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ESCOLA DE ECONOMIA DE SÃO PAULO

NATALIA CRISTINA LOPES

SPEED OF ADJUSTMENT OF CAPITAL STRUCTURE

EMPIRICAL STUDY

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Dissertação apresentada à Escola de Economia de São Paulo da Fundação Getúlio Vargas, como requisito para obtenção de título de Mestre em Finanças e Economia de Empresas.

Campo de conhecimento: Finanças Corporativas

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RESUMO

Analisamos o impacto de características específicas da empresa, bem como os fatores econômicos sobre a velocidade de ajustamento para alcançar o ponto ótimo da dívida.

Usando métodos diferentes, encontramos velocidades de ajustamento que variam de 14,4% a 37%. Os resultados indicam que a velocidade de ajustamento é afetada por variáveis do ciclo de negócios: O termo de interação relacionado ao *term spread* revela, como esperado, um ajustamento mais rápido em *booms* do que em recessões e uma relação negativa entre o *spread* de curto prazo e velocidade de ajustamento. Mostramos também que a velocidade de ajustamento torna-se estacionária quando o aumento das de firmas com dívida zero é considerado.

Palavras-chave: finanças corporativas, estrutura de capital, velocidade de ajustamento, variáveis macroeconômicas.

ABSTRACT

We analyze the impact of firm-specific characteristics as well as economic factors on the speed of adjustment to the target debt ratio.

Using different methods, we document speeds of adjustment ranging from 14.4% to 37%. The results indicate that the speed of adjustment is affected by business-cycle variables: The interaction term related to term spread reveals, as expected, faster adjustment in booms than in recessions and a negative relationship between short term spread and adjustment speed. We also show that the speed of adjustment becomes stationary when the increasing fractions of zero-debt firms are considered.

Key-words: corporate finance, capital structure, adjustment speed, macroeconomic variables.

Summary

1. Introduction

In this study we examine the determinants of the speed of adjustment of capital structure henceforth referred as SOA). Our estimates of the speed of adjustment range from 14 to 37%,i.e. the typical firm closes 50% of the leverage gap in between 1.5 to 4.5 years. This study also analyzes the time variation of the speed of adjustment given that both the capital structure target and the SOA can vary over time. In this case, important macroeconomic variables as term spread and short term spread are shown to impact significantly on the speed of adjustment.

Since the Modigliani & Miller (1958 and 1963) theorems about Capital Structure, many other theories have been developed to prove that the capital structure is an important issue that a firm should be aware of. Modigliani & Miller proved that under certain circumstances the leverage of the firm have no effect on the market value of the firm. Some new theories have been proposed since then and have been very important on this field.

The first one is the Trade-off theory proposed by Kraus and Litzenberger (1973). Basically, it considers a tradeoff between bankruptcy and tax savings benefits. This theory added corporate income tax to the irrelevance proposition that creates a debt that can have the benefit to shield earnings from taxes.

Another theory is the Pecking Order proposed by Myers (1984) predicts that firms prefer internal to external financing and debt to equity if external financing is used.

A third theory, the market timing theory proposed by Baker e Wurgler (2002) states that firms prefer external equity when the cost of equity is low, and prefer debt otherwise. This theory contrasts with the pecking order theory, it assumes that managers are able to exploit information asymmetries to benefit existing shareholders and as in the pecking order theory, this theory does not imply reversion to an optimal debt ratio.

Assuming that there is an optimal capital structure, the determinants of the capital structure became the central focus of many academic papers. These studies have contributed to test the assumptions from the theories about the determinants of capital structure.

These three theoretical approaches currently dominate the debate on the capital structure of companies and its determinants of adjustment speed.

Given what have been said, the main objectives of this research are:

I. Use different models to determine the optimal capital structure and the speed of adjustment to the optimal structure target.

II. Test if the speed of adjustment varies over time and test what determinants affect the speed (firm-specific effects and macroeconomic effects)

We found that the speed of adjustment can vary given the different dynamic adjustment models. Using Fama-McBeth method, the speed of adjustment of the sample is 14.4%, while using fixed effects the speed of adjustment is 36.6%.When considering that the target debt ratio is bounded between 0 and 1, the TOBIT estimate of the SOA becomes 24.4%. Those different methods have different assumptions that will be more detailed on the following sections.

We also study the determinants of the speed of adjustment assuming that the capital structure target changes over time and we found that the speed of adjustment is higher when the term spread is higher and when economic prospects are good. However, when unlevered firms are taken into account, the SOA becomes time-stationary.

In the next section, we review the literature on SOA. Section 3 presents the data and methodology. In section 4, we discuss our results and section 5 presents our conclusions.

2. Literature Revision

This chapter presents the review of the literature on the subject. First, discusses capital structure, the main types of debt and historical research on this topic. This section also details the main theoretical lines that bear discussion on the speed of adjustment and its determinants that can be firm specific and also macroeconomics.

2.1 Adjustment Speed Literature

If there is an optimal capital structure as academic studies have been reaffirming (Kraus and Litzenberger (1973), Jensen & Meckling (1976), Myers (1984), Myers and Majluf (1984), Baker e Wurgler (2002), Huang and Ritter (2009), one must consider which factors determine the choice of funding mix. The possible determinants of the capital structure became the central focus of many academic papers (Baker e Wurgler (2002), Huang and Ritter (2009). These studies have contributed decisively to formulate and test theories about the determinants of capital structure, especially in markets like the US and Europe.

These three theoretical approaches such as Trade-Off, Peking Order and Market Timing Theorycurrently dominate the debate on the capital structure of companies. In order to test the assumptions from the theories, several studies have been developed over the past decades, where the authors propose different methods to empirically test the speed of adjustment toward target leverage.

Fama and French (2002) use the trade off and pecking order theories to test predictions about dividend payout ratio and the interaction between the payout ratio and leverage and found that more profitable firms are less levered, firms with more investments have less market leverage and firms with more investments have lower long-term dividend payouts.

Flannery and Rangan (2006) employ a more general model of firm leverage that indicates that firms do have target capital structures. In their study, the typical firms closes about one-third of the gap between its actual and its target debt ratios each year.

Drobetz and Wanzenried (2006) consider a dynamic adjustment model to investigate the determinants of a time varying target capital structure. They analyze the impact of firm-specific characteristics as well as macroeconomic factors on the speed of adjustment to target debt ratio.

Huang and Ritter (2009) also contemplate the two-step approach to test the trade-off theory to estimate the speed of adjustment of U.S. firms. They found a much larger proportion of their financing deficit with external equity when the cost of equity capital is low. Their estimates of the speed of adjustment toward target leverage are found at a moderate speed, with a half-life of 3.7 years for book leverage, even after controlling for the traditional determinants of capital structure and firm fixed effects.

Frank and Goyal (2007) substitute the target adjustment equation and then estimate the resulting structure used to test the effect of top managers on corporate financing decisions.

Oztekin and Flannery (2012) compare firm's capital structure adjustments across countries and investigates whether institutional differences help explain the variance in estimated adjustment speed.

Elsas and Florysiac (2013) propose a new unbiased estimator for adjustment speed toward target leverage in the presence of fractional dependent variables that also controls for unobservable heterogeneity and unbalanced panel date.

Although there are corporate capital structure theories explaining firms' financing decisions, not much is known about the effect of macroeconomic conditions on adjustment speed of capital structure towards target leverage.

Hackbarth et al. (2006) develop a contingent model for analyzing the impact of macroeconomic conditions on dynamic capital structure choice. Allowing for dynamic capital structure adjustments, their model predicts that firms should adjust their capital structure faster in booms than in recessions.

Cook and Tang (2010) test the relationship between macroeconomic conditions and capital structure adjustment speed using both two-stage and integrated partial adjustment dynamic capital structure models.

Drobets and Wanzenried (2006) present a simple model that endogenizes the target leverage ratio and the speed of adjustment and find relation on the determinants of the target capital structure.

3. Methodology

3.1 Model

The standard partial adjustment equation is:

$$LEV_{i,t+1} - LEV_{i,t} = \lambda(LEV^{*}_{i,t+1} - LEV_{i,t}) + \varepsilon_{i,t+1}, \quad (1)$$

where $LEV_{i,t}$ is the leverage ratio of firm i at the end of year t; $LEV^{*}_{i,t}$ is firm i´s target leverage ratio in year t; λ measures the proportional adjustment during one year.

This specification permits each firm´s optimal leverage ($LEV^{*}_{i,t}$) to vary over time and according to its characteristics. The adjustment speed (λ) permits the typical firm to move only part way to its target leverage within any given year.

To determine the target leverage (LEV^{*}) some studies use a function of firm and macroeconomic characteristics and include some firm fixed effects as equation 2 as follows:

$$LEV^{*}_{i,t+1} = \beta X_{i,t}, \quad (2)$$

where β is a coefficient vector to be estimated and $X_{i,t}$ is a vector of firm and macroeconomic characteristics related to leverage ratios.

Applying the trade-off theory, $\beta \neq 0$, it is achieved:

$$LEV_{i,t+1} = (\lambda\beta) X_{i,t} + (1-\lambda)LEV_{i,t} + \varepsilon_{i,t+1} \quad (3)$$

In other methods of debt adjustment, the target debt ratio can be included in the model as a linear function of the determining factors of capital structure.

The results were obtained through statistical techniques, whose goal was verify determinants of the capital structure target and the adjustment speed in each model.

The analysis was used through five different models: Fixed Effects, Fama Mcbeth, Fama Mcbeth Demeaned, IV Panel and Tobit model (DPF).

It is common in numerous studies to apply regression models and arrange data in cross-section or time series. These techniques tend to be more common, but when the data has dimensions cross-section and time series, the panel data analysis is the recommended even when it is unbalanced (with missing data).

The fixed effects model represents the observed quantities in terms of explanatory variables that are treated as if the quantities were non-random. If we assume fixed effects, we impose time independent effects for each entity that are possibly related to the regressors.

On Fama-Macbeth regression the parameters are estimated in two stage of cross-sectional method. Fama Mcbeth Demeaned use the mean of each parameter as a determinant factor.
The DPF estimator (dynamic panel data with a fractional dependent variable) was proposed by Elsas and Florysiac (2013) and is a doubly-censored Tobit estimator (bounded at 0 and 1), relying on a latent variable approach to account for the fractional nature of the dependent variable.

Among the models used, we focus our conclusions on the latter given the nature of our dependent variable: our debt ratio variable is limited between zero and one with a non-negligible fraction of the population standing at the zero bound.

Some recent studies adopt a two-step procedure in which an equation for the target is estimated first and the adjusted value is then substituted into the equation.

The dynamic panel model with firm fixed effects can be summarized in the following two structural equations above, assuming that the target leverage is determined by observed firm characteristics and unobserved characteristics that are captured by firm fixed effects.

Following De Miguel and Pindado (2004), Hovakimian *et al.* (2011) and Drobetz and Wanzenried (2006) the study extend the class of models that the optimal level of debt is externally determined and endogenize the speed of adjustment to the target debt ratio.

To explain the speed of adjustment, we assumed that λ_{it} varies over time and is a linear function of a constant term and predetermined explanatory variables. These predetermined variables of the speed of adjustment (Z_{it}) can be a firm-specific factor or a macroeconomic variable as shown on Equation 4 below

$$\lambda_{it} = \beta_0 + \beta_1 Z_{it} \quad (4)$$

When using firm-specific variables to explain the speed of adjustment, Z_{it} has a time series and a cross-sectional dimension. In the case of macroeconomic variables, Z_{it} is not firm specific.

Rearranging the target adjustment model in Equation 1, treating target leverage, LEV^*_{it}, as linearly dependent from the capital structure determinants as specified in Equation 2, and substituting the linear specification for adjustment speed, δ_{it}, from Equation 4 the following expression is found for the leverage ratio at time *t*.

$$LEV_{it} = (1 - \delta_{it})LEV_{it-1} + \delta_{it}LEV^*_{it} + u_{it}$$

$$= (1 - \beta_0 - \beta_1 Z_{it})LEV_{it-1} + (\beta_0 + \beta_1 Z_{it}) \times ({}_{j=1}^{L} \alpha_j X_{it}) + u_{it} \quad (5)$$

Using different methods to estimate the target leverage we expect to see if the speed of adjustment is influenced by the factors and if it is time varying.

Some studies have proved that changes in debt have played an important role in assessing the pecking order theory. Also, it is a fact that firms frequently adjust their debt and the financing deficit plays a role in these decisions. The traditional determinants are very important to the decision of the financing deficit.

3.1. Data

3.2.1 Determinants of the Capital Structure

The sample was constructed by all firms from the North America Compustat Industrial Annual database between 1965 - 2013 with complete data for two or more consecutive years. According to previous research, it is necessary to exclude financial firms (SIC 6000-6999) and regulated utilities (SIC 4000-4999) because of their different aspect about capital structure.

The sample comprises 20,983 firms with 217,559 firm-years with an average of 10.3 years each. Annual observations are on fiscal basis (not calendar) and there are no size restrictions on the sample. All variables, except market debt ratio MDR_{it}, are winsorized at the 1^{st} and 99^{th} percentile to exclude the influence of extreme observations. Most of the variables are expressed as ratios. For the variables that are not ratios, nominal values are expressed in dollars, using the consumer price index as a deflator. Table 1 defines the variables used in the study and Table 2 shows their summary statistics.

Table 1 – Variables Definition

Variable	Definition	Source
EBIT_TA	Earnings before interest and taxes as a proportion of total assets	Compustat
MB	Market to book ratio of assets	Compustat
DEP_TA	Depreciation as a proportion of total assets	Compustat
lnTa	Log of asset size	Compustat
FA_TA	Fixed Assets Proportion (property, plant and equipments)	Compustat
RD_TA	R&D Expenses	Compustat
RD_dum	Dummy variable equal to one if firm did not report R&D expenses	Compustat
Ind_Median	Median Industry Market Debt Ratio calculated for each year based on the industry gropings in Fama and French (2002)	Compustat

Table 2 - Summary Statistics

Sample includes all Industrial Compustat firms with complete data for two or more adjacent years during 1965 – 2013. Total 20,983 firms; 217,559 firm years. All variables are winsorized at the 1st and 99th percentile to avoid the influence of extreme observations.

Variable	Number of observations	Mean	Std. Dev.	Min	Max
MDR	217,558	0.2470	0.2499	0.0000	1.0000
EBIT_TA	217,558	-0.0225	0.5883	-4.6455	0.4381
MB	217,558	2.2914	4.6108	0.2499	39.4755
DEP_TA	217,558	0.0474	0.0422	0.0000	0.2832
lnTA	217,558	17.8372	2.4626	11.4348	23.9312
FA_TA	217,558	0.3119	0.2425	0.0000	0.9389
RD_TA	217,558	0.0462	0.1183	0.0000	0.8261
RD_dum	217,558	0.4772	0.4995	0.0000	1.0000
Ind_Median	217,558	0.1975	0.1377	0.0000	0.8124

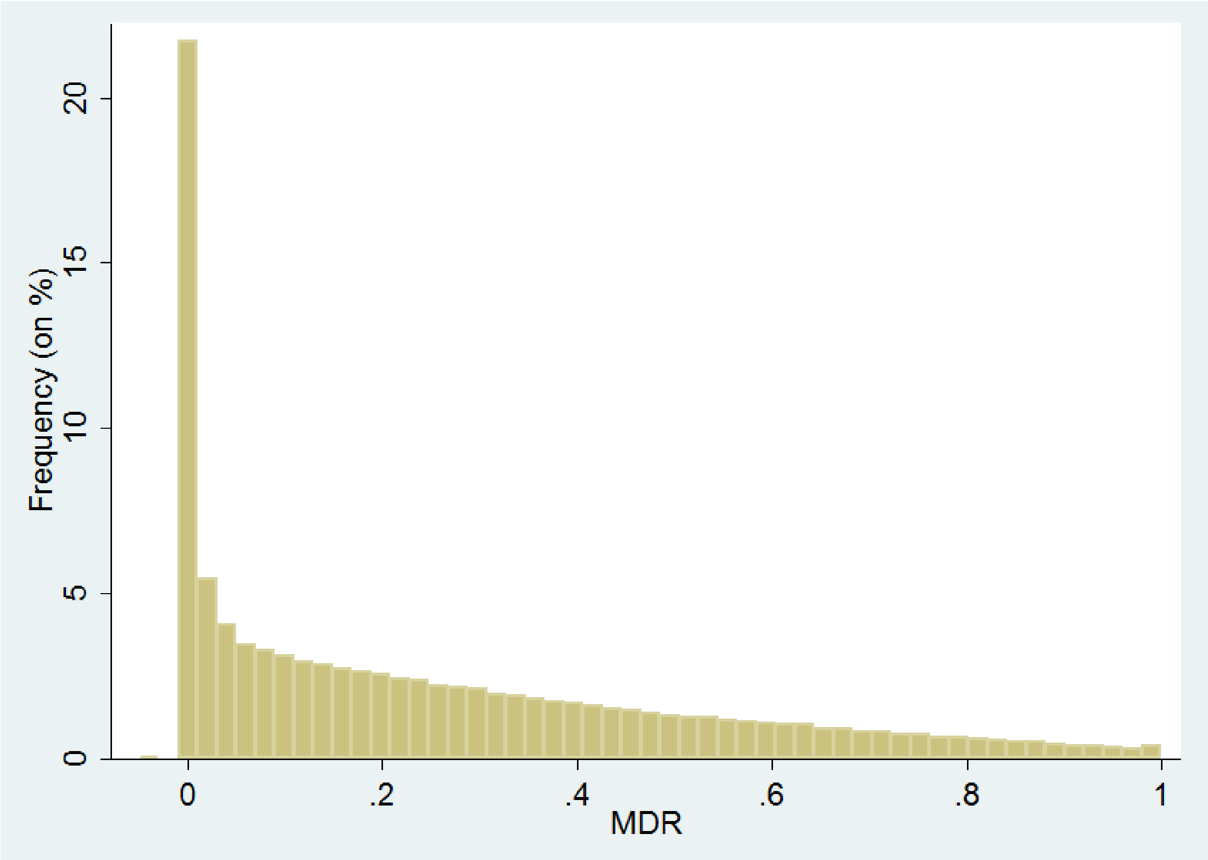
MDR: market debt ratio = book value of debt (short plus long term).

Our leverage measure is a firm´s market debt ratio

$$MDRi,t \; = \frac{Di,t}{Di,t + Si,tPi,t},$$

where $D_{i,t}$ denotes the book value of firm *i*´s interest bearing debt (long term and short term debt) at time *t*, $S_{i,t}$ equals the number of common shares outstanding at time *t*, and $P_{i,t}$ denotes the price per share at time *t*. The distribution of MDR on the database is given as follow on Chart 1:

Chart 1 - Distribution of the dependent variable



As the Chart 1 above shows, there is a concentration of firms with MDR equals to zero.

Using the existent literature to model the target debt ratio and define the set of firm characteristic ($X_{i,t}$) we have the expected effects on target debt ratio divided in four groups as follows:

Profitability

The variable related to profitability is EBIT_TA which is our measure of profitability: earnings before interest and taxes. Profitability can be positive or negative related to leverage. In the trade-off theory, the agency costs, taxes and bankruptcy make the more profitable firms to have higher leverage. The agency models of Jansen and Meckling (1976) and Jensen (1986) show that high leverage helps control agency problems forcing managers to have a strong commitment to pay creditors which suggests a positive relationship between profitability and leverage. Alternatively, the

pecking order model implies that leverage and profitability have a negative relation. Since firms prefer raising capital first from retained earnings, second from debt and third from issuing new debt, higher earnings should result in less leverage.

Market-to- Book

We relate market-to-book to the variable MB which is market to book ratio of assets: book liabilities plus market value of assets. It is generally acknowledge that cost of issuing debt and the associated agency conflicts are higher for firms with more growth opportunity. Although, the trade-off model reports that firms with more investment opportunity have less leverage. In accordance to Jensen (1986), firms with more investment opportunity have minor necessity on effective debt payment to control free cash flows. According to previous studies, another reason for the negative relation is that firms with high market to book ratio have higher costs of financial distress. Also, a higher MB can be a sign of good future growth options which tends to limit the leverage.

Tangibility

The fixed assets proportion expressed as variable FA_TA is an important determinant of leverage. Usually, firms operating more tangible assets have a higher debt capacity because creditors have an improved guarantee of payment. The trade-off theory implies a positive relation between fixed assets proportion and leverage.

The variable R&D_TA (research and development expenses ratio of total assets) is a measure of tangibility since firms with more intangible assets as R&D Expenses will prefer to have more equity instead of debt.

The variable R&D_Dum is a dummy variable for firms that have or not R&D Expenses.

Size

Log of real total assets expressed as Ln_TA variable is a measure of size. The trade-off theory predicts a positive relationship between size and leverage since the probability of bankruptcy is inverse related to size. Also, according to Jensen (1986) size has a positive relation on the supply of debt. Resuming, larger firms tend to operate with more leverage and the reasons can be that they are more transparent, have lower asset volatility or have better access to public debt markets.

Besides those four groups that constantly appear in previous studies, other important variables are also part of firm characteristics that influence the target debt ratio. DEP_TA the depreciation as a proportion of total assets have an important impact on debt ratio as firms with more depreciation expenses have less need for interest deductions provided by debt financing.

The variable Ind_Median which is the prior year´s median leverage ratio for the firm´s industry based on the 48 industry categories in Fama and French (1997) is used to control for industry characteristics not captured by other explanatory variables. Hovakmian et al. (2011) and Leary and Roberts, (2005) also use this variable as a determinant of capital structure target.

3.2.2 Determinants of the speed of adjustment

Recent studies have proposed to include in addition to the determinants of capital structure the determinants of the speed of adjustment to the capital structure target. These variables can be divided in two groups:

i) Firm-specific factors: according to Drobetz and Wanzenried (2006) the firm-specific factors that influence the capital structure target can be interpreted by the notion of weighting the costs of changing the capital structure against the costs associated with particular leverage level. It is assumed that the SOA depends on three firm-specific factors which two of them also are also determinants of the target leverage (Market-to-book and Size). The third determinant is the difference between observed leverage and the target leverage that is expressed by DIST.

ii) Macroeconomic factors: according to Hackbart *et al*. (2006) the speed of adjustment depends on the stage of the business cycle. If the economy is in a boom the speed of adjustment would be higher than if is in recession. Banerjee *et al*. (2008) include time-specific aspects to capture the impact of the economic factors on the speed of adjustment. However, it is known that these time-specific aspects are difficult to interpret. Following the paper Drobetz and Wanzenried (2006), it is assumed that the four factors influence the speed of adjustment are: the term spread (TERM), the short-

term interest (ISHORT), the default spread (DEF) and the TED spread (TED).

The macroeconomic factors are defined below:

Term Spread (TERM): measures the difference between interest rates at two different maturities. Also known as the slope for the bond yield curve, a higher value of the term spread can be interpreted as an indicator of good economic prospects. If the spread is positive, the long-term rate is higher than the short-term rate and the yield curve is said to be "normal". If the spread is negative, the yield curve is inverted. According to Hackbarth *et al*. (2005), it is expected faster adjustment in booms than in recessions, hence the coefficient on the interaction term between lagged leverage and TERM in Equation 5 should be positive.

Short Term interest rate (ISHORT): also called money market rate, short-term interest rates are rates on loan contracts-or debt instruments such as Treasury bills, bank certificates of deposit or commercial paper-having maturities of less than one year. Historically, the short-term interest rate has been highly correlated with the fed funds rate. Central banks do not control long-term interest rates. The equilibrium pricing for long-term bonds are determines by market forces (supply and demand) which set long-term interest rates. If the bond market believes that the central bank has set the fed funds rate too low, expectations of future inflation increase, which means long-term interest rates increase relative to short-term interest rates therefore the yield curve steepens. If the market believes that the central bank has set the fed funds rate too high, the opposite happens and long-term interest rates decrease relative to short-term interest rates - the yield curve flattens. In this case, it is expected a negative relationship between ISHORT and adjustment speed.

Default Spread (DEF): The default spread is usually defined as the yield or return differential between long-term BAA corporate bonds and long-term AAA or U.S. Treasury bonds with the same maturity. It is assumed that default spread is a legitimate proxy for global default risk. Supporting the prediction from Hackbarth *et al.* (2005) that the speed of adjustment is faster in good states than in bad states, where states are defined by term spread, default spread, GDP growth rate, and market

dividend yield, a negative relationship is expected between the speed of adjustment and DEF.

TED spread (TED): Is the price difference between three-month futures contracts for U.S. Treasuries and three-month contracts for Eurodollars having identical expiration months. It can be used as an indicator of credit risk because U.S. T-bills are considered risk free while the rate associated with the Eurodollar futures is thought to reflect the credit ratings of corporate borrowers. As TED increases, default risk is considered to be increasing, and investors will have a preference for safe investments. As TED decreases, the default risk is considered to be decreasing. For this determinant variable is also expected a negative relationship between the adjustment speed and TED.

4. Results

4.1 Comparison of estimation Results

In this section we report the results from Equation 3. According to recent studies such as Flannery and Rengan (2006), Huang and Ritter (2009) and Elsas and Florysiak (2013) there are no notable differences between book and market debt ratio based on adjustment speeds. Since that, all the regressions use market debt ratio.

Following this model, recent studies reached different conclusions about the speed of adjustment to its target. Fama and French (2002) estimate between 7-18% depending on dividends payouts. Other studies such as Leary and Roberts (2005) report that the speed of adjustment is faster then what Fama and French have found,between 21-24% which is around 2-3 years of half-life[1].

Table 3 presents the results of different regression methods, using estimation techniques considered appropriate by Flanery and Regan (2006), the first column presents Fama and MacBeth (1974) estimates of Equation 3. Most of the lagged variables representing the determinants of optimum debt ratio show significant coefficients and the expected sign, excepting MB which is not statistical significant.

The coefficients and the sign of the variables are in accordance with Flannery and Rengan (2006) and Elsas and Florysiack (2013). EBIT_TA shows a negative sign in accordance with pecking order model, implying that leverage and profitability have negative relation. Growth opportunities (proxied by MB) also appears with a negative sign, which can be interpreted as firms with larger expected investments have less current leverage although the variable does not appear significant to the model. Depreciation and taxes (DEP_TA) reveals a negative sign in accordance with the specification that firms with depreciation expenses have less need for the interest deductions from debt financing. Size (Ln_TA) shows a positive sign as larger firms tend to operate with more leverage. The tangibility measure (FA_TA) has a positive coefficient following the statement that firms with greater tangible assets have a

[1] Half-life is the time the process needs to close the gap between the actual debt ratio and the target by 50%. Half-life is calculated as log (0.5) / log (1 – Speed of Adjustment).

higher debt capacity. R&D expenses (R&D_TA) show negative and positive sign respectively which can be interpreted as firms with more R&D expenses will prefer to have less debt than equity. Ind_Median (firm´s lagged industry median debt ratio) appears with a positive sign that shows that industry characteristics not captured by other variables also contribute to explain the firm´s leverage.

Equation 3 shows that the speed of adjustment can be inferred by one minus the coefficient on lagged MDR. In this case is 14.4%, which means that the firms close 14.4% of the gap between current and desired leverage within one year. The associated half-life of leverage is 4.5 years for this method, meaning that the typical firm closes 50% of the leverage gap in about 4.5 years.

Column (2) presents the results of the fixed effects panel regression. The coefficients of the estimation and the signs are similar to FM, except for MB which in this case is not significant. In this method, adjustment speed is significantly faster (36.6%) implying a half-life of 18 months.

The coefficients and the signs of the variables are also in accordance with Flannery and Rengan (2006) and Elsas and Florysiack (2013), the only difference between FM method and Fixed Effects method is the R&D_dum sign that appears as negative in this case.

The addition of fixed effects could explain the faster adjustment speed in column 2, the panel regression constraint that the slope coefficients remain constant over time could also be a factor to explain a faster SOA. Trying to see the difference between these two possibilities, we use the Fama and Mac-Beth demeaned data. In this method, each variable is expressed as a deviation from that firm´s mean value.

Table 3 – Regression Results

Regression results for the model:

$$MDR_{i,t+1} = (\lambda\beta)\, X_{i,\,t} + (1-\lambda)MDR_{i,\,t} + \varepsilon_{i,t+1},$$

Where MDR is the market debt ratio. The (lagged) "X" variables determine a firm´s long-run target debt ratio and include:

EBIT_TA: earnings before interest and taxes as a proportion of total assets
MB:market-to-book ratio of firm assets
DEP_TA:depreciation expenses as a proportion of total assets
LnTA:log of total assets
FA_TA:fixed assets as a proportion of total assets
RD_TA: R&D expenses as a proportion of total assets
RD_dum:dummy variable indicating if the firm did not report R&D expenses
Ind_Median:median debt ratio of firm´s Fama and French (2002) industry classification at time t
Rated:dummy variable equal to one if the firm has a public debt rating in Compustat, zero otherwise.

T-statistics are shown in parentheses. Reported R^2 numbers for models including fixed effects are "within" R^2 statistics.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Fama/ Mac-Beth	Fixed Effects	Fama/Mac-Beth Demeaned	FE Panel with Dummy year	IV Fixed Efects Panel	"Base" Specification	DPF
MDR	0.856***	0.634***	0.646***	0.636***	0.655***	0.630***	0.756***
	(76.23)	(170.16)	(63.27)	(172.39)	(8.52)	(168.25)	(331.54)
EBIT_TA	-0.0320***	-0.0143***	-0.0244***	-0.0227***	-0.0127*	-0.0142***	-0.00693***
	(-5.23)	(-9.38)	(-3.96)	(-14.49)	(-2.20)	(-9.30)	(-6.13)
MB	-0.000648	-0.000354*	-0.00112	-0.000379**	-0.000201	-0.000331*	0.000718***
	(-1.05)	(-2.50)	(-1.88)	(-2.61)	(-0.34)	(-2.33)	(5.62)
DEP_TA	-0.107***	-0.116***	-0.191***	-0.0601***	-0.127**	-0.113***	-0.183***
	(-5.02)	(-7.05)	(-5.87)	(-3.63)	(-3.11)	(-6.90)	(-15.46)
lnAT	0.00114*	0.00865***	0.0104***	0.0194***	0.00813***	0.00878***	0.00700***
	(2.20)	(19.09)	(11.02)	(27.64)	(4.26)	(19.45)	(21.82)
FA_TA	0.0210***	0.0596***	0.0659***	0.0496***	0.0567***	0.0601***	0.0729***
	(3.62)	(13.29)	(13.00)	(11.15)	(5.00)	(13.43)	(22.69)
RD_TA	-0.0632***	-0.0173**	-0.0458**	-0.00750	-0.0149	-0.0174**	-0.000510
	(-4.16)	(-2.86)	(-3.08)	(-1.21)	(-1.48)	(-2.90)	(-0.09)
RD_dum	0.00402**	-0.00381*	0.00103	0.00149	-0.00384**	-0.00365*	-0.00408**
	(3.44)	(-2.38)	(0.74)	(0.92)	(-3.01)	(-2.28)	(-3.05)
Ind_Median	0.0722***	0.0338***	0.125***	0.0562***	0.0201	0.0324***	-0.0417***
	(8.40)	(5.97)	(7.09)	(6.93)	(0.40)	(5.72)	(-8.38)
Rated						0.0293***	0.0258***
						(15.61)	(17.28)
N	217,559	217,559	217,559	217,559	215,241	217,559	217,559

In this case, the SOA of column (3) (35.4%) is very close to fixed effects model in column (2) and the coefficients are also similar, only MB and R&D_Dum don't carry significant coefficients. All the signs of the variables are the same as FM method and the half-life implied on the demeaned FM method is 1.6 years.

In Column (4), we added year fixed effects to the fixed effects panel model which, i.e. we included a dummy variable for each year in the sample. The reason is to try to absorb any omitted time varying influence on capital structure. The results are very close to column (2), except for the variables R&D_TA and R&D_Dum that appears insignificant on the fixed effects with dummy year model. Our interpretation is that this is due to the fact that only recently Compustat has been recording R&D expenses so not every firm has this variable available for every year. For this method SOA is 36.4% and the half-life is 18 months.

Estimating the SOA in a dynamic panel requires a careful attention on correlations properties and error term. Trying to minimize this issue and the correlation between a lagged dependent variable and the error term, column (5) uses an instrument method (IV Panel), which consists on substitute a fitted value for the lagged dependent variable, using the lagged BDR (book value of leverage) and X_t as instruments following Flannery and Rengan (2006). In this case, the sign of the variables follow the same patters as FM method, except for the variable R&D_dum that have a negative coefficient. The implied SOA is 34.5%, a very similar result to columns 2-4. The reported half-life is around 1.6 years.

Column (6) presents the "base" specification for the regression. The difference from column (2) is the additional variable Rated as firm specific characteristics. Rated is a dummy variable equals to one when a firm has a public debt rating, and zero if not[2]. In this method the sign of the variables are the same as FM method, except for the variable R&D_dum that have a negative coefficient. The Rated variable has a marginally significant positive coefficient as in Faulkender and Petersen (2006) and Flanerry and Regan (2006), but its addition has no meaningful effect in the other coefficient estimates. The result of SOA in this case is a little higher - 37% with a half-

[2]Compustat does not report the variable Rated before 1981, so this variable is not computed for the other methods.

life of 1.5 years and the coefficients are very similar as the fixed effects method on column (2).

Following a recent study from Elsas and Florysiak (2013), it´s also important to pay attention to the ratio aspect of the dependent variables on the regressions. They proposed a new unbiased estimator for adjustment speed trying to minimize the problem that debt ratios are fractional – bounded between 0 and 1. The DPF estimator (*dynamic panel* data with a *fractional* dependent variable) in the presence of fractional dependent variables controls for unobserved heterogeneity and unbalanced panel data. Column (7) uses this method that consists in a doubly censored Tobit estimator (bounded at 0 and 1)[3] relying on a latent variable approach to account for the fractional nature of the dependent variable. The coefficient of the variables is very close to FM method. The implied SOA of this model is 26% which correspond to a half-life of leverage of 2.3 years.

4.2 SOA changes over time

Following the model proposed from Flannery and Rengan (2006) it is assumed that firms would always maintain their target leverage. However, due to shocks or other random changes, firms can temporarily deviate from their target of capital structure. The estimated model permits partial adjustment of the firm´s initial capital toward its target within each year.

The specification according to Flannery and Rengan (2006) implies that

(1) The firm´s actual debt ratio eventually converges to its target debt ratio, $\beta X_{i,t}$.

(2) The long-run impact of $X_{i,t}$ on the capital ratio is given by its estimated coefficient, divided by λ.

(3) All firms have the same adjustment speed (λ).

[3] The boundary values can be set to any other closed interval depending in the economic definition of the dependent variable. In this case, as Elsas and Florysiac (2013) specification of a fractional variable is used boundary between 0 and 1.

To test if the speed of adjustment changes over time we use the fixed effects and Tobit method including a dummy variable to half of the sample (from 1989 – 2013) interaction with MDR to see if there is an evidence of changes in SOA.

The results are shown on Table 4 above.

Table 4 - DPF and Fixed Effects with dummy year

	(1)	(2)
	Fixed Effects	DPF
MDR	0.675***	0.780***
	(158.98)	(284.40)
MDR*dummy	-0.0609***	-0.0384***
	(-15.58)	(-15.85)
N	217,559	217,559

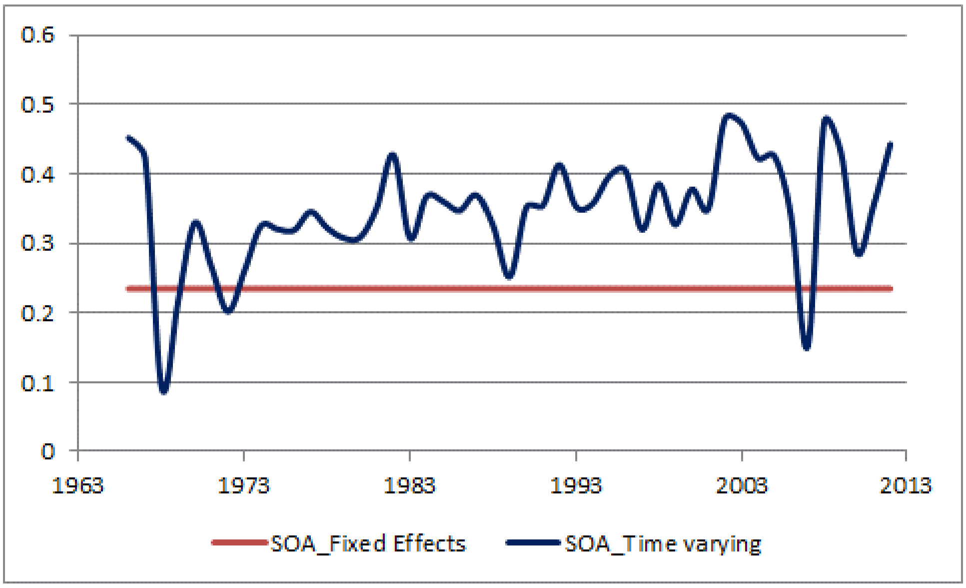
The results are similar on both methods. As we can see on table 4, the SOA for the whole period is 35.5% for the fixed effects method (half-life of 1.8 years) and for the DPF method SOA is 22% (2.8 years of half-life). Including the dummy variable, we can infer that the speed of adjustment is greater on both cases as we add the coefficient of MDR*dummy to the coefficient of MDR. For fixed effects SOA is 38.6% and half-life of 1.4 years and for DPF method SOA is 25.8% with a half-life of 2.3 years.

These results show that the speed of adjustment changes over time since the coefficient is different when the dummy variable is included.

Another way to analyze the speed of adjustment over time is calculating the speed of adjustment for each year using a dummy variable on the regression.

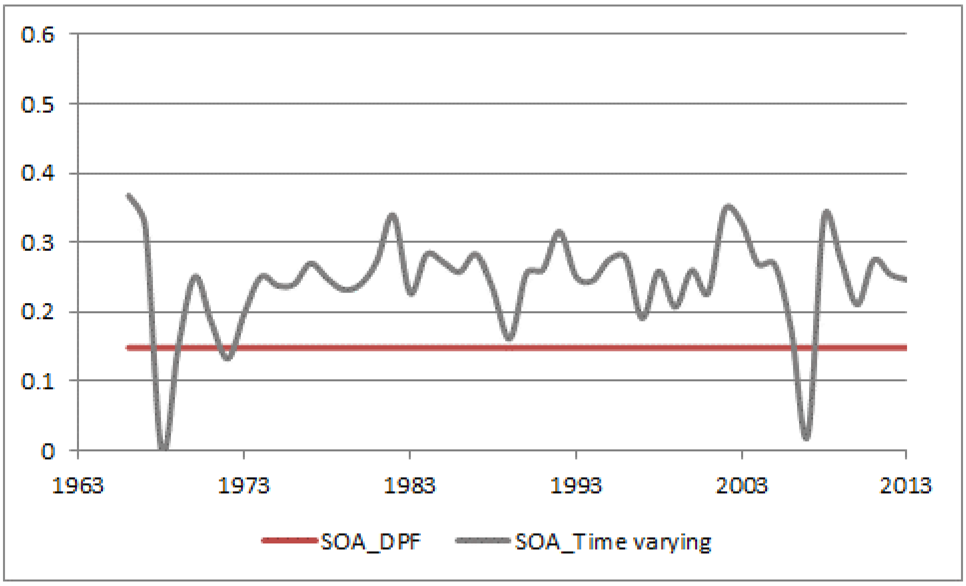
We use two methods to compare the speed of adjustment over time, the fixed effects and DPF. We calculate the speed of adjustment of each year interacting the dummy variable of each year with the measure of leverage (MDR). The charts above show the speed of adjustment of each year and a comparison with the speed of adjustment found on the basic regression (without dummy year variables).

Chart 2 – Speed of adjustment with Fixed Effects vs. Time varying



Source: author

Chart 3 - Speed of adjustment with Tobit vs. Time varying



Source: author

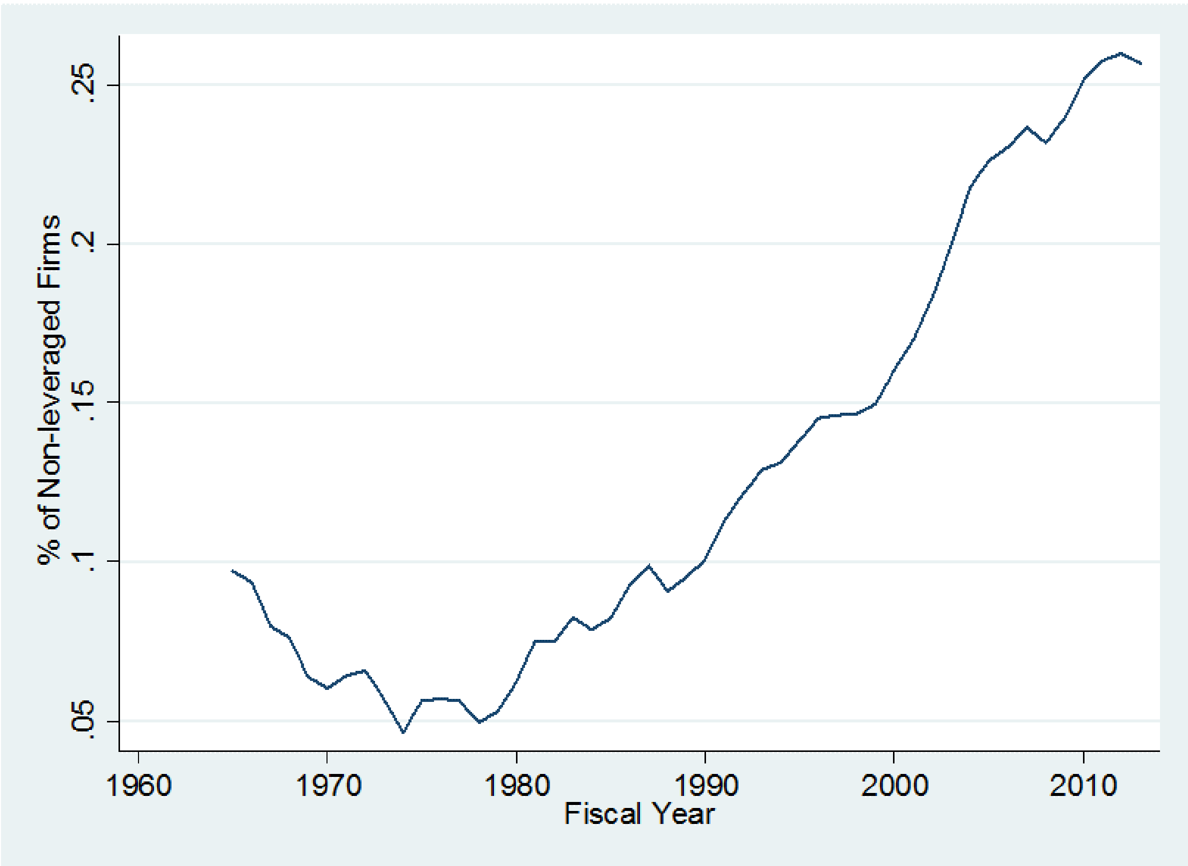
Analyzing the Charts 2 and 3, it can be inferred that on both methods the speed of adjustment varies on time, on the fixed effects method the speed of adjustment tends to be less stable comparing to the Tobit model (DPF).

On Chart 2, the Fixed Effects model shows a growth trend of the speed of adjustment over time showing that the SOA would be higher over the years. On Chart 3, this trend is not observable, the SOA_Time varying is more likely to vary around the

speed of adjustment given by the equation where it is assume that the speed of adjustment does not changes over time (SOA_DPF).

These graphics are relevant to the study as they show the importance to use the Tobit model. Chart 4 proves that the indication of a higher speed of adjustment on graphic 1 is influenced by the % of firms with no leverage. As the % of firms with no leverage is higher over the years, the fixed effects model does not capture this effect and show a higher speed of adjustment on the latest years. The Tobit model captures the effect and makes the corrections, so the results are more reliable.

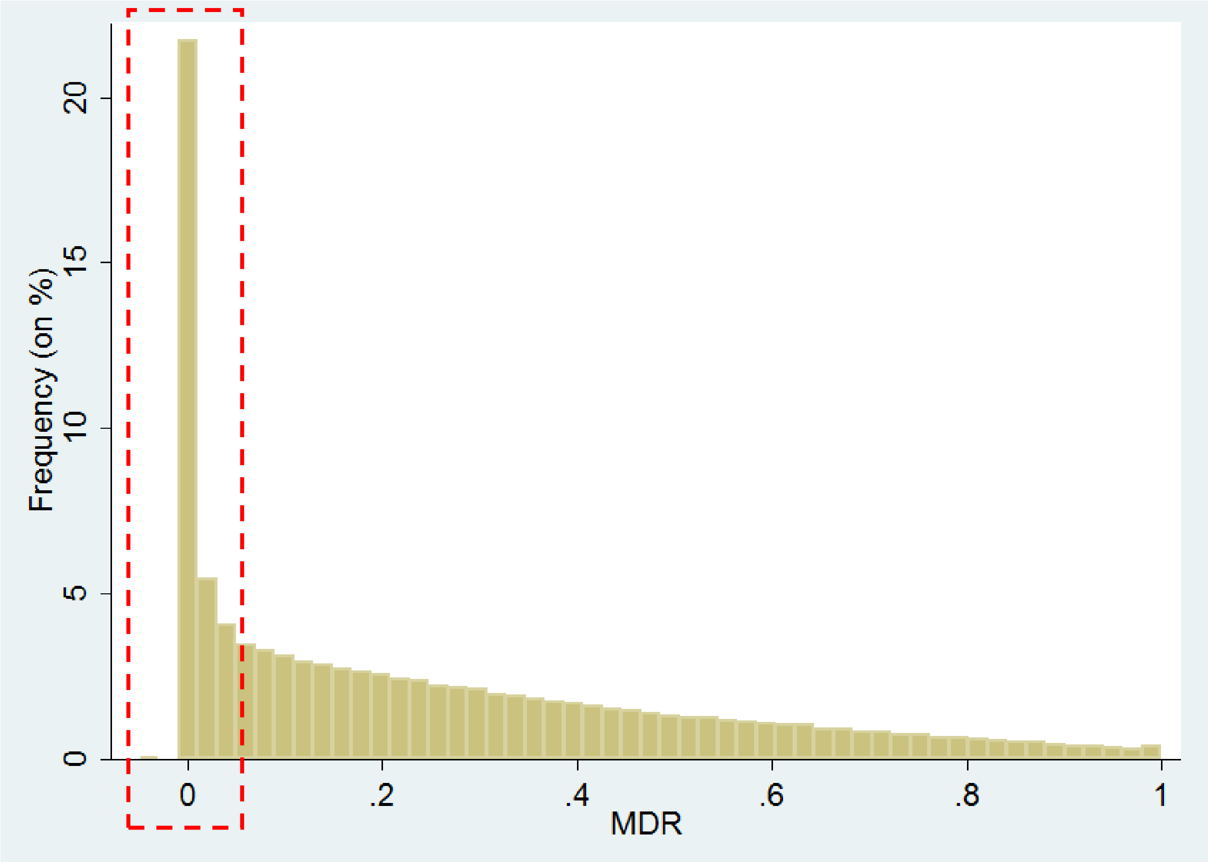
Chart 4 – Histogram of the dependent variable over the years



Source: Compustat

Chart 5 as well confirms a concentration of zeros for the dependent variable (MDR) which also prove that the Tobit model is the correct model to be used in this type of analysis.

Chart 5 - Distribution of the dependent variable – concentration of zeros



Source: Compustat

As highlighted in the Chart 5, the sample have a concentration of zeros (firms that do not have debt) and have a continuous distribution in the remaining values of the dependent variable.

4.3 Including macroeconomic variables influencing SOA (λ)

In this section is reported the dynamic panel estimation results of Equation 5, which includes the hypothesis that adjustment speed varies over time. We use two regression methods to compare and show the results. The main focus is estimating b_1, which is the coefficient on the interaction term between the lagged leverage, LEV_{it-1} and the determinant variable of adjustment speed, $Z_{it.}$ The coefficient on this interaction term, b_1, together with the coefficient on lagged debt ratio, denoted as ($1-b_0$) are reported. Equation 5 specifies a negative sign on b_1, therefore the signs of the estimated coefficients on the respective interaction terms must be interpreted on the same way.

Table 5 -Macroeconomic adjustment factors

	DPF
MDR	0.797***
	(157.91)
MDR_TERM	-0.00479***
	(-4.60)
MDR_ISHORT	0.00734***
	(13.33)
MDR_TEDspread	0.0899***
	(31.95)
MDR_DEFspread	-0.118***
	(-39.96)
N	206,876

Table 5 contains the results for the impact of the macroeconomic variables on adjustment speed.

Using the Tobit model (DPF) the results are consistent with the hypothesis considered on section 3.2 and with Drobetz and Wanzenried (2006), the coefficients on the interaction terms related to TERM and ISHORT are positive and negative, respectively.

A large term spread and a low short-term interest rate indicate that economic prospects are good, the results above confirms the prediction of Hackbarth *et al.*(2006) that in booms, the speed of adjustment is higher than in recessions.

The coefficient of the interaction term with TED spread is also consistent with the expected results as a negative relation to adjustment speed. As TED increases, default risk is considered to be increasing, as TED decreases, the default risk is considered to be decreasing.

In contrast, the only coefficient on the interaction terms that did not appear as the ex-ante intuition is the Default Spread (DEF). The positive coefficient is difficult to interpret. In accordance with Drobetz and Wanzenried (2006), an alternative hypothesis that is compatible with the results is that firms are forced to correct

deviations from the target capital structure more readily in times of high uncertainty, i.e., the cannot afford to stay off the optimum.

Folowing Korajczyk and Levy (2003) as their results differ for subsamples of financially constrained and unconstrained firms, the sensitivity of the adjustment speed to the business cycle variables should be higher for financially unconstrained firms. But, since this paperwork does not split the sample this way it is difficult to interpret the positive relation of DEF and adjustment speed.

5. Conclusion

In this study we bring an additional contribution to the subject of speed of adjustment of capital structure analyzing the determinant of the capital structure target given by different models based on the existent literature.

Many empirical evidence indicates that firms seek a target debt-equity ratio. The dependence of firm´s leverage ratios is most associate to firm-specific factors. This study also introduce the analysis of the nature of the speed of adjustment process towards the target debt ratio that shows evidence on the determinant of a time-varying adjustment speed and about the influence of macroeconomic variables on the adjustment process.

A recent estimator is used and appears to be the most consistent in the context of unbalanced dynamic panel data with a fractional dependent variable (DPF estimator).

We begin by estimating a standard partial adjustment model of leverage for North America Compustat data from 1965 to 2013. The estimated speed of adjustment was given by different methods as a percentage of 14.4% to 37% which means a half-life of 1.5 to 4.5 years.

The study also tests if the speed of adjustment changes over time using two different methods. First, including a year dummy variable interacting with the leverage variable on the regression. Second, calculating the speed of adjustment for each year using a dummy variable on the regression.

We confirm that speed of adjustment changes over time since the coefficient of the interaction is different when a dummy variable of year is included and also when comparing basic regression with the new one (including the dummy year variables).

Since the speed of adjustment is confirmed to change, the study analyzes the determinants of the speed of adjustment that influence the changes over time.

We found results consistent with the hypothesis given by recent literature that the coefficients on the interaction terms related to term spread and short-term spread are positive and negative, respectively.

This result mean that a large term spread and a low short-term interest rate indicate that economic prospects are good so the speed of adjustment is higher in booms than in recessions.

The other macroeconomic factors used on this study: ted spread and default spread are more difficult to interpret, even though the coefficient of the interaction term with TED spread was found consistent with the expected results as a negative relation to adjustment speed. In contrast, the interaction term with default Spread (DEF) did not bring the expected results.

We also found that, when the increasing proportion of unlevered firms is taken into account, the speed of adjustment fluctuates around the mean level, instead of an apparent positive trend.

6. References

BAKER, Malcolm; WURGLER, Jeffrey. Market timing and capital structure. *The journal of finance*, v. 57, n. 1, p. 1-32, 2002.

BANERJEE, Shantanu; DASGUPTA, Sudipto; KIM, Yungsan. Buyer–supplier relationships and the stakeholder theory of capital structure. *The Journal of Finance*, v. 63, n. 5, p. 2507-2552, 2008.

COOK, Douglas O.; TANG, Tian. Macroeconomic conditions and capital structure adjustment speed. *Journal of Corporate Finance*, v. 16, n. 1, p. 73-87, 2010.

DE MIGUEL, Alberto; PINDADO, Julio; DE LA TORRE, Chabela. Ownership structure and firm value: New evidence from Spain. *Strategic Management Journal*, v. 25, n. 12, p. 1199-1207, 2004.

DROBETZ, Wolfgang; WANZENRIED, Gabrielle. What determines the speed of adjustment to the target capital structure?. *Applied Financial Economics*, v. 16, n. 13, p. 941-958, 2006.

ELSAS, Ralf; FLORYSIAK, David. Dynamic capital structure adjustment and the impact of fractional dependent variables. *Journal of Financial and Quantitative Analysis (JFQA), Forthcoming*, 2013.

FAMA, Eugene F.; MACBETH, James D. Tests of the multiperiod two-parameter model. *Journal of Financial Economics*, v. 1, n. 1, p. 43-66, 1974.

FAMA, Eugene F.; FRENCH, Kenneth R. Industry costs of equity. *Journal of financial economics*, v. 43, n. 2, p. 153-193, 1997.

FAMA, Eugene F.; FRENCH, Kenneth R. Testing trade-off and pecking order predictions about dividends and debt. *Review of financial studies*, v. 15, n. 1, p. 1-33, 2002.

FAULKENDER, Michael; PETERSEN, Mitchell A. Does the source of capital affect capital structure?. *Review of Financial Studies*, v. 19, n. 1, p. 45-79, 2006.

FLANNERY, Mark J.; RANGAN, Kasturi P. Partial adjustment toward target capital structures. *Journal of Financial Economics*, v. 79, n. 3, p. 469-506, 2006.

FRANK, Murray Z.; GOYAL, Vidhan K. Corporate leverage: How much do managers really matter?. Available at SSRN 971082, 2007.

GAUD, Philippe et al. The capital structure of Swiss companies: an empirical analysis using dynamic panel data. *European Financial Management*, v. 11, n. 1, p. 51-69, 2005.

HACKBARTH, Dirk; MIAO, Jianjun; MORELLEC, Erwan. Capital structure, credit risk, and macroeconomic conditions. *Journal of Financial Economics*, v. 82, n. 3, p. 519-550, 2006.

HOVAKIMIAN, Armen; LI, Guangzhong. In search of conclusive evidence: How to test for adjustment to target capital structure. *Journal of Corporate Finance*, v. 17, n. 1, p. 33-44, 2011.

HUANG, Rongbing; RITTER, Jay R. Testing theories of capital structure and estimating the speed of adjustment. *Journal of Financial and Quantitative analysis*, v. 44, n. 02, p. 237-271, 2009.

JENSEN, Michael C. Agency cost of free cash flow, corporate finance, and takeovers. *Corporate Finance, and Takeovers. American Economic Review*, v. 76, n. 2, 1986.

JENSEN, Michael C.; MECKLING, William H. Theory of the firm: Managerial behavior, agency costs, and ownership structure. *Journal of Financial Economics*, 3, pp. 305–360, 1976

KORAJCZYK, Robert A.; LEVY, Amnon. Capital structure choice: macroeconomic conditions and financial constraints. *Journal of Financial Economics*, v. 68, n. 1, p. 75-109, 2003.

KRAUS, Alan; LITZENBERGER, Robert H. A state-preference model of optimal financial leverage. *The Journal of Finance*, v. 28, n. 4, p. 911-922, 1973.

LEARY, Mark T.; ROBERTS, Michael R. Do firms rebalance their capital structures? *The Journal of Finance*, v. 60, n. 6, p. 2575-2619, 2005.

MODIGLIANI, Franco; MILLER, Merton H. Corporate income taxes and the cost of capital: a correction. *The American economic review*, p. 433-443, 1963.

MODIGLIANI, Franco; MILLER, Merton H. The cost of capital, corporation finance and the theory of investment. *The American Economic Review*, p. 261-297, 1958.

MYERS, Stewart C. The capital structure puzzle. *The Journal of Finance*, v. 39, n. 3, p. 574-592, 1984.

MYERS, Stewart C.; MAJLUF, Nicholas S. Corporate financing and investment decisions when firms have information that investors do not have. *Journal of financial economics*, v. 13, n. 2, p. 187-221, 1984.

ÖZTEKIN, Özde; FLANNERY, Mark J. Institutional determinants of capital structure adjustment speeds. *Journal of Financial Economics*, v. 103, n. 1, p. 88-112, 2012.