Explaining earnings persistence: a threshold autoregressive panel unit root approach

Galimberti, Jaqueson Kingeski and Cupertino, César Medeiros

Federal University of Santa Catarina

23 March 2009

Explaining Earnings Persistence:
A Threshold Autoregressive Panel Unit Root Approach

César Medeiros Cupertino[1]
Jaqueson Kingeski Galimberti[2]

First draft on: March 23, 2009.

Abstract

This paper proposes a reassessment to the hypothesis that the persistence of current earnings performance is decreasing in the magnitude of the accrual component of earnings and increasing in the magnitude of the cash flow component of earnings. For this purpose, a threshold autoregressive panel unit root approach is proposed using a Fisher-type. This approach allowed us to distinguish between unconditioned and conditioned measures of persistence, making it possible to infer whether the earnings components condition its persistence. The approach was applied to a sample of 126 Brazilian firms in the period from 1995 to 2007. Our main results are the finding of relevant earnings persistence heterogeneity between the firms in the sample, a relatively lower unconditioned measure of earnings persistence, and a partial rejection of the hypothesis afore mentioned, specifically about the effects of the accruals components over the earnings persistence.

Keywords: earnings persistence, accruals, threshold autoregressions, panel unit root tests.

JEL Classification: C23, G10, M41.

1. Introduction

The earnings disclosed by companies is a measure of synthesis used for various purposes and by a wide group of users. For example, some incentives given to executives (e.g., executive equity compensations) are bound to the superior performance that administrators provide to the entity's profitability[3]. Moreover, financial analysts also have a special interest in this measure, requiring its disclosure in order to analyze and compare their projections of future earnings. In turn, the accountants continue to emphasize the role of measurement of earnings and suggest some possible reasons for this: the desire to have a single measure of income or, recognizing the extent of the information contained in the accounting earnings (HENDRIKSEN, VAN BREDA, 1991). The Financial Accounting Statement Committee (SFAC) nº 1 (FASB, 1978) reinforces this intuition by defining the profit and its components as the main objective of financial statements, and noted that, together with cash flow, earnings

[1] Master in Economics Program at Federal University of Santa Catarina (UFSC) – Florianópolis – SC - Brasil. Master in Accounting Program at University of Brasília (UnB) – Brasília – DF – Brasil.
Email: cupertino.cmc@gmail.com.
[2] Master in Economics Program at Federal University of Santa Catarina (UFSC) – Florianópolis – SC - Brasil.
Financial support from REUNI program of Brazilian Education Ministry (MEC) is gratefully acknowledged.
Email: jakaga2002@yahoo.com.br.
[3] The compensation includes rewards in cash, stocks, facilities, etc. A detailed discussion about "Executive Equity Compensation" is available in Core, Guay e Larcker (2003).

is used to verify the ability to generate future results. Pankoff and Virgil (1970) also argue that there is an understanding that the accounting income is one of the most important measures of public data available.

The academic research on disclosed earnings is extended to its effect on the capital market. One of seminal studies is dated back to the 1960s, with the work of Ray Ball and Phillip Brown (BALL; BROWN, 1968). They showed that bond prices ranged in the same direction as the accounting income, increasing the relevance of the latter. The information content of earnings is also observed in studies on valuation and informational asymmetry that exists between insiders and external public. On the first, models that take into account the earnings[4] now appear as an alternative to the discounted cash flows (LUNDHOLM, 1995). In relation of informational asymmetry, there may be an increase in bias about earnings' changes (shocks), according to the information disclosed.

Recently, the identification of the behavior of components of the earnings came to play a leading role in studies of market efficiency, since Sloan's work (SLOAN, 1996). The approach was entitled as "Accruals Anomaly" and has the assumption that the non-financial component (Accruals) of earnings has a different behavior than their financial component (cash flow), with implications for earnings' persistence. If investors and other users of financial statements are able to identify this difference in behavior of earnings' components, the information would be quickly absorbed by the market when it becomes available. Moreover, when the perception is failure (i.e., the market is myopic in the identification of the behavior of the earnings' components) there are opportunities for abnormal gains by a possible inefficiency (anomaly).

This paper aims to reassess the first hypothesis of Sloan (1996, p.291) that "the persistence of current earnings performance is decreasing in the magnitude of the accrual component of earnings and increasing in the magnitude of the cash flow component of earnings". The motivation behind the research is to identify some of the mechanisms that drive the earnings' persistence, given their usefulness in various applications in research on capital markets (valuation, for instance). For this purpose, a threshold autoregressive panel unit root approach is proposed extending the technique introduced by Caner and Hansen (2001) to a panel data context using a Fisher-type test as proposed by Maddala and Wu (1999). This approach allowed us to distinguish between unconditioned and conditioned measures of persistence, making it possible to infer whether the earnings components condition its persistence properties. The approach was applied to a sample of 126 Brazilian firms in the period from 1995 to 2007.

Our approach allowed us to observe the existence of relevant heterogeneity between the firms in the sample, which lead to conclude that pooling methods of aggregation are not recommended to the study of earnings persistence. Regarding the persistence measures derived from the unit root tests results we have found an unconditioned measure of persistence of more than half lower than that obtained by Sloan (1996). Moreover, conditioning earnings persistence to the accruals and the cash flow components led us to partially reject the first hypothesis of Sloan (1996, p.291), specifically about the effects of the accruals components over the earnings persistence.

The remainder of the paper is organized as follows: Section 2 presents a brief review of some related empirical evidence; Section 3 presents our methodology; Section 4 describes our data sources and the construction of our samples; Section 5 presents the results on our empirical application; finally, the paper ends with our conclusions.

[4] Residual Income, for instance (see, among others: PEASNELL, 1982 and LEHMAN, 1993).

2. Earnings Persistence Empirical Studies

The idea that the current value of earnings is a starting point for the prediction of future earning is not new. Graham and Dodd (1951, apud FRANKEL; LITOV, 2008) highlighted the fact in the 1950s. Ball and Brown (1968) in classical study showed that bond prices ranged in the same direction as the accounting earnings, increasing the informational content of the latter. From these seminal studies, a wide spread of literature has arisen on the importance of earnings for the prediction of future profitability and valuation of companies (DAMODARAN, 1999 and PENMAN, 2007 are some texts of reference). Frankel and Litov (2008) emphasize that such literature stimulated researchers to develop methods and identify determinants of persistence in earnings.

The classic formulation to estimate the persistence of earnings is a naive model, which relates this observation with data lagged by 1 period:

$$E_t = \alpha_0 + \alpha_1 E_{t-1} + \varepsilon_t \qquad (2.1)$$

where E_t represents the earnings[5] during the period t and ε_t is the error term that includes all information not captured by earnings from the previous period (E_{t-1}) to explain the current earning.

Sloan (1996) found a high persistence (over 0.7) of earnings in relation to past earnings, a fact observed in aggregate (pooled) and also at sector level (by industry). The study was conducted for U.S. companies (excluding financial) for the period 1962-1991. The statistical significance found for the coefficient α_1 has lead to the rejection of the null hypothesis that the performance of the earnings is purely transitory. To test the influence of the components of earnings (accruals and cash flow) in the persistence of earnings, Sloan (1996) applied the flowing specification of Eq. (2.2).

$$E_{t+1} = \gamma_0 + \gamma_1 ACC_t + \gamma_2 FCO_t + v_{t+1} \qquad (2.2)$$

where ACC stands for the accruals components and FCO for the operating cash flows. The results showed that $\gamma_1 < \gamma_2$ for both aggregate and sector level (by industry). This evidence based the Sloan's conclusion that the accrual component of earning is less persistent than the cash flow component of earning to explain the current earnings.

In general, studies of the accruals anomaly use the same specification adopted by Sloan, but with different data and periods. For example, Pincus et. al. (2007) found that $\gamma_1 < \gamma_2$ analyzing the international evidence of the accruals anomaly. Their result is robust regardless of the accounting system (common law or code law) and the concerned country. The sample was composed by 20 countries (with 9 code law countries and 11 common law countries) for the period 1994-2002. Kaserer et al. (2008) corroborate this result for German companies in the period 1995-2002, regardless of the adoption of an accounting system under the German (IFRS / IAS) or U.S. rules (U.S. GAAP). Fairfield, Whisenant and Yohn (2003) show contrary evidence on the impact of the accruals and cash flow components in the persistence of profits, but using a different deflator than generally used in studies of accruals anomaly[6].

---

[5] Usually, the measure is based on operational earnings or earnings before extraordinary items (see, among others: SLOAN, 1996 and FRANKEL; LITOV, 2009).

[6] For instance, Sloan (1996), Xie (2001), Pincus et. al. (2007) employed total assets.

3. Methodology

In order to study the persistence properties of firm's earnings our approach is divided into two stages. First we focus on the unconditioned persistence of earnings, testing for the existence of a unit root at each firm earnings series. To aggregate the individual results to the panel context we use the Maddala and Wu (1999) Fisher type test, which combines the individual unit root *p*-values to test for unit root in panel data. At the second stage we test for conditioning effects of threshold variables over the earnings persistence, extending the procedure of Caner and Hansen (2001) to a panel data context. As exogenous threshold variables we consider the accrual and the cash flow components of earnings allowing us to adequately test the first hypothesis of Sloan (1996, p.291), regarding the effects of earnings composition on the persistence of earnings.

3.1. Measuring Unconditioned Persistence

An indirect measure of persistence can be obtained as a byproduct of unit root tests estimatives. Considering the sum of the autoregressive coefficients as our measure of persistence, the augmented Dickey-Fuller (ADF) test specification, in Eq. (3.1), provides an easy way to access this measure (Eq. 3.2).

$$\Delta y_{i,t} = \rho_i y_{i,t-1} + \sum_{j=1}^{p_i} \theta_{ij} \Delta y_{i,t-j} + \alpha_i + \varepsilon_{i,t} \tag{3.1}$$

where i indexes for the individual firms, t denotes the year, Δ is the first-difference operator, $y_{i,t}$ is the firm i earnings time series, α_i is an individual constant[7], $\varepsilon_{i,t}$ is an iid error term, and p_i is the autoregressive lag order included to ensure that the regressions residuals behave like white-noise processes[8].

$$\rho_i = -\left(1 - \sum_{j=1}^{p_i} a_{ij}\right) \quad \Leftrightarrow \quad \sum_{j=1}^{p_i} a_{ij} = \rho_i + 1 \quad \Leftrightarrow \quad P_i = \rho_i + 1 \tag{3.2}$$

On a panel data context Maddala and Wu (1999) propose a simple test for the null hypothesis of a unit root process (H0: $\rho_i = 0$) against the alternative of a stationary process (H1: $\rho_i < 0$), at each individual series. To allow for heterogeneity in the parameters estimatives, they propose a Fisher type test to combine the evidence on the unit root hypothesis from the individual unit root tests performed on each cross-section unit of the panel. The test consists of combining the observed significance levels (*p*-values) from the individual unit root tests. If the test statistics are continuous, the significance levels π_i (i=1, 2,.., N) are independent uniform (0, 1) variables, and $-2\log\pi_i$ has a χ^2 distribution with two degrees of freedom. Using the additive property of the χ^2 variables, we get the Fisher test of Eq. (3.3) which has a χ^2 distribution with 2N degrees of freedom.

$$p_\lambda = -2\sum_{i=1}^{N} \log \pi_i \tag{3.3}$$

---

[7] Notice that we do not include an exogenous linear trend on the specification as there is no good theoretical reasoning for that, but this extension could be easily done in other contexts.

[8] The procedure of lag order selection used in the entire paper is the minimization of the Akaike information criterion defined as: $AIC = -2(l/T) + 2(k/T)$, where l is the log of the likelihood function with k parameters estimated using T observations.

This panel unit root test has several advantages over other tests. First, it does not need the assumption that all the series follow the same process, as the pooled unit root test of Levin, Lin and Chu (2002). It also does not require a balanced panel, as in the case of the Im, Pesaran and Shin (2003), and one can use different lag lengths and exogenous variables in the individual ADF regressions. Finally, its usefulness is not restricted to the ADF unit root test, as it is allowed to be derived for any univariate unit root test that lead to continuous test statistics.

The disadvantages of the Maddala and Wu (1999) test are that, firstly, its significance levels have to be derived by simulation, and secondly, the test is valid under the crucial assumption of cross-sectional independence. While the first point refers just to the computational burden, the second point is one of the major regards of current research on panel unit root tests (see Breitung and Pesaran, 2005, and Hurlin and Mignon, 2007). As proposed by Maddala and Wu (1999, p.645), one way out of the problem of cross-correlated errors is to make inferences based on bootstrapped empirical distributions of the test statistics.

The bootstrap procedure consists of generating a bootstrap sample under the null of a unit root ($\rho_i = 0$), fixing the other parameters from the ADF estimation of Eq. (3.1), and drawing with replacement from the residual series obtained from the individuals ADF estimations. However, instead of resampling directly from $\hat{\varepsilon}_{i,t}$, we must resample from $\hat{\varepsilon}_t = \left[\hat{\varepsilon}_{1,t}, \hat{\varepsilon}_{2,t}, ..., \hat{\varepsilon}_{N,t}\right]$ in order to keep the cross-correlations among $\hat{\varepsilon}_{i,t}$. Repeating the experiment some thousand times we get the empirical distribution of the Fisher test statistic, from which the significance level (p-value) of the actual statistic value can be obtained. This bootstrap procedure also has advantage against the asymptotic critical values when data availability restricts the time dimension of the sample.

3.2. Measuring Conditioned Persistence

After examining the univariate measure of persistence derived from unit root tests, one would ask how this persistence may be affected by other explanatory variables. Actually, this is exactly the kind of question implied on testing the first hypothesis of Sloan (1996, p.291). A subsequent and relevant question is how to appropriately make inference about the effect of an exogenous variable over the persistence of a time series. One answer to this question may be found on the recent developments on threshold autoregressive (TAR) models estimatives. Relaying on the major class of regime switching models, the TAR models allow the behavior of an autoregressive process to depend on the state of the system[9]. Specifically interesting for our case is the contribution of Caner and Hansen (2001) that developed a procedure to test for threshold effects over either the null hypothesis of a unit root and the alternative of a stationary process. Allowing the threshold to be an exogenous variable dividing the autoregressive process into two regimes, the authors propose bootstrap approximation procedures to infer about the significance of both the threshold and the unit root hypothesis. In what follows we give a brief review of the estimation and inference procedures proposed by Caner and Hansen (hereinafter C-H), while details can be obtained directly from the original work.

The TAR specification that we consider on this paper is presented in Eq. (3.4). Differing from the specification proposed by Caner and Hansen (2001, p. 1557) we allow for a threshold effect only at the rho coefficient, while the former authors formulate their model with a threshold for the whole group of explanatory variables. Our decision to focus only at

[9] An introduction to TAR models can be found in Enders (2004, Chapter 7).

the unit root test parameter stems from the short time dimension of our sample, leading us to choose a specification with a lower number of parameters. Another difference is that our model is specified with the cross-section subscript identifiers in order to extend the tests to a panel data context.

$$\Delta y_{i,t} = \rho'_i y_{i,t-1} 1_{\{Z_{i,t-1}<\lambda_i\}} + \rho''_i y_{i,t-1} 1_{\{Z_{i,t-1}\geq\lambda_i\}} + \sum_{j=1}^{p_i} \theta_{ij} \Delta y_{i,t-j} + \alpha_i + \varepsilon_{i,t} \qquad (3.4)$$

where $1_{\{.\}}$ is the indicator function, Z_{t-1} is the threshold variable, and λ_i is threshold value that divides the process into two regimes.

The estimation and inference approach proposed by C-H may be divided into three stages: the first stage deals with a grid search estimation of the unknown threshold value; the second stage refers to testing for non-linearity; and the third stage relates to the test for a unit root when a threshold effect may be present.

Before describing each of these stages some remarks about the threshold variable and the threshold value are needed. First, although C-H specify the threshold variable as an *m*-order difference of the dependent variable, resulting in a momentum-threshold autoregressive (M-TAR) model, the particular specification for the threshold variable is not statistically essential. The only requirements are that the threshold variable must be predetermined, strictly stationary, and ergodic with a continuous distribution. Another remark is about the possible values for the unknown threshold (λ) which should be taken from the interval $\Lambda = [\lambda_1, \lambda_2]$ where λ_1 and λ_2 are picked from the threshold variable series in a way that the $\pi\%$ lower and higher threshold values are excluded from the grid search estimation procedure. This restriction imposes that no regime has less than $\pi\%$ of the total sample.

The first step on the estimation procedure of the TAR model is to estimate the model of Eq. (3.4) for each $\lambda \in \Lambda$ by ordinary least squares (OLS), which leads to one estimated residual variance for each possible threshold value. The least-squares estimate of the threshold ($\hat{\lambda}$) is found by minimizing this residual variance, and the other parameters estimates are then found by plugging in this threshold value into Eq. (3.4). This procedure is based on Chan (1993), which showed that this least-squares estimate of the threshold is super-consistent.

The second stage of the approach is to test for the non-linearity hypothesis against the null of linearity. To this purpose C-H propose the Wald test (W_T) of Eq. (3.5), which is found to have a nonstandard asymptotic null distribution, partially due to the presence of a parameter that is not identified under the null (a nuisance parameter), and partially due to the assumption of a nonstationary autoregression. To approximate the sampling distribution the authors propose two model-based bootstrap procedures, one appropriate for the stationary case, and the other appropriate for the unit root case. As the true order of integration is unknown, the authors suggest calculating the bootstrap *p*-values both ways, and base inference on the more conservative *p*-value.

$$W_T = T\left(\frac{\hat{\sigma}_0^2}{\hat{\sigma}^2} - 1\right) \qquad (3.5)$$

where $\hat{\sigma}^2$ is the residual variance obtained from the threshold model estimation, and $\hat{\sigma}_0^2$ is the residual variance from OLS estimation of the null hypothesis linear model.

At the last stage of the approach C-H propose another Wald statistic to test for a unit root when a threshold effect may be present. While the null hypothesis of the test is the existence of a unit root (Eq. 3.6), the alternative hypothesis may have three possible formulations,

where the first (Eq. 3.7) is the stationarity case, and the last two (Eqs. 3.8, 3.9) refers to partial unit root cases.

$$H_0: \rho' = \rho'' = 0 \tag{3.6}$$

$$H_1: \rho' < 0 \text{ and } \rho'' < 0 \tag{3.7}$$

$$H_2: \rho' < 0 \text{ and } \rho'' = 0 \tag{3.8}$$

$$H_3: \rho' = 0 \text{ and } \rho'' < 0 \tag{3.9}$$

To test for the null of a unit root process against the alternative of a stationary process (Eq. 3.7), C-H suggest constructing a one-sided Wald statistic based only on the *t*-statistics of the ρ parameters with negative values (Eq. 3.10). However, this test has power against all alternatives, and thus, to discriminate between the stationary case (H_1) and the partial unit root cases (H_2 and H_3), the authors suggest examining the individual *t*-statistics. If only one of these *t*-statistics is statistically significant the process is consistent with the partial unit root cases.

$$R_{1T} = t_1^2 1_{\{\hat{\rho}' < 0\}} + t_2^2 1_{\{\hat{\rho}'' < 0\}} \tag{3.10}$$

To obtain the significance levels for this unit root tests C-H derive asymptotic approximations to the distributions of the statistics. However, the authors suggest again the use of bootstrap approximations to obtain improved finite sample inference. Two possible bootstrap distributions can be constructed, one imposing an identified threshold, and other imposing an unidentified threshold effect. Both bootstrap samples must be constructed under the null of a unit root. The only difference between then is the original residual series from which the resampling is done.

In order to extend the C-H approach to a panel data context we propose the use of the Maddala and Wu (1999) Fisher type test to combine the individual results of the C-H approach into panel measures of their statistics. Special attention must be given to the bootstrapping procedures as now we have panel data. To keep the cross-correlation between the errors we extend the bootstrap procedures of C-H to panel context using the resampling rule suggested by Maddala and Wu (1999). With this extension we may have panel results for the *W*-statistic to test for threshold effects, for the R_{1T}-statistic to test for a unit root with threshold, and also for the *t*-statistics of the ρ parameters.

Finally, as our focus is not exactly on testing for stationarity, but to access the effects of earnings composition on its time series persistence, our inference might focus on the results of each individual firm. Specifically, in order to validate the first hypothesis of Sloan (1996, p.291) we should derive the conditional measures of persistence by Eq. (3.11) from the individual firms ρ parameters estimates. When testing for the accrual component as a threshold to earnings persistence, Sloan first hypothesis imply that we should find that $P_i^1 > P_i^2$, while for the cash flow component as a threshold to earnings persistence the hypothesis imply that $P_i^1 < P_i^2$.

$$P_i^1 = \rho'_i + 1 \text{ and } P_i^2 = \rho''_i + 1 \tag{3.11}$$

3.3. Approach Summary

From the discussion above we may now summarize our empirical approach to study earnings persistence into the following steps:

1. Derivate unconditioned persistence measures of firm's earnings from the Maddala and Wu (1999) panel unit root test.
2. Test for unit root on the accruals and the cash flow components of earnings, to ensure that these series satisfy the requirements to be a threshold variable.
3. Estimate the threshold autoregressive specification of Eq. (3.4) with firm's earnings as dependent variable, and, the lagged accruals and cash flow components of earnings as threshold variables.
4. Test for the significance of the threshold effects at each individual firm series, and at the panel level.
5. Test for a unit root with threshold at each individual firm series, and at the panel level.
6. Derivate the conditioned persistence measures of each firm's earnings in order to access the validity of the first hypothesis of Sloan (1996, p.291).

4. Data Sources and Sample

The analyses require historical accounting data (in annual basis) of Brazilian companies for the period 1995-2007. The year 1995 was used as a baseline because it coincides with the establishment of a stable monetary standard in Brazil (the Real - R$), which allows consistency and comparability of the numbers presented in financial statements. Data were extracted from Economatica, excluding financial firms (banks, life insurance, etc.) in the selection.

The variables of interest are Earnings, Accruals and Cash Flow. The definition of earnings is operation income after depreciation. This measure is usually employed by studies about accruals anomaly and ensure that non-recurring items (e.g., extraordinary items) are excluded from the selection[10]. Accruals are measured by the balance sheet approach (Eq. 4.1). This study used the approach of balance sheet because the cash flow statement is not a financial statement required by Brazilian legislation and therefore, the data are not readily available. The ACC is identified on the specification given below, commonly used in the literature on earnings management (DECHOW, SLOAN, SWEENEY, 1995).

$$ACC_{i,t} = \left(\Delta CA_{i,t} - \Delta Cash_{i,t}\right) - \left(\Delta CL_{i,t} - \Delta DEB_{i,t}\right) - Dep_{i,t} \qquad (4.1)$$

where ΔCA is the change in current assets, $\Delta Cash$ is the change in cash and cash equivalents, ΔCL is the change in current liabilities, ΔDEB is the change in debt included in current liabilities and Dep is the depreciation and amortization expense.

Cash flow is given by the following specification of Eq. (4.2).

$$FC_{i,t} = E_{i,t} - ACC_{i,t} \qquad (4.2)$$

All variables were standardized by the size of the company to facilitate comparisons. The measure of size is total assets, measured by the average of values of the beginning and the end of the year.

Finally, we restricted our sample to firms were there was data availability for the whole sample, in order to form a balanced panel dataset. This sample consisted of the 126 Brazilian

[10] Non-recurring items are problematic (difficult to decompose cash and accrual components) and they are not related with continuing operations (SLOAN, 1996).

companies listed on Appendix A. Although we have restricted our sample to a balanced panel of data, the methodology can be easily extended to applications with non-balanced data.

5. Results

This section presents the results obtained from the approach proposed in the previous sections to measure the persistence of earnings on a sample of 126 Brazilian firms from 1995 to 2007. All bootstrapped significance levels presented here were obtained by 10.000 replications. The program codes and data to replicate our empirical work with the software EViews 6.0 is available from the webpage http://sites.google.com/site/jkgecono/trabalhos-tecnicos.

5.1. Linear Unit Root Tests

The first two steps of our empirical approach relay on testing for panel unit roots over the earnings, the accrual and the cash flow series. To this matter we present results obtained from several panel unit root tests: the LLC from Levin, Lin and Chu (2002); the IPS from Im, Pesaran and Shin (2003); and the ADF Fisher-type test from Maddala and Wu (1999). Notice that while the LLC tests for a common unit root on the individual series, the last two allow each individual series to have a distinct autoregressive process. As discussed at section 3.1 of this paper, the results from these panel unit root tests will be used to derive unconditional measures of earnings persistence, which we present at the end of this section.

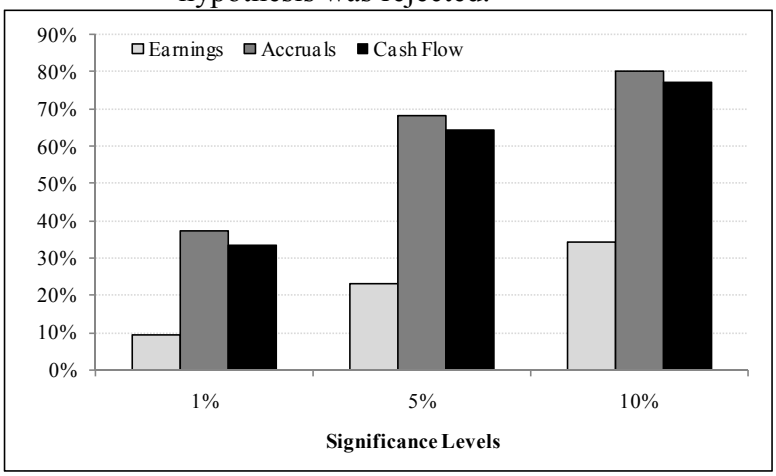
Table 5.1 – Results of Panel Unit Root Tests.

Variables/Unit Root Tests	Earnings		Accruals		Cash Flow	
	Stat.	*p*-val	Stat.	*p*-val	Stat.	*p*-val
LLC t*-stat	-21.66	0.00	-30.18	0.00	-25.60	0.00
IPS W-stat	-10.48	0.00	-23.63	0.00	-18.02	0.00
ADF-Fisher Bootstrap	531.20	0.00	905.60	0.00	925.94	0.00

Overall, from the results reported on Table 5.1, we can strongly reject the hypothesis of a unit root at the panel level for the three series under study. Regarding our proposed threshold series, the panel unit root tests give robust evidence that these series satisfy the requirements enlightened on section 3.2. It is also worthwhile to take a look at the individual firms' results for the ADF-Fisher unit root test. Figure 5.1 presents an overview of these results.

Notice that the percentage of firms on which the earnings series could be considered as stationary is about one third the percentage of firms on which the unit root hypothesis is rejected for the accruals and the cash flow series. This result sheds some doubts about the validity of studies which derive earnings persistence measures from linear unit root tests, especially those which assumes a common autoregressive process. The big message from this subsection is that the autoregressive process of earnings, and consequently its persistence, seems to be heterogenous between the firms.

Figure 5.1 - Percentage of firms on which the unit root hypothesis was rejected.



5.2. Threshold Autoregressive Model Estimates

As we have discussed above, one alternative to test for a unit root is to allow for a threshold dividing the autoregressive process into two regimes. Focusing on the firms earnings series we estimated the TAR specification of Eq. (3.4) considering as threshold the accruals and the cash flow components of earnings. This estimates allowed us to test the significance of the threshold effects and for the existence of a nonlinear unit root on the autoregressive process of the earnings series. Table 5.2 presents the results obtained on the panel data context.

Table 5.2 – Results for the Panel Threshold Autoregressive Model.

Tests		Accruals		Cash Flow	
		Stat.	*p*-val	Stat.	*p*-val
For a Threshold	*W*-stat (H0 of a unit root)	258.35	0.38	288.13	0.06
	W-stat (H1 of stationarity)	287.31	0.06	305.13	0.01
For a Unit Root	R_{1T} (unidentified threshold)	451.34	0.00	491.05	0.00
	R_{1T} (identified threshold)	377.84	0.00	489.86	0.00
	t_1-stat	411.80	0.00	428.58	0.00
	t_2-stat	417.33	0.00	463.57	0.00

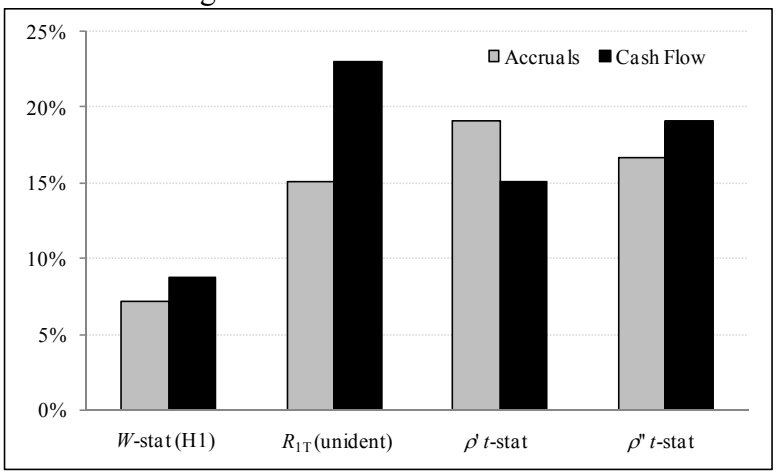
Notes: the TAR specifications of these results have the earnings as dependent variable ($y_{i,t}$) and the lagged accruals/cash flow components as threshold variables ($Z_{i,t-1}$).

Testing for the significance of threshold effects, we can see that choosing the most conservative *p*-value lead us to conclude that the accruals components cannot be considered as a threshold for the earnings autoregressive process, but the cash flow can. However, as the results of the unit root tests robustly reject the null of a unit root, we may base our inference about the threshold effects on the Wald test obtained over the stationarity assumption. Thus, the results at Table 5.2 lead us to reject the null of a linear autoregressive process against the TAR alternative for both the accruals and the cash flow components as threshold variables at

the significance levels of 6% and 1%, respectively. Moreover, the results obtained from the *t*-stats indicate that we may reject the null of a unit root against the alternative of stationarity, putting away the possibility of a partial unit root process. This means that even having a two-regime-fold adjustment process, we may say that both regimes tend to a mean equilibrium.

A different picture emerges when we move our focus to the individual firms' results. Figure 5.2 provides an overview of these results, where we present the percentage of firms on which the null hypothesis of each test is rejected at the 5% level of significance. Overall the results obtained using the cash flow as threshold present a higher number of firms rejecting the null hypothesis than using the accruals threshold. For the *W*-stat threshold test we have found that the linear specification is rejected favoring the TAR model with the accruals (cash flow) threshold on only 7% (9%) of the firms. For the R_{1T}-stat unit root test the results seems a bit better. However, rejecting the null of a unit root on only 15% of the firms, for the accruals threshold, and 23% of the firms, for the cash flow threshold, is still a poor result to allow the analysis of earnings persistence to be made based on the assumption of homogeneity between the firms. The same inference may be derived from the ρ's *t*-stats, where we have found that only 6% (9%) of the firms' series rejected both nulls of unit root with the accruals (cash flow) threshold. This means that from the lower percentage of firms where the null of a unit root was rejected, the partial unit root alternative hypothesis is the most frequent.

Figure 5.2 - Percentage of firms on which the statistic significance is found.



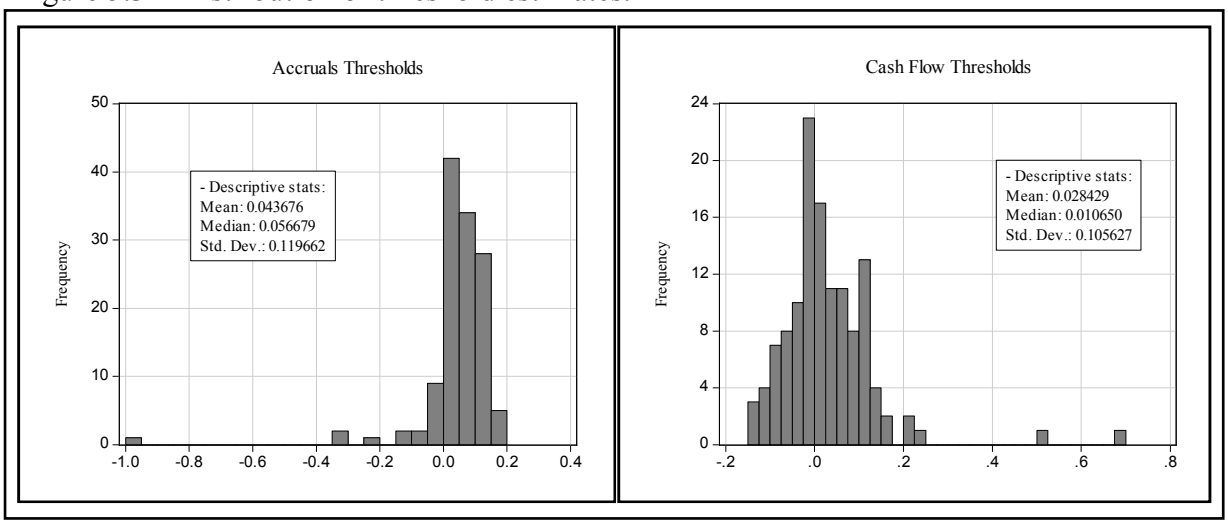
Notes: Results obtained considering a 5% significance level.

Regarding the threshold estimates ($\hat{\lambda}$), Figure 5.3 presents their distributions through the 126 individual firms estimatives. Remembering from previous sections, these are the values that divide each firm earnings autoregressive process into two regimes. Notice the high variability of these estimates as can be inferred from the standard deviation measures relatively to the mean estimate.

Again the results seem to indicate that pooled measures of persistence might suffer from heterogeneity problems. However, some caution must be taken when trying to generalize our results. First, our sample refers to a quite small sample of Brazilian firms. A fruitful way for future research would be to apply the methodology that we have developed with a broader sample of firms, and also from other different countries. Another remark is about the time series span size of our sample, which could be considered as too short to univariate time series

analysis. After these remarks we follow to derive the persistence measures of earnings both as a panel mean, and individually by firms.

Figure 5.3 – Distribution of threshold estimates.



Notes: notice that the two graphics have different scales.

5.3. Persistence Measures Estimates

At this point we arrived to the main aim of this paper, that is, to obtain measures of earnings persistence in order to allow us to access the validity of Sloan (1996, p.291) hypothesis about the effects of the accruals and the cash flow components over earnings persistence. To this end, we will first present the persistence measures derived from the linear autoregressive model (unconditioned persistence, Eq. 3.2), to then focus on the measures derived from the TAR specification (conditioned persistence, Eq. 3.11).

From Eq. 3.2 and the average of the ρ parameters estimates we obtained the results presented at Table 5.3. These results show that while for the whole sample the average estimate of earnings persistence is about 0.38, when considering only those firms where the unit root hypothesis was rejected this persistence measure gets even lower. This is an interesting result, especially if we compare this persistence measure with that obtained by Sloan (1996, p.299) of about 0.84.

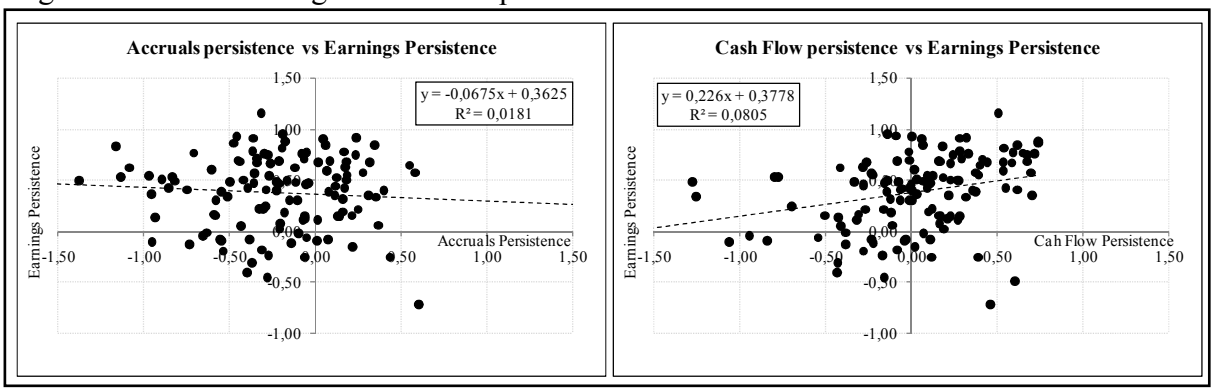
Table 5.3 – Unconditioned Measures of Persistence.

Measures/Samples	All	Only significant		
		1%	5%	10%
Number of firms	126	12	29	43
Average ρ	-0.6178	-1.1200	-1.0871	-0.9825
Average persistence	0.3822	-0.1200	-0.0871	0.0175

A first look at the relationship between earnings persistence and its components persistence (accruals and cash flow) can be done from persistence measures derived from the individual unit root tests. The scatter diagrams of these estimates are presented at Figure 5.4.

As it can be seen, the earnings persistence seems to be negatively correlated with the accruals persistence, and positively correlated with the cash flow persistence. Besides these results are in accordance with those found by Sloan (1996), the dispersion of the estimatives is too high to confidently draw this inference. Furthermore, the relationships presented at Figure 5.4 are based on point estimatives obtained independently from each series. This might be thought as an inadequate procedure given that both accruals and cash flow are components of earnings, thus, their persistence is simultaneously determined. A better view of the effects of earnings components over its persistence might be found using the threshold approach to obtain conditioned measures of persistence.

Figure 5.4 – Scatter diagram between persistence measures.



Notes: seven outliers are not presented to allow a better visualization, six on the accruals persistence, and one on the cash flow persistence.

Focusing now on the conditioning effects of the accruals and the cash flow, Table 5.4 presents the conditioned measures of earnings persistence according to each threshold variable. Considering the persistence measures derived as averages of the whole sample (column 'All') the results show that both threshold variables have a positive effect on earnings persistence. That is, both persistence measures are found higher on the second regime which corresponds to higher values of the threshold variables. Also notice that while the persistence difference between each regime is of 0.106 for the accruals threshold, this difference is of 0.161 for the cash flow threshold. This result is in accordance with our previous finding that the threshold effect has more significance for the cash flow than for the accruals component.

We have also reported on Table 5.4 the average persistence measures derived when considering only those firms where the unit root hypothesis was rejected. Again, a different picture emerges when considering restricted subsamples of firms, corroborating the conclusion from previous sections that the persistence of firm's earnings is heterogenous. Furthermore, our approach leads to the conclusion that this heterogeneity might not be explained by the accruals or the cash flow components of earnings.

Finally we may confront our results to those predicted by the first hypothesis of Sloan (1996, p.291). First, regarding the accrual component of earnings the hypothesis is that earnings persistence is decreasing in the magnitude of the former. However, our results showed that the relationship is contrary to this prediction. Specifically, our estimatives is that firms on a low accrual regime exhibit a persistence of its earnings of about 0.33, while when the firm is on a high accrual regime its earnings persistence raises to about 0.44.

Table 5.4 – Conditioned Measures of Persistence.

Measures/Samples	All	Only significant		5% Jointly Significance*
		5%	10%	
Accruals Threshold (Avg. $\hat{\lambda} = 0.0437$)				
- 1st Regime				
Number of firms	126	24	32	8
Average ρ'	-0.6666	-1.4214	-1.2890	-1.5780
Average persistence	0.3334	-0.4214	-0.2890	-0.5780
- 2nd Regime				
Number of firms	126	21	33	8
Average ρ''	-0.5606	-1.3671	-1.1746	-1.6402
Average persistence	0.4394	-0.3671	-0.1746	-0.6402
Cash Flow Threshold (Avg. $\hat{\lambda} = 0.0284$)				
- 1st Regime				
Number of firms	126	19	28	11
Average ρ'	-0.7316	-1.2966	-1.3590	-1.4536
Average persistence	0.2684	-0.2966	-0.3590	-0.4536
- 2nd Regime				
Number of firms	126	24	35	11
Average ρ''	-0.5707	-1.4856	-1.3106	-1.8263
Average persistence	0.4293	-0.4856	-0.3106	-0.8263

Notes: * The jointly significance results refer to those firms where both ρs were found to be significant at the 5% level.

Second, regarding the cash flow component of earnings the hypothesis is that earnings persistence is increasing in the magnitude of the former. On this matter, our results do not reject the hypothesis prediction. Specifically, our estimatives is that firms on a low cash flow regime exhibit a persistence of its earnings of about 0.27, while when the firm is on a high cash flow regime its earnings persistence raises to about 0.43.

Though our results on the accruals effects over earnings persistence indicate the rejection of Sloan (1996) first hypothesis, it is important to remark that it was exactly on the accruals threshold estimates that our inference showed some weakness to reject the linear autoregressive specification favoring the TAR model. Moreover, an important finding of this paper relates to the relevance of firms heterogeneity, which seems to prohibit any pooling approach to measure earnings persistence. Overall, our findings suggest that it is not possible to robustly explain earnings persistence with composition effects such as the accruals and the cash flow components.

Concluding Remarks

This paper proposes a reassessment to the first hypothesis of Sloan (1996, p.291) that the magnitude of the accruals and the cash flow components of earnings determine the persistence of the later. For this purpose, a threshold autoregressive panel unit root approach is proposed extending the technique introduced by Caner and Hansen (2001) to a panel data context using a Fisher-type test as proposed by Maddala and Wu (1999). This approach allowed us to obtain a new measure of conditioned persistence, making it possible to infer whether the earnings components condition its persistence properties. The approach was applied to a sample of 126 Brazilian firms in the period from 1995 to 2007.

As our method to obtain panel estimates did not make the assumption of a common autoregressive process for every firm on the sample, it allowed us to observe these firms heterogeneity regarding its earnings persistence. Our results indicated that there are relevant differences between the firms in the sample, leading us to conclude that pooling these firms' earnings series might lead to wrong conclusions about its persistence. Furthermore, the threshold estimates showed that conditioning earnings persistence to its accruals and cash flow components did not explained this heterogeneity. Though this could be seemed as a disappointing result, it gives directions to future research. Fruitful paths might be to apply our approach to verify the conditioning effects of other well known factors, usually thought to be determinants of firms' performance, such as capital structure and firms' riskiness.

We proceed to obtain estimatives of earnings persistence in order to validate Sloan's hypothesis. Using the Maddala and Wu (1999) panel approach we obtained an average unconditioned measure of earnings persistence with a magnitude more than a half lower than that obtained by Sloan (1996). Specifically, our estimates was that about 38% of last period earnings is carried out through current earnings, while the estimates of Sloan (1996) was of about 84%. This difference may be due both to the use of distinct samples and distinct methods. While Sloan (1996) result is obtained from a US firms sample with a pooling procedure, our results are averages over individual Brazilian firms' estimates.

Focusing on the conditioning effects of the accruals and the cash flow components of earnings on its persistence, we estimated a TAR model for each firm which allowed us to find threshold values that divide the autoregressive process of earnings into two regimes, according to each threshold variable (accruals and cash flow). While our inference allowed us to reject the panel TAR unit root hypothesis for both threshold variables, the threshold effect was found to be strongest using the cash flow component as threshold. Regarding the relationship between earnings components and its persistence, we have found that higher levels of both accruals and cash flow are related to higher persistence of earnings. This result partially contradicts the prediction of Sloan's first hypothesis that earnings persistence is decreasing in the magnitude of the accruals component.

Overall, our findings suggest that it is not possible to robustly explain earnings persistence with composition effects such as the accruals and the cash flow components, for Brazilian firms over the analyzed period. The evidence presented was that these components have weak explanation power for the variance of earnings persistence of the sample firms. This is a relevant result, especially considering the wide spread of studies about the so-called accruals anomaly where the conditioned persistence is the base hypothesis. Our results suggest that an anomaly would actually be to find that the identification of the accruals (and cash flow) information is relevant to the stock market price determination, and not the other around.

However, one has to take into account the weaknesses of our empirical application to derive such conclusions. One of them is the short time span size of our sample, which turned

out to make it difficult to efficiently identify the thresholds. It would be another fruitful extension of this work to apply the approach on a larger sample, at different countries. On the methodological context a prominent issue for future research would be to extend Caner and Hansen (2001) approach to a panel context using pooled estimation techniques such as that of Levin, Lin and Chu (2002).

References

BALL, R.; BROWN, P. Empirical Evaluation of Accounting Income Numbers. **Journal of Accounting Research**, v.6, n.2, p.159-178, 1968.

BREITUNG, J.; PESARAN, M. H.. Unit Roots and Cointegration in Panels. **Cambridge Working Papers in Economics**, n.0535, 2005.

CANER, Mehmet; HANSEN, Bruce E. Threshold Autoregression with a Unit Root. **Econometrica**, v. 69, n. 6, p.1555-1596, Nov. 2001.

CHAN, K. S. Consistency and Limiting Distribution of the Least Squares Estimator of a Threshold Autoregressive Model. **The Annals of Statistics**, v. 21, p.520-533, 1993.

CORE, J. E.; GUAY, W. R.; LARCKER, D. F. Executive Equity Compensation and Incentives: a Survey. **Economic Policy Review**, April, 2003.

DAMODARAN, A. **Investment Valuation:** Tools and Techniques for Determining the Value of any Asset. New York: John Wiley & Sons, 1996.

DECHOW, P.; SLOAN, R.; SWEENEY, A. Detecting Earnings Management. **The Accounting Review**, v.70, p.3-42, 1995.

ENDERS, Walter. **Applied Econometric Time Series**. Second Edition, USA: John Wiley & Sons, 2004.

FAIRFIELD, P.M., WHISENANT, S.; YOHN, T.L. The Differential Persistence of Accruals and Cash Flows for Future Operating Income Versus Future Profitability. **Review of Accounting Studies**, v.8, n.2-3, p.221-243, 2003.

FASB, Financial Accounting Standards Board. Statement of Financial Accounting Concepts No. 1 (SFAC nº 1): Objectives of Financial Reporting by Business Enterprises, 1978.

FRANKEL, R.; LITOV, L. Earnings Persistence. **Journal of Accounting and Economics**, v.47, n.1-2, p.182- 190, 2009.

HENDRIKSEN, E. S.; VAN BREDA, M. F. **Accounting Theory**, 5 ed., Irwin Professional Publishing, 1991.

HURLIN, Christophe; MIGNON, Valérie. Second Generation Panel Unit Root Tests. **HAL Working Papers**, halshs-00159842_v1, Jul. 2007.

IM, K. S.; PESARAN, M. H.; SHIN, Y. Testing for Unit Roots in Heterogeneous Panels, **Journal of Econometrics**, v. 115, p. 53-74, 2003.

KASERER, C., KLINGLER, C. The Accrual Anomaly Under Different Accounting Standards - Lessons Learned From the German Experiment. **Journal of Business Finance & Accounting**, v.35, n.7-8, p.837-859, 2008.

LEHMAN, B. Earnings, dividend policy, and present value relations: building blocks of dividend policy invariant cash flows. **Review of Quantitative Finance and Accounting**, v. 3, p.263-82, 1993.

LEVIN, A.; LIN, C. F.; CHU, C. Unit Root Tests in Panel Data: Asymptotic and Finite-Sample Properties. **Journal of Econometrics**, v. 108, p. 1-24, 2002.

LUNDHOLM, R. J. A Tutorial on the Ohlson and Feltham/Ohlson Models: Answers to some Frequently Asked Questions. **Contemporary Accounting Research**, v. 11, p.749-761, 1995.

MADDALA, G. S.; WU, Shaowen. A Comparative Study of Unit Root Tests with Panel Data and a New Simple Test. **Oxford Bulletin of Economics and Statistics**, University Of Oxford, v. 61, Special Issue , p.631-652, 1999.

PANKOFF, L.D.; VIRGIL, R.L. Some Preliminary Findings From A Laboratory Experiment on the Usefulness of Financial Accounting Information to Security Analysts. **Journal of Accounting Research***,* 8 (Supplement): 1-48, 1970.

PEASNELL, K. V. Some Formal Connections between Economic Values and Yields and Accounting Numbers. **Journal of Business, Finance and Accounting**, v. 9, 361-381, 1982.

PINCUS, M., RAJGOPAL, S., VENKATACHALAM, M. The Accrual Anomaly: International Evidence. **Accounting Review**, v.82, n.1, p.169-203, 2007.

SLOAN, Richard G. Do Stock Prices Fully Reflect Information in Accruals and Cash Flows About Future Earnings? **The Accounting Review**, v. 71, n. 3, p.289-315, Jul. 1996.

XIE, H. The Mispricing of Abnormal Accruals. **The Accounting Review**. v. 76, n. 3, 2001.

Appendix A – Firms Sample

Sector Classification	Firms	Averages* – 1995-2007		
		EBIT	Accruals	Cash Flow
1 - Food and Beverage (obs.=11)	Ambev, Cacique, Eleva, Iguaçu Café, J B Duarte, Leco, Minupar, Parmalat, Perdigão S/A, Sadia S/A, Vigor.	0.0384	0.0493	-0.0109
2 - Commerce (obs.=6)	Dimed, Globex, Grazziotin, Lojas Americanas, Lojas Renner, P.Açúcar-CBD.	0.0690	0.0604	0.0087
3 - Construction (obs.=6)	Azevedo, Const. Beter, Lix da Cunha, Mendes Jr, Sergen, Sultepa.	0.0054	0.0117	-0.0063
4 - Electronics (obs.=4)	Brasmotor, Itautec, Trafo, Whirlpool.	0.0656	0.0631	0.0025
5 - Electric Power (obs.=15)	Ampla Energ, CEB, Celesc, Celg, Cemat, Cemig, Cesp, Coelba, Coelce, Copel, Eletrobras, Enersul, Escelsa, Light S/A, Paul F Luz.	0.0487	0.0318	0.0169
6 - Industrial Machinery (obs.=4)	Bardella, Inds Romi, Nordon Met, Weg.	0.0252	0.0363	-0.0110
7 - Mining (obs.=2)	Magnesita, Vale Rio Doce.	0.1215	0.0554	0.0660
8 - Non-metallic Minerals (obs.=2)	Eternit, Portobello.	0.0945	0.0617	0.0328
9 - Pulp and paper (obs.=5)	Aracruz, Klabin S/A, Melpaper, Suzano Papel, VCP.	0.0730	0.0621	0.0109
10 - Oil and gas (obs.=6)	Comgas, Ipiranga Dis, Ipiranga Pet, Ipiranga Ref, Petrobras, Wlm Ind Com.	0.0966	0.0405	0.0560
11 - Chemical (obs.=11)	Bombril, Braskem, Elekeiroz, Fosfertil, M G Poliest, Millennium, Petroflex, Petroq União, Pronor, Unipar, Yara Brasil.	0.0566	0.0489	0.0077
12 - Steel and Metallurgy (obs.=20)	Aços Vill, Am Inox Br, Caraiba Met, Confab, Eluma, Ferbasa, Fibam, Forjas Taurus, Gerdau, Gerdau Met, Hercules, Kepler Weber, Mangels Indl, Metisa, Micheletto, Mundial, Paranapanema, Rimet, Sid Nacional, Usiminas.	0.0659	0.0500	0.0159
13 - Telecommunications (obs.=3)	Brasil Telec, Telemar N L, Telesp.	0.0812	0.1259	-0.0447
14 - Textile (obs.=18)	Alpargatas, Botucatu Tex, Buettner, Cambuci, Cia Hering, Coteminas, Dohler, Fab C Renaux, Guararapes, Karsten, Marisol, Pettenati, Schlosser, Tecel S Jose, Teka, Tex Renaux, Vulcabras, Wembley.	0.0234	0.0354	-0.0120
15 - Vehicles and Parts (obs.=13)	DHB, Embraer, Fras-le, Iochp-Maxion, Marcopolo, Metal Leve, Plascar Part, Pro Metalurg, Randon Part, Recrusul, Schulz, Tupy, Wetzel S/A.	0.0345	-0.0274	0.0619

Note: *All measures are divided by total assets.