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Market reaction to annual earnings innovations and alternative time-series assumptions: evidence of the Brazilian market

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Abstract

This paper analyses the market reaction to earnings innovations under different time-series assumptions for reported earnings and high interest rate conditions. The sample consists of 176 Brazilian listed firms from 1995 to 2013 and the empirical analysis compares different assumptions of earnings persistence. The results show that that different ARIMA assumptions lead to different cross-sectional classifications of firms into high and low earnings persistence and that high levels of interest rates and transitory components in earnings can significantly reduce the forward-looking usefulness of accounting information. Additionally, the results show that market agents react more to earnings that exhibit high time-series persistence and that low-order ARIMA models work at least as well as high-order models in representing the time-series process of earnings in the earnings-returns association. .

1. INTRODUCTION

By defining reported accounting earnings as a measure of an enterprise's financial performance, one can consider earnings as a function of fundamental financial performance and accounting methods (DECHOW, GE and SCHRAND, 2010). In that sense, the accounting literature has analyzed the effect of the accounting system on decision-making and suggested that reported earnings play an important role in financial analysis and valuation systems (SCOTT, 2012). However, it is largely accepted that equity value is affected by both accounting and non-accounting information (WANG, 2014) and that the usefulness of earnings is directly affected by the quality (information content) of reported accounting information (LEV, 1983).

Typically, the usefulness of reported earnings is expressed in terms of investor responsiveness to earnings by the earnings response coefficient (ERC), which can be described as the market reaction to new information in reported earnings. However, this new information in earnings can be due to permanent or transitory components. Thus, the magnitude of which current earnings affect future earnings (i.e., the earnings time-series dynamic) is established as the earnings persistence parameter and has relevant implications for valuation purposes: since innovations in earnings tend to persist along time, more persistent earnings yield better inputs to equity valuation models (KORMENDI and LIPE, 1987).

In this regard, this paper analyses the market reaction to earnings innovations under alternative time-series assumptions in the Brazilian market. Specifically, we analyze (1) if different ARIMA assumptions affect the cross-sectional classification of firms in high- and low- earnings persistence; (2) the extent to which interest rates affect the persistence parameter; and (3) the extent to which market agents adjust stock prices by reviewing the future benefits expectation given new information in reported earnings under different time-series assumptions. Hence, given the lack of empirical literature in the Brazilian market, this paper combines different ARIMA assumptions in order to estimate the persistence parameters and different measures of unexpected earnings often used in accounting and finance literature. The sample consists of 176 Brazilian listed firms from 1995 to 2013 with minimum time-series observations.

Despite several attempts, the international literature of earnings-return association and earnings persistence is not unanimous in determining the most accurate way to describe the time-series properties of annual

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earnings, which include the random walk process, moving average, and autoregressive properties. In addition to the international conflicting evidence, we consider the Brazilian case to be of high interest due to its high interest rate considering that high interest rate levels affect the present value of earnings innovation and the time orientation of market agents.

Specifically, this paper tests the hypothesis that the revision of future earnings expectation due to news in earnings is affected by the earnings time-series process (i.e. earnings persistence and time-series assumption) and interest rates, which can both be captured by the persistence parameter (PER parameter). The PER parameter is measured as the present value of revisions in expected earnings and, thus, is affected by both time-series assumption and interest rates.

The relevance of the study lays on the fact that recent evidence in Freeman, Koch and Li (2011) shows that historical ERCs are useful in predicting future returns-earnings relations. Additionally, recent evidence in Bradshaw *et al.* (2012) and Lacina, Lee and Xu (2011) shows that earnings forecast based on time-series estimation are more accurate than analysts' forecasts, consequently being better inputs for stock valuation purposes. Similarly, Dalmácio *et al.* (2013), Martinez and Dumer (2012) and Saito, Villalobos and Benetti (2008) document significant errors and biases in analysts' projections for Brazilian firms. Moreover, Martinez and Dumer (2012) show that the IFRS adoption in 2010 did not significantly change the accuracy and bias of the analysts' forecasts, which suggests a continuous effort to improve estimations of value components (i.e. earnings and dividends). Thus, the understanding of the time-series process, which is closer to the underlying earnings process and the economic pattern of accounting earnings, has implications for a more efficient design of market-based accounting research and earnings quality studies.

The remainder of the paper is outlined as follows. Section 2 reviews the literature of interest and presents the model. Section 3 presents the definition of variables and research design. Section 4 presents the sample and the description of variables. Section 5 analyzes and discusses the empirical results. Section 6 presents additional tests and sensitivity analysis. Finally, Section 7 offers some concluding remarks.

2. CONCEPTUAL FRAMEWORK AND LITERATURE OF INTEREST

Accounting-based valuation models consider that the parameter of earnings persistence plays an important role in predicting firm value. The residual income valuation model (OHLSON, 1995) states that firm value is influenced by abnormal earnings which follow an autoregressive process in which the parameter of earnings persistence indicates how sensitive the firm value is to earnings realization. Scott (2012) claims that investors estimate earnings conditionally to current information and the current state of nature. However, neither the investors' forecasts nor the value of the firm are objective. Since investors know that their predictions are subject to errors, they will be alert for information that enables them to revise their forecasts, such as the income statement. As a consequence, income statements only have information content when abnormal earnings persist over time (SCOTT, 2012).

Dechow *et al.* (2010) suggest that firms with more persistent earnings have a more 'sustainable' earnings/cash flow stream that will make it a more useful input into equity valuations models. Thus, reported accounting earnings will be a function of fundamental economic performance and accounting methods. Among these fundamental economic variables, interest rates seem to play an important role since earnings persistence would be negatively related to interest rate. In order to shed some light on this issue, Lipe (1990), Kormendi and Lipe (1987), Easton and Zmijewski (1989), Ohlson (1995), Lipe and Kormendi (1994), Gode and Ohlson (2004), and Wang (2014), among many others, derive the value of the firm as a function of expected earnings and persistence. The following section relies heavily on the seminal paper of Kormendi and Lipe (1987) in describing the association between earnings persistence and firm valuation.

If one considers that reported earnings innovations, *UX*, (i.e. earnings surprise or unexpected earnings) induce changes in price and that the stock market returns (*R*) will vary in reaction to new information in earnings, in a given time (*t*), total market return (R_t) will be a function of (1) unconditional expected return (R_t^{ex}) plus (2) return induced by new information of reported earnings, *R(UX)*, and (3) an unexpected UR_t. Then:

$$R_t = R_t^{ex} + R(UX_t) + UR_t \tag{1}$$

Thus, assuming that (1) in the long run the present value of expected earnings equals the present value of expected cash flow and (2) that market expectation can be captured by a univariate time-series model, the return induced by new information of reported earnings, *R(UX)*, can be expressed by:

$$R(UX_t) = \left\{ 1 + \left[\frac{1}{(1-B)^d \left(1 - \sum_{s=1}^{N} B^s \varphi_s \right)} - 1 \right] \right\} \frac{UX_t}{P_{t-1}} \quad (2)$$

where,

$B = 1/(1+r)$, where r is the appropriate rate for discounting expected future earnings

φ_s = autoregressive parameter of order s

d = level of consecutive differencing

The content in the square brackets is the persistence parameter (*PER*) and the content in the braces is the earnings response coefficient. Thus, the theoretical ERC is equal to 1+*PER*. By doing this, Kormendi and Lipe (1987) propose the following firm-specific system relation:

$$R_t = \delta_0 + \delta_1 \frac{UX_t}{P_{t-1}} + UR_t \quad (3)$$

$$\Delta X_t = k_0 + \varphi_1 \Delta X_{i,t-1} + \varphi_2 \Delta X_{t-2} + UX_t \quad (4)$$

where: δ_1 is the earnings response coefficient, φ_1 and φ_2 are autoregressive parameters and the terms UX_t and UR_t are residuals assumed to be independent white-noise process, which represents the portion of X_t and R_t, respectively, unexplained by the system. Lipe and Kormendi (1994) modify the estimating equations in 3 and 4 to accommodate the use of higher and lower order autoregressive models.

The system formed by Eq. 3 and 4 suggests that δ_1 (the earnings response coefficient) can be interpreted as the effect stock returns reaction to a unit in the earnings innovation in the previous two years. That is, one plus the "present value of the revision in expected current and future equity benefits induced by $1,00 earnings innovation" (KORMENDI and LIPE, 1987, p. 326).

Although, Eq. 3 and 4 are presented in a firm-specific approach (as expected for valuation purposes), many studies investigate the determinants and consequences of cross-section variation in earnings persistence. Lev (1983) and Baginski *et al.* (1999), for example, analyze the firm-size, product-type, barriers-to-entry and capital intensity as determinants of earnings persistence. in the literature Chen (2013, p. 555) identifies three groups of determinants of earnings persistence: (1) variables that capture aspects of firm's competiveness environment; (2) financial ratios, such as profit margin, asset turnover and growth in assets; and (3) variables related to accounting accruals.

In the Brazilian market Coelho, Aguiar and Lopes (2011) find a significant effect of industrial sector and market share in abnormal annual earnings persistence while Pimentel and Aguiar (2012) document evidence, that quarterly earnings persistence is typically lower in the Brazilian market when compared to international evidence and that earnings persistence is an increasing function of size and corporate governance standards. Martinez *et al.* (2008), and Fabris and Costa Jr (2010) analyze the time-series patterns of quarterly earnings and find conflicting evidence. The first study suggests a mean reversion of quarterly earnings (earnings growth above average tend to revert in subsequent periods) whereas the second study claim that quarterly earnings have a random behavior, described by a random walk with drift. This paper extends the literature by analyzing annual earnings rather than quarterly information, since it is well accepted that annual earnings have different time-series processes than interim earnings (Kothari, 2001).

The Brazilian literature also analyses other aspects of market reaction to earnings announcements without accounting for earnings persistence. Indeed, Paulo, Sarlo Neto and Santos (2013), Santos *et al.* (2013), Pimentel and Lima (2010b), Neto, Galdi and Dalmácio (2009) and Galdi and Lopes (2008) find significant relationships in the short and long-term market reaction to content information in accounting earnings reports.

This paper also has implications on earnings forecasts. By using time-series forecasts from historical data one can avoid extremely optimistic and pessimistic bias typically found in analysts' forecasts, especially under stressed conditions. Recent evidence in Bradshaw *et al.* (2012) suggests that "simple time series EPS forecasts are more accurate than analysts' forecasts over longer horizons". Surprisingly, naive earnings extrapolations provide the most accurate estimate of long-term (2- and 3-year-ahead) earnings. "These findings redefine prior generalizations about the superiority of analysts' forecasts and suggest that they are incomplete, misleading, or both." (BRADSHAW *et al.*, 2012, p. 944).

3. VARIABLES DEFINITION AND RESEARCH DESIGN

The accounting and financial literature has been discussing and analysing several ways to measure the extent to which stock markets react to new information within reported earnings (earnings innovation). However, the measures of unexpected earnings (*UX*) and respective stock prices reactions (*R* or *UR*) as well as earnings persistence are all subject to measurement errors. Thus, given the lack of previous empirical evidence in the Brazilian market, this paper estimates earnings persistence and earnings response coefficients using different measures for unexpected earnings and different time-series assumption, which could potentially lead to more robust results.

3.1. Persistence parameter measure

According to Baginski *et al.* (1999), "the persistence parameter (PER) of an earnings series captures how a current shock is expected to affect the whole stream of future realization of earnings series". However, there are several assumptions to describe the relationship between current shocks (innovation) and time-series behaviour of earnings. Following Baginski *et al.* (1999), this paper estimates the persistence parameter considering four different common ARIMA assumptions: ARIMA (1,0,0), analysed by Easton and Zmijewski (1989) and Wang (2014); ARIMA (1,1,0) analysed by Lipe and Kormendi (1994),; ARIMA (2,1,0) analysed by Kormendi and Lipe (1987) and Lipe and Kormendi (1994) and the integrated moving average ARIMA (0,1,1) analysed by Collins and Kothari (1989) and Ali and Zarowin (1992a). Additionally, we included an ARIMA (1,0,0) model with earnings scaled by assets according to Dichev and Tang (2009) and Frankel and Litov (2009).

Following the well know estimation ARIMA (p,d,q) model specification, the persistence is a function of the autoregressive and moving-average parameter as follows (KORMENDI and LIPE, 1987; COLLINS and KOTHARI, 1989; BAGINSKI *et al.*, 1999):

$$PER = \frac{1-\sum_{i=1}^{q} B^i \theta_i}{(1-B)^d \left(1-\sum_{j=1}^{p} B^j \varphi_j\right)} - 1 \quad (5)$$

Where:

B = 1/(1+*r*) where *r* is the appropriate rate for discounting expected future earnings

θ_i = moving-average parameter of order i

φ_j = autoregressive parameter of order j

d = is the differencing level

After many years of intensive international research, two main empirical issues regarding Eq. 5 remain unclear, especially in emerging markets. The first is related to the best time-series assumption to efficiently measure the persistence parameter: which estimation model best represents real-world firms remains an empirical question. The second addresses the discount rate: which should be the most suitable discount rate to represent the extent to which market agents discount future dividends given a current earnings innovation (i.e. new information in reported earnings).

Baginski *et al.* (1999) and Lipe and Kormendi (1994) explicitly analysed the first issue considering annual data and Baginski *et al.* (2003) analysed the same issue but using quarterly data. The overall results are that "higher-order ARIMA models do a better job of capturing the value-relevance of current period earnings than lower-order models" (BAGINSKI *et al.,* 1999, p. 106). One direct consequence of this result is that more time-series data is required to efficiently design accounting studies. This evidence has a great impact on the Brazilian academic literature given the lack of long time-series length of accounting earnings. Thus, investigating if the same length is also required in the Brazilian market can contribute to the local empirical literature.

Regarding the second issue, studies developed in the US market usually use the fixed discount rate of 10% (see KORMENDI and LIPE, 1987; COLLINS and KOTHARI, 1989; BAGINSKI *et al.*, 1999) and they usually argue that similar results can be found under other levels of discount rate (usually up to 20%). This is explained due to the cross-sectional nature of the earnings-return study and the classification of firms according to their earnings persistence rank (FRANKEL and LITOV, 2009). However, for valuation purposes, by using Eq. 5, it becomes evident that, under increasing interest rates, the persistence parameter is low, and vice versa.

Different economic settings in terms of interest rates can change the time horizon of market agents and firms since higher interest rates make firm's cost of borrowing money more expensive, reducing the ability to make new investments (SILBERBERG; SUEN, 2001). High interest rates are a common and persistent phenomenon in the Brazilian market which can have significant implications in the stock market returns. Figure 1 illustrates that during the analysed period the credit risk-free interest rates, measured by the nominal CDI rate (*interbank deposit rate*), are significantly higher than those in the US or other developed markets.

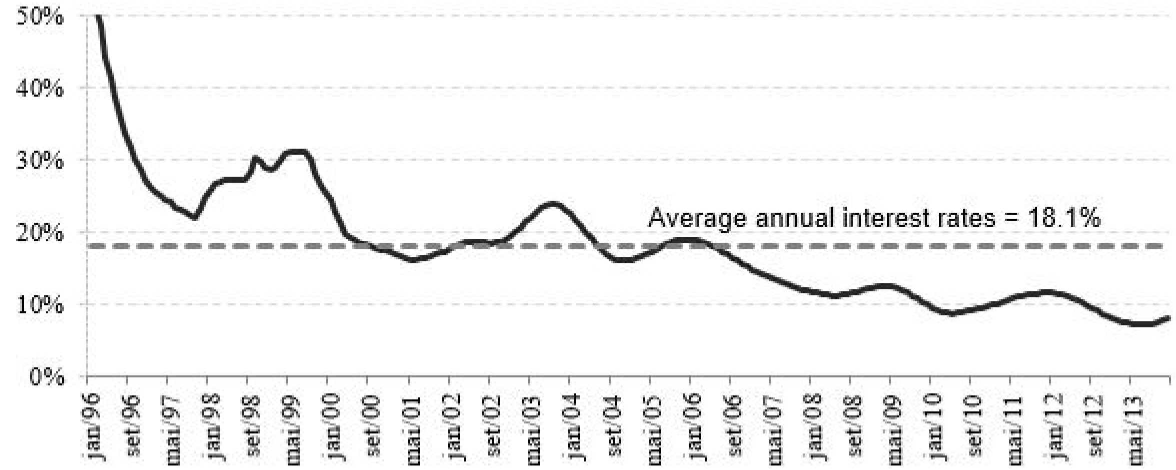

Figure 1. Official 12 months 'risk-free' interest rates (CDI) in Brazil from 1996 to 2013

One direct consequence of the high interest rates level, implied in Eq. 5, is that the present value of an earnings innovation will be lower. Thus, high interest rates can potentially reduce earnings persistence, since high interest rates can decrease the present value of future earnings (and dividends), and expectations in futures earnings are less affected by current innovation in earnings.

A second effect of interest rates that is not implicit in Eq. 5 is that high interest rates can affect managerial time-orientation and reduce the incentives for long-term earnings components. Thus, with high interest rates, managers have incentives to generate short-term earnings. As a consequence, more transitory components in earnings can be found along the time-series of earnings. The central idea is that high interest rates may generate incentives to managers to artificially produce short-term (transitory) gains rather that produce long-term value components.

The two aspects (low present value of future outcomes and incentives to transitory components) can potentially decrease the persistence parameters. As a consequence, high interest levels diminish the relevance of current innovations in earnings to compound current expectations of future earnings patterns. Moreover, the theoretical response, in Eq. 2, to earnings innovation (ERC) is lower under high interest rates. Considering both the direct and indirect effects of interest rates in earnings persistence estimation, this paper uses 18.1% interest rate (the average annual interest rate) to estimate the persistence parameter, which represents the present value of the revision in expected future earnings induced by a unit in current innovation in earnings. The implication of keeping the same mean rate along the entire period is that, given the significant decrease of interest rates in the period (and its volatility), in some periods PER values are underestimated while in others they are overestimated.

This paper also uses estimation with 10% discount rate in order to compare the results to previous literature. In all the ARIMA approaches, if shocks in earnings are purely transitory the PER parameter will be equal to zero and $1 shock in earnings will have $1 impact in price. On the other hand, if shocks are completely permanent, $1 shock in earnings will have an impact of $1/r$ in price, and, consequently, the PER parameter will be equal to 10.0 ($1/0.1) when the interest rate is 10% and equal to 5.5 ($1/0.181) when the interest rate is 18.1% (the historic nominal risk-free in the Brazilian market). Values of PER > 10 (extrapolation) or PER <0 (reversal) can also be accommodated in the model (MILLER and ROCK, 1985).

Since the persistence parameter in this paper is fixed throughout time (i.e. only one coefficient is estimated for each firm considering the total length of earnings available), this paper does not consider interest rates as a stochastic (or time-varying) variable. This means that only one interest rate level is used for the entire period, although the persistence parameter is simulated with more than one level (see Figure 2). In order to analyse interest rates as a stochastic variable, Feltham and Ohlson (1999), Nissim and Penman (2003), and Gode and Ohlson (2004) derive and implement accounting-based valuation models that accommodate stochastic and time-varying interest rates. However, for the purpose of this paper, implementing a stochastic analysis would also require a model that allows the persistence parameter to vary along time. The time-varying earnings persistence is already suggested, analysed and implemented by Chen (2013); however a comprehensive derivation of the relation between the time-varying earnings persistence and stochastic interest rates is not available in the literature and it goes beyond the objective of this paper.

3.2. Earnings innovation measures (unexpected earnings)

The earnings-return literature has used several measures of unexpected earnings by commonly assuming ARIMA time-series properties of earnings, including the random walk, moving average, and autoregressive properties. Typically, the residuals in each model are assumed to represent the unexpected earnings, i.e. the portion of earnings which cannot be explained by time-series behaviour of past earnings. Overall, we test four different approaches for unexpected earnings in this paper.

First, the most common approach is based on an entrenched naïve expectation model in which earnings per share variation is scaled by price. Thus, it is assumed that earnings follow a random walk process, and the best unbiased estimate of current earnings expectation is simply the last period of annual earnings. It is calculated by the variation of earnings per share, X, in a period (fiscal year) scaled by the price in the beginning of the period, P_{t-1}. Thus,

$$UX_{it}^{RW} = (X_{it} - X_{i,t-1}) / P_{i,t-1} \tag{6}$$

Although naïve, this measure "is also consistent with a research design to study the contemporaneous effect of price changes at a point in time." (ARIFF, FAH and NI, 2013, p. 99). However, the random walk condition of reported annual earnings is puzzling: "unlike the random walk property of security prices, which is a theoretical prediction of the efficient capital markets hypothesis, economic theory does not predict a random walk in earnings." (KOTHARI, 2001, p. 145). So, differently from stock, there is no economic reason to expect annual earnings to follow a random walk.

Second, in order to reduce potential bias in earnings-relation analysis by simply considering the random walk property, Ball, Kothari and Watts (1993) adjust the scaled earnings change in Eq. 6 with respect to the market return as:

$$UX_{t}^{ORT} = \gamma_{0t} + \gamma_{0t}(R_M - R_{RF}) + \eta_{it} \tag{7a}$$

$$UX_{t}^{ORT} = \gamma_{0t} + \eta_{it} \tag{7b}$$

where R_m is the Ibovespa (Brazilian' stock market index) accumulated annual return by summing monthly returns, and R_f is CDI (*interbank deposit rate*), considered as the measure of credit risk-free rate in the Brazilian market. According to Ball *et al.* (1993, p. 626), this measure "avoids any correlation between the market return and the assignment of stocks to portfolio that could induce a spurious association between changes in risk and changes in earnings".

Third, we consider the well documented second-order integrated ARIMA presented by Kormendi and

Lipe (1987). Nevertheless, recent papers have been ignoring the superiority of higher-order models, which might be a problem especially when a long-term analysis is considered (see ARIFF *et al.*, 2013). On the other hand, higher order ARIMA models limit the length of the series which can be a problem when only short series are available. The estimation firm-specific process of unexpected return for year *t* as the residual of a firm-specific autoregressive model of earnings:

$$\Delta X_t = k + \varphi_1 \Delta X_{i,t-1} + \varphi_2 \Delta X_{t-2} + UX_t^{AR2} \tag{8}$$

where, UX_t^{AR2} = is the residual of an autoregressive model, representing unexpected earnings as the portion of earnings which cannot be explained by the equation with past earnings ($X_{t-\tau}$). Thus, this measure considers the autoregressive time-series process of earnings (i.e. the persistence parameter, φ_i) in earnings estimation, and, as a consequence, the residual is the unexpected part of accounting earnings.

Finally, Lipe and Kormendi (1994) modify Eq. 8 to accommodate the use of higher and/or lower order autoregressive models, so it is possible to estimate unexpected earnings based on a first order model, UX_t^{AR1} as the fourth proxy unexpected earnings. We, however, do not estimate higher than two autoregressive order models due to restrictions in the length of the series.

3.3. Stock returns measure

The annual returns are calculated from April of year *t* to March of *t* + 1 to capture any return reaction associated with the announcement of earnings for year *t,* for each firm. The return is measured as continuous capitalization by considering a buy-and-hold strategy as: $RET_t = \ln(P_t/P_{t-1})$, where P_t is the price adjusted to dividends in March of year *t*. Particularly, Collins and Kothari (1989) suggest that in earnings-returns studies, the nominal *ex post* return, inclusive of dividends, can be an appropriate measure of return for three reasons: (1) *ex ante* measures of riskless rates and risk premia are not readily available; thus, return expectation conditional to the realized market return introduces error into the return metric. (2) The variability in unexpected return is small when compared with the temporal and cross-sectional variability in RET. (3) Earnings/returns relation is essentially the same whether one uses R_{it}, inclusive or exclusive of dividends or market model prediction errors.

In this paper, we also used two more measures of *ex post* abnormal return that are reported and described in the additional tests subsection.

4. SAMPLE AND VARIABLES DESCRIPTION

The analysis is based on all public Brazilian non-financial companies listed in The Sao Paulo Stock Exchange from 1995 to 2013 which attended a minimum time-series length requirement. In order to avoid survivor bias, all the firms with a minimum of six consecutive annual observations were included in the analysis. This criteria selection yielded 176 firms. The data was collected in the ECONOMATICA database and comprises the whole period of relative monetary stability – which began in 1995 with the “Real Plan”.

Therefore, given the availability of data, the 176 firm-specific lengths varied from 6 to 19 annual earnings time-series observations. On average, earnings-year observation by firm is 14 and total length is reduced when variation and previous historical information is required for the construction of variables. The sample included firms from different economic sectors and the market capitalization of these companies accounted for approximately 80% of the total market capitalization of The Sao Paulo Stock Exchange (Bovespa).

Stock prices and stock market index were collected on a monthly and quarterly basis (as mentioned in variable descriptions) and were adjusted for subsequent stock splits and stock dividends, allowing for this adjusted figure to become the default price. When prices were based on the month’s last trading day and there were missing values of price for up to three consecutive months, prices were estimated by using the return of the general market index (this was the case for confirmatory tests only, as described in “additional test” subsection). Historical EPS for each company was also adjusted for subsequent changes in equity structures (e.g., stock splits, mergers and acquisitions, etc.), allowing for this adjusted figure to become the default EPS.

5. EMPIRICAL RESULTS

The empirical results are divided in two sub-sections. The first estimates the persistence parameter and deals with the two first objectives of this paper: (1) to analyze the extent to which interest rates affect the persistence parameter; and (2) to analyze if different ARIMA assumptions affect the cross-sectional classification of firms in high and low earnings persistence. The second sub-section investigates the extent to which market agents adjust stock prices by reviewing future benefits expectation when given new information in reported earnings under different time-series assumptions.

5.1. Estimation and analysis of earnings persistence

The first step in the empirical study is to find the autoregressive and moving average parameters considering the five time-series assumptions for the most common annual earnings in the literature, specifically, ARIMA (1,0,0); ARIMA (1,0,0)S (scaled by assets); ARIMA (1,1,0); ARIMA (2,1,0) and ARIMA (0,1,1). Once the time-series parameters are estimated, we find the persistence parameter (PER), defined as the present value of revisions in expected future earnings induced by a R$ 1.00 current-earnings innovation (KORMENDI and LIPE, 1987). Then, we analyze the extent to which interest rates affect the persistence parameter, and if different ARIMA assumptions affect the cross-sectional discrimination of earnings persistence.

When first-order autoregressive models are considered, $0 \leq \varphi \leq 1$ is expected and $\varphi = 1$ suggests a random walk process and a given shock is permanent; if $\varphi = 0$, the shocks are entirely transitory. However, values of $\varphi >$ 1(extrapolation) or $\varphi <0$ (reversal) can also be accommodated in the model (Miller and Rock, 1985). When higher-order models are considered the non-linear transformation presented in Eq. 5 is required for proper interpretation. When the moving average model is considered and $\theta=0$, earnings are assumed to follow a random walk process, and all earnings innovations are expected to be permanent; when $\theta=1$ earnings follow a mean reverting process, and all earnings innovations are expected to be purely transitory. In all cases, when PER, as in Eq. 5, is considered, it is expected that a random walk process would be defined as PER = $1/r$, where r is the discount rate.

Table 1 presents the descriptive statistics for the firm-specific parameters estimated in each ARIMA model for reported annual earnings per share. Estimated coefficients present significant differences between firms in a given model. The two autoregressive models (ARIMA(1,0,0) and ARIMA(1,0,0) Scaled by assets) have similar distributional characteristics and show that, on average, around 63% of innovations in earnings seem to persist in the future. The majority of autoregressive coefficients fits between the 0 to 1 interval however some reversals ($\varphi <0$) can be observed after the 5^{th} percentile implying negative correlations between current and past earnings. These negative coefficients are also documented in previous literature (see KOTHARI, 2001, p.145).

Table 1. Descriptive statistics: distributional characteristics of firm-specific ARIMA paramete

		Mean	Std. dev.	5 th Percentile	25th Percentile	Median	75th Percentile	95th Percentile
ARIMA(1,0,0)	φ_1	0,632	0,351	-0,094	0,431	0,754	0,929	0,981
ARIMA(1,0,0) Scaled by assets	φ_1	0,627	0,315	-0,036	0,498	0,694	0,89	0,954
ARIMA(1,1,0)	φ_1	-0,156	0,356	-0,623	-0,398	-0,25	0,044	0,528
ARIMA(2,1,0)[b]	φ_1	-0,237	0,456	-0,876	-0,53	-0,263	0,093	0,581
	φ_2	-0,187	0,496	-0,809	-0,452	-0,226	0,058	0,368
ARIMA(0,1,1)	θ_1	0,275	0,645	-0,962	-0,107	0,338	0,879	1,018

Notes. [a] φ_1 and φ_2 are first and second-order autoregressive parameter, respectively. θ_1 is the first-order moving average parameter. [b] Eight firms dropped during the estimation of second order model due to insufficient observations

Despite the reversals cases, the firms, are expected to have, on average, more than 50% of earnings innovations persisting over time. Similar conclusions can be drawn when moving average characterization is considered (ARIMA(0,1,1)). In this scenario, the distributional characteristics show that, on average, around 73% (1 – 0.275) of innovations in earnings are assumed to persist in the future. All in all, consistent with the bulk of international literature, the evidence in Table 1 suggests that earnings in Brazil are closer to a random walk process than a mean reverting process. Thus, some of the information in earnings is incorporated to future periods, except for transitory components.

The transitory components are due to macroeconomic and political aspects and/or due to shifts in the accounting standard towards mark-to-market measurements for some assets and liabilities. Thus, an additional possible reason to expect Brazilian firms to show mean reversion pattern in earnings is the local market's high instability which is caused, for instance, by high exchange rates variations or political decisions. Examples of high changes in earnings caused by dramatic exchange rate variation happened in 2002, with the Argentinean and emerging economies crises, and in 2008, with the international financial crisies. In both crises, several companies presented huge losses with foreign currency, and some of the biggest firms in Brazil went bankrupt in these periods. An example of a political decision causing high changes in earnings is the recent generalized losses in energy sector in 2012 caused by reduction in energy tariffs forced by government regulators in Brazil.

As a consequence of local instability and poor cycles-recurrent performance, we should expect that the Brazilian market presents lower levels of earnings persistence when compared to the US and UK markets. In order to better explore this comparison, Table 2 shows the distributional characteristics of the persistence parameters, PER, estimated according to Eq. 5 by considering two levels of interest rates: 10%, which allows direct comparability to international previous evidence, and 18.1%, which represents the average credit default risk-free interest rates in Brazil during the period of analysis (1995-2013) as presented in Figure 1.

Table 2. Descriptive statistics: distributional characteristics of PER[a]

Panel A – Persistence Parameter (PER) – Interest rates = 10%[b]

	Mean	Std. Dev.	5th Percentile	25th Percentile	Median	75th Percentile	95th Percentile
ARIMA(1,0,0)	3,075	2,826	-0,079	0,645	2,175	5,420	8,242
ARIMA(1,0,0) Scaled	2,500	2,159	-0,031	0,829	1,708	4,239	6,515
ARIMA(1,1,0)	10,074	6,214	6,025	7,077	7,960	10,458	20,160

Panel A – Persistence Parameter (PER) – Interest rates = 10%[b]

	Mean	**Std. Dev.**	**5th Percentile**	**25th Percentile**	**Median**	**75th Percentile**	**95th Percentile**
ARIMA(2,1,0) [d]	9,061	9,717	3,938	5,085	6,940	10,267	24,441
ARIMA(011)	7,253	6,446	-0,179	1,207	6,623	11,067	19,616
ARIMA(1,0,0)	2,096	1,704	-0,074	0,575	1,763	3,680	4,904
ARIMA(1,0,0) Scaled	1,814	1,388	-0,029	0,730	1,424	3,059	4,194
ARIMA(1,1,0)	5,452	2,975	3,273	3,880	4,383	5,777	10,803
ARIMA(2,1,0)[d]	7,131	29,173	2,099	2,822	3,854	5,718	12,667
ARIMA(0,1,1)	4,007	3,562	-0,099	0,667	3,659	6,114	10,837

Notes. [a] PER is calculated by Eq. 5. [b] Panel A considers PER calculation using 10% discount rate to compare with previous literature. [c] Panel B considers PER calculation using 18.1% reflectings the average Brazilian short-term interest rate during the period. [d] Eight firms dropped during the estimation of the second order model due to insufficient observations.

First, Panel A of Table 2 documents that *earnings persistence is slightly lower in Brazil than in the US*: even under the same level of international interest rates (10%), earnings are typically more transitory in Brazil than in the US market. While Lipe and Kormendi (1994) find median PER parameters of 8.96 and 7.78 for ARIMA(1,1,0) and ARIMA(2,1,0), in Brazil we find medians of 7.96 and 6.94, respectively. When the earnings process is analyzed by moving average process (ARIMA(0,1,1)) results are consistent with those of Baginski *et al.* (1999) who reported a mean of 6.43 in the US against 7.96 in the Brazilian market. Nonetheless, *the Brazilian sample shows much higher dispersions across the firms than that of the US market*: The higher dispersions across firms are also valid for the all the characterization of time-series of earnings.

The problem with the direct comparison above is that a 10% interest rate is an unrealistic assumption for the Brazilian market during the period of analysis. The effects described above are much stronger when the local ("true") interest rate (18.1%) is considered, as documented in Panel B, Table 2. Thus, *under the local high interest rates, the PER parameter is significantly reduced and the proportional dispersions across firms are increased*. The interest rate level is a crucial point, since the forward-looking accounting usefulness might be also reduced when considering the high interest rate environment as discussed above. As suggested by Eq. 5, the PER parameter is a non-linear function of the discount rate assumption and the autoregressive or moving average parameters. From 1996 to 2013, the annual interest rates have decrease from around 25% to around 10%; as a consequence, the present value of revision parameter can sharply decrease. The non-linear effect of interest rates might cause problems in research specifications and might lead investors and financial analysts to fail in fully recognizing the process of earnings, especially under a high level of interest rates. Figure 2 illustrates this decreasing effect of PER parameter by varying the sample's median time-series coefficients from 5% to 40%.

It is easy to observe that the revision of future earnings expectation due to innovations (new information) in earnings is much higher under low levels of interest rates. *The practical implication is that high interest levels diminish the relevance of current innovations in earnings to compound current expectations about future earnings patterns*. Thus, it generates short-term orientation towards future earnings. For instance, imagine a current shock of $1.00 in a firm completely with permanent earnings (random walk process with φ=0 or θ=1).

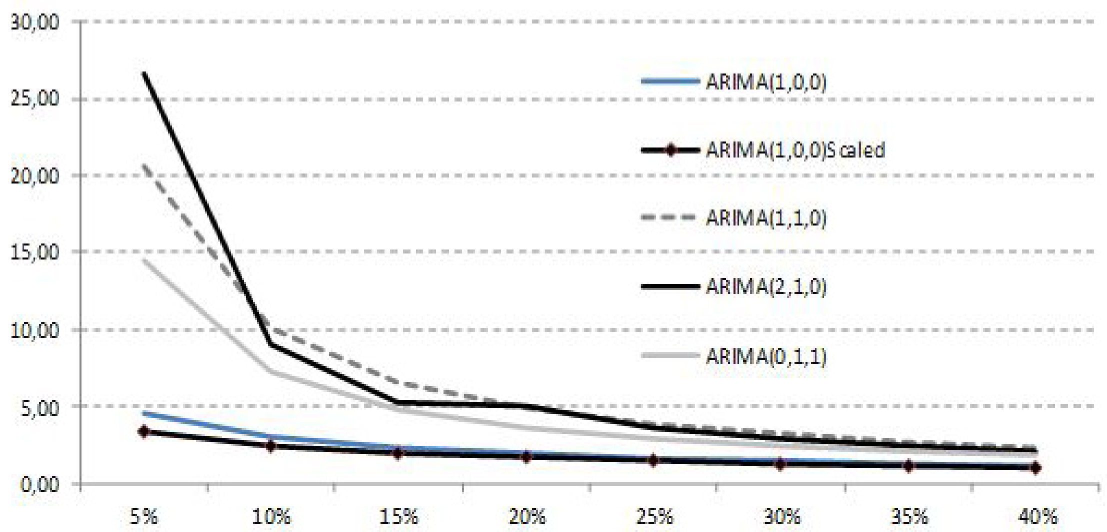

Figure 2. Decreasing of PER parameter to different discount rates

The results documented in Table 2 and Figure 2 also show that the PER parameters under high order ARIMA are smaller, more disperse and more sensitive to interest rates. Thus, high order ARIMA estimation does not imply higher persistence but the opposite: high order ARIMA decreases earnings persistence suggesting mean reversion over long horizons. Specifically, a smaller PER for high order models implies that "the earnings generating processes of these firms exhibit partial mean reversion" (LIPE and KORMENDI, 1994, p.34). In other words earnings are, on average, less persistent with long horizons. Additionally, the results suggest that integrated models are more associated with higher earnings persistence estimation

The second analysis aims to check whether different ARIMA assumptions affect the cross-sectional classification of firms in high and low earnings persistence. Basically, if different time-series assumptions affect the cross-sectional classification, they might lead to different results under different specifications. Hence, Table 3 (lower diagonal) shows the Spearman rank-order correlations between the five different time-series assumptions. Additionally, Table 3 shows the portfolio discrimination accuracy for the pairwise comparison, i.e. firms were divided into four portfolios according to the magnitude of earnings persistence. Thus, firms were divided into portfolios with high, average-high, average-low and low persistence firms and accounted for the percentage of correspondence between the portfolios' classification. This means, for instance, that 64.2% of firms have exactly the same portfolio classification in ARIMA(1,0,0) and ARIMA(1,0,0)Scaled methods.

Table 3. Spearman rank-order correlation and portfolio discrimination accuracy

	ARIMA(1,0,0)	ARIMA(1,0,0)S	ARIMA(1,1,0)	ARIMA(2,1,0)	
ARIMA(1,0,0)		64,20%	47,20%	52,30%	55,10%
ARIMA(1,0,0)Scaled	0.829***		42,00%	45,50%	47,70%
ARIMA(1,1,0)	0.634***	0.536***		57,40%	64,80%
ARIMA(2,1,0)	0.729***	0.588***	0.824***		63,60%
ARIMA(0,1,1)	0.726***	0.609***	0.842***	0.843***	

Notes. Lower diagonal presents the non-parametric Spearman rank-order correlation coefficient for the persistence parameters, PER, under the five different ARIMA assumptions; *** indicates a statistically significant correlation at 1% level. Upper diagonal shows the percentage of discrimination accuracy between four portfolios of high, average-high, average-low and low persistence parameters according the specific ARIMA approach.

Overall, the results show that there is a slight difference between the models and there is a relatively high difference between integrated and non-integrated models. The correlations are above 0.60, the discrimination accuracy around 60%, and the main differences occur when ARIMA(100)S (scaled by assets) is considered. The explanation is straightforward: this is the only model which assumes a second variable rather than earnings (total assets). So, variations in persistence can be due to changes or cross-sectional differences in assets. Despite the relatively high correlations, there are still some relevant mismatches in the classifications. This evidence suggests that studies that consider high and low earnings persistence should be aware that the time-series assumptions can potentially yield different empirical outputs.

As a matter of practical suggestion based on the results above, accounting researchers who are interested in relating annual earnings persistence to other economic variables can improve their model specification and draw more robust conclusions by analyzing integrated and non-integrated earnings process.

5.2. Cross-firm relationship and the earnings response coefficient

The next step is to relate the magnitude of the return reaction to earnings innovations. This was done by estimating the linear firm-specific earnings response coefficient. The choice of firm-specific approach was driven by the nature of valuation models derived by Kormendi and Lipe (1987) and displayed in Eq. 3 and 4 as firm-specific estimations. Additionally, Teets and Wasley (1996, p. 279) documented that "if the hypotheses of equality of firm-specific coefficients and equality of firm-specific unexpected earnings variances are rejected, firm-specific estimation should be used instead of pooled estimation."

As discussed above, the ERC is found by regressing the four different and well-documented measures for earnings surprise according to each of the time-series approach against the observed return. Table 4 shows the distributional ERC estimates for the sample.

Table 4. Descriptive statistics: distributional characteristics of firm-specific earnings response coefficient

Unexpected Earnings		Mean	Std. Dev.	5th Percentile	25th Percentile	Median	75th Percentile	95th Percentile	Std. Err.	t-stat
UX^{RW}	δ_0	0,001	0,208	-0,356	-0,11	0,024	0,153	0,257	0,015	0,04

	δ_1	2,124	5,703	-1,68	0,087	0,514	2,18	11,801	0,427	4.94***

Table 4. Descriptive statistics: distributional characteristics of firm-specific earnings response coefficient (continuation)

Unexpected Earnings		Mean	Std. Dev.	5th Percentile	25th Percentile	Median	75th Percentile	95th Percentile	Std. Err.	t-stat
	R^2	*0,259*	*0,241*	*0,003*	*0,052*	*0,175*	*0,444*	*0,689*	*0,018*	
UX^{ORT}	δ_0	0,038	0,232	-0,362	-0,079	0,071	0,193	0,322	0,017	2.19**
	δ_1	1,488	6,37	-4,781	0,033	0,436	1,906	13,018	0,493	3.09***
	R^2	*0,26*	*0,247*	*0,003*	*0,047*	*0,195*	*0,414*	*0,761*	*0,019*	
UX^{AR1}	δ_0	0,012	0,212	-0,368	-0,083	0,039	0,156	0,256	0,016	0,76
	δ_1	1,868	4,65	-1,447	0,059	0,539	1,988	11,454	0,362	5.33***
	R^2	*0,247*	*0,238*	*0,001*	*0,049*	*0,162*	*0,4*	*0,681*	*0,018*	
UX^{AR2}	δ_0	0,022	0,205	-0,334	-0,076	0,044	0,158	0,275	0,016	1,37
	δ_1	1,911	5,167	-1,335	0,106	0,617	2,27	11,763	0,398	4.79***
	R^2	*0,256*	*0,244*	*0,003*	*0,056*	*0,178*	*0,433*	*0,742*	*0,019*	

Notes. Distributional characteristics of firm-specific estimation base on Eq. 3 $R_t = \delta_0 + \delta_1 (UX_t / P_{t-1}) + UR_t$, where δ_1 is the earnings response coefficient. The six first unexpected earnings are based on different ARIMA models, *UX* is the variation of reported earnings scaled by beginning of period prices. *UNORT* is the *UX* orthogonalized by stock market returns. The t-stat tests the distributional average equal to zero and ***, ** and * indicate that the distributional δ_0 and δ_1 are significantly different from zero at 1%, 5% and 10% level.

Table 4 documents that, on average, the ERCs, δ_1, are statistically and significantly different from zero in most of the estimation processes but the distributional dispersion is impressively broad due to some extreme high values. As a consequence, the difference in the magnitudes of mean and median ERC estimates is high. The ERC "significantly greater than zero is consistent with reported earnings conveying information to the stock market" (KORMENDI and LIPE, 1987, p. 335).

Particularly, the magnitudes of ERC in Table 4 can be directly compared to previous international literature in which the average firm-specific estimation is analyzed. In this regard, as per Pimentel and Lima (2010a), market reaction to earnings surprise is lower in Brazil than those documented in the US and other international markets. This is consistent with the overall idea that earnings information is less relevant in the Brazilian market due to local economic environment and several specific factors affecting the local market. In order to extend the analysis of the relationship between the ERC (δ_1) presented in Table 4 and the persistence parameter presented in Table 2 (PER), this paper provides two different tests: (1) we estimate the Spearman rank-order correlation and (2) we test the linear relation between ERC and PER by OLS regression and the ERC theoretical magnitude assumed in Eq. 2.

Table 5 presents the rank-order correlation coefficient relating δ_1, under different measures of unexpected earnings, and PER, under each specific ARIMA assumption. Results show that ERC (δ_1) and PER are positively correlated, with standard statistical significance, in all ARIMA assumptions. However when the four unexpected earnings measures are analyzed, the orthogonalized scaled earnings change UX^{ORT} is not statistically significant.

Table 5. Spearman rank-order correlation between ERC and persistence parameter (PER)

	ERC (δ_1) x PER (ARIMA models)								
	δ_1 (UX^{RW})	δ_1 (UX^{ORT})	δ_1 (UX^{AR1})	δ_1 (UX^{AR2})	ARIMA (1,0,0)	ARIMA (1,0,0)S	ARIMA (1,1,0)	ARIMA (2,1,0)	ARIMA (0,1,1)
$\delta_1(UX^{RW})$	1,000								
$\delta_1(UX^{ORT})$	0.684***	1,000							
$\delta_1(UX^{AR1})$	0.905***	0.734***	1,000						
$\delta_1(UX^{AR2})$	0.860***	0.671***	0.902***	1,000					

Table 5. Spearman rank-order correlation between ERC and persistence parameter (PER) (continuation)

ERC (δ_1) x PER (ARIMA models)									
	δ_1 (UX^{RW})	δ_1 (UX^{ORT})	δ_1 (UX^{AR1})	δ_1 (UX^{AR2})	ARIMA (1,0,0)	ARIMA (1,0,0)S	ARIMA (1,1,0)	ARIMA (2,1,0)	ARIMA (0,1,1)
ARIMA(1,0,0)	0.282***	0,046	0.186**	0.176**	1,000				
ARIMA(1,0,0)S	0.281***	0,053	0.198***	0.195**	0.829***	1,000			
ARIMA(1,1,0)	0.325***	0,127	0.244***	0.241***	0.634***	0.536***	1,000		
ARIMA(2,1,0)	0.276***	0.156**	0.192**	0.165**	0.729***	0.588***	0.824***	1,000	
ARIMA(0,1,1)	0.293***	0,114	0.201***	0.164**	0.726***	0.609***	0.842***	0,843	1,000

Notes. Four firm-specific earnings response coefficient, δ_1, in Eq. 3 based on different unexpected earnings measures (UX^{RW}, UX^{ORT}, UX^{AR1}, and UX^{AR2}). ***, ** and * indicate if the correlation is statistically significant at 1%, 5% and 10% level, respectively.

The highest levels of correlation are those under the scaled earnings change, UX^{RW}, measure of unexpected earnings (around 30%). The two autoregressive measures, UX^{AR1} and UX^{AR2}, have similar coefficients with the first-order model having a small advantage when compared with the second. The practical implication of these results is as follows: first, a simple random-walk assumption seems to outperform more complex autoregressive measures when the earnings-return relation is analyzed; second, differently from the international literature (KORMENDI and LIPE, 1987; LIPE and KORMENDI, 1994; BAGINSKI *et al.*, 1999), we document that low-order autoregressive models work at least as well as high-order models in representing the time-series process of earnings in the earnings-returns association.

The second approach to examine the relation between ERC and PER – the OLS regression between the theoretical magnitudes of ERC due to PER parameter – is displayed in Table 6. Overall, the results corroborate the correlation coefficients previously discussed; however the additional tests of a slope coefficient equal to one are presented. The results show that only the non-integrated ARIMA and first-order autoregressive models have, at the same time, a linear relation different from one and are statistically indistinguishable from one.

Table 6. OLS regression between the theoretical magnitudes of ERC and the PER parameter

	(UX^{RW})		**(UX^{ORT})**		**(UX^{AR1})**		**(UX^{AR2})**	
	Const.	α_1	Const.	α_1	Const.	α_1	Const.	α_1
ARIMA(1,0,0)	-1,472	**1,162**	0,13	0,439	-0,387	**0,729**	-0,27	**0,708**
H_0: α_i=0	*[-1.8]**	*[4.9]****	*[0.1]*	*[1.6]*	*[-0.6]*	*[3.6]****	*[-0.3]*	*[3.1]****
H_0: α_1=1		*[0.5]*		*[4.0]***		*[1.9]*		*[1.6]*
ARIMA(1,0,0)S	-2,305	**1,574**	-0,028	0,539	-1,193	**1,088**	-1,055	**1,067**
H_0: α_i=0	*[-2.6]***	*[5.5]****	*[0.0]*	*[1.6]*	*[-1.6]*	*[4.5]****	*[-1.2]*	*[3.8]****
H_0: α_1=1		*[4.0]*		*[1.8]*		*[0.1]*		*[0.1]*
ARIMA(1,1,0)	-3,112	**0,812**	-0,99	0,384	-0,63	0,387	-0,822	0,428
H_0: α_i=0	*[-3.3]****	*[6.2]****	*[-0.9]*	*[2.4]***	*[-0.8]*	*[3.4]****	*[-0.9]*	*[3.2]****
H_0: α_1=1		*[2.1]*		*[14.9]****		*[28.5]****		*[18.5]****
ARIMA(2,1,0)	2,019	0,013	1,597	-0,013	1,688	0,022	-0,474	0,404
H_0: α_i=0	*[4.5]****	*[0.9]*	*[3.2]****	*[-0.8]*	*[4.7]****	*[1.9]**	*[-0.6]*	*[3.5]****
H_0: α_1=1		*[4455.]****		*[3762.]****		*[6679.]****		*[26.2]****
ARIMA(0,1,1)	-1,231	0,67	0,277	0,242	-0,064	0,386	0,052	0,376
H_0: α_i=0	*[-1.8]**	*[6.1]****	*[0.3]*	*[1.8]**	*[-0.1]*	*[4.1]****	*[0.1]*	*[3.4]****
H_0: α_1=1		*[9.0]****		*[31.9]****		*[42.2]****		*[32.3]****

Notes: Tests for the theoretical value of ERC as implicit in Eq. 2. OLS regression between the four firm-specific earnings response coefficients, δ_1, on the on different persistence parameter (PER) plus 1. Regressions test for if slopes, α_1, are equal to zero (H_0: $\alpha_1=0$) and/or equal to one (H_0: $\alpha_1=1$). Coefficients highlighted in bold are statistically different from zero and indistinguishable from one, according hypothesized in Eq. 2. ***, ** and * indicate statistical significance at 1%, 5% and 10% levels.

The results presented in Table 6 do not support Ali and Zarowin (1992b) who argue that scaled earnings variation can be biased towards zero. Although studies might exercise caution when using scaled variation of earnings, in the Brazilian market, the random walk assumption in unexpected earnings measure does not seem to yield inferior results than other commonly used models in the literature.

Overall, the results documented in this paper show that the significance and the parameters can vary according to the assumption of time-series process of reported earnings. Under stressed macroeconomic environments (specifically under high interest rates conditions and high level of transitory components), the usefulness of accounting for decision making can be reduced. In these cases, low-order time-series models can mainly provide the same results as high-order models, which facilitates the implementation of earnings-return studies in Brazil.

6. ADDITIONAL TESTS, LIMITATIONS AND FUTURE EXTENSIONS

Similar to all market-based studies, this paper is subject to a series of potential biases from measure errors in variables, quantitative approach, and sample selection. First, it is important to point out that the tests above are in-sample in nature: a different firm-selection process and/or different period can yield different results.

In order to reduce those potential biases and due to the lack of empirical evidence, the paper itself develops analyses under different assumptions of time-series and earnings expectation. Additionally, two *ex-post* measures of abnormal return, *ABRET*, were considered, which are conditional to the realized market return for period *t*: the first is based on monthly returns by regressing firm-specific return on market returns (market model). Thus, $UR_{it} = R_{it} - (\lambda_{1i} + \lambda_2 R_{Mt})$, where, λ_1 and λ_2 are the coefficients of OLS regression between monthly return, R_{it}, and the market return, R_m, over 48 months (minimum of 24 months is required). The annual returns are accumulated from April of year *t* to March of *t + 1* in order to capture any return reaction associated with the announcement of earnings for year *t*. The second is based on similar methodology but λ_1 and λ_2 are estimated based on monthly returns over the entire period (1995 to 2013) and returns in *t* are compounded annually from March to March as a buy-and-hold methodology. The results considering abnormal returns are qualitatively the same and are available from the authors upon request.

One potential problem is the low lengths of the historical series of earnings (six years), and thus, we face a trade-off: on the one hand, short lengths increase the number of analysed firms and allow a higher coverage of the listed firm population. On the other hand, these short lengths reduce the ability of time-series procedures to capture the 'true' long-term persistence coefficients and can induce bias in the results. This effect will naturally be reduced as more years of monetary stabilizations are to come and future studies can provide additional long-term considerations.

Recent evidence in Clubb and Wu (2014) and Dichev and Tang (2009) show that earnings persistence is negatively related to earnings volatility. Since Brazilian firms can show mean reversion pattern in earnings caused, for instance, by high instability of the local market, by high exchange rates variations or by political decisions, it can be fruitful to future studies for cross-sectionally analyze the role of earnings volatility in the earnings persistence measures, consequently in the ERC.

7. CONCLUSIONS AND IMPLICATIONS

This paper analyses the market reaction to earnings innovations, specifically to which extent the market adjusts stock prices by reviewing future benefits expectations when new information in reported earnings is given. The sample of analysis consists of 176 Brazilian listed firms from 1995 to 2013. Given the lack of empirical literature using emerging markets, this paper combines estimated annual parameters of different ARIMA models according to time-series assumptions of earnings, and different measures of unexpected earnings often used in accounting and finance literature. Specifically, we analyze (1) if different ARIMA assumptions affect the cross-sectional classification of firms into high and low earnings persistence ; (2) the extent to which interest rates affect the persistence parameter; and (3) the extent to which market agents adjust stock prices by reviewing future benefits expectations given new information in reported earnings under different time-series assumptions.

We document evidence that different ARIMA assumptions led to different cross-sectional classifications of firms into high and low earnings persistence. As a consequence, studies that consider high and low earnings persistence should be aware that the time-series assumptions can potentially yield different empirical outputs.

By comparing the results in the Brazilian and the US markets, the empirical analysis of this paper documents that earnings persistence parameters (PER) in Brazil are, on average, lower than those in the US and the difference between earnings persistence across firms (dispersions) is higher in the Brazilian market. Those results are especially true under the local high interest rates, since one can expect that high interest rates can potentially reduce earnings persistence for two reasons: first, high interest rates can decrease the present value of future earnings (and dividends) and, thus, expectations in futures earnings are less affected by current innovation in earnings; second, since high interest rates reduce the incentives for long-term earnings components, managers have incentives to generate short-term earnings and, as a consequence, more transitory components in earnings. The two aspects (low present value of future outcomes and incentives to transitory components) can potentially decrease the persistence parametersThe consequence is that high interest levels diminish the relevance of current innovations in earnings to compound current expectations of future earnings patterns. Moreover, the theoretical response to earnings innovation (ERC) is lower under high interest rates. Whether the lower PER and the lower ERC are related to lower present value of revision in earnings expectations or related to higher transitory components is a venue for future research.

Additionally, results show that market react more to earnings that exhibit high time-series persistence. Thus, low transitory components in earnings are related to more useful accounting information. Finally, similarly to most international literature, we cannot reject the random walk time-series property for annual earnings. However, differently from previous evidence, we documented that a simple random-walk assumption seems to outperform more complex autoregressive measures when the earnings-return relation is analyzed. Hence, low-order autoregressive models work at least as well as high-order models in representing the time-series process of earnings in the earnings-returns association. One potential explanation is that due to the relatively short time-series length in the Brazilian market, high-order models do not provide additional information. That conclusion can change as more years are added to the relative stable inflationary environment.

Since the significance and the parameters can vary according to the assumption of time-series process of reported earnings, research design of accounting studies under non-stable markets must be considered with cautions when used for both valuation and stewardship purposes. While this paper tried to discuss some possible reasons and implications for these results, it seems imperative that more studies be developed in order to understand determinants of earnings persistence for Brazilian listed companies.

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