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Determinants of corporate debt maturity in Latin America

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Abstract

Purpose – The purpose of this paper is to test the main theories of corporate debt maturity in a multi-country framework, in an attempt to understand country-specific constraints.

Design/methodology/approach – Dynamic panel data analysis estimated by the generalized method of moments, techniques that account properly for cross-section and time series variation allowing for dynamic effects.

Findings – There is a substantial dynamic component in the determination of a firm's maturity structure; firms face moderate adjustment costs towards its optimal maturity, and the determinants of maturity structure and their effects are similar between Latin American countries and the USA; and there is a partial empirical support for each of the theoretical hypotheses tested.

Research limitations/implications – Firm ownership, accounting standards, financial market depth, and the degree of supervision on financial reporting may vary across countries, which may affect the quality and consistency of some variables.

Practical implications – Firms face costs in adjusting the maturity of their debt, which gives such decision a long-term character, and the determinants of debt maturity do not seem very sensitive to a country's business and financial environment.

Originality/value – The paper focuses on a sample of developing countries that have so far been ignored in empirical studies, employs empirical techniques that account properly for cross-section and time series variation, and the model allows for dynamic effects that have seldom been considered in previous research.

Keywords Debts, Capital structure, Data analysis, South America

Paper type Research paper

1. Introduction

The breakthrough work of Modigliani and Miller (1958, henceforth MM) laid the basis for what is conventionally regarded as the modern corporate finance. In their influential paper and the ones that followed (Miller and Modigliani, 1961; Modigliani and Miller, 1963; Miller, 1977), these authors laid down the conditions under which the firm would be largely indifferent to the sources of its financing. In the past 50 years, several papers have explored both theoretically and empirically the implications of their famous Propositions I, II and III. Capital structure and dividend policy are perhaps the most

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studied issues in corporate finance. Much less attention however has been devoted to the maturity structure of the firm's financing.

The financial turmoil that began in mid-2007 and scaled up in late 2008 has spread worldwide. Its consequences over the credit and liquidity of firms are being felt in developed and emerging countries alike. Indeed, Campello *et al.* (2009) document that the immediate effects of the financial crises has made financially constrained firms from the USA, Europe, and Japan to burn through cash reserves, to run on their bank credit lines, cut back on capital investment, employment, research and development spending, marketing expenditures, and dividends, and to sell assets to obtain cash. Although no such survey has been published so far focusing firms in emerging markets, it is well known that they face generally harsher financial constrains than similar firms in developed markets. So, it is fair to conjecture that the dire effects of this crisis may be even more pronounced in these countries. In such context, understanding how firms manage their debt becomes thus more than an academic question to become a real-world problem for practicing managers.

This paper contributes to the existing body of knowledge in several ways. Here, I test a few theories of debt-maturity structure in a multi-country framework, in an attempt to understand country-specific differences. I focus on a sample of developing countries that have so far been ignored in empirical studies. Moreover, I do so by employing empirical techniques that account properly for cross-section and time series variation. Also, the model allows for dynamic effects that have seldom been considered in previous research. Finally, I compare my results for Latin American countries to a sample of firms from the USA.

My main findings are that there is a substantial dynamic component in the determination of a firm's maturity structure, firms face moderate adjustment costs towards its optimal maturity, and the determinants of maturity structure and their effects are similar between Latin American countries and the USA, despite obvious differences in the financial and business environments of these countries. The study also finds some empirical evidence for each theoretical hypothesis tested, although no theoretical proposition alone is able to explain the maturity decision.

The remaining of the paper is structured as follows: the next section presents the theoretical framework, while Section 3 details the methodology, presents the data sources, and describes the variables used in the empirical model. Section 4 reports and comments the estimation results. Section 5 concludes the paper.

2. Theoretical framework

A number of explanations for the maturity structure of corporate debt have been put forward. The main criticism that can be made of this body of literature is that it does not emerge from a general equilibrium theory, but as a set of partial explanations that have not been unified into one single theory. I do not intend to tackle such an ambitious task in this paper. However, in order to concisely understand the many and disperse theoretical contributions to the question of an optimal maturity, I classify the literature into four major groups: the tradeoff hypothesis, the agency hypothesis, the signaling hypothesis, and the maturity-matching hypothesis. Of course, such simplification is open to criticism, but my classification is ample enough to encompass most theoretical work done so far, yet discriminating enough to point out the fundamental differences between each group of hypotheses.

Theoretical explanations for the choice of corporate debt maturity are already implied in MM's original paper, but are eventually formalized by Stiglitz (1974). MM's paper does not consider a multi-period setting, and Stiglitz (1974) provides a rigorous analysis of the MM model in such circumstances. His conclusions are that, under a fairly general set of conditions (absence of taxation, transaction costs, bankruptcy costs, and other frictions), the maturity choice of the firm is irrelevant, just as MM's findings regarding the firm's leverage ratio under the same conditions. Of course, once one departs from the ideal world of the financial economists[1], such frictions matter, and therefore the maturity decision would influence the firm's valuation just as would the set of other financial policies. A large family of hypotheses explores the tax-based, bankruptcy costs and transaction costs approaches in order to offer an explanation for the maturity choice.

Arguments for the tradeoff hypothesis are based on the proposition that the optimal maturity of debt is determined by the tradeoff between the costs to rollover short-term debt *vis-à-vis* the usually higher interest rate bore by long-term debt. In many senses, the arguments rely on explicit transaction costs of different kinds of debt such as flotation and rollover costs as well as tax-shield benefits and implicit bankruptcy costs. The tax-based explanation suggested by Brick and Abraham Ravid (1985) and Brick and Abraham Ravid (1991) are perhaps the best known examples.

Another whole family of hypotheses derives from the asymmetric information problem formalized by Jensen and Meckling (1976) and extended by Myers (1977). In this case, the maturity structure is yet another instrument that firms can use in order to solve the agency problems faced by the various stakeholders of the firm. The agency hypothesis suggests that firms choose the optimal debt maturity in order to solve the information asymmetry that gives rise to the underinvestment (Myers, 1977; Myers and Majluf, 1984) and/or overinvestment (Jensen and Meckling, 1976; Jensen, 1986) problems. Barnea *et al.* (1980) offer an explanation for the debt-maturity choice – as well as for complex financial contracting – based on market failure in resolving agency problems costlessly.

Also within the asymmetric information mindset, the maturity structure can also be regarded as a means of overcoming the adverse selection problem (Akerlof, 1970) in terms of providing a credible signal to the market, alongside the general lines suggested by Ross (1977). The signaling hypothesis is therefore also rooted on information asymmetry arguments, but suggests that the maturity choice – as for a number of other publicly known corporate decisions – is used by managers as a way to convey information to the market thus reducing the firm's cost of capital. Within this group is situated Flannery's (1986) proposition that risky debt maturity is a valid signal if transaction costs are positive, because high-quality firms can signal their true quality.

Finally, there is the textbook rule-of-thumb that firms should match the maturity of their liabilities to the maturity of their assets. This intuitive recommendation seems to have emerged from the practitioners' experience before it had been rationalized into theory, relying mainly on liquidity risks, inefficient liquidation, and goods market cycle arguments. An argument combining the agency and signaling hypotheses can be used in order to explain why the maturity of liabilities should match the maturity of assets. Indeed, several finance textbooks allude to this rule when discussing the investment and financing decisions (Ross *et al.*, 2002; Brealey and Myers, 2003). Hart and Moore (1994) propose one explanation based on the asymmetry of information regarding the entrepreneur's true intentions. Maturity matching in this case would signal the entrepreneur's commitment to abide by his intentions. Alternatively, firms would match the maturity of their liabilities

to that of their claims in order to avoid a liquidity problem that would trigger inefficient liquidation of the firm. Excess liquidity, on the other hand, has a high opportunity cost and is also inefficient in the firm's perspective. Diamond (1991) proposes a model of maturity choice in which highly and poorly rated firms choose short-term debt while middle-rated firms choose to match the maturity of their debt to the timing of their operating cash flows. In Diamond's (1991) model, poorly rated firms have no choice other than expose themselves to premature liquidation because of moral hazard concerns from the lenders, while highly rated firms choose to borrow short-term because they expect good news to arrive and therefore obtain better long-term financing deals. The maturity-matching hypothesis is also supported by Emery's (2001) insightful paper, which argues that firms match the maturity of their assets and liabilities as a means to avoid the term premium in interest rates. His arguments are based on the demand cycle in the goods market and the reduction in the firm's long-run marginal costs achieved by optimal use of short-term debt.

The predictions of these various theories regarding the effects of each determinant of maturity structure are summarized in Table I. It is clear that discriminating amongst the hypotheses is difficult, because in many aspects they lead to the same prediction, and in many cases the hypotheses are silent about the effect of a particular variable.

Determinant factors	Theoretical hypothesis	Predicted effect on debt maturity	Empirical proxy	Formula
Leverage	Agency/ matching/ tradeoff	Negative/negative/ positive	Debt-equity ratio	Long-term debt/book equity
Asset maturity	Matching	Positive	Asset maturity ratio	(Current assets/cost of goods sold) + (net fixed assets/ depreciation)
Size	Agency/ signaling	Positive	Log of sales	Ln(sales)
Growth opportunities	Agency/ matching/ tradeoff	Negative/positive/ positive	Market-to-book ratio	(Book liabilities + market equity)/(total book assets)
Profitability	Agency/ signaling	Positive/negative	Return on Assets	Operating income/total book assets
Business risk	Agency/ tradeoff	Positive/negative	Degree of operational leverage	Sales/operating income
Dividend policy	Agency/ tradeoff	Negative/positive	Dividend yield	Dividend per share/share price
Liquidity	Signaling	Positive	Current liquidity ratio	Current assets/current liabilities
Tangibility	Tradeoff	Positive	Degree of asset immobilization	Net fixed assets/total book assets
Tax effects	Agency/ tradeoff	Positive/negative	Average effective tax rate	Taxes/taxable earnings
Industry	Control variable	Undetermined	Dummy variables	0 or 1
Country	Control variable	Undetermined	Dummy variables	0 or 1
Year	Control variable	Undetermined	Dummy variables	0 or 1

Table I.
Determinants of debt maturity, theoretical hypothesis, predicted effect, and empirical variables

Most empirical studies have concentrated on the USA. Mitchell's (1991) and Morris' (1992) pioneer studies have taken different empirical approaches to the problem. While Morris (1992) investigates the maturity structure of the firm's total indebtedness, Mitchell (1991) focuses on the maturity of single-bond issues. These are the two most common empirical approaches in the literature. The first approach is followed by Easterwood and Kadapakkam (1994), Barclay and Smith (1995, 1996), Stohs and Mauer (1996), Johnson (1997), Scherr and Hulburt (2001) and Lyandres and Zhdanov (2007). The second approach is preferred by Mitchell (1993), Guedes and Opler (1996) and Gottesman and Roberts (2004), the latter investigating the maturity of bank loans. Baker *et al.* (2003) also investigate bond issues, and in the aggregate, find evidence of market timing of bond issues.

Table II summarizes the empirical literature and their main findings. As can be seen, a great deal of conflicting evidence has been found on this issue. In general, very little support has been found for the tradeoff hypothesis. There is a considerable amount of controversy regarding the agency costs and signaling hypotheses, while convincing evidence has been found for the maturity-matching hypothesis.

Few studies investigate debt maturity in an international setting. Schiantarelli and Sembenelli (1997) investigate the maturity structure of 604 non-financial firms from the UK and 750 non-financial firms from Italy and find support for the maturity-matching hypothesis. Their results are in line with those of Ozkan (2000) who investigates the maturity issue for 429 non-financial British firms in the period 1983-1996 and Heyman *et al.* (2008) who investigate the maturity of 1,132 Belgian small firms. Antoniou *et al.* (2006) study the determinants of debt maturity for a sample of 358 French, 582 German, and 2,423 British non-financial firms and find that debt maturity depends on both firm-specific and country-specific factors, opening the question of the degree of influence of each group of factors on the maturity structure.

Larger sets of countries are studied by Demirgüç-Kunt and Maksimovic (1999) who explored the hypothesis that the financial development of a country determines the maturity of its firms' debt. The authors investigate 9,649 non-financial firms from 30 countries including developing ones in the period 1980-1991. They find support for the hypothesis that legal and institutional differences among countries explain a large part of the leverage and debt-maturity choices of firms. Fan *et al.* (2008) also study the subject for 11 industries in 39 countries in the period 1991-2006. Their results largely support Demirgüç-Kunt and Maksimovic's (1999) findings.

To the best of my knowledge, so far, the only study that focused specifically on developing countries is Erol (2004), who analyzed the strategic content of debt maturity in a sample of 15 manufacturing sectors from Turkey during the period 1990-2000. The author's findings are that long-term debt is strategic while short-term debt, despite being devoid of strategic content, is associated with financial constraint. In the next section, I describe the methods, variables, and data I employ in order to investigate the debt-maturity structure of non-financial firms in the seven biggest economies of Latin America.

3. Data, variables, and research methods

3.1 Data and variables

Accounting and stock market firm-level data are taken from the Economática Pro® database (Economática, 2003). Observations are yearly during the period 1987-2002 (subject to availability) and the unit of analysis is each firm. Countries that are the object

Table II.
Theoretical framework and previous findings in the empirical literature

Theoretical framework		Empirical studies		
Hypotheses	Main authors	Strongly supports	Moderately supports	Cannot support
Static tradeoff				
Bankruptcy costs Flotation costs Rollover costs Tax effects Transaction costs	Modigliani and Miller (1958) Brick and Abraham Ravid (1985)		Antoniou *et al.* (2006) Barclay and Smith (1995) Guedes and Opler (1996) Scherr and Hulburt (2001) Stohs and Mauer (1996)	Barclay and Smith (1996) Guedes and Opler (1996) Mitchell (1993) Ozkan (2000)
Agency costs				
Asset substitution Contracting costs Monitoring costs Overinvestment Underinvestment	Jensen and Meckling (1976) Myers (1977) Barnea *et al.* (1980)	Barclay and Smith (1995) Barclay and Smith (1996) Easterwood and Kadapakkam (1994) Guedes and Opler (1996) Lyandres and Zhdanov (2007)[a] Mitchell (1991) Mitchell (1993) Ozkan (2000)	Guedes and Opler (1996) Scherr and Hulburt (2001) Stohs and Mauer (1996)	Heyman *et al.* (2008) Lyandres and Zhdanov (2007)[b]
Signaling				
Asymmetric information Credit quality Liquidity signaling	Akerlof (1970) Diamond (1991) Flannery (1986)	Gottesman and Roberts (2004) Heyman *et al.* (2008) Mitchell (1991)	Barclay and Smith (1995) Barclay and Smith (1996) Guedes and Opler (1996) Mitchell (1993) Ozkan (2000) Stohs and Mauer (1996)	Antoniou *et al.* (2006)
Maturity matching				
Demand cycle Liquidity risk	Diamond (1991) Emery (2001)	Guedes and Opler (1996) Heyman *et al.* (2008) Morris (1992) Ozkan (2000) Scherr and Hulburt (2001) Schiantarelli and Sembenelli (1997) Stohs and Mauer (1996)		Demirgüç-Kunt and Maksimovic (1999)

Notes: [a]Underinvestment hypothesis; [b]overinvestment hypothesis

of this study are Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela (henceforth "Latin American 7" or simply "LA-7"). I also collect data of firms from the USA (henceforth simply "US"), as a benchmark. The database contains 2,486 firms in total for these eight countries (1,242 firms from Latin America and 1,244 from the US) over the period covered. In this study, I exclude all firms pertaining to the financial industry, such as "financial services and insurance" (427 firms), "holding and asset management companies" (41 firms), and "real estate" (44 firms), as well as "others" (seven firms) and "non-classified establishments" (four firms). The final sample contains 1,963 firms in total (986 firms from Latin America and 977 from the US). Industry sectors are classified based on the database documentation (22 industries) and on the North American Industry Classification System Level 1 Code (20 industries). Additional descriptive data on the firms' activities are available in the database and are used in order to re-classify the firms in the final 19 industries employed in this research whenever necessary. An overview of the number of firms available in the database by country and industry sector is shown in Table III.

From Table III it can be seen that Brazil heavily influences the sample: it has the most firms included amongst the Latin American countries and for the longest time period, responding for more than 40 percent of the Latin American sample composition. Venezuela, on the other hand, has little influence on the sample with less than 3 percent of the Latin American firms. Table III also shows that "Food and Beverages" is the predominant activity of the Latin American firms with a participation of about 11 percent. "Software" lies at the other end of the spectrum, with only two firms included. For the US, the predominant sector of activity is the "Electronic" industry, while "Agriculture" is represented by a single firm.

In this paper, I employ balance sheet data for individual firms with annual periodicity, since balance sheet information for yearly statements are usually more reliable[2]. Also, considering the long-term implications of the maturity structure choice, higher frequency data should not add much to the findings – but it might be noisier.

Accounting information in the database is available in local currency (real or nominal) and in US dollars. Since this is a cross-country study, I use figures denominated in US dollars in order to ease comparisons. In fact, such scaling is irrelevant since most variables in this study are ratios. However, a nominal variable such as firm size would be greatly misleading for comparison purposes if stated in local currency.

The dependent variable is a proxy of the maturity of debt carried by each firm, measured in two ways: long-term financial debt over short-term loans plus long-term financial debt ("Maturity Ratio 1", henceforth simply MR1), and long-term book liabilities over total book liabilities, i.e. long-term book liabilities plus current liabilities (MR2).

Strictly speaking, debt-maturity analyses should concentrate on bank loans, bonds and other sources of financial debt. However, trade financing and other short-term operational liabilities are important sources of funds in many emerging markets, which could distort the results if the analyses are limited to strictly defined debt. Hence, the use of a proxy defined in terms of total liabilities such as MR2 is appropriate.

The dilemma of employing book values versus markets values when studying debt caters for a lively discussion of its own. On one hand, book values are subject to "creative accounting" and discretionary criteria defined by regulatory authorities. On the other hand, market values are subject to distortions induced by low liquidity and concentrated trading in few participants. In this study, I choose book values instead of market values

Table III. Composition of the sample

	Country											
	Argentina	Brazil	Chile	Colombia	Mexico	Peru	Venezuela	Latin America	Latin American firms (%)	USA	All firms	All firms (%)
	Period											
Industry	1990-2002	1987-2002	1990-2002	1992-2002	1988-2002	1992-2002	1992-2002	1987-2002	1987-2002	1994-2002	1987-2002	1987-2002
Agriculture	6	1	23	3	4	10	1	48	4.9	1	49	2.5
Chemical	6	35	9	3	7	9	3	72	7.3	89	161	8.2
Construction	3	14	2	0	10	3	0	32	3.2	17	49	2.5
Electricity	7	34	23	1	0	10	2	77	7.8	37	114	5.8
Electronic	2	20	1	0	2	4	0	29	2.9	143	172	8.8
Food and beverages	6	36	17	4	23	24	2	112	11.4	32	144	7.3
Gas and oil	12	9	2	2	0	1	1	27	2.7	62	89	4.5
Machinery	1	15	0	0	3	5	0	24	2.4	33	57	2.9
Manufacturing	5	18	8	5	2	8	1	47	4.8	50	97	4.9
Mining	5	13	14	10	11	26	4	83	8.4	26	109	5.6
Pulp and paper	4	10	2	2	3	0	2	23	2.3	17	40	2.0
Retailing and wholesaling	2	16	18	3	29	2	0	70	7.1	132	202	10.3
Services	0	4	19	3	16	3	1	46	4.7	128	174	8.9
Software	1	0	0	1	0	0	0	2	0.2	77	79	4.0
Steel	6	43	7	2	10	6	5	79	8.0	19	98	5.0
Telecommunications	3	59	10	2	12	3	1	90	9.1	49	139	7.1
Textile	3	35	6	5	6	10	4	69	7.0	11	80	4.1
Transport and logistics	1	10	8	1	5	0	1	26	2.6	28	54	2.8
Vehicles and parts	3	23	0	0	2	2	0	30	3.0	26	56	2.9
All firms	76	395	169	47	145	126	28	986	100.0	977	1,963	100.0
All firms (%)	3.9	20.1	8.6	2.4	7.4	6.4	1.4	50.2		49.8	100.0	
LA-7 firms (%)	7.7	40.1	17.1	4.8	14.7	12.8	2.8	100.0				

because the reliability of market-based figures for Latin American firms, especially with respect to debt valuation, is questionable. Secondary markets in the region are thin, trade is often infrequent, and data availability is difficult. Given these shortcomings, I find book values more adequate to the purposes of this research.

Descriptive statistics for MR1 and MR2 are presented in Table IV. It is clear that maturity ratios for the US are substantially bigger than for the average Latin American firm. In turn, maturity ratios of LA-7 firms are more volatile (less so for MR2). Mexican firms present the larger maturity ratios amongst all Latin American firms. As expected, when trade finance is included in the definition of maturity, the ratios of both samples diminish, indicating a bigger dependence of short-term financing. Moreover, for MR2 ratios of LA-7 firms become closer to those of their North American peers (although still smaller).

One important aspect to be considered when investigating the debt-maturity choice of the firm is that it is usually a related decision with the capital structure (amount of debt *vis-à-vis* equity) decision. Many empirical studies overlook such aspects; thus, their results might be biased.

In order to treat this effect properly, I choose a two-stage strategy to obtain a proxy for capital structure in which in the first stage the leverage proxy is regressed against the (other) independent variables determining maturity[3] and then, in the second stage, the residuals of the first stage are introduced as regressors in the maturity equation[4]. This way, the leverage effect is taken into account in the maturity equation while not contaminating it by the capital structure decision since the leverage residuals are by construction orthogonal to the remaining independent variables[5].

Countries	Obs.	Mean	Median	SD
MR1				
Argentina	545	0.4181	0.4523	0.3288
Brazil	3,598	0.4467	0.4686	0.3100
Chile	1,536	0.5014	0.5615	0.3539
Colombia	244	0.4651	0.5067	0.3421
Mexico	1,236	0.5354	0.6159	0.3280
Peru	149	0.3967	0.4063	0.3399
Venezuela	146	0.4292	0.4717	0.3112
LA-7	7,454	0.4699	0.5059	0.3277
USA	4,599	0.7856	0.8844	0.2624
MR2				
Argentina	621	0.3374	0.3076	0.2590
Brazil	4,100	0.3786	0.3532	0.2626
Chile	1,770	0.4081	0.3910	0.2867
Colombia	283	0.3745	0.3776	0.2548
Mexico	1,411	0.4326	0.4613	0.2648
Peru	1,032	0.2789	0.2452	0.3712
Venezuela	175	0.3955	0.4040	0.2217
LA-7	9,392	0.3788	0.3609	0.2835
USA	5,028	0.5247	0.5769	0.2673

Notes: The table presents the descriptive statistics for each dependent variable in the period 1987-2002; "LA-7" refers to the pooling together of all firm-level data for Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela

Table IV.
Descriptive statistics

Firm-specific determinant factors for the debt-maturity structure are chosen from those often suggested in the extant literature. The set of firm-specific explanatory variables consists of the following: leverage, asset maturity, size, growth opportunities, profitability, dividend policy, liquidity, tangibility, tax effects, and business risk. These empirical proxies are also presented in Table I, alongside their theoretical predictions.

Firms with negative book equity are excluded from the sample, resulting in a total of 452 observations (323 observations from the LA-7 and 129 from the US). Descriptive statistics for exogenous variables are presented in two forms: in Table V variables are grouped by country while in Table VI the data are presented by variable to ease comparison[6]. Again, figures for US companies are usually bigger than for the typical Latin American firm. North American firms are more leveraged, riskier, bigger, more profitable, and they have shorter-lived assets, more growth opportunities, and pay more taxes. Latin American firms have more tangible assets and pay relatively more dividends. Firms are roughly comparable in terms of asset maturity and liquidity. Volatility of some variables is very high, especially for business risk, asset maturity, liquidity, and, for some countries, tax rate. The fact that Mexican firms present a substantially negative mean effective tax rate (− 408 percent in comparison to the median of only 24 percent) suggest the presence of large outliers that may inflate the standard deviation for this variable. In order to account for such cases, in this variable and others, in the data analyses that follows I take appropriate remedial measures.

Table VII presents the correlation matrix of independent variables. Correlations are generally low, ranging from − 0.1822 (liquidity versus tangibility) to 0.2741 (growth opportunities versus profitability) for the LA-7, and from − 0.3882 (size versus liquidity) to 0.333 (size versus dividend yield) for the US.

The quality of measurement of these variables, to what extent the data reported is accurate, is certainly an issue. Annual accounting reports are usually subject to independent auditing and, since all firms present in the sample are public, accounting reports are subject to supervision of each country's securities commission. The degree of compliance may nevertheless differ from one country to another depending on how stringent are each commission's standards and how much resolve and enforcement power the commission has. Similarly, stock market data are also dependent on each market's depth. Another possible source of measurement imprecision is the set of accounting standards adopted in each country. These issues shall be taken into account when analyzing the results.

Besides the above variables, I employ a set of dummy variables as instruments. First, the sector of activity of each firm is included, given the possible systematic effects that the nature of the firm's activities may have over its leverage, in particular the total leverage measures. The sector of activity is represented by a set of dummy variables based on the classification informed in the database. "Food and Beverages" is chosen as the base-case so that the instrument set may include an intercept. Likewise, country dummies are used to account for any country-specific variation such as the institutional framework, business environment, and macroeconomic conditions. "Brazil" is then chosen as the base-case. Finally, year dummies are employed in order to account for common time shocks to all firms. The year 2002 is chosen as the base-case.

One final remark is that, in determining debt-maturity structure, the nature of the ownership of the firm may induce systematic effects. State-owned firms, for instance, may have a lower bankruptcy probability due to implicit government guarantees – a factor that according to theory is decisive for the optimal maturity. Similarly, firms that belong

Table V.
Descriptive statistics

	Obs.	Mean	Median	SD	Obs.	Mean	Median	SD	Obs.	Mean	Median	SD
Variables		*Argentina*				*Brazil*				*Chile*		
Leverage	621	0.7965	0.1990	7.1732	4,104	1.2211	0.1620	13.6819	1,773	0.2832	0.1538	0.9845
Asset maturity	578	24.1646	17.6655	22.0867	3,059	42.6419	10.3246	1,430.8951	756	33.0753	15.7422	82.6603
Size	588	11.3737	11.5623	1.8339	3,635	11.4402	11.5013	1.8426	1,599	10.2118	10.3693	1.9252
Growth opportunities	500	0.9920	0.9177	0.4378	3,451	0.9489	0.7393	1.8685	1,330	2.2458	1.2905	8.7085
Profitability	621	0.0351	0.0268	0.0715	4,093	0.0316	0.0210	0.1201	1,779	0.0539	0.0473	0.1154
Business risk	601	0.7490	5.1550	154.7978	4,082	0.7878	4.3584	156.6401	1,654	12.6248	5.2892	124.6428
Dividend yield	597	0.0272	0.0000	0.0623	3,515	0.0551	0.0175	0.1149	1,361	0.0478	0.0314	0.1043
Liquidity	621	1.6889	1.1483	2.7276	4,093	2.3209	1.1333	20.2116	1,769	5.0118	1.4252	42.8555
Tangibility	604	0.4581	0.4508	0.2622	4,099	0.3537	0.3285	0.2565	1,743	0.4138	0.4036	0.2883
Tax rate	351	0.1370	0.0105	1.0322	4,090	0.3427	0.0267	11.1032	1,501	0.0291	0.0478	0.8786
		Colombia				*Mexico*				*Peru*		
Leverage	283	0.4484	0.1085	1.7798	1,396	0.6342	0.3478	1.2782	1,032	0.9174	0.1601	19.4520
Asset maturity	143	20.3571	6.2019	99.2809	1,282	19.9999	16.5800	17.2872	597	−0.4174	11.6497	398.9484
Size	300	11.0373	11.0497	1.5689	1,404	12.2737	12.3799	1.8025	1,023	10.1975	10.1482	1.2813
Growth opportunities	202	0.8311	0.7494	0.4341	879	1.2787	1.0921	0.6558	635	1.1095	0.8992	0.7238
Profitability	290	0.0207	0.0319	0.1300	1,411	0.0728	0.0739	0.0803	1,030	0.0565	0.0514	0.1208
Business risk	289	30.8389	7.0272	721.9443	1,411	16.3694	7.8969	191.8072	1,025	14.9237	6.8122	264.8394
Dividend yield	211	0.0349	0.0045	0.0859	881	0.0190	0.0000	0.0839	655	0.0267	0.0000	0.0479
Liquidity	284	1.6725	1.3209	1.1693	1,412	5.0568	1.4781	96.9031	1,032	1.9759	1.3498	4.1993
Tangibility	277	0.2478	0.2137	0.1891	1,412	0.5129	0.5497	0.2691	1,032	0.4783	0.4731	0.2225
Tax rate	290	0.1099	0.1487	1.5031	1,410	−4.0279	0.2361	134.0558	1,029	0.3190	0.2679	3.9418
		Venezuela				*Latin America*				*USA*		
Leverage	175	0.2757	0.1582	0.3367	9,384	0.8542	0.1796	11.2914	5,028	1.4295	0.7093	20.0382
Asset maturity	56	20.0323	13.6126	16.7686	6,471	30.7274	12.4473	991.8092	3,872	30.5036	7.8454	270.1606
Size	166	10.9196	10.9416	1.8189	8,715	11.1750	11.1845	1.9224	5,015	14.2248	14.3154	1.7925
Growth opportunities	140	0.7463	0.6920	0.3507	7,137	1.2412	0.8770	4.0221	4,879	2.7700	1.8240	3.6315
Profitability	175	0.0346	0.0133	0.0659	9,399	0.0447	0.0383	0.1120	5,027	0.0645	0.0744	0.1813
Business risk	171	2.1902	4.6788	51.4443	9,233	7.8228	5.6127	212.0266	5,027	46.4644	7.0704	2,837.0812
Dividend yield	207	0.0453	0.0124	0.1203	7,427	0.0439	0.0142	0.1019	5,956	0.0106	0.0000	0.0208
Liquidity	175	2.1203	1.4699	2.8290	9,386	3.1365	1.2848	44.0498	5,017	2.4590	1.5497	6.6818
Tangibility	175	0.5355	0.5708	0.2263	9,342	0.4097	0.4008	0.2682	5,028	0.3154	0.2495	0.2303
Tax rate	174	0.0971	0.0703	1.5772	8,845	−0.4306	0.0811	54.0800	5,027	0.3316	0.3607	2.9790

Notes: The table presents the descriptive statistics for each explanatory variable by country; the data cover the period 1987-2002; "LA-7" refers to the pooling together of all firm-level data for Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela

Table VI.
Descriptive statistics

Countries	Obs.	Mean	Median	SD	Obs.	Mean	Median	SD	Obs.	Mean	Median	SD	Obs.	Mean	Median	SD
		Leverage				*Business risk*				*Asset maturity*				*Dividend yield*		
Argentina	621	0.7965	0.1990	7.1732	601	0.7490	5.1550	154.798	578	24.1646	17.6655	22.0867	597	0.0272	0.0000	0.0623
Brazil	4,104	1.2211	0.1620	13.6819	4,082	0.7878	4.3584	156.640	3,059	42.6419	10.3246	1,430.90	3,515	0.0551	0.0175	0.1149
Chile	1,773	0.2832	0.1538	0.9845	1,654	12.6248	5.2892	124.643	756	33.0753	15.7422	82.6603	1,361	0.0478	0.0314	0.1043
Colombia	283	0.4484	0.1085	1.7798	289	30.8389	7.0272	721.944	143	20.3571	6.2019	99.2809	211	0.0349	0.0045	0.0859
Mexico	1,396	0.6342	0.3478	1.2782	1,411	16.3694	7.8969	191.807	1,282	19.9999	16.5800	17.2872	881	0.0190	0.0000	0.0839
Peru	1,032	0.9174	0.1601	19.4520	1,025	14.9237	6.8122	264.839	597	−0.4174	11.6497	398.948	655	0.0267	0.0000	0.0479
Venezuela	175	0.2757	0.1582	0.3367	171	2.1902	4.6788	51.444	56	20.0323	13.6126	16.7686	207	0.0453	0.0124	0.1203
LA-7	9,384	0.8542	0.1796	11.2914	9,233	7.8228	5.6127	212.027	6,471	30.7274	12.4473	991.809	7,427	0.0439	0.0142	0.1019
USA	5,028	1.4295	0.7093	20.0382	5,027	46.4644	7.0704	2,837.08	3,872	30.5036	7.8454	270.161	5,956	0.0106	0.0000	0.0208
		Size				*Liquidity*				*Growth opportunities*				*Tangibility*		
Argentina	588	11.3737	11.5623	1.8339	621	1.6889	1.1483	2.7276	500	0.9920	0.9177	0.4378	604	0.4581	0.4508	0.2622
Brazil	3,635	11.4402	11.5013	1.8426	4,093	2.3209	1.1333	20.2116	3,451	0.9489	0.7393	1.8685	4,099	0.3537	0.3285	0.2565
Chile	1,599	10.2118	10.3693	1.9252	1,769	5.0118	1.4252	42.8555	1,330	2.2458	1.2905	8.7085	1,743	0.4138	0.4036	0.2883
Colombia	300	11.0373	11.0497	1.5689	284	1.6725	1.3209	1.1693	202	0.8311	0.7494	0.4341	277	0.2478	0.2137	0.1891
Mexico	1,404	12.2737	12.3799	1.8025	1,412	5.0568	1.4781	96.9031	879	1.2787	1.0921	0.6558	1,412	0.5129	0.5497	0.2691
Peru	1,023	10.1975	10.1482	1.2813	1,032	1.9759	1.3498	4.1993	635	1.1095	0.8992	0.7238	1,032	0.4783	0.4731	0.2225
Venezuela	166	10.9196	10.9416	1.8189	175	2.1203	1.4699	2.8290	140	0.7463	0.6920	0.3507	175	0.5355	0.5708	0.2263
LA-7	8,715	11.1750	11.1845	1.9224	9,386	3.1365	1.2848	44.0498	7,137	1.2412	0.8770	4.0221	9,342	0.4097	0.4008	0.2682
USA	5,015	14.2248	14.3154	1.7925	5,017	2.4590	1.5497	6.6818	4,879	2.7700	1.8240	3.6315	5,028	0.3154	0.2495	0.2303
		Profitability				*Tax rate*										
Argentina	621	0.0351	0.0268	0.0715	351	0.1370	0.0105	1.0322								
Brazil	4,093	0.0316	0.0210	0.1201	4,090	0.3427	0.0267	11.1032								
Chile	1,779	0.0539	0.0473	0.1154	1,501	0.0291	0.0478	0.8786								
Colombia	290	0.0207	0.0319	0.1300	290	0.1099	0.1487	1.5031								
Mexico	1,411	0.0728	0.0739	0.0803	1,410	−4.0279	0.2361	134.056								
Peru	1,030	0.0565	0.0514	0.1208	1,029	0.3190	0.2679	3.9418								
Venezuela	175	0.0346	0.0133	0.0659	174	0.0971	0.0703	1.5772								
LA-7	9,399	0.0447	0.0383	0.1120	8,845	−0.4306	0.0811	54.0800								
USA	5,027	0.0645	0.0744	0.1813	5,027	0.3316	0.3607	2.9790								

Notes: The table presents the descriptive statistics for each country by explanatory variable in the period 1987-2002; "LA-7" refers to the pooling together of all firm-level data for Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela

Table VII.
Correlation matrices

	Leverage	Asset maturity	Size	Growth opportunities	Profitability	Business risk	Dividend yield	Liquidity	Tangibility
					Panel A – Latin America				
LA-7									
Asset maturity	−0.0002	1.0000							
Size	−0.0126	0.0110	1.0000						
Growth opportunities	0.0381	0.0548	0.2451	1.0000					
Profitability	−0.0120	0.0023	0.1881	0.2741	1.0000				
Business risk	0.0008	−0.0005	0.0109	−0.0068	0.0038	1.0000			
Dividend yield	−0.0417	−0.0044	−0.0226	−0.1324	0.0496	0.0120	1.0000		
Liquidity	−0.0283	−0.0032	−0.1199	0.0622	0.0431	0.0010	−0.0019	1.0000	
Tangibility	0.0088	−0.0128	0.2410	0.0222	0.0945	0.0004	−0.0556	−0.1822	1.0000
Tax rate	0.0021	0.0001	−0.0272	−0.0112	0.0071	−0.0032	0.0097	−0.0023	−0.0085
					Panel B – USA				
USA									
Asset maturity	0.0047	1.0000							
Size	0.0745	−0.0558	1.0000						
Growth opportunities	−0.0719	−0.0125	−0.2093	1.0000					
Profitability	−0.0180	−0.0317	0.1548	0.1256	1.0000				
Business risk	−0.0037	−0.0007	0.0009	−0.0062	−0.0076	1.0000			
Dividend yield	0.0853	−0.0243	0.3330	−0.1680	0.0521	−0.0117	1.0000		
Liquidity	−0.0528	0.2262	−0.3882	0.1715	−0.0865	−0.0124	−0.1593	1.0000	
Tangibility	0.0867	0.0184	0.1618	−0.1612	0.0787	0.0324	0.1773	−0.2329	1.0000
Tax rate	−0.0169	0.0001	0.0131	0.0034	0.0169	0.0026	−0.0185	−0.0041	−0.0127

Notes: Panel A presents the correlation matrix for firms in Latin America while Panel B presents the correlation matrix for firms in the USA; "LA-7" refers to the pooling together of all firm-level data for Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela while "USA" refers to the pooling of firm-level data for the USA; the data cover the period 1987-2002

to an industrial conglomerate or that are subsidiaries of powerful multinational corporations may face less credit constraints than independent local firms. Also, given the wide privatization process and mergers and acquisitions tide that took place in Latin America in the early 1990s, it would be important to precisely determine when the change of ownership status occurred for each firm. Despite the relevance of such aspect, the database does not provide reliable detailed information about the ownership of the firms for most of the countries and periods studied. Therefore, I opt for leaving the ownership variable out of the study[7].

3.2 Panel data analysis

Panel data analysis presents several advantages for the treatment of economic problems where cross-sectional variation and dynamic effects are relevant. Hsiao (1986) raises three advantages possessed by panel datasets: since they provide a larger number of data points, they allow increase in the degrees of freedom and reduce the collinearity among explanatory variables; they allow the investigation of problems that cannot be solely addressed by either cross-section or time series datasets; and they provide a means of reducing the missing variable problem. Baltagi (1995) adds to these the usually higher accuracy of micro-unit data respective to aggregate data and the possibility of exploring the dynamics of adjustment of a particular phenomenon over time.

Estimation of panel data models can be done by ordinary least squares (OLS) in the case of simple pooling and fixed-effects formulations and by generalized least squares (GLS) for the random-effects formulation (Hall and Cummins, 1997). However, in the presence of dynamic effects (lagged dependent variable amongst explanatory variables) OLS estimators are biased and inconsistent, and the same occurs with the GLS estimator (Baltagi, 1995). In order to overcome such problem, Anderson and Hsiao (1981) suggest a first difference transformation to the model so that all variables constant through time for each cross-section unit are wiped out, including the fixed effects intercept. The authors estimate the transformed model with an instrumental variable approach. Advancing upon such approach, Arellano and Bond (1991) suggest a two-step estimation procedure using GLS in the first step and then obtaining the optimal generalized method of moments (GMM) estimator in the second step (Hansen, 1982). Such estimation is convenient because GMM does not require any particular distribution form, solving therefore problems of heteroskedasticity, normality, simultaneity, and measurement errors (Antoniou *et al.*, 2006).

The main advantage of such method for the investigation of the problem proposed in this paper is that observations of firms from different countries can be pooled together in order to increase the degrees of freedom. Pooling together firms, on the other hand, assumes that parameters (slopes and intercepts) are constant across firms. This is, of course, a very strong assumption and subject to potential biases (Hsiao, 1986). That would be the case if the effects of a given independent variable are different for different kinds of firms, for instance small and large firms. The careful choice of firm-specific variables (such as firm size) helps control for these possible biases. Nevertheless, this remains a limitation of this research.

3.3 Empirical model

The first step is to define the following general (static) model:

$$MR_{it} = \beta_{0i} + \beta_{0t} + \sum_{k=1}^{K} \beta_{1k} Y_{ikt} + \sum_{l=1}^{L} \beta_{2l} Z_{ilt} + \upsilon_i + \varepsilon_{it} \quad (1)$$

Where MR_{it} is the stacked vector of the dependent variable (the ith-firm maturity ratio on the tth-period), Y_{ikt} is the matrix of K firm-specific independent variables (including industry dummies in the simple pooling and random-effects models), Z_{ilt} is the matrix of L country dummies (in the simple pooling and random-effects models for the LA-7), β_{0i} is the firm-specific intercept in the fixed-effects model, β_{0t} is the period-specific intercept, β_{1k} and β_{2l} are the matrices of coefficients, ν_i is the firm-specific error term in the random-effects model, and ε_{it} is a vector of error terms.

The next step is to test the model above for fixed- and random-effects[8]. Once it is established that the fixed-effects model provides a good fit for the model, then the lagged dependent variable is added to equation (1), which is then first-differenced yielding the dynamic model below:

$$\Delta MR_{it} = \beta_{0'i}\Delta MR_{it-1} + \sum_{k=1}^{K} \beta_{1k}\Delta Y_{ikt} + \varepsilon_{it} \quad (2)$$

One advantage of this specification is that the rate of adjustment of the firm towards its optimal maturity[9] can be estimated as $\lambda = (1 - \beta_{0'i})$. If adjustment costs are high, the rate of adjustment is expected to be small (λ approaching zero), while a very high rate of adjustment (λ approaching one) suggests the presence of negligible adjustment costs.

4. Empirical results

4.1 Preliminary specification tests

In order to determine which panel data model (simple pooling, fixed-effects, or random-effects) better suits the data, I perform two specification tests: the F-test of simple pooling versus fixed-effects model and the Hausman test of random versus fixed effects. The results are shown in Table VIII.

	Panel A: F-test		Panel B: Hausman test	
Region	MR1	MR2	MR1	MR2
LA-7	F(664,3346)	F(741,3855)	χ^2(16)	χ^2(11)
	4.7601**	7.6756**	40.4090**	31.6360**
p-value	0.000	0.000	0.001	0.001
USA	F(595,2683)	F(624,3024)	χ^2(10)	χ^2(10)
	6.9207**	14.1590**	33.3920**	31.6810**
p-value	0.000	0.000	0.000	0.001

Notes: Significance at: *5 and **1 percent levels; Panel A presents the F-test of a simple pooled OLS against a fixed-effects specification; this test statistic is for testing the null hypothesis that firms' intercepts in the basic fixed-effects panel data model are all equal, against the alternative hypothesis that each firm has its own (distinct) intercept; the test assumes identical slopes for all independent variables across all firms, and it is distributed $F(df_1,df_2)$; Panel B presents the Hausman specification test of random-effects against fixed-effects specification; this test statistic is for testing the null hypothesis of the random-effects specification against the alternative hypothesis of the fixed-effects specification in the basic panel data model, and it is distributed χ^2(df). "LA-7" refers to the pooling together of all firm-level data for Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela while "USA" refers to the pooling of firm-level data for the USA; the data cover the period 1987-2002; dependent variables: MR1 = long-term debt/total debt; MR2 = long-term book liabilities/total book liabilities

Table VIII.
Specification tests

The first step is to determine whether the panel data specification that simply pools together all available data for all firms and time periods is adequate to describe the data. As pointed out by Hsiao (1986), simple least squares estimation of pooled cross-section and time series data may be seriously biased[10]. The model tested in equation (1) includes firm-specific variables described above, as well as country-specific dummy variables for the LA-7. The results in Table VIII strongly reject the single intercept hypothesis, both for the LA-7 and for the US.

The next step is to determine which model of variable intercepts across firms better fits the data. Table VIII also presents the results for a Hausman specification test of random- versus fixed-effects. The test, as suggested by Hsiao (1986, p. 49), is particularly appropriate in situations where N (the number of cross-sectional units) is large relative to T (the number of time periods) – precisely the case of this study. Again, the model in equation (1) above is employed. The test strongly rejects the random-effects specification for both groups of countries.

Given these results, I conclude that the fixed-effects specification is an adequate fit to the data. Therefore, after first differencing equation (1), firm-specific intercepts disappear and the dynamic model of equation (2) is used in the estimation that follows.

4.2 Dynamic panel data estimation results

Preliminary runs of the fixed-effects model of equation (1) revealed a substantial presence of autocorrelation in the residuals. This finding raises the question that the maturity choice of the firm may be dynamic, i.e. current maturity may depend on past maturity. Antoniou *et al.* (2006) explicitly model such possibility, and suggest that a dynamic rather than static panel data analysis may be more adequate. However, as mentioned above, usual OLS and GLS estimators are biased and inconsistent when the lagged dependent variable is included in the right-hand side of the panel data model. In order to overcome this problem, GMM estimation is used instead.

Equation (2) is then estimated by GMM using as instruments first-order lagged values of the levels[11] of explanatory variables, sector dummies, country dummies (for Latin America), year dummies, and a constant[12]. In order to control for outliers, I exclude influential observations based on Cook's distance indicator. As a result, 26 observations are excluded for MR1 and 28 for MR2 in Latin America (respectively 40 and 45 in the US). The number of excluded observations is minimal given the samples size (less than 2 percent). Nevertheless, I report results with and without outliers in Tables IX and X, respectively. Standard errors are heteroskedasticity robust according to the method proposed by White (1980)[13] and are also robust to autocorrelation.

One important issue when estimating via GMM is to make sure that the instrument set is adequate. Tables IX and X report the Sargan's test statistic for the null hypothesis that moment restrictions hold. Results cannot reject the restrictions at usual significance levels in all cases, with the exception of MR2 for the US when outliers are excluded from the sample. Therefore, I conclude that the instrument set is valid in general[14]. Results also indicate that the model provides a reasonable fit for the data. Adjusted R^2 range close to 0.5, being very similar to both samples.

One robust result is that the lagged dependent variable is positive and highly significant for both samples and both measures of maturity. The estimated rate of adjustment to an optimal maturity structure ranges between 0.46 and 0.68, an indication that firms in the sample face moderate adjustment costs. Adjustment costs for the measure

Table IX.
Panel data analysis of maturity ratios for Latin America and the USA

	Region							
	Latin America				USA			
	Dependent variables							
Independent variables	MR1	*t*-statistics	MR2	*t*-statistics	MR1	*t*-statistics	MR2	*t*-statistics
Maturity_{t-1}	0.3134**	7.062	0.5056**	11.535	0.3897**	5.096	0.5412**	7.461
$\text{Residual leverage}_t$	0.0021	0.481	−0.0020	−1.284	0.0033	0.919	0.0079	1.648
Asset maturity_t	0.0001**	2.587	−0.0000	−0.704	−0.0000	−1.696	−0.0000	−0.848
Size_t	0.0364	1.251	−0.0109	−0.599	−0.0364	−1.300	−0.0088	−0.504
$\text{Growth opportunities}_t$	0.0453	1.791	0.0016	0.125	0.0011	0.214	−0.0039*	−2.321
Profitability_t	0.2191	1.934	−0.0579	−0.936	−0.0402	−0.663	−0.1074	−1.559
Business risk_t	0.0000	1.637	0.0000*	2.559	−0.0000	−1.513	−0.0000**	−7.037
Dividend yield_t	−0.1126	−1.372	−0.0458	−0.922	0.9360	0.953	0.1909	0.282
Liquidity_t	0.0417**	3.004	0.0148	1.640	0.0057	0.691	0.0135	1.485
Tangibility_t	0.1605	0.881	−0.0788	−0.757	−0.3243	−1.063	−0.2286	−1.204
Tax effects_t	−0.0001**	−3.269	−0.0000**	−3.989	0.0026	0.533	−0.0004	−0.201
Number of observations	2,814		3,360		2,136		2,479	
Adjusted R^2	0.4980		0.5005		0.4979		0.5016	
F-statistic	246.2480**		292.5154**		194.6664**		224.2141**	
$F(df_1; df_2)$	(10; 2,803)		(10; 3,349)		(10; 2,125)		(10; 2,468)	
Sargan's test statistic								
p-value	0.605		0.385		0.994		0.292	
χ^2	35.0935		39.9244		10.1432		27.2775	
df	38		38		24		24	
Durbin-Watson statistic	2.2938		2.4133		2.1757		2.2020	

Notes: Significance at: *5 and **1 percent levels; first-differences model so that idiosyncratic firm-effects constant through time are eliminated; the model is estimated by GMM using as instruments first-order lagged values of the levels of explanatory variables, sector dummies, country dummies (for Latin America), year dummies, and a constant; estimation in the period 1987-2002; "Latin America" refers to the pooling together of all firm-level data for Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela; dependent variables: MR1 = long-term debt/total debt; MR2 = long-term book liabilities/total book liabilities; reported *t*-statistics are calculated using heteroskedasticity-robust standard errors (White) and are also robust to autocorrelation (Bartlett Kernel); Model: $\Delta MR_{it} = \beta_{0i}\Delta MR_{it-1} + \sum_{k=1}^{K}\beta_{1k}\Delta Y_{ikt} + \varepsilon_{it}$

Table X.
Panel data analysis of maturity ratios for Latin America and the USA, excluding outliers

	Region							
	Latin America				USA			
	Dependent variables							
Independent variables	MR1	*t*-statistics	MR2	*t*-statistics	MR1	*t*-statistics	MR2	*t*-statistics
$Maturity_{t-1}$	0.3175**	7.115	0.4906**	11.797	0.3416**	4.897	0.3224**	6.042
$Residual\ leverage_t$	0.0069	1.246	0.0033	0.940	0.0241	1.735	0.0361**	4.452
$Asset\ maturity_t$	0.0001*	2.556	−0.0000	−0.909	−0.0000	−1.477	0.0000	0.425
$Size_t$	0.0368	1.248	−0.0113	−0.617	−0.0089	−0.262	0.0308	1.761
$Growth\ opportunities_t$	0.0443	1.754	0.0016	0.127	0.0045	0.977	−0.0030*	−2.236
$Profitability_t$	0.2158	1.879	−0.1040	−1.673	−0.0643	−1.094	−0.1077	−1.710
$Business\ risk_t$	0.0000	0.996	0.0000*	2.575	−0.0000	−1.126	−0.0000**	−5.056
$Dividend\ yield_t$	−0.1574	−1.863	−0.0535	−1.034	1.1893	1.316	0.2778	0.400
$Liquidity_t$	0.0421**	3.006	0.0144	1.621	0.0593**	2.839	0.0490**	4.224
$Tangibility_t$	0.1198	0.661	−0.0989	−0.969	−0.1504	−0.455	−0.0711	−0.424
$Tax\ effects_t$	−0.0001**	−3.238	−0.0000**	−3.962	0.0037	0.786	−0.0017	−1.053
Number of observations	2,788		3,332		2,096		2,434	
Adjusted R^2	0.4982		0.5008		0.4981		0.5041	
F-statistics	277.7467**		335.1202**		208.9407**		248.2950**	
$F(df_1; df_2)$	(10; 2,777)		(10; 3,321)		(10; 2,085)		(10; 2,423)	
Sargan's test statistic								
p-value	0.653		0.255		0.992		0.000	
χ^2	34.0444		43.3049		10.4880		59.3516**	
df	38		38		24		24	
Durbin-Watson Statistic	2.2973		2.4152		2.0687		1.9876	

Notes: Significance at: *5 and **1 percent levels;.first-differences model so that idiosyncratic firm-effects constant through time are eliminated; the model is estimated by GMM using as instruments first-order lagged values of the levels of explanatory variables, sector dummies, country dummies (for Latin America), year dummies, and a constant; influential observations have been removed based on Cook's D. estimation in the period 1987-2002; "Latin America" refers to the pooling together of all firm-level data for Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela; dependent variables: MR1 = long-term debt/total debt; MR2 = long-term book liabilities/total book liabilities; reported *t*-statistics are calculated using heteroskedasticity-robust standard errors (White) and are also robust to autocorrelation (Bartlett Kernel); Model:$\Delta MR_{it} = \beta_{0i}\Delta MR_{it-1} + \sum_{k=1}^{K}\beta_{1k}\Delta Y_{ikt} + \varepsilon_{it}$

including trade finance are in general higher than pure financial sources, and this is a common pattern between the LA-7 and the US samples[15]. This is in line with the reasoning that trade finance maturity depends largely on the business practices of each sector of activity, which makes it difficult for the firm to change. At the same time, adjustment to the target maturity is by no means costless and instantaneous.

Consistent results are also obtained for liquidity. It appears to have a positive effect on debt maturity, as postulated by theory (signaling hypothesis), once outliers have been removed from the sample.

As for the other determinants of debt maturity, no significant effect is detected for size, profitability, dividend yield, and tangibility. Some weak evidence is found for residual leverage (positive effect, but only in the US for MR2 without outliers), Asset maturity (positive effect for MR1 in the LA-7), and growth opportunities (negative, but only in the US for MR2). I conclude from these results that the capital structure decision does not have a singular effect on the debt-maturity decision, once simultaneity is resolved. Also, the significant and positive effect of asset maturity supports the maturity-matching hypothesis for financial debt in Latin America. This is in line with most of the previous empirical evidence, which finds a positive and significant effect of asset maturity. One possibility is that many studies employed measures of debt maturity that include trade finance (as MR2), which is more sensitive to the business practices of each sector, as argued above. The fact that it does not cause any effect in the US sample, nor does it to MR2 in the LA-7, suggests that financial debt in emerging markets is more sensitive to the life of a company's assets than in a developed market. A possible interpretation for this result is that debt financing may be more rationed in emerging markets[16] Finally, the negative effect of growth opportunities on MR2 for the US supports the agency hypothesis. However, the fact that it is significant only for a measure including trade finance in a developed market is difficult to interpret.

Disparities in signs between the samples are found for business risk. My results indicate that riskier firms in Latin America have longer debt maturity (which supports the agency hypothesis) while riskier firms in the US have shorter maturity (which supports the tradeoff hypothesis). Both results are found only for the measure including trade finance. This is the one empirical pattern that clearly differed between emerging and developed markets. At face value, it is awkward that riskier firms in volatile and financially constrained markets obtain longer term financing. It suggests that the role of trade financing in such markets goes beyond the mere provision of funds, but has also implications for the operating risk profile of firms. Nevertheless, a more in-depth investigation of this finding is called for.

Finally, tax effects seem to have a consistently significant negative effect over the debt maturity of Latin American firms, but an insignificant effect for North American ones. This result is puzzling since the average effective tax rate of US companies in the sample is much larger than those of Latin America.

A summary of the findings is presented in Table XI. A simple inspection of that table is enough to convey the main message: no single theoretical explanation is strongly empirically supported in this study. Moreover, none of the four hypotheses tested failed to find some support in the data. Jointly, they do obtain some success in explaining debt maturity. These findings are not unlike most previous empirical evidence in the literature.

Determinant factors	Theoretical hypothesis	Predicted effect on debt maturity	Empirical findings: Latin America, Financial debt only	Empirical findings: Latin America, Plus trade finance	Empirical findings: USA, Financial debt only	Empirical findings: USA, Plus trade finance
Lagged maturity	Dynamic effects	Positive	Positive	Positive	Positive	Positive
Residual leverage	Agency/ matching/ tradeoff	Negative/ negative/ positive	Insignificant	Insignificant	Insignificant	Positive
Asset maturity	Matching	Positive	Positive	Insignificant	Insignificant	Insignificant
Size	Agency/ signaling	Positive	Insignificant	Insignificant	Insignificant	Insignificant
Growth opportunities	Agency/ matching/ tradeoff	Negative/ positive/ positive	Insignificant	Insignificant	Insignificant	Negative
Profitability	Agency/ signaling	Positive/ negative	Insignificant	Insignificant	Insignificant	Insignificant
Business risk	Agency/ tradeoff	Positive/ negative	Insignificant	Positive	Insignificant	Negative
Dividend policy	Agency/ tradeoff	Negative/ positive	Insignificant	Insignificant	Insignificant	Insignificant
Liquidity	Signaling	Positive	Positive	Insignificant	Positive	Positive
Tangibility	Tradeoff	Positive	Insignificant	Insignificant	Insignificant	Insignificant
Tax effects	Agency/ tradeoff	Positive/ negative	Negative	Negative	Insignificant	Insignificant

Table XI.
Summary of empirical findings

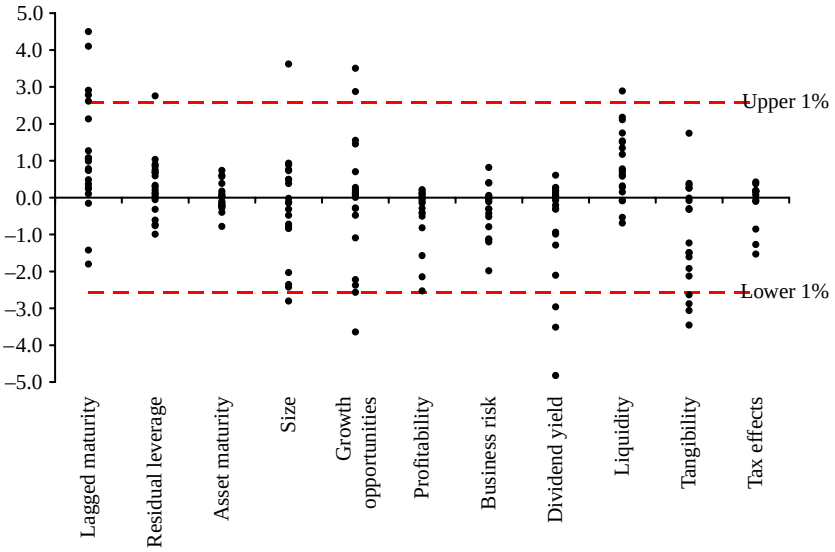
4.3 Sensitivity analyses

One question that emerges from the cross-country approach chosen in this paper is whether a single country may be driving the results. In order to check for the robustness of the findings, I apply Leamer's (1983) global sensitivity approach to the sample. I therefore re-estimate equation (2), dropping one country at a time. I also check for the influence of a single year over the results by dropping a year at a time. The results are reported in Figure 1 for MR1 and in Figure 2 for MR2. These graphs plot each (standardized) coefficient estimated from the procedure described above against the 1 percent confidence intervals and are similar to testing the null hypothesis that each sensitivity analysis coefficient is equal to the full sample estimates reported in Table IX.

Results of these sensitivity analyses in general support the robustness of the previous findings, albeit they are more robust for MR1 than for MR2. Coefficients for independent variables are similar to the results reported above. In particular, the significance is in general confirmed in the Leamer's plots for those variables that are significant in the whole sample analysis (lagged maturity, asset maturity, and tax effects). I therefore conclude that results reported in this paper are robust to the choice of countries and period covered.

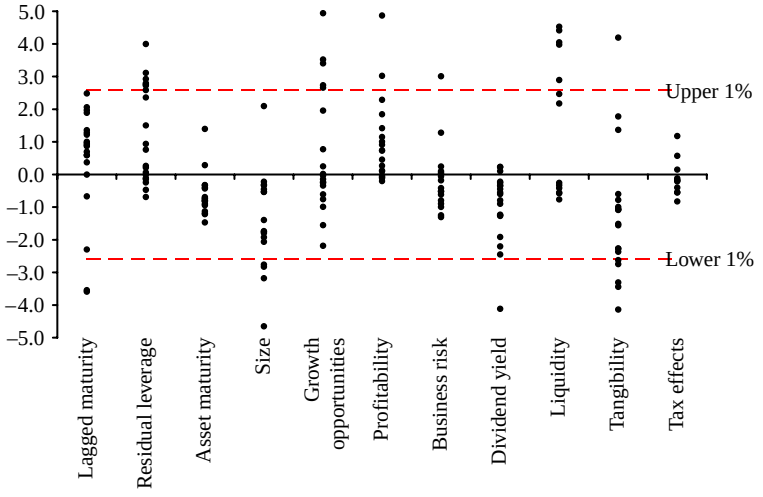
5. Summary and concluding remarks

This paper investigates the determinants of debt maturity for a sample of 1,693 non-financial firms from the seven biggest economies of Latin America and from the US



Note: Standardized coefficients

Figure 1.
Global sensitivity analysis for MAT1



Note: Standardized coefficients

Figure 2.
Global sensitivity analysis for MAT2

over a 16-year period. Employing dynamic panel data analysis, I test some of the best-known explanatory hypotheses in the theory, including agency costs, signaling, tradeoff, and maturity matching arguments.

My findings indicate that:

- there is a substantial dynamic component in the determination of the firm's maturity structure, and such effect is common to Latin America and the US;

- firms face moderate adjustment costs towards its optimal maturity;
- the determinants of maturity structure and their effects seem mostly similar between Latin American countries and the US, despite obvious differences in the financial and business environments of these regions; and
- although no theoretical proposition alone clearly finds strong empirical support in this study, all four of them find at least partial empirical support.

Of course, the study presented here has its shortcomings: as mentioned before, there may be systematic effects induced by the nature of ownership of the firm, an omitted variable here. The quality of the measurement of the variables is also an issue. As noted, accounting standards, financial market depth, and the degree of supervision on financial reporting may vary largely across countries.

The main conclusion of this study is that the present theoretical framework does not provide a complete and general explanation of the maturity decision of the firm. As a matter of fact, the "theory" is not more than a collection of partial explanations for this phenomenon. The gap in theoretical research in this case becomes evident in the empirical results where many hypotheses are at best only partially supported.

On the one hand, it is frustrating not being able to provide a straight answer to the question "how do firms choose debt maturity?" On the other hand, it is reassuring to observe that most factors that affect this kind of firm's decision in developed capital markets behave similarly in emerging markets. It suggests that the determinants of debt maturity may be relatively independent of each country's business and financial environment, which opens room for the development of general theories. Such theories become even more important in periods of financial turmoil such as those observed from 2007 on.

Directions for future empirical research include the joint estimation of the leverage and maturity decisions through a system of simultaneous equations, which seems a reasonable theoretical approximation to real-life decision-making. Also, cross-country variation in maturity structure can be explored further using financial development and business condition indicators for these countries, along Demirgüç-Kunt and Maksimovic's (1999) lines such as shareholder rights index, stock market capitalization to GDP, stock market turnover, bank financing to GDP, etc. These shall be my next steps.

Notes

1. In Merton Miller's own words (Ross *et al.*, 2002, p. 401).
2. Quarterly data are also available in the Economática® database.
3. The proxies for determinants of maturity choice are similar to a number of independent variables often suggested as determinants of leverage choice in the capital structure literature.
4. The residuals of the leverage equation can be viewed as the "exogenous" leverage effect on maturity.
5. According to Pagan (1984), such approach yields consistent estimates with only a small loss of efficiency.
6. Figures for leverage are original debt-equity ratios instead of residuals.
7. Indeed, most empirical studies on capital and maturity structure overlook such variable as well. However, since most of these studies are conducted for developed countries, and the US

in particular – where the presence of state-owned firms is less prevalent – such omission is more forgivable there than here.

8. Such tests are not strictly required to implement the dynamic model, but they are reassuring in that the first differences model is indeed adequate.
9. Assuming that the optimal maturity structure is determined by the exogenous variables ΔY_{ikt}.
10. Hsiao (1986, p. 6) refers to this as the "heterogeneity bias".
11. As suggested by Arellano (1989).
12. I choose to report results for the most complete instrument set. Several different specifications and instrument sets have been employed in preliminary runs. Results are robust to various sets of instruments as well as to instruments in levels or first-differences.
13. Given the heterogeneity in the firms in the sample, I anticipate that heteroskedasticity might be a problem.
14. Results for MR2 in the US outlier-purged sample should therefore be taken with caution.
15. Once outliers are excluded for the US.
16. Such interpretation however is weakened since tangibility – a measure of collateral value – is not significant.

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