9.8630]**	0,0057	[-11.9046]**	0,0071	[-10.5523]**	-0,0077	[-3.3622]**
LAME4	0,0092	[-8.3612]**	0,0059	[-11.0988]**	0,0072	[-9.2447]**	-0,0402	[-4.8859]**
LEVE4	0,1419	[2.6094]**	0,1356	[2.2421]*	0,1523	[2.7721]**	0,2004	[3.3299]**
LIGT3	0,1327	[1.7275]*	0,1542	[2.9109]**	0,1389	[1.8008]*	0,1530	[2.2736]*
MGEL4	0,0055	[-5.8261]**	0,0183	[-4.5448]**	0,0084	[-5.5982]**	0,0168	[-4.1387]**
PETR3	0,0282	[-3.4916]**	0,0268	[-5.0753]**	0,0277	[-4.3297]**	0,0890	[3.7582]**
PETR4	0,0335	[-2.3070]*	0,0311	[-3.5584]**	0,0325	[-2.9523]**	0,0898	[3.7166]**
PMAM4	0,1506	[1.8054]*	0,1813	[2.4388]*	0,1608	[1.9848]*	0,4314	[3.8640]**
PMET6	0,0324	[-1.9792]*	0,0413	-1,2196	0,0372	-1,5961	0,0440	-0,6737
RPAD6	0,0299	-0,9200	0,0381	-0,7855	0,0357	-0,7684	0,0438	-0,3472
SDIA4	0,0292	[-3.2459]**	0,0260	[-3.1614]**	0,0268	[-3.2916]**	0,0193	[-2.9260]**
SUZB5	0,0268	[-2.6132]**	0,0230	[-3.0640]**	0,0223	[-3.0467]**	0,0216	[-2.0766]*
TLPP3	0,1952	[2.5782]**	0,1757	[2.8771]**	0,1865	[2.6723]**	0,2666	[3.2309]**
TLPP4	0,2016	[3.6590]**	0,2015	[4.0717]**	0,2036	[3.8352]**	0,2513	[4.2697]**
TUPY4	0,0213	[-5.3178]**	0,0216	[-44.2334]**	0,0217	[-45.5614]**	0,0081	[-6.6396]**
UBBR3	0,0167	[-0.4276]**	0,0155	[-19.9432]**	0,0160	[-19.6128]**	0,0194	[-0.6809]**
UBBR4	0,0384	[-2.8530]**	0,0375	[-3.0158]**	0,0378	[-3.2001]**	0,0524	0,3571

VAGV4	0,1414	1,5291	0,1599	[1.6924]*	0,1492	[1.8271]*	0,1210	0,6734
VALE3	0,0199	[-6.3231]**	0,0192	[-9.1246]**	0,0191	[-7.5069]**	0,0259	-1,1686
VALE5	0,0223	[-5.6007]**	0,0221	[-7.9303]**	0,0219	[-6.5931]**	0,0534	0,1165
VCPA4	0,0442	-0,7152	0,0458	-0,4119	0,0456	-0,4350	0,0668	[2.7539]**
Panel Results								
				Without Time *Dummies*				
Between	0,0501	[-0.9000]**	0,0587	[-35.3943]**	0,0531	[-32.1966]**	0,0736	[-8.9565]**
				With Time *Dummies*				
Between	0,0310	[-4.7497]**	0,0408	[-15.0615]**	0,0348	[-14.8422]**	0,0359	[-9.4386]**

Note: *t*-stats refer to $H_0: \beta_i = 0{,}05$, assuming a constant discount rate of 5%. *, ** indicate rejection levels of 10%, 1%. “Between” reports the group-mean panel FMOLS and group-mean panel DOLS from Pedroni (2001).
Source: Elaborated by the authors.

4.2 PRESENT VALUE MODEL: TIME-VARYING EXPECTED RETURNS

Analogously to the previous section, as presented in Tables 8 and 9, we cannot reject the hypothesis that the log prices series are integrated of order one for the entire panel or for most companies comprising it.

Table 8 – Panel Unit Root Tests: $ln(p_{it}/rpi_t)$

Model	Restricted		Individual Intercept		Intercept and Trend	
	Automatic Lag Length Selection (AIC): 0 to 4					
Method	*Stat.*	Prob.	*Stat.*	Prob.	*Stat.*	Prob.
Ho: Unit Root (common unit root process)						
Levin-Lin-Chu *t**	-0,2571	0.3986	-9,9786	[0.0000]***	-4,9128	[0.0000]***
Breitung *t*-stat	-	-	-	-	-3,8620	[0.0001]***
Ho: Unit Root (individual unit root process)						
Im-Pesaran-Shin *W*-stat	-	-	-3,2532	[0.0006]***	-3,0595	[0.0011]***
Fisher-ADF Chi-Square	44,2570	0.2244	74,6544	[0.0004]***	65.1216	[0.004]***
Choi-ADF Z-stat	-0,2327	0.4080	-2,6553	[0.0040]***	-2,8838	[0.002]***
Fixed Lags						
Method	*Stat.*	Prob.	*Stat.*	Prob.	*Stat.*	Prob.
Ho: Unit Root (common unit root process)						
Levin-Lin-Chu *t**						
0	-0,9670	0.1668	-4,8287	[0.0000]***	-5,2323	[0.0000]***
1	0,4396	0.6699	-3,7322	[0.0001]***	-3,3773	[0.0004]***
2	1.26903	0.8978	-2,9644	[0.0015]***	-0,8664	0.1932
3	-1,2171	0.1118	-13,6157	[0.0000]***	-5,5994	[0.0000]***
4	0.53430	0.7034	-9,3469	[0.0000]***	-2,8954	[0.0019]***
Breitung *t*-stat						
0	-	-	-	-	-2,2706	[0.0116]**
1	-	-	-	-	-4,1063	[0.0000]***
2	-	-	-	-	-4,3026	[0.0000]***
3	-	-	-	-	-3,6470	[0.0001]***
4	-	-	-	-	-4,3934	[0.0000]***
Ho: Unit Root (individual unit root process)						
Im-Pesaran-Shin *W*-stat						
0	-	-	-0,6155	0.2691	-2,7438	[0.0030]***
1	-	-	0.76235	0.7771	-1,2569	0.1044
2	-	-	1.48880	0.9317	-0,1016	0.4595
3	-	-	-6,2005	[0.0000]***	-3,0948	[0.0010]***
4	-	-	-3,7333	[0.0001]***	-1,7158	[0.0431]**
Im-Pesaran-Shin *t*-bar						
0	-	-	-1,6512	-	[-2.71403]***	-
Fisher-ADF Chi-Square						

0	40.3850	0.3653	34.6763	0.6239	61.5960	[0.0091]***
1	30.1359	0,8146	26.2765	0.9245	49.8591	[0.0943]*
2	21.5970	0.9851	19.9634	0.9929	37.3257	0,5005
3	42.8599	0.2706	124.475	[0.0000]***	64.3843	[0.0048]***
4	29.8534	0.8246	91.3763	[0.0000]***	43,4911	0,2490
Choi-ADF Z-stat						
0	-0,4948	0.3104	-0,6238	0,2664	-2,7726	[0.0028]***
1	0,9720	0.8345	0,8552	0.8038	-1,2774	0.1007
2	2.10231	0,9822	2,0900	0.9817	0,7718	0,7799
3	-0,1716	0,4319	-5,2331	[0.0000]***	-2,4580	[0.007]***
4	1.11142	0,8668	-2,2146	[0.0134]**	-0,5869	0.2786
Fisher-PP Chi-Square	39.3927	0.4074	49.5406	[0.0995]*	59.9175	[0.0132]**
Choi-PP Z-stat	-0,1195	0.4524	-1,7268	[0.0421]**	-2,4541	[0.0071]***
Ho: Stationarity (common unit root process)						
Hadri Z-stat	-	-	12.8874	[0.0000]***	7.96190	[0.0000]***
Heterocedastic Consistent Z-stat	-	-	12.3916	[0.0000]***	6.45350	[0.0000]***

Note: ***, **, * represent test statistics significant to the 1%, 5%, and 10% levels, respectively. Probabilities for Fisher tests are computed using an asymptotic chi-square distribution. All other tests assume asymptotic normality. LLC, Fisher-PP and Hadri: Newey-West bandwidth selection using Bartlett kernel. Critical *t*-bar values obtained from original Im, Pesaran e Shin (2003) paper. In Hadri test, high correlation leads to severe size distortion, leading to over-rejection of the null.
Source: Elaborated by the authors.

In Table 9, although the diagnosis of $I(0)$ stationarity or nonstationarity $I(1)$ of $\ln(d_{it}/rpi_t)$ shows sensitivity to the inclusion or exclusion of trend as well as to the lag order established, we cannot reject the hypothesis that the log dividends series have a unit root for the entire panel or for most companies analyzed.

Table 9 – Panel Unit Root Tests: $\boldsymbol{ln(d_{it}/rpi_t)}$

Modelo	Restricted		Individual Intercept		Intercept and Trned	
	Seleção Automática de *Lags* (AIC): 0 a 4					
Method	*Stat.*	Prob.	*Stat.*	Prob.	*Stat.*	Prob.
Ho: Unit Root (common unit root process)						
Levin-Lin-Chu *t**	-5,09552	[0.0000]***	-2,38531	[0.0085]***	-8,49012	[0.0000]***
Breitung *t*-stat	-	-	-	-	-6,45523	[0.0000]***
Ho: Unit Root (individual unit root process)						
Im-Pesaran-Shin *W*-stat	-	-	0.36816	0.6436	-6,08052	[0.0000]***
Fisher-ADF Chi-Square	66.6386	[0.0028]***	30.5928	0.7979	103.591	[0.0000]***
Choi-ADF Z-stat	-3,77041	[0.0001]***	0.54857	0.7084	-5,54669	[0.0000]***
Fixed Lags						
Method	*Stat.*	Prob.	*Stat.*	Prob.	*Stat.*	Prob.
Ho: Unit Root (common unit root process)						
Levin-Lin-Chu *t**						
0	-4,6359	[0.0000]***	-4,2985	[0.0000]***	-9,2589	[0.0000]***
1	-5,4494	[0.0000]***	-2,9482	[0.0016]***	-5,6599	[0.0000]***
2	-4,9674	[0.0000]***	0.47473	0,6825	-3,6396	[0.0001]***
3	-6,6183	[0.0000]***	-0,2382	0.4059	-2,3163	[0.0103]**
4	-7,3675	[0.0000]***	-2,5701	[0.0051]***	-0,1053	0,4581
Breitung *t*-stat						
0	-	-	-	-	-7,0509	[0.0000]***
1	-	-	-	-	-3,8601	[0.0001]***
2	-	-	-	-	-1,3439	[0.0895]*
3	-	-	-	-	-0,3096	0,3784
4	-	-	-	-	-0,0551	0.4780
Ho: Unit Root (individual unit root process)						

Im-Pesaran-Shin *W*-stat						
0	-	-	-1,6220	[0.0524]*	-6,4221	[0.0000]***
1	-	-	-0,0884	0.4648	-3,3213	[0.0004]***
2	-	-	2.30597	0,9894	-2,5171	[0.0059]***
3	-	-	2.12015	0,9830	-1,7215	[0.0426]**
4	-	-	0,0491	0.5196	-1,3821	[0.0835]*
Im-Pesaran-Shin *t*-bar						
0	-	-	[-.86316]***	-	[-3.44628]***	-
Fisher-ADF Chi-Square						
0	69,8298	[0.0013]***	46.2368	0,1687	109.271	[0.0000]***
1	71,0728	[0.0009]***	34,8069	0.6179	68,6632	[0.0017]***
2	56.6501	[0.0263]**	14.7155	0.9998	62.0666	[0.0082]***
3	77,3693	[0.0002]***	12,6275	1.0000	50,2907	[0.0875]*
4	90,6491	[0.0000]***	28,5764	0.8660	37.6216	0.4868
Choi-ADF Z-stat						
0	-4,0962	[0.0000]***	-1,6870	[0.0458]**	-5,6883	[0.0000]***
1	-4,1503	[0.0000]***	-0,0895	0,4644	-3,5115	[0.0002]***
2	-2,9852	[0.0014]***	3.00612	0,9987	-1,8493	[0.0322]**
3	-3,8173	[0.0001]***	3,0873	0,9990	-1,1098	0,1335
4	-5,2002	[0.0000]***	1.16681	0,8784	-0,2229	0,4118
Fisher-PP Chi-Square	71.1481	[0.0009]***	42.0507	0.2998	128.727	[0.0000]***
Choi-PP Z-stat	-4,1547	[0.0000]***	-1,0112	0.1560	-6,0296	[0.0000]***
Ho: Stationarity (common unit root process)						
Hadri Z-stat	-	-	10.0588	[0.0000]***	6.08075	[0.0000]***
Heterocedastic Consistent Z-stat	-	-	10.3840	[0.0000]***	6.58750	[0.0000]***

Note: ***, **, * represent test statistics significant to the 1%, 5%, and 10% levels, respectively. Probabilities for Fisher tests are computed using an asymptotic chi-square distribution. All other tests assume asymptotic normality. LLC, Fisher-PP and Hadri: Newey-West bandwidth selection using Bartlett kernel. Critical *t*-bar values obtained from original Im, Pesaran e Shin (2003) paper. In Hadri test, high correlation leads to severe size distortion, leading to over-rejection of the null.
Source: Elaborated by the authors.

In PVM with time-varying expected returns, it is expected that the log price-dividend ratio is $I(0)$ stationary, as discussed in the presented literature. In relation to the panel unit root tests applied to the log price-dividend ratio $\ln(p_{it}/d_{it})$ in Table 10, we cannot reject the hypothesis that the log price-dividend series is stationary for the entire panel or for most companies surveyed. Hence, we cannot reject the PVM with time-varying expected returns from the panel unit root tests applied.

Table 10 – Panel Unit Root Tests: $\boldsymbol{ln(p_{it}/d_{it})}$

Model	Restricted		Individual Intercept		Intercept and Trend	
	Automatic Lag Length Selection (AIC): 0 to 4					
Method	*Stat.*	Prob.	*Stat.*	Prob.	*Stat.*	Prob.
Ho: Unit Root (common unit root process)						
Levin-Lin-Chu *t**	0,9207	0.8214	-7,4314	[0.0000]***	-9,8575	[0.0000]***
Breitung *t*-stat	-	-	-	-	-4,0628	[0.0000]***
Ho: Unit Root (individual unit root process)						
Im-Pesaran-Shin *W*-stat	-	-	-5,6561	[0.0000]***	-7,2686	[0.0000]***
Fisher-ADF Chi-Square	16.4246	0.9991	98.8030	[0.0000]***	118.509	[0.0000]***
Choi-ADF Z-stat	2.31517	0.9897	-5,5439	[0.0000]***	-6,8077	[0.0000]***
Fixed Lags						
Method	*Stat.*	Prob.	*Stat.*	Prob.	*Stat.*	Prob.

Ho: Unit Root (common unit root process)						
Levin-Lin-Chu *t**						
0	-0,6768	0,2493	-7,5096	[0.0000]***	-8,7274	[0.0000]***
1	0,0897	0.5357	-3,7880	[0.0001]***	-5,9819	[0.0000]***
2	2,3266	0.9900	-4,6717	[0.0000]***	-3,8049	[0.0001]***
3	2.25206	0.9878	-7,7817	[0.0000]***	-6,8276	[0.0000]***
4	2.04021	0.9793	-1,3151	[0.0942]*	-0,5330	0.2970
Breitung *t*-stat						
0	-	-	-	-	-3,9018	[0.0000]***
1	-	-	-	-	-4,1904	[0.0000]***
2	-	-	-	-	-3,1874	[0.0007]***
3	-	-	-	-	-2,0977	[0.0180]**
4	-	-	-	-	-2,3300	[0.0099]***
Ho: Unit Root (individual unit root process)						
Im-Pesaran-Shin *W*-stat						
0	-	-	-5,6798	[0.0000]***	-5,5960	[0.0000]***
1	-	-	-2,2525	[0.0121]**	-3,3798	[0.0004]***
2	-	-	-2,8588	[0.0021]***	-2,2744	[0.0115]**
3	-	-	-4,9641	[0.0000]***	-4,6352	[0.0000]***
4	-	-	-1,5202	[0.0642]*	-2,5130	[0.0060]***
Im-Pesaran-Shin *t*-bar						
0	-	-	[-.7177]***	-	[-3.28183]***	-
Fisher-ADF Chi-Square						
0	23.4241	0.9694	98.2319	[0.0000]***	92,5410	[0.0000]***
1	16.9649	0.9987	54,0128	[0.0444]**	69.4866	[0.0014]***
2	10,8752	1,0000	60.5261	[0.0115]**	52.2975	[0.0612]*
3	11,2678	1,0000	90,0918	[0.0000]***	80.9519	[0.0001]***
4	13.1011	0.9999	44,1307	0,2284	48,6339	0.1157
Choi-ADF Z-stat						
0	0,7801	0.7823	-5,5898	[0.0000]***	-5,4040	[0.0000]***
1	1.77628	0,9622	-2,3896	[0.0084]***	-3,5429	[0.0002]***
2	3,5401	0.9998	-2,6051	[0.0046]***	-1,7646	[0.0388]**
3	3,6267	0,9999	-4,8542	[0.0000]***	-4,4830	[0.0000]***
4	3.30058	0.9995	-0,7539	0.2255	-1,6519	[0.0493]**
Fisher-PP Chi-Square	16.6648	0.9990	102.158	[0.0000]***	87.7192	[0.0000]***
Choi-PP Z-stat	2.25669	0.9880	-5,6978	[0.0000]***	-4,8319	[0.0000]***
Ho: Stationarity (common unit root process)						
Hadri Z-stat	-	-	8.94344	[0.0000]***	4.90039	[0.0000]***
Heterocedastic Consistent Z-stat	-	-	8.17192	[0.0000]***	4.67303	[0.0000]***

Note: ***, **, * represent test statistics significant to the 1%, 5%, and 10% levels, respectively. Probabilities for Fisher tests are computed using an asymptotic chi-square distribution. All other tests assume asymptotic normality. LLC, Fisher-PP and Hadri: Newey-West bandwidth selection using Bartlett kernel. Critical *t*-bar values obtained from original Im, Pesaran e Shin (2003) paper. In Hadri test, high correlation leads to severe size distortion, leading to over-rejection of the null.
Source: Elaborated by the authors.

Once verified that log real prices and log real dividends are predominantly $I(1)$, we apply the panel cointegration tests. The results are presented in Tables 11, 12 and 13. As in the previous section, we employ the residual Kao (1999) and multiple Pedroni (2000, 2004) tests based on Engle-Granger. Regarding the Kao (1999) tests, under the model with individual intercept, we fail to reject the hypothesis of no cointegration by the automatic lag selection criterion. Analyzing the sensitivity of the results, we reject the hypothesis of no cointegration only for fixed lag of order 1.

Table 11 – Residual-Based Kao Tests: $ln(d_{it}/rpi_t)$ and $ln(p_{it}/rpi_t)$

Ho: No Cointegration										
Model with Individual Intercept										
Automatic Selection: 2 Lags based on AIC										
	ADF	Residual Variance	HAC Variance	RESID (-1)	D (RESID(-1))	D (RESID(-2))	D (RESID(-3))	D (RESID(-4))	D (RESID(-5))
t	-0,578378	0.547553	0.240670	-8,2723	0,2567	1,9307	2,7037	2,4586	1,7572
Prob.	0.2815	-	-	[0.0000]***	0,7976	[0.0545]*	[0.0073]***	[0.0145]**	[0.0799]*
Coeff.	-	-	-	-0,6987	0,0200	0,1344	0,1729	0,1387	0,0821
Std. Error	-	-	-	0,0845	0,0779	0,0696	0,0640	0,0564	0,0467
	R-squared	0,359367		Adjusted R-squared	0,348618		DW stat	1,855529	
Fixed Lag: 1									
	ADF	Residual Variance	HAC Variance	RESID(-1)	D(RESID(-1))	D(RESID(-2))	D(RESID(-3))	D(RESID(-4))	D(RESID(-5))
t	-2,67432	0.547553	0.240670	-10,2632	-1,1026	-	-	-	-
Prob.	[0.0037]***	-	-	[0.0000]***	0,2709	-	-	-	-
Coeff.	-	-	-	-0,5871	-0,0555	-	-	-	-
Std. Error	-	-	-	0,0572	0,0503	-	-	-	-
	R-squared	0,314529		Adjusted R-squared	0,312716		DW stat	1,989273	
Fixed Lag: 2									
	ADF	Residual Variance	HAC Variance	RESID(-1)	D(RESID(-1))	D(RESID(-2))	D(RESID(-3))	D(RESID(-4))	D(RESID(-5))
t	-1,008305	0.547553	0.240670	-8,68069	-0,722653	-0,548263	-	-	-
Prob.	0.1567	-	-	[0.0000]***	0,4704	0,5839	-	-	-
Coeff.	-	-	-	-0,578228	-0,045029	-0,028165	-	-	-
Std. Error	-	-	-	0,0666	0,0623	0,0514	-	-	-
	R-squared	0,306226		Adjusted R-squared	0,30235		DW stat	2,00231	
Fixed Lag: 3									
	ADF	Residual Variance	HAC Variance	RESID(-1)	D(RESID(-1))	D(RESID(-2))	D(RESID(-3))	D(RESID(-4))	D(RESID(-5))
t	-1,009833	0.547553	0.240670	-8,682141	0,181872	0,992354	1,748719	-	-
Prob.	0.1563	-	-	[0.0000]***	0,8558	0,3217	[0.0812]*	-	-
Coeff.	-	-	-	-0,642049	0,012756	0,061606	0,089116	-	-
Std. Error	-	-	-	0,074	0,0701	0,0621	0,051	-	-
	R-squared	0,324138		Adjusted R-squared	0,318139		DW stat	1,900052	
Fixed Lag: 4									
	ADF	Residual Variance	HAC Variance	RESID(-1)	D(RESID(-1))	D(RESID(-2))	D(RESID(-3))	D(RESID(-4))	D(RESID(-5))
t	-0,645677	0.547553	0.240670	-8,3362	0,2974	1,7297	2,1715	2,4325	-
Prob.	0.2592	-	-	[0.0000]***	0,7663	[0.0846]*	[0.0306]**	[0.0155]**	-
Coeff.	-	-	-	-0,6526	0,0215	0,1146	0,1271	0,1167	-
Std. Error	-	-	-	0,0783	0,0724	0,0662	0,0585	0,0480	-
	R-squared	0,336621		Adjusted R-squared	0,328277		DW stat	2,012181	

Note: ***, **, * represent test statistics significant to the 1%, 5%, and 10% levels, respectively. Newey-West bandwidth selection using Bartlett kernel.
Source: Elaborated by the authors.

Examining the Pedroni (2000, 2004) tests, although they display residual sensitivity to the inclusion of linear trends and the lag order established, the prevalence is evident in relation to the rejection of the null hypothesis of no cointegration between log real prices and log real dividends, considering the companies examined, hence validating the PVM with time-varying expected returns.

Table 12 – Pedroni Multiple Tests: $ln(d_{it}/rpi_t)$ e $ln(p_{it}/rpi_t)$

	Ho: No Cointegration						
	Panel Tests				Group Tests		
	v-Statistic	rho-Statistic	PP-statistic	ADF-statistic	rho-Statistic	PP-Statistic	ADF-Statistic
	T1	T2	T3	T4	T5	T6	T7
	Ha: Common AR coefficients (*within-dimension*)				Ha: Individual AR coefficients (*between-dimension*)		
	Automatic Lag Length Selection: Max Lag of 4 based on AIC						
	Restricted Model						
S1	-2,320615	0.852759	-0,327815	-0,450724	2.892510	-0,031545	0.190499
Prob.	[0.0270]**	0.2773	0.3781	0.3604	[0.0061]***	0.3987	0.3918
S2	-2,749949	1.405288	0.283771	0.151808	-	-	-
Prob.	[0.0091]***	0.1486	0.3832	0.3944	-	-	-
	Model with Individual Intercept						
S1	0.725685	-7,502796	-8,381973	-8,177851	-4,679801	-8,272106	-7,118092
Prob.	0.3066	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***
S2	-0,565953	-7,008678	-8,045238	-7,906151	-	-	-
Prob.	0.3399	[0.0000]***	[0.0000]***	[0.0000]***	-	-	-
	Model with Intercept and Trend						
S1	-2,605238	-3,859219	-8,350767	-8,545791	-1,87901	-8,600209	-9,226538
Prob.	[0.0134]**	[0.0002]***	[0.0000]***	[0.0000]***	[0.0683]*	[0.0000]***	[0.0000]***
S2	-3,78896	-4,272121	-9,451235	-10,24465	-	-	-
Prob.	[0.0003]***	[0.0000]***	[0.0000]***	[0.0000]***	-	-	-
	Fixed Lag: 1						
	Restricted Model						
S1	-2,320615	0.852759	-0,327815	-0,736761	2.892510	-0,031545	-0,30462
Prob.	[0.0270]**	0,2773	0.3781	0.3041	[0.0061]***	0.3987	0.3809
S2	-2,749949	1.405288	0.283771	-0,449634	-	-	-
Prob.	[0.0091]***	0.1486	0.3832	0.3606	-	-	-
	Model with Individual Intercept						
S1	0.725685	-7,502796	-8,381973	-4,663635	-4,679801	-8,272106	-5,102836
Prob.	0.3066	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***	[0.0000]***
S2	-0,565953	-7,008678	-8,045238	-5,445578	-	-	-
Prob.	0.3399	[0.0000]***	[0.0000]***	[0.0000]***	-	-	-
	Model with Intercept and Trend						
S1	-2,605238	-3,859219	-8,350767	-5,365327	-1,87901	-8,600209	-5,766578
Prob.	[0.0134]**	[0.0002]***	[0.0000]***	[0.0000]***	[0.0683]*	[0.0000]***	[0.0000]***
S2	-3,78896	-4,272121	-9,451235	-7,115894	-	-	-
Prob.	[0.0003]***	[0.0000]***	[0.0000]***	[0.0000]***	-	-	-
	Fixed Lag: 2						
	Restricted Model						
S1	-2,320615	0.852759	-0,327815	0.565074	2.892510	-0,031545	1.193997
Prob.	[0.0270]**	0.2773	0.3781	0.3401	[0.0061]***	0.3987	0.1956
S2	-2,749949	1.405288	0.283771	0.797833	-	-	-
Prob.	[0.0091]***	0.1486	0.3832	0.2902	-	-	-
	Model with Individual Intercept						
S1	0.725685	-7,502796	-8,381973	-2,718612	-4,679801	-8,272106	-2,50548
Prob.	0.3066	[0.0000]***	[0.0000]***	[0.0099]***	[0.0000]***	[0.0000]***	[0.0173]**
S2	-0,565953	-7,008678	-8,045238	-2,25192	-	-	-
Prob.	0.3399	[0.0000]***	[0.0000]***	[0.0316]**	-	-	-
	Model with Intercept and Trend						
S1	-2,605238	-3,859219	-8,350767	-3,861804	-1,87901	-8,600209	-3,082535
Prob.	[0.0134]**	[0.0002]***	[0.0000]***	[0.0002]***	[0.0683]*	[0.0000]***	[0.0034]***
S2	-3,78896	-4,272121	-9,451235	-3,646666	-	-	-
Prob.	[0.0003]***	[0.0000]***	[0.0000]***	[0.0005]***	-	-	-
	Fixed Lag: 3						
	Restricted Model						
S1	-2,320615	0.852759	-0,327815	0.379225	2.892510	-0,031545	-0,210801

Prob.	[0.0270]**	0.2773	0.3781	0.3713	[0.0061]***	0.3987	0.3902
S2	-2,749949	1.405288	0.283771	0.476399	-	-	-
Prob.	[0.0091]***	0.1486	0.3832	0.3561	-	-	-
			Model with Individual Intercept				
S1	0.725685	-7,502796	-8,381973	-2,826191	-4,679801	-8,272106	-1,843368
Prob.	0.3066	[0.0000]***	[0.0000]***	[0.0074]***	[0.0000]***	[0.0000]***	[0.0730]*
S2	-0,565953	-7,008678	-8,045238	-2,099366	-	-	-
Prob.	0.3399	[0.0000]***	[0.0000]***	[0.0440]**	-	-	-
			Model with Intercept and Trend				
S1	-2,605238	-3,859219	-8,350767	-2,589613	-1,87901	-8,600209	-1,9807
Prob.	[0.0134]**	[0.0002]***	[0.0000]***	[0.0140]**	[0.0683]*	[0.0000]***	[0.0561]*
S2	-3,78896	-4,272121	-9,451235	-2,081384	-	-	-
Prob.	[0.0003]***	[0.0000]***	[0.0000]***	[0.0457]**	-	-	-
			Fixed Lag: 4				
			Restricted Model				
S1	-2,320615	0.852759	-0,327815	-0,428197	2.892510	-0,031545	-1,453913
Prob.	[0.0270]**	0,2773	0.3781	0.3640	[0.0061]***	0.3987	0.1386
S2	-2,749949	1.405288	0.283771	-0,216119	-	-	-
Prob.	[0.0091]***	0.1486	0.3832	0.3897	-	-	-
			Model with Individual Intercept				
S1	0.725685	-7,502796	-8,381973	-2,040289	-4,679801	-8,272106	-0,73111
Prob.	0.3066	[0.0000]***	[0.0000]***	[0.0498]**	[0.0000]***	[0.0000]***	0.3054
S2	-0,565953	-7,008678	-8,045238	-1,217195	-	-	-
Prob.	0.3399	[0.0000]***	[0.0000]***	0.1902	-	-	-
			Model with Intercept and Trend				
S1	-2,605238	-3,859219	-8,350767	-2,553367	-1,87901	-8,600209	-1,687606
Prob.	[0.0134]**	[0.0002]***	[0.0000]***	[0.0153]**	[0.0683]*	[0.0000]***	[0.0960]*
S2	-3,78896	-4,272121	-9,451235	-1,790198	-	-	-
Prob.	[0.0003]***	[0.0000]***	[0.0000]***	[0.0804]*	-	-	-

Note: ***, **, * represent test statistics significant to the 1%, 5%, and 10% levels, respectively. S1 represents the statistics, and S2 denotes the weighted statistics. Newey-West bandwidth selection using Bartlett kernel.
Source: Elaborated by the authors.

Regarding the Maddala and Wu (1999) cointegration tests that combine the *p*-values from the trace test and maximum eigenvalue of Johansen-Fisher, in the model with intercept (no trend) in CE and VAR – particularly suitable for the PVM analysis – we reject the hypothesis of zero cointegrating relationships in both statistics based on the trace test and maximum eigenvalue at the 1% level; in relation to the hypothesis of at most 1 cointegrating vector, it is also rejected in both trace statistics and maximum eigenvalue at the 1% level.

Thus, from panel cointegration tests of Kao (1999), Pedroni (2000, 2004) and Maddala and Wu (1999), we cannot reject the hypothesis of no cointegration between real log prices and real log dividends, considering the sample companies examined, validating, therefore, the present value model between prices and dividends with time-varying expected returns developed seminally in Campbell and Shiller (1988a,b).

Table 13 – Panel Johansen-Fisher Test: $ln(d_{it}/rpi_t)$ e $ln(p_{it}/rpi_t)$

Deterministic Trend Specification: No Trend in Data				
No Intercept or Trend in CE or VAR				
Hypothesized No. of CE(s)	Fisher Stat.* (from *trace test*)	Prob.	Fisher Stat.* (from *max-eigen test*)	Prob.
None	46.52	0.1616	50.43	[0.0855]*
At most 1	18.35	0.9970	18.35	0.9970
Intercept (no trend) in CE - no intercept in VAR				
Hypothesized No. of CE(s)	Fisher Stat.* (from *trace test*)	Prob.	Fisher Stat.* (from *max-eigen test*)	Prob.
None	65.09	[0.0040]***	47.60	0.1367
At most 1	52.18	[0.0626]*	52.18	[0.0626]*
Deterministic Trend Specification: Linear Trend in Data				
Intercept (no trend) in CE and VAR				
Hypothesized No. of CE(s)	Fisher Stat.* (from *trace test*)	Prob.	Fisher Stat.* (from *max-eigen test*)	Prob.
None	69.49	[0.0014]***	55.82	[0.0311]***
At most 1	69.45	[0.0014]***	69.45	[0.0014]***
Intercept and trend in CE no trend in VAR				
Hypothesized No. of CE(s)	Fisher Stat.* (from *trace test*)	Prob.	Fisher Stat.* (from *max-eigen test*)	Prob.
None	58.79	[0.0168]*	53.60	[0.0479]**
At most 1	33.30	0.6864	33.30	0.6864
Deterministic Trend Specification: Quadratic Trend in Data				
Intercept and trend in CE – linear trend in VAR				
Hypothesized No. of CE(s)	Fisher Stat.* (a partir do *trace test*)	Prob.	Fisher Stat.* (a partir do *max-eigen test*)	Prob.
None	116.2	[0.0000]***	71.08	[0.0009]***
At most 1	138.4	[0.0000]***	138.4	[0.0000]***

Note: ***, **, * represent test statistics significant to the 1%, 5%, and 10% levels, respectively. Lags interval (in first differences): 1 1. Probabilities are computed using asymptotic χ^2 distribution.
Source: Elaborated by the authors.

The present value model holds when logged prices and dividends are cointegrated and $\beta_i = 1$. A one-for-one cointegrating equilibrium implies that the price-dividend ratio is stationary. Regressing dividends on price, if overvaluation is defined as stock price movements neither backed nor justified by dividend movements, stocks are overvalued if $\beta_i < 1$. Inversely, if $\beta_i > 1$, stocks are considered undervalued. Individual FMOLS and DOLS estimates and *t*-statistics are reported for $H_0: \beta_i = 1$. In Table 14, results are reported for panel estimators in the presence and absence of time dummies. Assuming a time-varying discount rate of 5%, the results from both individual and panel tests predominantly reject the null hypothesis between the 1% and 10% levels and parameters obtained evidence overvaluation of real prices for most sample companies.

Table 14 – Panel Cointegration Estimates: Time-Varying Returns

$$ln(d_{it}/rpi_t) = \alpha_i + \beta_i ln(p_{it}/rpi_t) + \mu_{it}$$

Firm	FMOLS	*t*-stat	DOLS	*t*-stat	FMOLS	*t*-stat	DOLS	*t*-stat
	Dynamic Lags = 0				*Dynamic Lags* = 1			
	Lags = 0				*Lags* = 1			
AMBV4	0,6660	[-4.1745]**	0,6800	[-2.9387]**	0,6784	[-3.7075]**	0,7254	[-2.8127]**
BBDC3	0,2998	[-8.4873]**	0,3081	[-9.4885]**	0,2943	[-8.0915]**	0,3670	[-8.6561]**
BBDC4	0,3027	[-8.2670]**	0,3279	[-0.6468]**	0,3123	[-8.0680]**	0,3737	[-8.7662]**
BRGE12	0,5456	[-3.3786]**	0,5477	[-4.8361]**	0,5349	[-3.9154]**	0,5060	[-3.9392]**
BRIV3	0,4703	[-8.1317]**	0,4699	[-7.0023]**	0,4401	[-7.4180]**	0,2551	[-0.3507]**
BRIV4	0,4426	[-6.8149]**	0,4475	[-7.2908]**	0,4243	[-6.8395]**	0,2896	[-7.3145]**
CGRA4	0,5340	[-4.4843]**	0,5199	[-5.4078]**	0,5207	[-3.8871]**	0,6270	[-4.8391]**
CMIG4	0,7760	-0,8368	0,8591	-0,7059	0,8429	-0,6458	0,9929	-0,0290
CRUZ3	0,4526	[-2.8423]**	0,4159	[-4.7312]**	0,4199	[-3.6985]**	0,4780	[-2.8393]**
DURA4	0,4091	[-2.0673]*	0,5608	[-1.6957]*	0,4276	[-2.0411]*	0,5848	-1,1724
ITSA4	0,7236	[-2.7553]**	0,7030	[-3.9292]**	0,7175	[-2.7844]**	0,7655	[-2.3771]*
ITUB3	0,6375	[-6.7288]**	0,6570	[-6.3453]**	0,6402	[-5.8147]**	0,6181	[-6.6575]**
ITUB4	0,6156	[-7.3155]**	0,6414	[-6.8692]**	0,6206	[-6.2242]**	0,5973	[-7.8197]**
KLBN4	1,4102	1,2621	1,6419	[2.3380]*	1,4872	1,5643	1,5151	1,2801
RPAD6	0,5110	[-3.3393]**	0,5151	[-4.9430]**	0,5016	[-3.8898]**	0,4765	[-3.9541]**
SDIA4	0,5736	[-3.7536]**	0,4867	[-3.8868]**	0,5084	[-3.8287]**	0,5077	[-3.2931]**
TLPP4	0,8330	-0,7301	0,8970	-0,6804	0,8570	-0,7247	0,8767	-0,8392
UBBR3	0,3154	[-9.8822]**	0,2850	[-3.3121]**	0,2970	[-1.4098]**	0,3053	[-0.1315]**
UBBR4	0,2938	[-8.6413]**	0,2856	[-2.5763]**	0,2922	[-0.2644]**	0,3174	[-8.4551]**
Panel Results								
				Without Time Dummies				
Between	0,5691	[-20.9614]**	0,5921	[-24.0768]**	0,5693	[-21.0349]**	0,5884	[-21.3280]**
				With Time Dummies				
Between	0,3127	[-1.6389]**	0,3847	[-1.4404]**	0,3229	[-1.1922]**	0,3095	[-1.4610]**

Note: *t*-stats refer to $H_0\colon \beta_i = 1$, assuming a time-varying discount rate. *, ** indicate rejection levels of 10%, 1%. "Between" reports the group-mean panel FMOLS and group-mean panel DOLS from Pedroni (2001).
Source: Elaborated by the authors.

In summary, in the Present Value Model with Constant Expected Returns, we cannot reject the hypothesis that real prices and real dividends are non-stationary $I(1)$ as seen in theory. Applying the panel cointegration tests, Kao tests reveal predominance that real prices and real dividends are cointegrated; similarly, Pedroni tests show that we cannot reject the null hypothesis that the series under analysis are cointegrated, thus validating the PVM with constant returns; finally, the proposed Johansen-Fisher tests by Maddala and Wu (1999), particularly in the model with intercept (no trend) in CE and VAR, suitable for evaluation of the PVM, reject the null hypothesis that zero cointegrating relations exists, also rejecting the hypothesis that at most one cointegrating relationship exists. Thus, the first generation panel unit root tests indicate that real prices and real dividends are non-stationary $I(1)$; panel cointegration tests reveal that real prices and real dividends are cointegrated, hence validating the Present Value Model with Constant Expected Returns.

Regarding the results of the Present Value Model with Time-Varying Expected Returns, the analysis indicate that we cannot reject the hypothesis that log real prices and log real dividends have a unit root and follow, therefore, an $AR(1)$ process as provided in the literature. Additionally, we cannot reject that the log price-dividend ratio series is a stationary $I(0)$ process, representing the validity of the time-varying returns hypothesis. Applying the panel cointegration tests, Kao tests do not show predominance that log real prices and log real dividends are cointegrated; Pedroni tests, moreover, clearly indicate that we cannot reject the hypothesis that the underlying series are cointegrated, validating the PVM under time-varying returns; finally, Johansen-Fisher panel tests proposed by Maddala and Wu (1999), particularly in the model with intercept (no trend) in CE and VAR, suitable for the assessment of the PVM, reject the null hypothesis that zero cointegrating relations exists, also rejecting the hypothesis that at most one cointegrating relationship exists. Thus, the panel unit root tests reveal that log real price and log real dividends have a unit root and the log price-dividend ratio is stationary; the panel cointegration tests reveal that log prices and log dividends are cointegrated, indicating the validity of the Present Value Model with Time-Varying Expected Returns. The main results can be observed in Tables 15 and 16 as follows.

Table 15 – PVM with Constant Expected Returns

Unit Root Tests: No of Rejections of the Null						
AIC	Model					
	Restricted		Individual Intercept		Intercept and Trend	
	PRICE	DIVIDEND	PRICE	DIVIDEND	PRICE	DIVIDEND
Unit Root (Common Process)	1 out of 1	1 out of 1	0 out of 1	1 out of 1	0 out of 2	0 out of 2
Unit Root (Individual Process)	1 out of 2	2 out of 2	1 out of 3	3 out of 3	3 out of 3	3 out of 3
Individual Lags						
Ho	Model					
	Restricted		Individual Intercept		Intercept and Trend	
	PRICE	DIVIDEND	PRICE	DIVIDEND	PRICE	DIVIDEND
Unit Root (Common Process)	4 out of 5	3 out of 5	3 out of 5	2 out of 5	3 out of 10	2 out of 10
Unit Root (Individual Process)	6 out of 12	9 out of 12	5 out of 18	13 out of 18	10 out of 18	13 out of 17
Stationarity	0 out of 0	0 out of 0	2 out of 2	2 out of 2	2 out of 2	2 out of 2
Cointegration Tests						
Kao (1999)						
No of Rejections of the Null (No Cointegration)						
AIC	Model					
	Individual Intercept					
	Rejection of Null					
Individual Lags						
Fixed Lag	Model					
	Individual Intercept					
1	Rejection of Null					
2	Rejection of Null					
3	Rejection of Null					
4	Rejection of Null					
Pedroni (1997, 1999, 2000, 2004)						
No of Rejections of the Null (No Cointegration)						

AIC	Model		
	Restrict	Individual Intercept	Intercept and Trend
	11 out of 11	10 out of 11	10 out of 11
Individual Lags			
Fixed Lag	Model		
	Reastricted	Individual Intercept	Intercept and Trend
1	11 out of 11	10 out of 11	10 out of 11
2	11 out of 11	10 out of 11	10 out of 11
3	11 out of 11	8 out of 11	7 out of 11
4	11 out of 11	8 out of 11	8 out of 11

Maddala e Wu (1999)		
No of Rejections of the Null		
Ho	Deterministic Trend Specification: No Trend in Data	
	No Intercept or Trend in CE or VAR	Intercept (no trend in CE) - no intercept in VAR
No CE	2 out of 2	2 out of 2
At most 1 CE	2 out of 2	0 out of 0
Ho	Deterministic Trend Specification: Linear Trend in Data	
	Intercept (no trend) in CE and VAR	Intercept and trend in CE - no trend in VAR
No CE	2 out of 2	2 out of 2
At most 1 CE	2 out of 2	0 out of 0
Ho	Deterministic Trend Specification: Quadratic Trend in Data	
	Intercept and trend in CE - linear trend in VAR	
No CE	2 out of 2	
At most 1 CE	2 out of 2	

Cointegration Estimation				
No of companies with Rejections of Ho				
Estimators and Significancies	*Lags/Dynamic Lags*		*Between*	
	0	1	No Time Dummies	With Time Dummies
FMOLS				
10%	9	8	0	0
1%	30	31	2	2
DOLS				
10%	6	8	0	0
1%	35	25	2	2

Source: Elaborated by the authors.

Table 16 – PVM with Time-Varying Expected Returns

Unit Root Tests: No of Rejections of the Null									
AIC	Model								
	Restricted			Individual Intercept			Intercept and Trend		
	PRICE	DIVIDEND	RATIO	PRICE	DIVIDEND	RATIO	PRICE	DIVIDEND	RATIO
Unit Root (Common Process)	0 out of 1	1 out of 1	0 out of 1	1 out of 1	1 out of 1	1 out of 1	2 out of 2	2 out of 2	2 out of 2
Unit Root (Individual Process)	0 out of 2	2 out of 2	0 out of 2	3 out of 3	0 out of 3	3 out of 3	3 out of 3	3 out of 3	3 out of 3
Individual Lags									
Ho	Model								
	Restricted			Individual Intercept			Intercept and Trend		
	PRICE	DIVIDEND	RATIO	PRICE	DIVIDEND	RATIO	PRICE	DIVIDEND	RATIO
Unit Root (Common Process)	0 out of 5	5 out of 5	0 out of 5	5 out of 5	3 out of 5	5 out of 5	9 out of 10	7 out of 10	9 out of 10
Unit Root (Individual Process)	0 out of 12	12 out of 12	0 out of 12	8 out of 18	3 out of 18	16 out of 18	11 out of 18	15 out of 18	17 out of 18
Stationarity	0 out	0 out of	0 out	2 out	2 out	2 out of	2 out of	2 out of	2 out of

	of 0	0	of 0	of 2	of 2	2	2	2	2
	Cointegration Tests								
	Kao (1999)								
	No of Rejections of the Null (No Cointegration)								
AIC				Model Individual Intercept					
				Cannot Reject Ho					
	Individual Lags								
Fixed Lag				Model Individual Intercept					
1				Rejection of Ho					
2				Cannot Reject Ho					
3				Cannot Reject Ho					
4				Cannot Reject Ho					
	Pedroni (1997, 1999, 2000, 2004)								
	No of Rejections of the Null (No Cointegration)								
AIC				Model					
	Restricted			Individual Intercept			Intercept and Trend		
	3 out of 11			9 out of 11			11 out of 11		
	Individual Lags								
Fixed Lag				Model					
	Restricted			Individual Intercept			Intercept and Trend		
1	3 out of 11			9 out of 11			11 out of 11		
2	3 out of 11			9 out of 11			11 out of 11		
3	3 out of 11			9 out of 11			11 out of 11		
4	3 out of 11			7 out of 11			11 out of 11		
	Maddala e Wu (1999)								
	No of Rejections of the Null								
Ho	Deterministic Trend Specification: No Trend in Data								
		No Intercept or Trend in CE or VAR					Intercept (no trend in CE) - no intercept in VAR		
No CE		1 out of 2					1 out of 2		
At most 1 CE		0 out of 2					2 out of 2		
Ho	Deterministic Trend Specification: Linear Trend in Data								
		Intercept (no trend) in CE and VAR					Intercept and trend in CE - no trend in VAR		
No CE		2 out of 2					2 out of 2		
At most 1 CE		2 out of 2					0 out of 2		
Ho	Deterministic Trend Specification: Quadratic Trend in Data								
				Intercept and trend in CE - linear trend in VAR					
No CE				2 out of 2					
At most 1 CE				2 out of 2					
	Cointegration Estimation								
	No of companies with Rejections of Ho								
Estimators and Significancies				*Lags/Dynamic Lags*			*Between*		
							No Time Dummies	With Time Dummies	
				0	1				
FMOLS									
10%				1	1		0	0	
1%				15	15		2	2	

DOLS				
10%	2	1	0	0
1%	15	14	2	2

Source: Elaborated by the authors.

5. CONCLUSION

The empirical evidence on the long-term relationship between stock prices and dividends remains scarce. As stock prices rose, analysts questioned whether the fundamental value of a share related to innovations in dividends, since low dividend payouts and record-high stock prices suggested an overvaluation. From then on, the validity of the Present Value Model (PVM) has been subject of debate, because the recent collapse of stock prices underlines the importance of traditional measures in the valuation of stocks, since they relate stock prices to the fundamental value of corporations.

While most studies focusing on the relationship between prices and dividends have examined the long-term relationship between a stock price index and an index of dividends of a particular country of interest, the empirical analysis in this paper is based on prices and dividends at the firm level through first generation panel unit root and panel cointegration estimation methods to test the long-term relationship between stock prices and dividends for the Brazilian stock market. The use of firm level data allows the analysis of patterns and relationships that can be obscured at the aggregate stock market level through averaging in the aggregation process. Thus, the power increase and precision obtained by the procedures allow the application of recent data, as well as possible structural changes in the data that occur more frequently over longer periods, and the more accurate assessment regarding the consistency of the present value model under considerable fluctuations in the stock market.

Regarding the results obtained in the Present Value Model with Constant Expected Returns, from the panel unit root tests, the statistics reveal sensitivity to the presence of individual effects and individual linear trends and to the lag order. The ambivalent results of the tests are expected and also found in Goddard *et al*. (2008). However, there is an inclination to the failure of rejecting the hypothesis that real prices and real dividends series have a unit root for the entire panel or for most companies surveyed, considering the different null and alternative hypotheses tested. From the panel cointegration tests of Kao (1999), Pedroni (1997, 1999, 2000, 2004) and Maddala and Wu (1999), results fail to reject the hypothesis of no cointegration between real prices and real dividends considering the different sample companies examined, validating, therefore, the Present Value Model between prices and dividends with Constant Expected Returns developed seminally in Campbell and Shiller (1987).

Analyzing the Present Value Model with Time-Varying Expected Returns, the apparent ambivalence of the unit root tests is expected and verified, in which the diagnosis of $I(0)$ stationarity or nonstationarity $I(1)$ depends on whether or not the trend is included, as well as upon the lag order established. However, results cannot reject the hypothesis that real log prices and real log dividends series have a unit root for the entire panel or for most companies comprising it, considering the different null and alternative hypotheses tested. In accordance to the theory, results do not reject that log price-dividend ratio is a $I(0)$ stationary process, indicating the validity of the Present Value Model. Finally, from the cointegration tests for panel data, statistical results cannot reject the hypothesis of cointegration between real prices and real dividends, considering the different sample companies observed, hence validating the Present Value Model between prices and dividends with Time-Varying Expected Returns developed seminally in Campbell and Shiller (1988a,b).

Finally, it is presented that, for panel cointegrated regression models, the asymptotic properties of the estimators of the regression coefficients and the associated statistical tests are different from those of the time series cointegration regression models. Panel cointegration models direct to the assessment of long-term relationships verified in macroeconomic and financial data. Thus, results from the FMOLS and DOLS estimators applied to cointegrated panels, individual companies show evidence of overvaluation of stock prices for most examined companies, assuming either the hypothesis of constant or time-varying expected returns.

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