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Comparison Of The Residual Income Valuation, Abnormal Earnings Growth And Free Cash Flow Models: An Empirical Study Of The Brazilian Capital Market

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ABSTRACT: This study compares the explanatory power of the residual income valuation (RIV), abnormal earnings growth (AEG) and free cash flow (FCF) models in the Brazilian capital market, through an empirical test to compare the three models, using data on companies listed on the BOVESPA. Each model was analyzed annually over the period from 1995 to 2002 by multiple linear regression. The results show that from 1995 to 1999 the RIV model had better explanatory power than the other two models, and from 2000 to 2002 the AEG and RIV models were the same, an indicator of the Brazilian market's development in the more recent years of the study period. The FCF model had the least explanatory power in all the years analyzed. The results were confirmed by panel data analysis.

Keywords: residual income valuation, abnormal earnings growth, free cash flow, panel data.

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1. INTRODUCTION

The model of Ohlson (1995) supplied a theoretical and mathematical framework for pricing shares function of accounting variables by means of the residual income valuation (RIV) model. Later, Ohlson (2005) presented modifications in his structure, in which the book value is excluded from the model, which works only with earnings and their variations, under the assertion that earnings are at least as good an estimator as book value, and never worse. This became known as the abnormal earnings growth (AEG) model.

Works such as Damodaran (1997), Brealley and Myers (2000), Brigha et al. (2001) helped to disseminate the concept that a company's worth is the present value of its projected free cash flow. Lopes and Galdi (2006, p. 3) stressed that the use of this methodology in Brazil "is even employed in lawsuits as a way to determine the price of a company's shares."

The free cash flow (FCF) method is tested in this work and compared against the Ohlson models. The comparison of these three models can help in understanding the relevance of FCF, earnings and book value in the pricing of assets. The majority of works on this subject have been carried out in countries such as the United States and England, which have different characteristics than emerging countries like Brazil. The relevance of book vale in relation earnings can be higher in these economies, contradicting Ohlson (2005), who affirmed that earnings are at least as good an estimator as book value, and never worse.

In Brazil, the work of Lopes (2001) can be considered seminal in the national accounting literature. Besides being pioneering in positive research in the area, it demonstrates that there are no indications that dividends are more relevant in pricing shares than the information generated by accounting.

Given the characteristics of the Brazilian market, where funding is more often raised through debt, the capital market is concentrated and the legal framework is inspired by Roman law, book value might be more relevant than earnings because bondholders affect the pricing process of shareholders, making book value more important in valuing companies.

The work of Sant'Anna (2004) sought to find indications of the relevance of book value in relation to earnings in Brazil, using realized earnings as a proxy for expected earnings. He did not find evidence that the predictive power of the RIV model was greater than that of the AEG model, and concluded that there is no distinction between the importance of earnings and book value in Brazil.

The study by Lopes and Galdi (2006) showed that the price-to-book (P/B) ratio calculated from the estimates of analysts, who used the discounted cash flow method, had greater explanatory power than estimates by means of the RIV model. In turn, Ohlson and Lopes (2007) demonstrated the theoretical superiority of the AEG model in relation to the PVED, FCF and RIV models.

The aim of this work is to perform an empirical test the work of Ohlson and Lopes (2007) in Brazil, using the parameterized version of the AEG model proposed by those authors, and to compare the performance of the RIV, AEG and FCF models by means of the R^2 statistic.

2. THEORETICAL FRAMEWORK – MODELING

2.1 Problem, Objective and Hypothesis of the Work

In the residual income valuation (RIV) model proposed by Ohlson (1995), the value of a company corresponds to its current book value of equity plus the present value of the sum of its expected future residual income. According to Lopes and Martins (2005), the residual income is defined as the residual return (income) obtained above the company's cost of capital applied on its book value. As utilized by Sant'Anna (2004), the rate paid on savings accounts is used as the risk-free rate of return.

The premises of this model are:

P_0 is the share price of the firm at time 0;

x_t^a is the residual income in period t;

x_t is the income in period t ;

y_{t-1} is the book value of equity in period t-1;

d_t is the net dividends distributed in period t;

$\mathrm{E}(d_t)$ is the expected value of net dividends distributed on date t;

r is the risk-free rate.

1. The firm's value is equal to the sum of the net present values of its expected future dividends; $P_0 = \sum_{t=1}^{\infty} \frac{\mathrm{E}(d_t)}{(1+r)^t}$ (1);

2. The residual income corresponds to the income above its book value multiplied by a risk-free rate; $x_t^a = x_t - r \cdot y_{t-1}$ (2);

3. Clean surplus relations: the variation of the book value for a period is equal to the income minus net dividends distributed in the period, so that dividends affect the variation of book value in the period and do not affect the income, only the expected earnings in subsequent years. Thus, the dividend distribution policy becomes irrelevant for pricing a company's shares (LOPES, 2001); $y_t - y_{t-1} = x_t - d_t$ (3);

Some algebraic manipulations produce the model proposed by Ohlson (1995). $P_0 = y_0 + \sum_{t=1}^{\infty} \frac{\mathrm{E}(x_t^a)}{(1+r)^t}$ (4).

In this scenario, the residual income replaces dividends as a parameter to predict a company's value (SANT'ANNA, 2004).

2.2 Abnormal Earnings Growth (AEG) Model

The model of Ohlson (2005) has the same purpose as the RIV model, to price a company's shares based on accounting data. It emerged from an attempt to perfect the RIV model. In the AEG model, the company's value is given by the perpetual value of income added to the present value of expected abnormal growth.

The premises of the model are:

P_0 is the firm's share price in period 0;

y_t is the book value of equity in period t;
dps_t is the value of the dividends per share distributed in the period;
eps_1 is the value per share at the end of period 1;
eps_t is the value per share at the end of period t;
$E(dps_t)$ is the expected value of the dividends per share distributed referring to period t;
R is the risk-free rate plus one (R = r + 1);
r is the risk-free rate.

1. The company's value is equal to the sum of the values of its expected dividends, brought to the present (Equation 5); $P_0 = \sum_{t=1}^{\infty} \frac{E(dps_t)}{(1+r)^t}$ (5).

2. The following tautology is utilized: the sum of the book value and its future variations capitalized at a constant rate is equal to zero.

$$0 = y_0 + \sum_{t=1}^{\infty} \frac{y_t - [(1+r) \cdot y_{t-1}]}{(1+r)^t} \quad (6).$$

Working with these two premises leads to Equation (7):

$$P_0 = y_0 + \sum_{t=1}^{\infty} \frac{E(y_t - R \cdot y_{t-1} + dps_t)}{(1+r)^t} \quad (7).$$

Using:

$$y_0 = \frac{eps_1}{r} \longrightarrow y_t = \frac{eps_{t+1}}{r} \quad (7.1).$$

Some algebraic manipulation produces the model proposed by Ohlson (2005):

$$P_0 = \frac{eps_1}{r} + \sum_{t=1}^{\infty} \frac{z_t}{(1+r)^t} \quad (8); \text{ and}$$

$$z_t = \frac{1}{r}(eps_{t+1} - R \cdot eps_t + r \cdot dps_t) \quad (9).$$

The term z_t corresponds to the abnormal variation in earnings, replacing the expected future abnormal earnings by the abnormal variation/growth of earnings.

It should be observed here that Ohlson (2005) uses as the first term in his AEG model (Equation 8) exactly the same first term as in Equation (4.2). In other words, an equivalence is made between the initial investment (book value) and the constant perpetual return given by the opportunity cost of this investment (constant normal earnings).

To understand the second term of Equation (8), it is necessary to understand the term Z_t, specified by Equation (9). Because it is strictly focused on earnings, the AEG model has some theoretical and practical advantages, since the presuppositions are less rigid in relation to the RIV model. In this respect, the RIV can be considered a particular case of the AEG model.

The advantage of not having the clean surplus relation premise avoids some problems presented by the RIV model, when capital transactions occur. In this sense, Sant'Anna (2004, p.30) enumerates three advantages of the AEG model in relation to the RIV stressed by Ohlson:

(a) The AEG model does not need the book value or the clean surplus relation assumption, meaning that trading of the shares in circulation do not cause problems or adverse implications for the model. With less rigid assumptions, it becomes easier to work with its formula either with per share data (earnings per share) or total data (total earnings).
(b) The focus on earnings will never be worse than the focus on book value, but the contrary will not be true. The advantage of the formula based on earnings over that based on book value comes from the idea that the errors between the predicted figures would be smaller in the AEG than in the RIV model, since in the RIV model the errors between the book value and real market value of the company (P - BV) refer to the goodwill, while the errors between the capitalized earnings and the company's value (P - E/r) refer to the changes in goodwill (i.e., while in the RIV model residual, or abnormal, earnings justify all the goodwill, in the AEG the abnormal growth of earnings only justifies a part of or a change in goodwill). This implies that when a finite number of periods is used, the AEG model presents a smaller error than the RIV (and the shorter this period the greater will be the difference between the errors of the two models). This is an important characteristic in financial practice.
(c) Financial practice is based much more on earnings and their subsequent growth than on book value and its subsequent growth.

2.3 The Free Cash Flow Model

The free cash flow is the flow from the company's operations, disregarding financial expenses and adding expenses that do not mean outflow of cash, such as amortization and depreciation, and subtracting investments in working capital and permanent assets[1].

The free cash flow is the flow directly available to the company's security holders (common and preferred shareholders and debt holders). It is calculated from operating income, including taxes, before any return to the mentioned security holders.

The FCF model is defined as: $P_0 = -D_0 + \sum_{t=1}^{\infty} R^{-t} c_t$ (10);

Where:

D_0 = the company's current debt;

c_t = Free cash flow expected on date t.

In turn where,

C_t = EBIT – taxes + dep.amort + (Δfixed assets + inc.def) – working capital investments (10.1).

Where:

EBIT= earnings before interest and taxes;

Taxes = Taxes on operating income (EBIT X 0.34[2]);

Dep.amort = depreciation and amortization;

Δfixed assets = variation of fixed assets (purchase of fixed assets);

Inc.def = increase in deferred charges (if any);

[1] Permanent assets is a category in Brazil that includes fixed assets, equity investments and deferred charges.
[2] The sum of taxes on company income in Brazil.

Working capital investments = variation of working capital;

Working capital = (inventories + accounts receivable from customers – accounts payable to suppliers) x (sales/365).

The FCF model is summarized as follows by Lopes and Galdi (2006, p. 7):

> Therefore, in the free cash flow (FCF) concept, only the amounts coming from operational activities are considered, net of taxes, reduced by the cash necessary for investments in working capital and fixed assets. The FCF concept is based on an evaluation of the capacity to generate free cash flows resulting from the firm's assets. In short, it can be said to be the amount available to all suppliers of funds. For this reason it must be determined before payment of dividends (principle and interest). The FCF concept is the initial base for calculating the economic value of the firm (based on the firm's free cash flow) and the value to shareholders (based on the free cash flow to the shareholders).

2.4 Valuation of companies based on accounting numbers

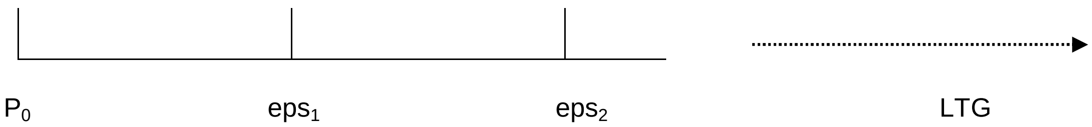
2.4.1. A parameterized version of the abnormal earnings growth model.

The AEG model becomes more robust if an assumption is added, which is:

$z_t = \gamma z_t, t \geq 1$, where $\gamma \geq 1$ is an assumed growth parameter. For z_1 > 0, starting from z_1 = 0, then $P_0 = ear_{t+1}/r$, where: eps_1: expected earnings per share in period 1;

- Short-term growth (STG) in year 2 vs. year 1 on the expected EPS;
- A measure of long-term growth (LTG) on expected EPS;
- A discount factor that reflects the risk (cost of capital).

Therefore, the vision of investors on the future is represented as follows:



After some algebraic manipulation, $P_0 = \frac{eps_1}{r} \times \left(\frac{g_s - g_l}{r - g_l} \right)$ (27)

is obtained, where:

r = cost of capital;

$$g_s = \frac{eps_2 - eps_1}{eps_1} + \frac{r \times dps_1}{eps_1} \quad (28)$$

(28).

$$g_l = \frac{eps_t - eps_{t-1}}{eps_{t-1}} \quad (29).$$

For $t \to \infty$ (assuming full payment of dividends) ≡ LTG. The term $r \times dps_1 / eps_1$ refers to the incorporation of the dividends distributed at the end of year 1. As $t \to \infty$, it is expected that the values of firms will converge over the long run, so g_l would be the same for all firms, varying by 3% to 4%. The problem with this reasoning is the restriction it imposes, but it permits using *r* as a different long-term growth parameter for each firm or sector.

A usual drawback of the analysis is due to the fact that the discount rate (r) is not a known number, and for this reason the analysis in practice uses P_0 as a parameter for calculating the value of r for each firm. In this case, the formula obtained is:

$$r = A + \sqrt{A^2 + \frac{eps_1}{P_0} \times \left[\frac{\Delta eps_2}{eps_1} - (\gamma - 1) \right]} \quad (30),$$

where $A \equiv \frac{1}{2}\left(\gamma - 1 + \frac{dps_1}{P_0} \right)$ (31),

for $1 \leq \gamma \leq R$. This formula enables some evaluations: (i) r becomes a risk parameter of the firm; (ii) if r is high, the value of eps1 will be adjusted downward in the near future; and (iii) if the firm is undervalued, it becomes an attractive opportunity.

2.4.2. Empirical evidence for the models based on Brazilian accounting numbers

The article of Ohlson and Lopes (2007) presents empirical evidence of the models based on accounting numbers in Brazil, in turn based on Lopes (2001; 2005), and demonstrates the superiority of the RIV model in relation to the present value of expected dividends (PVED). The authors show that companies with low price/book ratios generate abnormal returns, evidence of the validity of the AEG model.

The evidence presented demonstrates that despite the peculiarities of the Brazilian scenario, in which accounting numbers are not considered very informative and macroeconomic problems strongly influence the financial market, models based on accounting numbers are still efficient. However, there is a need for further study to gain a better understanding of the role of accounting variables in valuing companies. (LOPES and WALKER, 2007 and LOPES, 2006).

The work of Ohlson and Lopes (2007) concludes by summarizing how the different company valuation approaches can be unified. By adding the supposition of growth to the AEG structure, a formula is obtained that approaches the “real world” situation. The model also contains no improbable assumptions regarding dividends.

3. REVIEW OF THE LITERATURE

The work by Ray Ball and Philip Brown (1968) was the first trying to find a relationship between accounting numbers and the capital market. The authors compared the reaction of share prices in relation to good news (higher than expected earnings) or bad news (lower than expected earnings), based on estimates. This work is summarized by Lopes and Martins (2005, p. 77) as follows:

> The empirical literature on the relationship between accounting figures and the financial market began with the seminal work of Ball and Brown (1968). These authors analyzed the reaction of market prices to the disclosure of abnormal earnings. [...] The evidence demonstrates that abnormal earnings start to grow some months before earnings disclosure. The authors attribute this result to the existence of other sources of information on the company’s performance besides accounting numbers. On the date of disclosure, they find abnormal returns of around 7.5%.

Following the same line of research, Beaver (1968) related the behavior of stock prices and trading volume in the eight weeks preceding the announcement of accounting numbers and the eight weeks afterward. This work demonstrated that the volume and price are highly influenced by accounting information, principally in the week of the disclosure.

Foster (1977) carried out a study similar to that of Ball and Brown (1968), but with analysis of daily return information and quarterly financial statements, and altered the methodology used before by the two authors. In his work he created a new concept: cumulative abnormal return (CAR). Foster (1977) concluded that there is no evidence that the signs of the variation of earnings and abnormal earnings are correlated, corroborating the work of Ball and Brown (1968).

Works such as those of Fama and French (1992), Baruch and Thiagarajan (1993), Fama and French (1995), Fama and French (1996), Abarbanell and Bushee (1997), Abarbanell and Bushee (1998), Ali and Hwang (2000), Bird, Gerlach and Hall (2001), Piotroski (2000; 2005), Mohanram (2005), Lopes and Galdi (2006), Nossa (2007) and Werneck (2007), among others, have sought to relate stock returns to accounting information.

After the publication of Ohlson (1995), many other studies sought to explain the behavior of stock prices as a function of balance sheet figures. Barth et al. (1993), Landsman (1986) and Collins et al. (1997) illustrate that the importance depends on various factors, among them the type of industry and financial condition.

The work of Lev (1989) examined the importance of accounting earnings for investors, recognized that R^2 is a measure that helps to understand the usefulness of earnings, admitted that the influence of earnings is low and asserted that this low correlation is due to the different accounting practices followed.

Brown et al. (1999) demonstrated the interference of the scale effect in the R^2 calculated in previous works and obtained an adjustment for the temporal variations not related to income.

Lopes (2001, 2002) identified the importance of income and dividends in Brazil, showing that the relevance of book value in Brazil cannot be ignored.

Sarlo Neto (2004, p. 177) repeated the work of Ball and Brown (1968) in the Brazilian context. One of the conclusions was the importance of accounting in reducing the information asymmetry in the Brazilian market.

Lopes and Galdi (2006) reported the estimated value of companies by the discounted cash flow (DCF) model and according to that of Ohlson (1995). The authors' innovation was the use of figures projected by analysts, with the aim of capturing the expectations of market agents. The authors found a significant difference in the forecasts of the two models, with the DCF model performing the best.

Penman (1995, p. 4) illustrated the problem that theoretical models work with infinite horizons, and the DCF and RIV models are equivalent over this horizon.

4. METHODOLOGY

The data were collected from the Economática database of shares traded on the São Paulo Stock Exchange (BOVESPA) in the period from 1995 to 2006. The data cover all the companies in all sectors listed on the BOVESPA, following the criterion of only one stock per company when having more than one type listed (the most liquid stock in this case). The companies that did not have shares listed in at least one of the years and did not disclose accounting data in the four subsequent years were eliminated from the sample, along with companies with negative book value.

We used the multiple regression technique to calculate the annual R^2 values of the RIV, AEG and FCF models, adopting the criterion of discarding outliers from the boxplot, with the objective of trying to homogenize the sample and ensure that the regression premises were satisfied.

The verification of the predictive power of the models was done by comparing the R^2 year by year, only in one stock per company (the most liquid). Verification of the statistical difference between the R^2 values calculated was done by Vuong's test.

Voung's test follows the classic precepts of a statistical test, by means of a maximum likelihood ratio, standardizes the ratio and compares it with a normal probability distribution. Besides the regression, We used panel date modeling to strengthen the conclusions obtained by the regression. We applied this technique in three periods, first the entire study interval from 1995 to 2002, then to two sub-intervals: from 1995 to 1999 and 2000 to 2002. The reason for this division is because the initial conclusions from the year-by-year regressions indicated different behaviors in these periods.

The models were generated following the orientation of Brown et al. (1999), by dividing the share price by that of the previous year, to eliminate the scale effect. Besides this, a market liquidity variable was used as a control.

The market liquidity variable corresponds to the market liquidity index (MLI), available in the Economática database. The MLI measures the volume of trading of a stock on the exchange. The method of calculating the MLI is based on the financial volume, number and periodicity, according to Equation 32: $MLI = 100 * \frac{p}{P} * \sqrt{\frac{n}{N} * \frac{v}{V}}$ (32); Where:

p is the number of days in which there was at least one transaction with the stock in the period; **P** is the total number of days in the period; **n** is the number of trades with the stock in the period; **N** is the total number of trades with all stocks in the period; **v** is the monetary volume of the trades with all the stocks listed on the BOVESPA in the period; and **V** is the monetary volume of trading of all stocks on the BOVESPA in the period. Following the literature, We used a four-year period for the regression equation, as recommended by Lopes (2001) and Sant'Anna (2004):

> The use of four years reflects the consensus in the literature on this subject (BERNARD, 1995; BROMWHICH, 2000) that abnormal earnings do not last for very long periods due to the presence of competition, which winds up making this number tend to zero during the periods (LOPES, 2001, p. 157)

Therefore, the RIV model is generated as follows:

$$\frac{P_t}{P_{t-1}} = \beta_0 + \beta_1 \frac{y_0}{P_{t-1}} + \beta_2 \frac{x_{t+1}^a}{P_{t-1}} + \beta_3 \frac{x_{t+2}^a}{P_{t-1}} + \beta_4 \frac{x_{t+3}^a}{P_{t-1}} + \beta_5 \frac{x_{t+4}^a}{P_{t-1}} + \beta_6 \frac{l_t}{P_{t-1}} + \varepsilon_t \quad (33).$$

Where:

P_t is the share price in year t;

P_{t-1} is the share price in year t-1;

y_o is the company's book value;

x_{t+1}^a, x_{t+2}^a, x_{t+3}^a and x_{t+4}^a are the values of abnormal earnings calculated for years t+1, t+2, t+3 and t+4, brought to present value;

l_t is the liquidity of the share given by the Economática database; and

ε_t is the regression's stochastic error term.

Similar to the method followed to operationalize the RIV model, the AEG model is illustrated in Equation 34:

$$\frac{P_t}{P_{t-1}} = \alpha_0 + \alpha_1 \frac{eps_{t+1}/r}{P_{t-1}} + \alpha_1 \frac{z_{t+2}}{P_{t-1}} + \alpha_2 \frac{z_{t+3}}{P_{t-1}} + \alpha_3 \frac{z_{t+4}}{P_{t-1}} + \alpha_4 \frac{l_t}{P_{t-1}} + \varepsilon_t \quad (34)$$

Where:

P_t is the share price in year t;

P_{t-1} is the share price in year t-1;

eps_{t+1} is the company's earnings per share at the end of t+1;

r is the risk-free rate;

z_{t+2}, z_{t+3} and z_{t+4} are the abnormal earnings values calculated according to Ohlson (2005), for years t+2, t+3 and t+4, brought to present value and adjusted to the long-term growth, as suggested by Ohlson and Lopes (2007);

l_t is the liquidity of the share given by the Economática database; and

ε_t is the regression's stochastic error term.

We used a long-term growth rate of 3%, while Ohlson and Lopes (2007) referred to a rate varying from 3% to 4%. Therefore, We ran a sensitivity test to detect the influence of this variation on the results of this work. The variation found for the AEG model was not significant, hence the conclusions did not vary according to the rate utilized.

Following the same methodology employed in the works of Lopes (2001) and Sant'Anna (2004), We used the realized future earnings as a proxy for the expected future earnings. We applied an analogous method for the FCF, where the realized flow acted as a proxy for the expected flow.

To follow the same time period used to operationalize the two Ohlson models above, the FCF model follows the specification below:

$$\frac{P_t}{P_{t-1}} = \phi_0 - \phi_1 \frac{D_t}{P_{t-1}} + \phi_2 \frac{c_{t+1}}{P_{t-1}} + \phi_3 \frac{c_{t+2}}{P_{t-1}} + \phi_4 \frac{c_{t+3}}{P_{t-1}} + \phi_5 \frac{c_{t+4}}{P_{t-1}} + \phi_6 \frac{l_t}{P_{t-1}} + \varepsilon_t \quad (35).$$

Where:

P_t is the share price in year t;

P_{t-1} is the share price in year t-1;

D_t is the company's debt in year t;

c_{t+1}, c_{t+2}, c_{t+3} and c_{t+4} are the free cash flow values calculated for years t+1, t+2, t+3 and t+4, brought to present value;

l_t is the liquidity of the share given by the Economática database; and

ε_t is the regression's stochastic error term..

Chart 1 was taken from Lopes and Galdi (2006, p. 6), demonstrating step by step the calculation of the free cash flow, the same method used here.

Net sales revenues
(-) Selling costs
(-) Operating expenses
(=) Earnings before interest and income tax (EBIT)
(+) Adjustment of operating expenses that does not cause cash outflow (depr./amort,)
(=) Earnings before interest, taxes, depreciation and amortization (EBITDA)
(-) Taxes on operating income
(=) Generation of operating cash
(-) Investments – permanent assets and short-term assets
(=) Free cash flow (net cash flow from operations)

Chart 1: Calculation of Free Cash Flow
Source: Lopes and Galdi (2006)

5. RESULTS

The results are presented using two statistical techniques: (i) multiple linear regression; and (ii) panel data. The objective of using these two techniques was to make the conclusions more robust.

5.1 Descriptive Statistics

The table with the descriptive statistics is not shown in this work due to space limitations. Table 1 shows the number of observations in each year. These numbers are adequate to support the results obtained, but the inference from the conclusions depends on confirmation of the assumptions made in this work.

Table 1. Number of Observations per Year

Year	N
1995	117
1996	98
1997	90
1998	90
1999	88
2000	117
2001	108
2002	106
Total	**814**

Source: Authors

The results of the descriptive statistics reveal the high variability of the cash flow figures calculated, which persists even after exclusion of outliers.

5.2 Results by the multiple linear regression method

The results of the regressions using the models discussed in the preceding chapter are shown in the tables below. Each table presents the results of the tests for each parameter composing the regression along with the tests of the assumptions of multiple linear regression: absence of multicollinearity (VIF), normality of the residuals (KS); and absence of serial autocorrelation (DW). We did not test for homoskedasticity of the residuals, because in all the regressions We used the heteroskedasticity-robust regression for consistency of the standard errors and covariances.

Table 2. Results of the RIV Model

$$\frac{P_t}{P_{t-1}} = \beta_0 + \beta_1 \frac{y_0}{P_{t-1}} + \beta_2 \frac{x^a_{t+1}}{P_{t-1}} + \beta_3 \frac{x^a_{t+2}}{P_{t-1}} + \beta_4 \frac{x^a_{t+3}}{P_{t-1}} + \beta_5 \frac{x^a_{t+4}}{P_{t-1}} + \beta_6 \frac{l_t}{P_{t-1}} + \varepsilon_t \quad (36)$$

Years	β_0	β_1	β_2	β_3	β_4	β_5	β_6	F	Adjust. R^2	Normality (KS)	Serial Correlation (DW)
1995	0,431	0,041	-0,004	0,008	0,103	-0,267	0,044	4,37*	14,9%	0,067	1,85
	(11,09)*	(2,98)*	(-0,04)	(-0,08)	(2,16)**	(-3,75)*	(2,11)**			(p>0,15)	autocorrelation
VIF		1,3	1,7	1,3	1,7	2,3	1,0				absence
1996	0,869	0,057	-0,118	0,183	-0,072	-0,130	0,162	4,92*	19,5%	0,071	2,22
	(12,63)*	(4,13)*	(-2,35)**	(1,77)***	(-0,96)	(-1,55)	(4,35)*			(p>0,15)	autocorrelation
VIF		1,2	1,3	2,4	3,5	5,0	1,0				absence
1997	0,835	0,031	0,065	-0,028	0,003	0,155	0,124	1,93***	5,9%	0,08	2,09
	(10,58)*	(1,75)***	(1,05)	(-1,02)	(0,13)	(1,48)	(4,62)*			(p>0,15)	autocorrelation
VIF		1,4	3,0	3,7	3,7	1,1	1,0				absence
1998	0,680	0,020	-0,031	0,121	-0,145	0,013	-0,020	1,61	3,9%	0,055	1,93
	(13,86)*	(1,48)	(-1,67)***	(1,55)	(-1,56)	(0,56)	(-1,26)			(p>0,15)	autocorrelation
VIF		1,6	1,6	13,0	13,6	1,8	1,0				absence
1999	1,532	0,176	-0,104	-0,143	0,011	0,216	0,261	3,12*	12,8%	0,141	1,86
	(5,28)*	(3,46)*	(-0,49)	(-0,50)	(0,15)	(1,75)***	(1,38)			(p<0,01)	autocorrelation
VIF		1,1	2,3	3,3	4,1	3,2	1,0				absence
2000	0,997	0,024	-0,055	-0,037	0,106	-0,020	-0,053	3,67*	11,8%	0,136	2,08
	(16,18)*	(2,22)*	(-0,52)	(-0,36)	(1,73)***	(-0,23)	(-1,99)**			(p<0,01)	autocorrelation
VIF		2,7	5,0	3,8	4,9	4,1	1,0				absence
2001	0,900	0,017	0,059	-0,110	0,138	-0,013	-0,031	1,24	1,3%	0,052	2,02
	(15,96)*	(0,76)	(0,66)	(-1,35)	(1,75)***	(-1,07)	(-1,33)			(p>0,15)	autocorrelation
VIF		1,1	2,4	3,1	2,4	1,8	1,1				absence
2002	0,828	0,069	0,314	0,089	0,114	-0,233	-0,011	2,74**	9,0%	0,109	1,74
	(13,44)**	(2,88)*	(1,52)	(0,78)	(2,31)**	(-3,79)*	(-0,80)			(p<0,01)	inconclusive
VIF		1,6	1,9	2,2	1,7	2,2	1,0				

Source: Authors

Notes: P_t is the share price in year t; P_{t-1} is the share price in year t-1; y_t is the book value of the company in year t; x^a_{t+1}, x^a_{t+2}, x^a_{t+3} and x^a_{t+4} are the abnormal earnings values for years t+1, t+2, t+3 and t+4, brought to present value; l_t is the market liquidity value supplied by the Economática database; and ε_t is the regression's stochastic error term.*,**,*** significant at 1%, 5% and 10%, respectively (t-statistic in parentheses).

The RIV model was significant in 1995, 1996, 1997, 1999, 2000 and 2002. Only in 1998 and 2001, when it was not considered significant, was the book value (y_0) also considered statistically not significant. This result shows the relevance of this variable for the market.

Table 3. Results of the AEG Model

$$\frac{P_t}{P_{t-1}} = \alpha_0 + \alpha_1 \frac{eps_{t+1}/r}{P_{t-1}} + \alpha_2 \frac{z_{t+2}}{P_{t-1}} + \alpha_3 \frac{z_{t+3}}{P_{t-1}} + \alpha_4 \frac{z_{t+4}}{P_{t-1}} + \alpha_5 \frac{l_t}{P_{t-1}} + \varepsilon_t \quad (37)$$

Years	□□	α□	α□	α□	α□□	α□	F	Adjust. R^2	Normality (KS)	Serial Correlation (DW)
1995	0,517	-0,002	0,000	0,004	-0,006	0,051	1,01	0,0%	0,104	1,79
	(16,95)*	(-0,19)	(-0,22)	(0,71)	(-0,96)	(2,14)**			(p<0,01)	autocorrelation
VIF		1,0	1,7	17,7	16,6	1,0				absence
1996	1,051	0,007	0,016	-0,021	0,001	0,148	2,13**	5,5%	0,101	2,08
	(18,46)*	(1,32)	(0,96)	(-1,85)***	(0,15)	(3,93)*			(p=0,017)	autocorrelation
VIF		1,0	23,3	14,7	6,9	1,0				absence
1997	0,950	0,008	-0,004	-0,002	0,005	0,113	1,18	1,0%	0,069	2,04
	(15,56)*	(2,86)*	(-1,86)***	(-0,56)	(1,49)	(4,47)*			(p>0,15)	autocorrelation
VIF		1,0	4,7	16,9	17,8	1,0				absence
1998	0,752	0,001	-0,001	-0,001	0,002	-0,027	0,38	0,0%	0,073	1,88
	(20,73)*	(0,45)	(-2,53)**	(-0,38)	(0,83)	(-1,65)			(p>0,15)	autocorrelation
VIF		1,0	1,8	5,1	5,3	1,0				absence
1999	2,204	0,026	0,002	-0,002	0,000	0,150	1,13	0,8%	0,129	1,91
	(9,77)*	(1,07)	(1,15)	(-1,03)	(-0,10)	(1,39)			(p<0,01)	autocorrelation
VIF		2,0	17,9	18,1	1,0	1,0				absence
2000	1,023	0,010	-0,004	0,000	0,003	-0,058	4,41*	12,4%	0,127	2,16
	(21,72)*	(5,62)*	(-8,25)*	(0,30)	(5,96)*	(-2,22)**			(p<0,01)	autocorrelation
VIF		1,0	11,4	13,1	14,3	1,0				absence
2001	0,939	0,003	-0,006	0,006	-0,003	-0,034	1,41	1,9%	0,078	2,00
	(25,38)*	(0,55)	(-2,35)**	(1,78)***	(-0,89)	(-1,44)			(p>0,15)	autocorrelation
VIF		1,1	12,5	42,2	24,0	1,0				absence
2002	0,927	0,030	-0,002	0,005	0,003	-0,022	2,59**	7,0%	0,110	1,71
	(15,24)*	(1,73)***	(-1,60)	(4,78)*	(1,35)	(-1,64)			(p<0,01)	autocorrelation
VIF		1,0	11,5	4,4	13,9	1,0				absence

Source: Authors

Notes: P_t is the share price in year t; P_{t-1} is the share price in year t-1; eps_{t+1} is the company's earnings per share at the end of year t+1; r is the risk-free rate of return; z_{t+2}, z_{t+3} and z_{t+4} are the abnormal earnings values calculated according to Ohlson (2005), for years t+2, t+3 and t+4, brought to present value and adjusted to long-term growth rate, as suggested by Ohlson and Lopes (2007); l_t is the market liquidity value supplied by the Economática database; and ε_t is the regression's stochastic error term.*,**,*** significant at 1%, 5% and 10%, respectively (t-statistic in parentheses).

The AEG model was significant in 1996, 2000 and 2002. The development of the BOVESPA in this period can be measured by the increased relevance of earnings in relation to book value, and indicator that the Brazilian capital market is moving toward the model of developed markets, where the relevance of earnings is greater than or equal to book value for the market. The crisis of confidence in 2001, with a substantial depreciation of the Real, may have been one of the decisive factors causing the RIV and AEG models not to be significant this year, motivated by investors' caution in crisis periods.

High VIF (variance inflation factor) values indicate that the assumption of independence of the regression variables does not hold, i.e., multicollinearity is present. Since this involves the same variable in time, it is acceptable for the abnormal earnings growth value of one day to be affected by the abnormal earnings growth of the preceding day.

The fact that the residuals were not normally distributed in the results for 1995, 1999, 2000 and 2002 does not invalidate these results, but it does limit the conclusions from the sample studied, making any inference impossible.

Table 4. Result of the FCF Model

$$\frac{P_t}{P_{t-1}} = \phi_0 - \phi_1 \frac{D_t}{P_{t-1}} + \phi_2 \frac{c_{t+1}}{P_{t-1}} + \phi_3 \frac{c_{t+2}}{P_{t-1}} + \phi_4 \frac{c_{t+3}}{P_{t-1}} + \phi_5 \frac{c_{t+4}}{P_{t-1}} + \phi_6 l_t + \varepsilon_t \quad \textbf{(38)}$$

Years	ϕ_0	ϕ_1	ϕ_2	ϕ_3	ϕ_4	ϕ_5	ϕ_6	F	Adjust. R^2	Normality (KS)	Serial Correlation (DW)
1995	0,502 (18,69)*	-6,1E-03 (-0,92)	-6,1E-07 (-0,07)	3,0E-06 (0,48)	9,7E-06 (1,14)	-1,3E-05 (-1,48)	5,1E-02 (2,14)**	1,51	2,6%	0,085 (p=0,044)	1,73 inconclusive
VIF		2,4	10,2	11,9	42,2	43,9	1,0				
1996	1,056 (17,94)*	-6,3E-03 (-3,81)*	-3,9E-06 (-0,85)	-1,3E-05 (-1,53)	2,7E-05 (2,81)*	-8,9E-06 (-0,93)	1,6E-01 (4,97)*	1,86***	5,0%	0,138 (p<0,01)	2,09 autocorrelation absence
VIF		1,5	3,1	23,0	33,5	28,4	1,0				
1997	1,001 (17,93)*	1,8E-03 (0,91)	-1,8E-06 (-0,10)	-3,7E-07 (-0,02)	1,8E-05 (1,69)***	-1,6E-05 (-1,52)	9,3E-02 (4,04)*	1,15	1,0%	0,068 (p>0,15)	2,01 autocorrelation absence
VIF		1,1	21,4	60,2	38,8	20,2	1,0				
1998	0,772 (21,66)*	5,3E-03 (1,48)	-2,2E-05 (-1,36)	1,8E-05 (1,33)	-1,7E-07 (-0,02)	-4,1E-07 (-0,19)	-2,8E-02 (-1,77)***	0,79	0,0%	0,079 (p>0,15)	1,94 autocorrelation absence
VIF		1,1	52,5	70,9	22,2	7,0	1,0				
1999	2,373 (12,09)*	-8,0E-03 (-0,48)	9,2E-06 (0,91)	-1,1E-05 (-0,84)	6,2E-06 (0,35)	-3,6E-06 (-0,23)	1,1E-01 (1,01)	0,62	0,0%	0,134 (p<0,01)	1,79 autocorrelation absence
VIF		1,5	8,9	43,8	112,3	48,4	1,1				
2000	1,060 (21,47)*	-9,4E-03 (-3,55)*	6,3E-06 (0,76)	-5,6E-06 (-0,51)	1,8E-05 (2,31)**	-1,2E-05 (-1,70)***	-8,8E-02 (-2,22)**	1,75	3,6%	0,143 (p<0,01)	2,09 autocorrelation absence
VIF		1,2	64,1	175,5	222,4	177,7	1,5				
2001	0,956 (27,37)*	1,5E-03 (0,64)	-1,4E-06 (-0,39)	1,1E-05 (1,14)	-1,4E-05 (-1,71)***	4,8E-06 (1,19)	-4,2E-02 (-1,59)	1,15	0,9%	0,053 (p>0,15)	2,00 autocorrelation absence
VIF		1,5	11,3	61,2	56,7	34,6	1,0				
2002	1,054 (17,99)*	1,7E-02 (1,50)	3,2E-06 (0,23)	-2,5E-06 (-0,12)	4,0E-06 (0,24)	-3,5E-06 (-1,01)	-5,1E-02 (-2,35)**	0,73	0,0%	0,1 (p<0,01)	1,71 inconclusive
VIF		1,2	260,0	486,9	529,1	43,5	1,4				

Source: Authors

Notes: P_t is the share price in year t; P_{t-1} is the share price in year t-1; D_t is the company's debt in year t; c_{t+1}, c_{t+2}, c_{t+3} and c_{t+4} are the free cash flow values calculated for years t+1, t+2, t+3 and t+4, brought to present value; l_t is the market liquidity value supplied by the Economática database; and ε_t is the regression's stochastic error term.*,**,*** significant at 1%, 5% and 10%, respectively (t-statistic in parentheses).

The FCF model was significant only in 1996. The low significance of the FCF model may also be a product of the multicollinearity observed through the VIF values, which can be inflating the variance and increasing the chances of not rejecting the hypothesis that the betas are not significant. An exaggerated increase in the variance expands the non-rejection area of the test and increases the probability of a type II error (not rejecting a false null hypothesis). This means the betas can appear significant, but the inflated variance distorts the test's conclusions.

The FCF model performed the worst of the three presented in this study, illustrating the relevance of accounting information in the Brazilian market. To gain a better understanding of the relationship of the three models studied, below We compare the yearly R^2 values of each model (Figure 1):

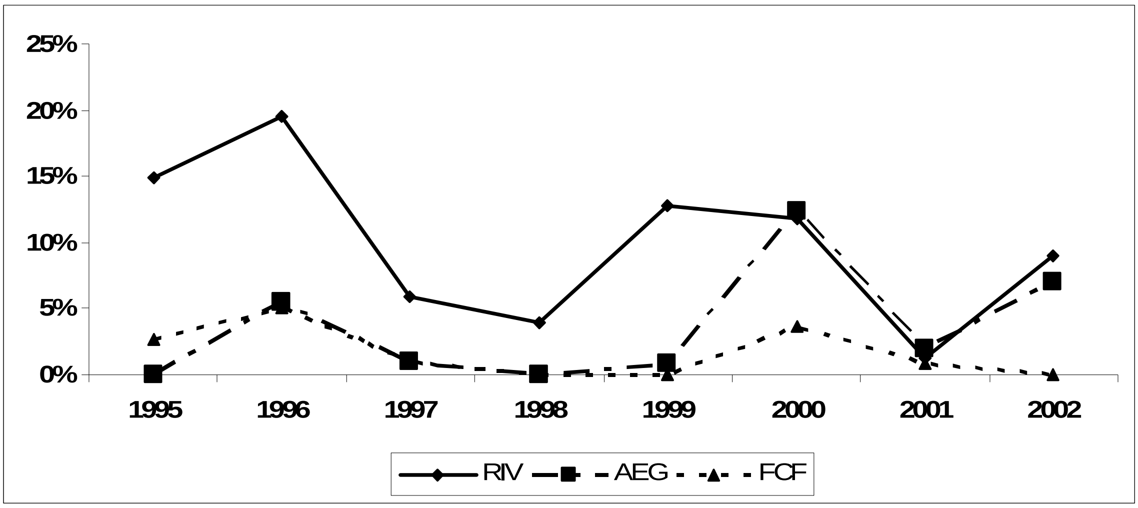


Figure 1 - Comparison of the R^2 of the RIV, AEG and FCF models.
Source: Authors

The results show that the RIV model is superior to the AEG up to 1999, after which the two models perform the same. The FCF model was not superior to the Ohlson models in any of the years studied.

Table 5 presents a comparison of the F-statistics of the models, which can help shed light on the significance of each model:

Table 5. Comparison of the values of the F-test of the regressions

Years	RIV	AEG	FCF
1995	4.37*	1.01	1.51
1996	4.92*	2.13**	1.86***
1997	1.93***	1.18	1.15
1998	1.61	0.38	0.79
1999	3.12*	1.13	0.62
2000	3.67*	4.41*	1.75
2001	1.24	1.41	1.15
2002	2.74**	2.59**	0.73

Source: Authors

In 1998, the three models were considered statistically significant, while in 2000 and 2002 only the RIV and AEG were statistically significant (Table 5). We applied Vuong's test to detect whether the difference of the R^2 obtained was significant. Table 6 shows the results of this test for the years and variables described above:

Table 6. Vuong's z-test

1996	
RIV x AEG	11.17*
RIV x FCF	11.63*
AEG x FCF	0.12
2000	
RIV x AEG	-0.03
2002	
RIV x AEG	0.48

Vuong's method is a test of the difference of R^2 based on the normal distribution. The test shows the difference between the RIV and the other two models in 1996 at 1%, so the RIV model has greater explanatory power this year. In the same year, the AEG and FCF models did not show any indications of a difference between R^2. In 2000 and 2001, no indications were found of a difference in the explanatory power of the RIV and AEG models.

An examination of Tables 4 and 5 and Graph 1 shows that the RIV model was better than the other models from 1995 to 1999. Starting in 2000, the RIV and FCF models were virtually the same, an assertion borne out by Vuong's test (Table 6). In 1998 and 2001 no model was significant.

1998 was a presidential election year in Brazil and also felt the effects of the 1997-1998 Asian crisis. These factors could have prompted investor fear, which may have caused the changes in the characteristics of the variables considered in this work, making them irrelevant to the market in this period. In 1999 only the RIV model was significant.

In 2000, the RIV and AEG models had the same R^2 (15%), which can mean there was a change in the market behavior, with an increase in the relevance of earnings. In 2001 no model was considered significant. This period saw an electricity crisis in Brazil, with rationing that cut down consumption and production. Then at the end of the year, the Real began to decline against the dollar, culminating in the maxi-depreciation in 2002.

In 2002, despite the difference in R^2 between the RIV and AEG models, this difference was not statistically significant, so the models can be said to be equivalent for this year.

5.3 Results by the panel data method

The conclusions were based on regressions that showed multicollinearity, as mentioned above. The use of the panel data technique resolves this problem, since the cause of multicollinearity is precisely the temporal correlation of the independent variables.

Table 7. Results of the models by panel data

Model	Parameters	1995 - 2006		1995 - 1999		2000 - 2002	
RIV	β_0	0,674	(4,31)*	0,536	(3,55)*	0,848	(18,79)*
AEG	α_0	0,763	(6,40)*	1,142	(10,17)*	0,876	(22,76)*
FCF	Φ_0	0,924	(11,03)*	0,969	(10,44)*	1,072	(29,79)*
RIV	β_1	0,100	(2,56)**	0,181	(5,19)*	0,620	(4,51)*
AEG	α_1	0,089	(3,26)*	0,024	(1,67)***	0,045	(5,65)*
FCF	Φ_1	-0,066	(-3,78)*	-0,054	(-3,58)*	0,017	(2,48)**
RIV	β_2	0,518	(1,74)***	-0,007	(-0,06)	0,337	(2,64)*
AEG	α_2	-0,013	(-2,53)**	-0,004	(-3,43)*	-0,004	(-3,90)*
FCF	Φ_2	-2,59E-05	(-1,25)	-3,79E-06	(-0,51)	-1,63E-06	(-1,43)
RIV	β_3	0,070	(0,33)	-0,058	(-0,42)	0,210	(2,31)**
AEG	α_3	-0,007	(-1,09)	0,001	(0,19)	0,003	(1,42)
FCF	Φ_3	-2,29E-06	(2,47)**	2,26E-05	(2,98)*	6,11E-07	(0,72)
RIV	β_4	-0,017	(-0,07)	0,118	(2,19)**	-0,055	(-1,33)
AEG	α_4	-0,013	(-5,86)*	0,001	(4,45)*	-0,004	(-3,41)*
FCF	Φ_4	-6,96E-06	(-0,58)	-2,25E-05	(-2,17)**	2,89E-06	(1,22)
RIV	β_5	0,511	(1,79)***	-0,029	(-0,38)	-0,030	(-0,80)
AEG	α_5	-0,092	(-1,33)	-0,238	(-1,73)***	-0,020	(-1,63)

FCF	Φ_5	-3,08E-06	(-1,85)***	-1,38E-06	(-0,19)	-3,06E-06	(-2,07)**
RIV	β_6	-0,035	(-0,57)	-0,160	(-1,30)	-0,019	(-1,52)
AEG							
FCF	Φ_6	0,083	(0,99)	-0,023	(-0,17)	-0,054	(-3,27)*
RIV	**F**	2,45**		6,49*		1.808,59*	
AEG		16,82*		12,26*		1.840,45*	
FCF		5,64*		8,95*		2.836,59*	
RIV	**Adjusted R^2**	16,10%		7,23%		20,17%	
AEG		15,10%		1,14%		19,58%	
FCF		2,72%		4,47%		4,93%	

Source: Authors

Analysis of the 1995 to 2002 period shows virtually the same R^2 values for the AEG and RIV models. This finding reinforces the general conclusion of this work that there are no indicators of a difference in the models. But the FCF model once again performed worse than the other two.

When separating the period into two intervals, from 1995 to 1999 and from 2000 to 2002, the lack of a statistical test, such as Vuong's, for panel date, stands out, therefore limiting the conclusions about the R^2 values found in the years from 1995 to 1999. Vuong's test is not applicable to panel data. The AEG was more significant when compared to the period from 2000 to 2002 in relation to the earlier period, illustrating the diminished importance of book value versus earnings (Table 8).

Table 8. R^2 values of the panel data

Years	RIV	AEG	FCF
1995-2002	16.10%	15.10%	2.72%
1995-1999	7.23%	1.14%	4.47%
2000-2002	20.17%	19.58%	4.93%

Source: Authors

6. CONCLUSION

This work examined the behavior of the AEG, RIV and FCF from 1995 to 2002 in Brazil.

The conclusion is that the RIV model was superior to the AEG and FCF models until 1999, illustrating the relevance of book value in Brazil in this period, resulting from the intrinsic characteristics of the Brazilian market, where accounting is highly regulated, the legal framework is defined by civil law, the capital market is concentrated and companies mainly obtain funding through bank loans.

The results show that in 2000 the market began to change, with the growth of companies traded on the BOVESPA, thus increasing the importance of earnings, making the AEG model equivalent to the RIV one. The theoretical equivalence was proved by means of the work of Ohlson and Lopes (2007) and empirically backed for in Brazil for 2000 and 2002.

The use of the panel data technique ratified the relative difference in significance of book value against earnings, that is, the AEG model increased its predictive power in relation to the RIV with the passage of time. The FCF model was inferior to the other two, despite the fact no statistical test was used to prove this difference was statistically significant between the models. However, this statistical difference was proved by Vuong's test in the yearly regressions, so the conclusions of this work still hold.

In the conclusion of the work of Lopes and Galdi (2006, p. 17), they argue that the FCF and RIV models are equivalent, when adequately used. Despite this, their work demonstrated that the estimates calculated by the two methodologies diverge.

Just as presented by Lopes and Galdi (2006), the results of this work illustrate the difference of these models in the Brazilian market. Penman (1995) commented that the operationalization of the models implies truncation of the premise of infinite values, which can lead to different estimates from models that are theoretically equivalent.

Although the books that deal with company valuation focus on the cash flow method, market analysts focus on earnings and their variations. The results of this study help shed some light on this preference of analysts.

The use of realized earnings and cash flow data as proxies for the estimated figures does not render the effort unfeasible. However, it deviates from the premise of the model to capture the market expectation by means of expected earnings and cash flow. For this reason, a suggestion for future work is to repeat this work using analysts' **projections.**

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