

AN EMPIRICAL STUDY ON THE INDEBTEDNESS OF BRAZILIAN COMPANIES*

Cláudio R. Lucinda**, Richard Saito***

Abstract

The aim of this paper is to provide insights on the determinants of the indebtedness of Brazilian companies. Initially, this paper replicates the main empirical tests on the literature. The reduced explanatory power of the results led us to propose a new methodology using the GMM method of Blundell and Bond (1998), which points out companies with higher proportions of fixed assets on total assets present higher indebtedness. Our results indicate that estimation of the equations implied by the target leverage model tends to generate seriously biased estimates if the endogeneity of the covariates is not explicitly considered in the analysis.

Keywords: Leverage, Generalized Method of Moments

* Paper based on Chapter 2 of Cláudio R. Lucinda Ph.D. thesis. The authors wish to thank all comments to previous versions of the paper.

** (Corresponding Author) Professor, São Paulo School of Business Administration and São Paulo School of Economics Address: Rua Itapeva, 474, 11º andar -01332-000. Phone: +55 (11) 3281-7765. E-mail: claudio.lucinda@fgv.br.

*** Professor, São Paulo School of Business Administration. Address: Rua Itapeva, 474, 8º andar – 01332-000. Phone: +55 (11) 3281-7899. E-mail: rsaito@fgvsp.br.

1. Introduction

The question on how Brazilian companies carry out its debt policy has interesting consequences to both the financial manager of a company as well as to the theoretical financial economist, interested on how market economies work. However, the Brazilian empirical literature on the subject is quite scarce. This paper aims to fill this gap by carrying out an econometric study evaluating the role different factors mentioned on the literature play on the leverage level of Brazilian companies.

In order to do so, this paper is composed of four parts, the first of which comprises this introduction. On the following section, a review of the international literature is presented, both regarding the Brazilian and international experiences. This survey is aimed to present the set of econometric models which could be estimated using Brazilian data. The third section carries out the econometric analysis, in which the results are presented and solutions to potential problems are presented and discussed. The fourth section concludes.

The research here presented has two main contributions to the literature; the first one being the analysis using a sample of Brazilian companies after January 1999⁴⁶, and the second one is to point out the potential biases that may arise if the endogeneity

problem in the econometric analysis is not addressed properly.

2. Review of Empirical Literature

As already stated in the beginning of the paper, the empirical literature on the subject of leverage of companies is mainly concerned with American companies. Since the eighties, some authors try to find empirical support for the claims implied by theoretical models⁴⁷. However, only after the paper of Shyam-Sunder and Myers (1994) can be discerned a trend on the literature dealing specifically with the comparison of different econometric models⁴⁸. We will start our analysis by describing in detail such models, including the actual specifications used, for they pose a starting point for the following analysis, in which they will be replicated.

In this paper of Shyam-Sunder and Myers (1994), one can find important evidences supporting the claim the *pecking order model* was more suitable to explain the observed behavior of debt patterns of American companies. This model is so called because it assumes companies start using debt only when the internal capacity of cash generation is exhausted. An analysis using Brazilian data was carried out by Júnior and Melo (1999), being the first study on the subject. Their specification of the *pecking order model* is presented below:

⁴⁶ January 1999 marks the end of the regime of fixed exchange rate in Brazil. In a few months, the exchange rate devaluated more than 20%, having significant impacts on the liability side of Brazilian companies.

⁴⁷ Rajan and Zingales (1995) do provide an interesting survey.

⁴⁸ A recent survey on the subject is Frank and Goyal (2005).

$$\Delta D_{it} = \alpha + \beta DEF_{it} + \varepsilon_{it} \quad (1)$$

$$D_{it} - D_{it-2} = \alpha + \beta(DEF_{it} + DEF_{it-1}) + \varepsilon_{it} \quad (2)$$

The “i” subscripts denote the companies used on the dataset, and the “t” subscripts denote the time periods. The variables were defined as:

- D_{it} = Long Term Debt.
- DEF_{it} = Variable constructed as a proxy for the need of external funding of companies. Constructed as follows:

$$DEF_{it} = I_{it} + DIV_{it} - A_{it}$$

In which:

- I_{it} = Investment on fixed assets. Constructed from the following variables:
 - Increase in Fixed Assets
 - Increase in Deferred Assets
- A_{it} = Level of Internally Generated Funds. Sum of the three items on the Financial Statements:
 - Net Income
 - Received Dividends
 - Transfers from Long-Term to Short-Term Assets
- DIV_{it} = Distributed Dividends

Equation (2) is only present on Júnior and Melo (1999) and intends to capture the role of unspecified adjustment costs on the debt decision. This specification follows from the reasoning companies will demand debt only if the internal demand for funds is superior to its self-financing capacity.

The estimation results can be considered as supportive to the *pecking order* hypothesis only if $\alpha=0$ and $\beta=1$ on equation (1). Furthermore, if one does find a result $\beta < 1$ on equation (2), this can be interpreted as a result in accord with the existence of adjustment costs.

For the target leverage model⁴⁹, these authors – following Shyam-Sunder and Myers (1994), they posit the following model:

$$\Delta d_{it} = \alpha + \beta(d^* - d_{it-1}) + \varepsilon_{it} \quad (3)$$

$$d_{it} - d_{it-2} = \alpha + \beta(d^* - d_{it-2}) + \varepsilon_{it} \quad (4)$$

In which the variables were defined as follows:

- d_{it} – Leverage, defined as Long-Term Debt as a percentage of total assets.
- d^* – *Target Leverage Ratio*, constructed by the authors as the time average of the d_{it} variable.

This model is based on the reasoning that companies tend to reduce its leverage in response to shocks which could put their leverage above its target level, and vice-versa. Equation (4), as equation (2) above, was presented only in Júnior and Melo (1999) paper, and was intended to capture the existence of unspecified adjustment costs on the behavior of the

leverage ratio. If the estimates of the β coefficient were statistically between zero and one on equation (4), this could be interpreted as favorable evidence on the existence of adjustment costs.

These models were subject of criticism from different fronts. First of all, Chirinko and Singha (2000) put forward a criticism on the hypothesis to be tested⁵⁰. The second line of criticism is put forward by Frank and Goyal (2003), which criticize Shyam-Sunder and Myers (1994) models by pointing out that the power of the models to explain the data diminishes when the sample is expanded to include the nineties.

These authors also propose an extension of the target leverage model, in which the target leverage is expressed not by the time average of the leverage ratio. The target leverage measure is defined as a function of other variables, intended to capture the role of moral hazard and informational asymmetries faced by the firm. Another way by which they extended the model was by allowing the adjustment velocity – expressed by the β coefficient on equation (4) – to be dependent on the same set of factors. Thus, the equation they chose to estimate was as follows:

$$\Delta d_{it} = \alpha + b_1(d^* - d_{it-1}) + \varepsilon_{it} \quad (5)$$

$$b_1 = \beta_0 + \beta_1 TANG_{it} + \beta_2 MBV_{it} + \beta_3 \ln(SALES)_{it} + \beta_4 PROFIT_{it} \quad (6)$$

$$d^* = \gamma_0 + \gamma_1 TANG_{it} + \gamma_2 MBV_{it} + \gamma_3 \ln(SALES)_{it} + \gamma_4 PROFIT_{it} \quad (7)$$

In which the variables were defined as:

- $TANG_{it}$ – Share of fixed assets on total assets
- MBV_{it} – Market to Book Value ratio
- $\ln(SALES)_{it}$ – Natural Logarithm of Sales
- $PROFIT_{it}$ – Profitability

The authors obtain estimates for the relevant coefficients by the reduced form of the system of equations (5)-(7)⁵¹. On the *pecking order* model, Frank and Goyal (2003) also present some contributions, especially as regards the definition of the internally generated funds variable. They investigate if the constraint implied by the definition of the DEF_{it} variable does not impose significant efficiency costs on the estimation of equations (1) and (2)⁵². They found the constraint to be statistically rejected. Finally, these authors also try to directly test the adequacy of both models by developing an encompassing model, concluding the target leverage model to be the most adequate given their sample.

⁵⁰ Specifically, these authors state that even if one does find a result statistically equal to $\beta=0$ and $\beta=1$, as predicted by the *pecking order* model, the company might, in fact, have been basing its behavior on the target leverage model. A similar criticism applies to the target leverage model.

⁵¹ They substituted equations (6) and (7) into equation (5) and estimated the resulting equation.

⁵² The implicit constraint is unity coefficients for the I_{it} , A_{it} , and DIV_{it} variables on the construction of the DEF_{it} variable.

⁴⁹ The target leverage model is so called because it is assumed companies have a goal on its leverage, and base their policies on adjusting the actual levels of leverage to its goal.

Finally, Lemmon and Zender (2004) start from a different point of view, by including into the definition of the DEF_{it} variable factors that might pose a limit to the self-financing capacity of the companies. They pose the following model:

$$\Delta D_{it} = \alpha + b_i DEF_{it} + \varepsilon_{it} \quad (1)$$

$$b_i = \beta_0 + \beta_1 EDEF_{it} + \beta_2 PPE_{it} + \beta_3 MBV_{it} + \beta_4 IPO_{it} \quad (6)$$

In which the variables not already defined are as follows:

- $EDEF_{it}$ – Estimated need for external financing. Defined as the moving average (3 years) of the DEF_{it} variable.
- PPE_{it} – Share of the Property, Plant & Equipment in total assets.
- IPO_{it} – Dummy variable marking the first year the company entered the authors' sample.

This approach has the advantage of robustness to the criticisms presented by Chirinko and Singha (2000), discussed above. These authors find evidence this expanded *pecking order* econometric model has support of the data.

Considering all these models, the next step was to proceed to the econometric estimation of them, using a sample of Brazilian companies. This will be carried out on the following section.

3. Estimation and Results

After presenting the literature on the econometric methodologies to be used, the aim of this section is to apply them to the Brazilian case. First of all, the sample used and the definition of variables merit some discussion. The primary source of data is the Economática system, which provides quarterly financial statement data. However, we chose to work with annual data, since some variables need to be defined from data presented on annual statements only.

The database comprises 333 companies from the period from 1995 to 2001⁵³. The descriptive statistics are presented on the Annex 1. The acronyms of the variables were intentionally kept to further stress the similarities between the following analysis and what we have seen so far. The variables were constructed as follows (see table below).

From the data presented above, we can see the average long-term debt increased from 1995 to a maximum of 38% of total assets by the year of 2000, followed by a reduction to almost half in the next year, returning to 1996 levels. The following step was to use this database to apply the models outlined previously.

⁵³ It is important to notice that not all the companies participated on every specification, since some of them did not possess enough data to carry out the transformations on the variables presented on the following analyses.

3.1. Econometric Analysis

The first step of the analysis was the replication of the analysis of Júnior and Melo (1999) for the *pecking order* model, whose estimates are presented on the columns marked (1) and (2) on the following table. The procedure followed during this section began by the estimation of the model by Ordinary Least Squares. After this estimation, the relevant diagnostic tests were carried out to check for serial correlation, groupwise heteroskedasticity, the significance of individual effects and on the modeling of these effects – fixed or random effects. Finally, the estimates obtained by the use of the most adequate estimator were presented. Such tests were especially important regarding the criticism posed by Fama and French (2002) to the studies on the literature⁵⁴. Although we chose not to follow their procedure, due to the short time dimension of the panel data we had, their criticism still stands⁵⁵.

⁵⁴ Their criticism is related to the disregard of the consequences of serial correlation, cross-sectional correlation and groupwise heteroskedasticity on the residuals. On their paper, they also present a procedure to correct these problems, which we chose to not follow. Silva and Brito (2004) try this methodology for the Brazilian case.

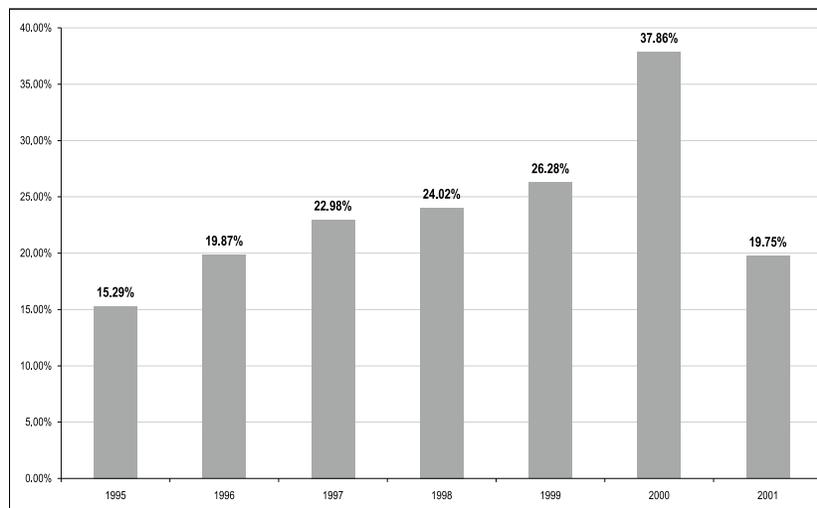
⁵⁵ On the following table are found the *p-values* for the tests mentioned. The software used was STATA, version 8.0. They are reported as:

- Fixed Effects Test: F-test with null hypothesis of non-significant individual effects.
- Het. Test: Modified Wald Test for Groupwise Heteroskedasticity. The null hypothesis for this test is equal residual variance for each cross-sectional unit.
- Autocorrelation Test: LM test for first-order serial correlation. The null hypothesis is non-existence of serial correlation.
- Hausman Test: Test for selection of modeling of individual effects. The null hypothesis is non-existence of correlation between the error term and the regressors, thus supporting the use of random effects.

Table 1. Definitions and Sources of Variables

Variable	Definition	Source
DEF _{it}	Proxy variable representing the needs for external funding of the company. Constructed as the difference between the company's investment on fixed assets and the self-financing capacity.	Original data from Economática and construction of the variable by the authors.
d _{it}	Long-Term Debt Ratio. Constructed as the ratio of Long-Term Debt and Total Assets (definition below)	Original data from Economática and construction of the variable by the authors.
d*	Proxy variable representing the Target Leverage of the company. Constructed as the average of the d _{it} variable during the period.	Original data from Economática and construction of the variable by the authors.
Assets _{it}	Total company assets in thousands of dollars (not consolidated)	Economática
TANG _{it}	Ratio Fixed Assets to Total Assets	Economática
MBV _{it}	Market to Book Value ratio	Original data from Economática and construction of the variable by the authors.
Ln(SALES) _{it}	Natural Logarithm of Sales Income in Dollars	Original data from Economática and construction of the variable by the authors.
PROFIT _{it}	Operating Profit divided by Total Assets	Original data from Economática and construction of the variable by the authors.
EDEF _{it}	Proxy for the expected need for external funding. Constructed as the average of the three leading years of the DEF variable	Original data from Economática and construction of the variable by the authors.

The following figure shows the behavior of the average leverage ratio during the sampled period.



Source: Authors' Calculations

Figure 1. Average Leverage Ratio

We can notice the coefficient values of the DEF_{it} variable do not present themselves as significant considering the robust standard errors. Even when significant, they present signs opposite to what one would expect, for instance in the case in which costs of adjustment are specifically considered. Finally, in all cases we are led to reject the hypothesis of $\alpha = 0$

and $\beta = 1$, indicating this version of the *pecking order model* does not apply to our sample. As regards the Target Leverage Model, the results are presented on the following table. The numbers on top of each column refer to the equation numbers on the previous section.

Table 2. Estimation Results – Pecking Order Model

	Models					
	1	1	1	2	2	2
	JM (1999)	Initial	Corrected	JM (1999)	Initial	Corrected
Constant	65367.00 (6.968)	25492.62 (10.190)	26981.51 (11.410)	37595.00 (1.887)	46884.13 (10.350)	51204.19 (11.090)
DEF _{it}	0.464 (7.411)	0.024 (2.420)	0.028 (1.510)			
DEF _{it} +DEF _{it-1}				0.594 (7.800)	-0.130 (-8.140)	-0.406 (-0.600)
R ²	0.217	0.003	0.204	0.278	0.030	0.477
Fixed Effects Test		0.000			0.000	
Het. Test		0.000			0.000	
Autocorr. Test		0.000			0.000	
Hausman Test		0.000			0.008	
Wald Test		0.000	0.000		0.000	0.000
Number Obs.		1440	1440		1044	1044

OBS: Asymptotic t statistics in parentheses. *Corrected* models estimated with fixed effects and Huber-White (QML) robust estimator of standard errors. Test results presented: *p-values*. Wald test line refer to the *p-value* of the test with null hypothesis $\square = 0$ and $\square = 1$.

Source: JÚNIOR e MELO (1999), marked as JM (1999) and authors' calculations.

Table 3. Estimation Results - Target Leverage Model

	Models					
	3	3	3	4	4	4
	JM (1999)	Initial	Corrected	JM (1999)	Initial	Corrected
Constant	0.744 (1.251)	0.028 (1.970)	0.032 (1.140)	0.416 (0.540)	0.027 (1.510)	0.032 (1.960)
(d*-d _{it-1})	0.395 (6.209)	0.719 (14.200)	0.743 (3.980)			
(d*-d _{it-2})				0.858 (10.359)	1.256 (20.400)	1.263 (1.490)
R ²	0.178	0.1224	0.0904	0.404	0.270	0.1797
Fixed Effects Test		1.000			1.000	
Het. Test		0.000			0.000	
Autocorr. Test		0.0023			0.013	
Hausman Test		0.000			0.000	
Number Obs.		1447	1447		1122	1122

OBS: Asymptotic t statistics in parentheses. *Corrected* models estimated Ordinary Least Squares with standard errors of the coefficients corrected for Groupwise Heteroskedasticity.

Source: JÚNIOR e MELO (1999), marked as JM (1999) and authors' calculations.

From the results presented above, two conclusions present themselves. The first one refers to the fact the point estimates for the coefficients of the (d*-d_{it-1}) and (d*-d_{it-2}) variables were higher than the ones found at Júnior and Melo (1999) paper. The second point refers to the low explanatory level found on both models – columns (3) and (4) labeled “Corrected”. And finally, the point estimate of the coefficient of the (d*-d_{it-2}) variable is over unity and not significant, indicating that an extension of this model à la Frank and Goyal (2003) might be necessary. The next step on the analysis was to try to compare directly the models under consideration. In order to do that, the path chosen was to adapt one of the models to be directly comparable to the other, which entails the redefinition of the dependent variable. We chose to that by redefining the dependent variable on the *pecking order* model by

expressing its dependent variable – Long Term Debt – as a share of total assets. The results of both models are presented in the next table.

Despite the problems each of the models presented, which have already been discussed previously, there are two points to be made. The first one is that, in every specification, the hypothesis consistent with the *pecking order model* is rejected. The second one is that this model does present a lower explanatory level than the target leverage model. Even so, the evidence gathered so far has not proved to be conclusive.

Given these results, the next step was to investigate the adequacy of some of the extensions of these models to the Brazilian case. The first step was to replicate the Frank and Goyal (2003) methodology, allowing greater flexibility on the target leverage level.

Table 4. Comparison of the Models

	Modelos			
	3	“1”	4	“2”
	Corrected	Corrected	Corrected	Corrected
Constante	0.032 (1.970)	0.0431 (2.310)	0.032 (1.960)	0.064 (2.860)
(d* _{it-1})	0.743 (1.140)			
(d* _{it-2})			1.263 (1.490)	
(DEF _{it} /Ativo _{it})		0.353 (2.490)		
(DEF _{it} /Ativo _{it})+(DEF _{it-1} /Ativo _{it-1})				0.301 (2.390)
R ²	0.0904	0.0316	0.1797	0.0731
Fixed Effects Test	1.000	0.793	1.000	0.000
Het. Test	0.000	0.000	0.000	0.000
Autocorr. Test	0.0023	0.000	0.013	0.000
Hausman Test	0.000	0.052	0.000	0.084
Wald Test		0.000		0.000
Number of Observations	1447	1169	1122	796

Fonte: Authors' Calculations

OBS: Robust t statistics in parentheses. Adjustments made: column “1” – OLS with standard errors adjusted for serial correlation of first order and groupwise heteroskedasticity. Column “2” – OLS with Huber-White (QML) robust standard errors (quotes are used to emphasize the models have different dependent variables than models presented on table 2). Models 3 and 4 are the same as presented on table 3, and the adjustment made there are the same. Wald test line refer to the *p-value* of the test with null hypothesis $\square = 0$ and $\square = 1$.

Table 5. Conditional Target Leverage Model

Dependent Variable: Δd_{it}	5	6
	Corrected	Corrected
Constant	-0.031 (-2.220)	0.335 (2.090)
d_{it-1}	0.381 (3.230)	-0.573 (-4.580)
TANG _{it}		0.034 (0.440)
MBV _{it}		-0.039 (-1.910)
Ln(SALES _{it})		-0.014 (-0.920)
PROFIT _{it}		-0.536 (-2.380)
R ²	0.0397	0.0573
Fixed Effects Test	0.972	0.000
Het. Test	0.000	0.000
Autocorr. Test	0.023	0.000
Hausman Test	0.010	0.000
Number of Observations	1447	1234

OBS: Asymptotic t statistics in parentheses. Model 5 Corrected: OLS with standard errors corrected for serial correlation of first order. Model 6 corrected: OLS with Huber-White robust Standard errors (QML). The characteristics of the tests are the same of the previous tables.

The results presented above indicate we cannot reject the hypothesis of a negative coefficient of the d_{it-1} variable. This implies the leverage tend to decrease after a positive shock, which is consistent with a mean reverting leverage ratio, a weaker version of the target leverage model. Furthermore, we can notice some of the variables included indeed have a role on the target leverage ratio.

For instance, we would expect a positive effect on target leverage of the share of fixed assets on total assets, since they could be used as collateral to the debt level. However, this variable does not present itself as significant. As regards the growth opportunities for the firm, summarized by its Market-to-Book Value ratio, the negative sign is consistent with the theoretical literature, since Rajan and Zingales (1995) assert firms with greater growth opportunities do not need to resort to financing forms intensive on monitoring, such as debt. Unfortunately, this coefficient does not present itself significant at 5%, only at 10%.

Concerning the firm size, the results point to a positive, albeit non-significant, sign of the coefficient associated with the firm size (proxied by the Ln(SALES_{it}) variable). According to Rajan and Zingales (1995) a theoretical case can be built for either a positive or a negative sign for this coefficient. Our results point to a negative and non-significant sign for this coefficient, different from the results presented by Frank and Goyal (2003). Finally, the literature also points out a negative sign for the coefficient associated with the profitability, which was confirmed by our sample. In particular, the result for the coefficient of the PROFIT_{it} variable indicates that an increase of profits in one percentage point as a percentage of total assets indicate a decrease of 0.937 percentage points on the target leverage as a percentage of total assets.

Even though the results are quite consistent with the theory, the explanatory power of these models

remains quite low⁵⁶, warning us to caution on the interpretation of the results. Specifically, we should be aware of potential identification problems. Even after correcting the standard errors for making them robust to first order serial correlation and groupwise heteroskedasticity, we must be sure of the potential endogeneity problem of the variables. This is especially true if we have in mind that the Target Leverage Model, from the results presented above, could be expressed as follows:

$$\Delta d_{it} = d_{it} - d_{it-1} = f(d_{it-1}, \dots) + \varepsilon_{it}$$

$$\varepsilon_{it} = \rho \varepsilon_{it-1} + \eta_{it}$$

On this specification, the term η_{it} represents the random component of the error. These results indicate a potential correlation between the error term and the right hand variables, severely biasing the coefficients' estimates. To face this problem, the specification above allows us to employ dynamic panel data models, an exercise that will be carried out on the following section.

3.2. Estimation by the Generalized Method of Moments

The first point to be addressed on the estimation is a further explanation of the potential biases that may arise in a dynamic specification as the one discussed previously. We can classify the target leverage model as presented on table 5 as a dynamic model, in which past values of the leverage ratio were held to explain the behavior of the changes on this variable. The application of this model on a panel data sample as used throughout this paper poses a problem on the identifiability of the individual effects. If one does suppose the individual effects as random – and by definition, uncorrelated with the contemporaneous error term – we must have a correlation of the lagged dependent variable with the composite error term implied by random effects estimation. This means the estimation by Generalized Least Squares must yield biased and inconsistent parameter estimates. This problem is also present on the Ordinary Least Squares estimation without individual effects, in which we are led to expect a positive bias to the coefficient for the lagged dependent variable.

On the other hand, the modeling of individual effects as fixed effects does not yield consistent estimates either. The within transformation implied by fixed effects estimation implies we can express the lagged leverage variable as deviations from cross-sectional means, or $d_{it} - [1/(T-1)](d_{i1} + \dots + d_{it} + \dots + d_{iT})$. The same transformation also implies we can express the error term as $\varepsilon_{it} - [1/(T-1)](\varepsilon_{i2} + \dots + \varepsilon_{it} + \dots + \varepsilon_{iT})$. As a consequence, the element $[(d_{it})/(T-1)]$ on the

transformed leverage variable is correlated with the $-[(\varepsilon_{it})/(T-1)]$ element on the transformed error term. This implies an especially acute downward bias on the coefficient of the lagged dependent variable.

To deal with these problems, Instrumental Variables estimators and Generalized Method of Moments were proposed, the first one of which was proposed by Arellano and Bond (1991). These estimators use different moment conditions, selected due to the assumptions on the correlation between the composite error (individual effects and random errors) and the right hand side variables, for the equations expressed in first differences. If one does assume the right hand side variables to be endogenous in a way we do not find correlation between the right hand side variables and the future errors, the t-2 lagged variables of these variables are valid instruments for the equations in first differences for the periods $t=3, 4, \dots, T$.

However, if we do suppose the right hand side variables to be predetermined, meaning the contemporaneous and future errors are uncorrelated with the right hand side variables, we can use all the lags (from t-1 on) of these variables as instruments. Finally, if one does suppose the right hand side variables to be strictly exogenous, meaning the past, present and future errors are uncorrelated with the right hand side variables, all leads and lags of the variables could be used as instruments.

This means the number of available instruments could be quite large as the number of time periods increases and one changes the exogeneity assumption on the right-hand side variables, which could cause severe small-sample biases on the coefficients. Two problems arise from the recognition of this problem. The first one was pointed out by Blundell and Bond (1998), who stated the instruments tend to be quite poor on the first differenced equation when they present a persistent behavior. They propose an extension of the model, including not only moment conditions associated with the differenced equation, but also the equations in levels. This method was named as GMM-System, as opposed to the GMM-Difference used presented initially by Arellano and Bond (1991).

The second problem was to select which instruments are, in fact, identifying the relevant parameters. Arellano and Bond (1991) propose a Sargan Difference Test, in which the difference on the values of the criterion function could be used to test the hypothesis of the adequacy of the instruments. This test could be used both to select the exogeneity assumption on the right hand side variables, as well as the adequacy of the GMM-System or GMM-Difference.

These methods are presented for the following specification, which is an extension of the model presented on Table 5:

⁵⁶ It was also carried out an investigation on the extension of the *pecking order model* as presented by Lemmon and Zender (2002). The results were not presented because in none of the estimations the relevant coefficient presented a result compatible with the theory.

$$d_{it} = \beta_{0i} + \beta_1 MBV_{it} + \beta_2 TANG_{it} + \beta_3 Ln(SALES_{it}) + \beta_4 PROFIT_{it} + \beta_5 d_{it-1} + \varepsilon_{it} \quad (11)$$

Table 6. Estimation Results - GMM

	O.L.S.	Fixed Effects	GMM-SYS Endogenous	GMM-SYS Predetermined	GMM-SYS Exogenous	GMM-DIFF Endogenous	GMM-DIFF Predetermined	GMM-DIFF Exogenous
dit-1	0.913*** (42.714)	0.426*** (11.270)	0.848*** (8.355)	0.846*** (7.731)	0.812*** (7.268)	0.437* (2.031)	0.593* (2.220)	0.338* (2.332)
MBVit	-0.004 (-0.552)	-0.039** (-3.065)	0.004 (0.208)	-0.009 (-0.601)	-0.004 (-0.223)	0.001 (0.030)	-0.025 (-1.209)	-0.037 (-1.620)
Ln(SALESit)	-0.005* (-2.215)	-0.014 (-1.537)	-0.004 (-0.533)	-0.005 (-0.664)	-0.010 (-1.350)	-0.015 (-0.669)	-0.001 (-0.040)	-0.009 (-0.512)
TANGit	0.079*** (4.565)	0.034 (0.568)	0.237*** (3.736)	0.203* (2.459)	0.216** (3.098)	-0.041 (-0.270)	-0.006 (-0.042)	0.054 (0.516)
PROFITit	-0.600*** (-12.134)	-0.536*** (-7.640)	-0.772** (-3.160)	-0.534* (-2.465)	-0.716*** (-4.034)	-0.171 (-0.730)	-0.197 (-0.678)	-0.509 (-1.803)
Constant	0.101*** (3.964)	0.336*** (3.456)	0.034 (0.478)	0.063 (0.807)	0.129 (1.506)			
N-Obs	1234	1234	1234	1234	1234	869	869	869
Sargan_Hansen			108.192	129.115	226.207	95.723	109.377	190.965
DF-Sargan_Hansen			95	119	194	70	90	165
P-Val. S-H			0.168	0.248	0.056	0.022	0.081	0.081
P-Val. AR(1)			0.004	0.005	0.005	0.058	0.044	0.036
P-Val. AR(2)			0.565	0.651	0.587	0.904	0.959	0.987

OBS: Robust asymptotic t statistics in parentheses. Sargan-Hansen (SH) test: test for the validity of the overidentifying restrictions. P-Val. AR(1) refers to the test for serial correlation of first order with null hypothesis absence of serial correlation (p-value reported).

The Sargan Difference test indicates the set of instruments most adequate for the estimation as being the GMM-SYS combined with the assumption of predeterminedness of the right-hand side variables. As regards the estimated coefficients, one does find a positive coefficient associated with the d_{it-1} variable, which does seem to be consistent with the theory of the target leverage. As regards the speed of convergence to the target leverage and the effects on it from changes on the other variables, we could use a Wald test in order ascertain its significance. The following table presents the estimates for the effects of these variables on the target leverage, as well as the speed of convergence.

The results presented there implies significant biases on both the speed of convergence and the impacts all the determinants described previously had on the target leverage. On the GMM-System model we only find the share of fixed assets on total assets as significant and only at the 10% significant level. This result indicates that an increase of one percentage point of the share of fixed assets on total assets imply an increase of 1.32 percentage points on the leverage – expressed as a fraction of total assets.

Finally, the results for the target leverage indicate that only 15% of the deviation from the target leverage does turn itself into a change on the leverage ratio, implying a much longer time for convergence than implied by the Ordinary Least Squares and Fixed Effects estimation. This corroborates one of the most important results of this paper, the severe potential biases arising from the endogeneity of the regressors.

Table 7. Speed of Convergence and Determinants of Target Leverage

	O.L.S.	Fixed Effects	GMM-SYS Predetermined
Speed of Convergence			
b1	0.087 (0.000)	0.574 (0.000)	0.154 (0.159)
Determinants of Target Leverage			
MBVit	-0.004 (0.579)	-0.092 (0.002)	-0.011 (0.638)
Ln(SALESit)	-0.057 (0.041)	-0.024 (0.124)	-0.032 (0.433)
TANGit	0.908 (0.001)	0.059 (0.572)	1.318 (0.098)
PROFITit	-6.897 (0.000)	-0.934 (0.000)	-3.468 (0.205)

OBS: P-Values of Wald Statistics

4. Conclusion

The aim of this paper was to apply the econometric methodology in order to understand the role of several factors on the indebtedness of Brazilian companies. In order to do so, a sample comprising 333 companies from all economic sectors – except banking – on the period between 1995 and 2001.

The first step was to apply the most important econometric specifications of the literature on the subject: the target leverage model and the pecking order model (For the Brazilian case Júnior and Melo (1999) and Silva and Brito (2004) were the most important

ones. For the American case, Lemmon and Zender (2002), Shyam-Sunder and Myers (1994) and Frank and Goyal (2001) are the main references). As regards the results, none of the models does present itself as having a decidedly increased explanatory power. This point led us to consider an extension of the econometric model in which the identification assumptions of the parameters are directly considered, the Generalized Method of Moments of Arellano and Bond (1991) and Blundell and Bond (1998). The results indicate a serious bias on the coefficients estimated with traditional techniques, especially as regards the speed of adjustment. On the Fixed Effects estimation, the convergence is about 57,4% of the difference between the observed leverage and the target leverage, while on the GMM estimation this is about 15,4%. Furthermore, this value is not significant at 10%.

References

- ARELLANO, M. and BOND, S., 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Review of Economic Studies*, 58, 277-297.
- ARELLANO, M. and BOVER, O., 1995. Another Look at the Instrumental Variable Estimation of Error-Components Models. *Journal of Econometrics* 68, 29-52.
- BALTAGI, B. H., 1995. *Econometric Analysis of Panel Data*. John Wiley & Sons, Chichester.
- BASKIN, J., 1999. An Empirical Investigation of the Pecking Order Hypothesis. *Financial Management*, spring, 26-35.
- BLUNDELL, R.W. and BOND, S. R., 1998. Initial Conditions and Moment Restrictions in Dynamic Panel Data Models. *Journal of Econometrics* 87, 115-143.
- BOND, S. R., 2002. Dynamic Panel Data Models: A Guide to Micro Data Methods and Practice. *The Institute for Fiscal Studies*, CEMMAP Working Paper CWPO9/02.
- CHIRINKO, R., and SINGHA, A., 2000. Testing Static Tradeoff against Pecking Order Models of Capital Structure: A Critical Comment. *Journal of Financial Economics* 58, 412-425.
- FAMA, E. F., and FRENCH, K. R., 2002. Testing Tradeoff and Pecking Order Predictions about Dividends and Debt. *Review of Financial Studies* 15, 1-33
- FRANK, M., and GOYAL, V., 2003. Testing the Pecking Order of Capital Structure *Journal of Financial Economics*, 67, 217-248.
- FRANK, M. and GOYAL, V., 2005 Trade-off and Pecking Order Theories of Debt. *Working Paper*, University of British Columbia.
- GLEN, J. and PINTO, B., 1994. Debt or Equity? How Firms in Developing Countries Choose *IFC Discussion Paper* 22.
- GOMES, A. and PHILLIPS, G. 2004 Why do Firms Issue Private and Public Securities? *Univesrity of Pennsylvania Working Paper*.
- GREENE, W. H., 1998. *Econometric Analysis*. Prentice-Hall, Upper Saddle River, New Jersey.
- JUNIOR, W. R. and MELO, G. M., 1999. Padrão de Financiamento das Empresas Privadas no Brasil. *Texto para Discussão* 653, IPEA.
- KNEZ, P. J. and READY, M. J., 1997. On the Robustness of Size and Book-to-Market in Cross-Sectional Regressions. *Journal of Finance* 52, 1355-1382.
- LEMMON, M L. and ZENDER, J F., 2004 "Debt Capacity and Tests of Capital Structure Theories". *Working Paper*, University of Utah.
- LUCINDA, C. and SAITO, R., 2001. O Problema de informação entre credores e devedores and o papel dos bancos. In: ENCONTRO DA SOCIEDADE BRASILEIRA DE ECONOMIA INSTITUCIONAL, 2, 2001, Campinas. *Proceedings*. Campinas, Sociedade Brasileira de Economia Institucional.
- MYERS, S. C., 1984. The Capital Structure Puzzle. *The Journal of Finance* 39, 575-592.
- MYERS, S. C. and MAJLUF N., 1984. Corporate Financing Decisions when Firms Have Information that Investors do not have. *Journal of Financial Economics* 13, 187-221.
- RAJAN, R. G. and ZINGALES L., 1995. What do we know about capital structure? Some Evidence from International Data. *The Journal of Finance*, vol. 50, nº 5, 1421-1460.
- SHYAM-SUNDER, L. and MYERS, S. C., 1994. Testing Static Trade-Off Against Pecking Order Models of Capital Structure. *NBER Working Paper* N.º 4722.
- SILVA, J. C. G. and BRITO, R. D., 2004. Testando as Previsões de Trade-Off and Pecking Order sobre Dividendos and Dívida no Brasil. *Proceedings of the IV Brazilian Finance Meeting*

Annex 1. Descriptive Statistics

	d_{it}	DEF_{it}	$TANG_{it}$	MBV_{it}	$\ln(SALES_{it})$	$PROFIT_{it}$	$ASSETS_{it}$
Mean	0.2488	-28814	0.3491	0.9581	11.2170	0.0237	1222089
Median	0.1496	-2850	0.3206	0.9177	11.4381	0.0185	248449
Maximum	21.6582	1449390	1.0000	6.6064	17.1451	0.4138	85822968
Minimum	0.0000	-7271253	0.0000	-4.2058	4.1431	-1.6444	10.0000
Standard Dev.	0.6601	255439	0.2728	0.6335	2.2215	0.1023	4679376
Number of Obs.	1782	1440	1781	1481	1669	1780	1782
Companies	333	318	333	319	326	333	333