ACCRUALS QUALITY AND DEBT MATURITY STRUCTURE

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Abstract

In this paper we use panel data and GMM estimation to examine the effect of accounting quality on debt maturity structure in a bank based financial system and show that, even after controlling for unobservable heterogeneity, endogeneity, variables reflecting operating volatility and the cost of debt, firms with poor accounting quality face a shorter debt term than firms with higher accounting quality. This association between accounting quality and debt maturity is consistent with accounting quality as a means of reducing information asymmetry problems and improving the monitoring of managers.

K**eywords:** Accruals quality, Accounting quality, Debt maturity, Information asymmetry, Endogeneity.

JEL classification: G31, G32.

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INTRODUCTION

Ever since Stiglitz (1974) suggested that the terms of debt were irrelevant, researchers have tried to explain the debt maturity structure by a variety of imperfections in capital markets. The financial literature has emphasized the importance of asymmetric information in determining firms' debt maturity (Barclay and Smith, 1995; Stohs and Mauer, 1996; Cuñat, 1999; Ozkan, 2000, Jun and Jen 2003, Berger, Espinosa-Vega, Frame and Miller 2005; Ortiz-Molina and Penas, 2008, among others), and has found that larger information asymmetries are related to shorter maturities.

In a context of information asymmetry and agency conflicts, financial reporting quality and disclosure are also a means to reduce adverse selection and moral hazard problems by improving contracting and monitoring (Healy and Palepu, 2001). Empirical studies have studied the economic consequences of financial reporting quality, finding that higher financial reporting quality allows firms to face a lower cost of capital and debt (Francis, Lafond, Olsson and Schipper, 2004; Francis, Lafond, Olsson and Schipper, 2005), higher investment efficiency (Biddle and Hilary, 2006; McNichols and Stubben, 2008; Biddle, Hilary and Verdi, 2008), lower adverse selection component of trading costs around earnings announcements (Bhattacharya, Desai and Venkataraman, 2007), and longer maturity of loans and less requirements of collateral (Bharath, Sunder, and Sunder, 2008).

Drawing on this previous research, the aim of the present paper is to show that accounting quality influences the debt maturity structure, allowing firms with higher accounting quality to access longer debt terms.

Following previous studies on accounting quality (Francis et al., 2005; Bhattacharya et al., 2007; Biddle et al., 2008; Bharath et al., 2008), we focus on accruals quality and abnormal accruals-based metrics as proxies of accounting quality. Earnings

will be more representative of cash flows if accruals are of good quality, so poor accruals quality, i.e., large differences between earnings and cash flows; will make it more difficult for creditors to estimate future cash flows (Dechow, 1994; Subramanyan, 1996). Thus, poor accruals quality can be a proxy of information risk for lenders, so they will impose more short term debt on their loans.

There is a recent study by Bharath et al. (2008) which uses a U.S. sample to examine the effect of borrower accounting quality on debt contract terms in public and private markets. Their results show that firms with poor accounting quality face a higher cost of debt, lower maturity, and higher likelihood of providing collateral in the private debt market, whereas in the public market differences in accounting quality are reflected completely in the interest spread. The focus of our paper on debt maturity is motivated because debt maturity decisions involve the asymmetric information problems not only between lenders and borrowers but also between managers and owners. In contrast to other debt contract features, accounting quality can mitigate information asymmetry between managers and owners and lead to a better monitoring of management, increasing the efficiency of investments and reducing the expropriation of investors' wealth (Bushman and Smith, 2001). This reduction in information asymmetry facilitates the monitoring of managers and implies a less need for short term debt to control management.

Our study is the first to examine the relation between accruals quality and debt maturity in a context of a code law country where firms are more likely to present lower accounting quality than in Anglo-Saxon countries. Along these lines, prior research (Lang, Smith and Higgins, 2003; Leuz, Nanda and Wysocki, 2003) has suggested that accounting quality is higher in US and Anglo-Saxon countries than in code law countries. Lang et al. (2003) found that foreign firms that cross-list in the US have

higher quality accounting data than those which do not. Leuz et al. (2003), on the other hand, found lower levels of earnings management in Anglo-Saxon systems characterised by strong investor protection, large capital markets and dispersed ownership. These results suggest that the quality of reported earnings is influenced by the country's legal and institutional environment.

Spain is classified as a code law country characterised by weak investor protection, a less developed capital market, a high concentration of ownership (La Porta, López-de-Silanes, Shleifer and Vishny, 1998; Faccio and Lang, 2002) and higher levels of earnings management than Anglo-American countries (Leuz et al., 2003). Nevertheless, different studies (Hung, 2001; D'Arcy, 2001; Bhattacharya, Daouk and Welker, 2003) show that in term of earnings opacity and accounting regulation, Spain occupies an intermediate position between Anglo-Saxon countries and European code law countries, something which supports the informative role of accruals. In addition, in contrast to the well developed capital markets in the US or UK, the financial system of continental European countries, and particularly Spain, is a banking oriented financial system (Schmidt and Tyrell, 1997) where most resources are channelled via financial intermediaries, basically the banks. According to Cuñat (1999), public debt in Spanish listed firms represents only 6.3% of all their debts. This implies that as banks have more re-contracting flexibility and processing abilities over bondholders, there is a more sensitive response to accounting quality in terms of maturity of loans in banks with respect to public lenders (Bharath et al., 2008: 3). In addition, Spanish firms, in contrast with US ones, present a very different debt maturity structure, with higher levels of short term debt. Indeed, the mean value for long term debt (over total debt) in Spanish firms is around 29%, value much lower than the 78.54% presented by US firms (Datta, Iskandar-Datta, Raman, 2005) (71.8% in Barclay and Smith, 1995).

Moreover, from a methodological perspective, our work improves on previous research since we use a panel data model, and the General Method of Moments (GMM) for estimations. This lets us control for potential endogeneity problems, allowing us to choose more efficient instruments. The endogeneity problems arise because it is possible that the observed relationships between debt maturity and firm-specific characteristics reflect not only the effect of independent variables on debt maturity but also the effect of debt maturity on those variables. Additionally, shocks affecting debt maturity are also likely to affect some other firm-specific characteristics, e.g., we control for the effect of firm size and other variables on the accruals quality and debt maturity relationship. The empirical model presented in this paper also allows us to control for unobservable firm-specific effects (unobservable heterogeneity) and firm invariant time-specific effects.

Our results suggest that, even after controlling for unobservable heterogeneity, endogeneity, variables reflecting operating volatility and the cost of debt, firms with poor accruals quality have shorter debt maturity than firms with good accruals quality. In particular, the increase in long term debt from the lowest quality quintile to the highest quality quintile is 36%. This shows the importance of accounting information in the determination of debt maturity in banking oriented financial systems like Spain. In this sense, our results suggest that is worthwhile for firms to improve the quality of their accounting information in order to avoid negative effects of asymmetric information on their access to long term loans. In addition, the results confirm that there is a non-monotonic relationship between long term debt and credit risk, as identified by Diamond (1991). We also find that firms use more long term debt when they are smaller and more leveraged. Finally, firms take decisions about debt maturity without considering tax effects.

These findings contribute to the debate on the role of accounting quality in reducing information asymmetries that impede efficient corporate financing policies and provide valuable insights for managers, creditors, and researchers. With respect to managers, our results suggest that by enhancing accounting quality firms could improve the management of their financial sources, so increasing the term of their debts. As regards creditors, our results confirm that they incorporate the quality of accounting information as a valuable factor into their decisions about the credit granted to customers. For researchers, our findings extend prior research on the relevance of accruals quality, and suggest the incorporation of a new construct to future studies on debt maturity.

The paper proceeds as follows: in the second section we present the previous literature on debt maturity structure and discuss the hypotheses to be tested. In the third section we describe the research design. The fourth section describes the model specification. Our results are discussed in the fifth section, and concluding comments are in the final section.

PREVIOUS LITERATURE

Information asymmetry and debt maturity

In recent years the financial literature has emphasized the importance of *asymmetric information* between insiders and investors in determining debt maturity of firms. Specifically, from different perspectives, higher levels of asymmetric information are related with shorter debt maturities.

From the perspective of the borrower, Flannery (1986) and Kale and Noe (1990) used a signalling framework to examine how debt maturity structure can be used to

transmit signals to the market about the quality of the firm. Flannery (1986) argues that firms with larger levels of asymmetric information are more likely to issue short-term because they affront larger information costs, while firms with lower levels of asymmetric information will prefer long term debt. The model predicts a shorter debt maturity when there is higher asymmetric information and less risk. More recently, Berger et al. (2005) found support for the predictions of Flannery's model for low risk firms as long as a reduction in informational asymmetries is associated with increased maturities for these firms. Pecking order theory, developed by Myers and Majluf (1984), also predicts a negative relationship between asymmetric information and debt maturity. Specifically, pecking order establishes a hierarchy in the use of financial resources because of the information cost that favours short-term over long-term debt.

From the perspective of the lender, asymmetric information in the private debt markets also affects debt maturity. Financial institutions face adverse selection and moral hazard problems granting credits. More informationally opaque firms are subject to more severe moral hazard problems and are more costly for lenders to monitor. Thus, debt maturity is used by creditors as a contract feature to control informational problems (Berger and Udell, 1998). Consistent with this, Ortiz-Molina and Penas (2008) find that creditors use shorter maturities to induce more frequent renegotiations of contract terms thus enforcing closer monitoring of more informational opaque and risky borrowers.

These problems are especially relevant in a bank-based financial system, where resources are channelled fundamentally by financial intermediaries (Schmidt and Tyrell, 1997), and where borrowers are subject to the discipline of the banks.

Accounting quality and debt maturity

In a context of information asymmetry and agency conflicts, financial reporting quality and disclosure are a means of reducing adverse selection and moral hazard problems by improving contracting and monitoring (Healy and Palepu, 2001). In this sense, Bushman and Smith (2001) demonstrate that high quality financial reporting could enhance economic efficiency and performance.

Some authors have also developed theoretical models which predict an association between accounting quality as a measure of information risk and expected returns (Easley and O'Hara, 2004; Lambert, Leuz and Verrecchia, 2007). According to Easley and O'Hara (2004), differences in expected returns are a consequence of asymmetries of information among investors, whereas Lambert et al. (2007) argue that the expected return effect is due to information uncertainty.

Based on the above, there has been increasing empirical research which has examined the economic effects of accounting quality. Francis et al. (2005) show that the cost of capital and the cost of debt decrease when a firm's quality of information increases; Biddle and Hilary (2006), Biddle et al. (2008) and McNichols and Stubben (2008) find that higher accounting quality improves investment efficiency in terms of lower investment-cash flow sensitivity and lower over- and under-investment.

Regarding debt maturity, Bharath et al (2008) examine how accounting quality affects the borrower's choice of private versus public debt market and the effects of accounting quality in the design of debt contracts. They conclude that information quality is priced incrementally to borrower risk. Since lenders across the two markets (public and private) differ in terms of access to information, ability to monitor the borrower, flexibility in resetting contract terms, and the cost of renegotiating the contract, they expect differences in the two markets. Their results show that firms with

poorer accounting quality are more likely to choose private debt than public debt because these firms face higher adverse selection costs in the public debt markets. Comparing the debt contracts across the two markets, they find that in the private debt market accounting quality affects the cost of debt, the maturity of loans and the likelihood of posting collateral, whereas in the public debt market, differences in accounting quality are reflected completely in the interest spread. Specifically, as a consequence of the lower renegotiation costs and the greater recontracting flexibility of banks which provide incentives to customize the loan contracts in the private debt market firms with poorer accounting quality face higher interest spread, shorter maturity and a greater likelihood of providing collateral. An interpretation of these results is that lenders with greater contracting flexibility impose more stringent contract terms on low accounting quality firms to compensate the information risk.

Most of these studies, with some exceptions such as Core, Guay and Verdi (2008), find significant associations between accounting quality and economic variables. Core et al. (2008) question the market pricing of accruals quality, i.e., the association between expected returns and accruals quality found by Francis et al. (2005), and conclude that quality is not associated to returns when conducting appropriate asset-pricing test accruals. Specifically they argue that the evidence in Francis et al. (2005) does not appear to be robust to the inclusion of operating volatility (Liu and Wysocki, 2007). Although they do find that the association between accruals quality and the implied cost of capital found in Francis et al. (2005) is robust.

Given the above, our research examines the effect of accounting quality on the debt maturity structure of firms and addresses the issue discussed by Core et al. (2008) and Liu and Wysocku (2007) in the robustness section. The different debt maturity structure between Spanish and US firms explains that our paper is particularly focused

on the effects of accounting quality on debt maturity. We do not study other contract terms for loans, as the cost of debt or collateral, because the cost of debt is quite similar between firms in both markets, and information on collateral is not available. Moreover, with this paper we aim to contribute not only to the accounting quality literature but also to the wide literature on debt maturity which has studied the determinants and implications of long term debt from different points of view, but no one (to our knowledge) has considered the effect of accounting information quality.

We expect a positive association between accounting quality and debt maturity for different reasons. One is that employed by Bharath et al. (2008), the reduction of information risk perceived by lenders, which leads to more accurate estimations of future cash flows: lenders, in particular banks, will impose shorter terms to monitor firms with lower accounting quality and thus compensate the higher information risk in these firms. Bushman and Smith (2001) indicate other arguments associated to the reduction of information asymmetries, which support the positive association between accounting quality and debt maturity: higher accounting quality leads to a better monitoring of managers and identification of project quality with the consequential increase in the efficiency of investments and a lower expropriation of investors' wealth. This will favour lenders imposing more lenient contracting conditions on their loans. Moreover, from the borrower's perspective, since higher accounting quality reduces information asymmetries between the managers and the owners and facilitates a better monitoring, there will be less need for short term debt to control management.

We expect this effect of accounting quality on debt maturity to happen in our Spanish sample because, as a bank-based financial system with low developed capital market, Spanish firms have a limited choice in obtaining long term debt outside banks. Moreover, banks have more access than public bondholders to information on the

borrowers, which they can monitor, and so have incentives to customize debt contracts terms according to the accounting quality of the borrowers (Bharath et al., 2008).

Other determinants of debt maturity

Previous literature on debt maturity structure has established other factors that can also have effects on the choice of debt maturity. We will use these factors as control variables.

Diamond (1991) extends the previous signalling model (Flannery, 1986, Kale and Noe, 1990) on asymmetric information to credit risk. He establishes a non-monotonic relationship between credit risk and debt maturity in which long-term borrowing is mainly distributed among firms of intermediate credit risk. Low risk firms will be able to capitalise on the advantages of short-term borrowing and face up to the risks of project refinancing, while high risk firms will not be able to obtain long-term loans, because of the high costs of adverse selection. Therefore, a non-monotonic (concave) relationship between debt maturity and credit risk is to be expected.

Agency conflicts between debtholders and equityholders might also be mitigated by the use of short-term loans. Myers (1977) argues that debt which matures before investment opportunities can be exercised could mitigate the problem of underinvestment. Assuming that firms with greater growth options usually have more conflicts between shareholders and debtholders, one might expect a positive relationship between growth opportunities and the use of short-term loans. Such a relationship has been confirmed in several studies (Barclay and Smith, 1995; Guedes and Opler, 1996; Stohs and Mauer, 1996; Cuñat, 1999; Ozkan, 2000; and Bevan and Danbolt, 2002).

Myers (1977) also argues that a firm can reduce agency problems between shareholders and bondholders if it matches the maturity of its debt to the life of its

assets. This would be consistent with the usual practice of adapting asset liquidity to the time it takes to settle liabilities. Previous evidence confirms this idea (Guedes and Opler, 1996; Stohs and Mauer, 1996; Danisevská, 2002 in the USA; Ozkan, 2000; and Bevan and Danboldt, 2002, in the UK; and Cuñat, 1999, in Spain). Thus, we expect a positive relationship between asset maturity and debt maturity.

On the other hand, smaller firms exhibit more debt-related agency conflicts (Smith and Warner, 1979), higher levels of asymmetric information (Berger and Udell, 1998), and higher bankruptcy risk and less access to capital markets (Titman and Wessels, 1988). All this means these firms have more difficulty in obtaining long-term financing. Thus, we expect a positive relation between debt maturity and firm's size. This is also supported in the case of US firms (Barclay and Smith, 1995; Stohs and Mauer, 1996; Jun and Jen, 2003), British firms (Ozkan, 2000) and Spanish firms (Cuñat, 1999).

The debt maturity choice could also be motivated by *tax concerns*. When the term structure of interest rates is not flat, Brick and Ravid (1985) showed that the expected tax deduction values of debt depend on maturity. Specifically, when the yield curve is upward-sloping, the holding of long-term debt allows reduced tax rates. In other words, during the early years, the real value of tax reductions will be higher for long-term debt. Brick and Ravid (1991) noted that a preference for long-term loans can also be found under flat or even negative term structures if there is uncertainty about interest rates. Mauer and Lewellen (1987) and Emery, Lewellen and Mauer (1988) also maintained that long-term debt might have a positive effect on firm's value. However, the empirical evidence is either not as expected (Barclays and Smith, 1995; Guedes and Opler, 1996) or provides no support for the tax hypothesis (Stohs and Mauer, 1996; Danisevská, 2002; Ozkan, 2000). In response to the empirical evidence, Emery (2001)

theorizes that firms are not concerned with the tax aspects associated with loan maturity structures, but instead use short-term debt to avoid the term premium between short-term and long-term loans.

Finally, leverage can also be related to debt maturity. Diamond (1991, 1993) suggests that highly leveraged firms would choose longer term debt. Thus, more indebted firms, which have higher financial risk, try to control risk by lengthening the average maturity of their debt. This was confirmed by Stohs and Mauer (1996) and Cuñat (1999). Accordingly, we expect a positive relationship between leverage and debt maturity.

RESEARCH DESIGN

Our research used data from two different sources. First, we collected balance sheets and profit and loss accounts from the Spanish Securities and Exchange Commission (CNMV) and, second, we extracted data on the market value of the company shares from the Daily Bulletin of the MSE (Madrid Stock Exchange).

Our analysis uses half yearly data for listed non financial companies between 1995 and 2001. In the period analysed, the Spanish Stock Market comprised around 90 non-financial firms. In order to estimate the model using two-step General Method of Moments (GMM) a minimum of five consecutive years is required. Additionally, firms are required with complete information for the period of analysis. After considering this, the final sample is composed of 67 firms. The selected firms are representative of the Spanish stock market, since they represent more than the 80% of the market value of non financial firms. In fact, the t test (p value 0.424) confirms that there are no significant differences between the average monthly return in our sample (mean return of 2.10% with standard deviation 6.07) and the average monthly return in the whole

market in the analysis period (mean return of 1.41% with standard deviation of 5.18). Likewise, neither are there significant differences between our sample and the non financial firms in the Spanish Stock Market for the ratio of long term debt to total debt (p-value of t test of 0.102), or for the size of assets (p-value of the t-test of 0.712). Specifically, the debt maturity structure is on average 0.2914, with standard deviation of 0.2245 for our sample, and 0.3118, with standard deviation of 0.2130 for the whole market; while the average size of assets in our sample is € 2,989.85 million (€ 2,795.6 million for the market) with standard deviation of € 9,266.08 (€ 9,218.90 for the market)

Dependent variable

The dependent variable is *long-term debt* (LTDEBT), defined as the ratio of long-term debt to total debt. We consider long-term debt as debt that matures after more than one year.

Accruals quality metric

We follow the model developed by Dechow and Dichev (2002) to estimate accruals quality. In this model, accruals quality is measured by the extent to which current working capital accruals map onto operating cash flows of the prior, current and future periods. Thus, Dechow and Dichev (2002) regress current working capital accruals (WCA_t) on cash flow from operations of the previous fiscal year (CFO_{t-1}), of the current year (CFO_t), and the subsequent fiscal year (CFO_{t+1}), all deflated by average total assets.

$$WCA_{it} = \beta_0 + \beta_1 CFO_{i,\,t-1} + \beta_2 CFO_{i,t} + \beta_3 CFO_{i,\,t+1} + \varepsilon_{it} \quad (1)$$

where

WCA_{it}: working capital accruals of firm i in year t, is calculated as the change in current assets *(ΔCA*), minus the change in cash and cash equivalents *(ΔCash*), minus the change in current liabilities *(ΔCL*) plus the change in short term bank debt *(ΔDebt*).

CFO_{it}, CFO_{t-1}, and CFO_{t+1}: cash flow from operations of firm i in years t, t-1 and t+1, respectively, are calculated as the difference between net income before extraordinary items (*NIBE*) and Total accruals (*TA*). Total accruals are calculated for each firm in year t, following Dechow, Sloan and Sweeney (1995), as working capital accruals (WCA_{it}) minus depreciation and amortization expenses for the period (Dep_{it}).

All variables are deflated by average total assets in order to avoid problems of heteroskedasticity. Average total assets are calculated for firm i in year t as the mean of firm's total assets in years t-1 and t. The model is estimated in its cross-sectional version for each industry-year combination based on the industry classification of the Madrid Stock Exchange. The residual vector reflects the variation in working capital accruals unexplained by cash flows of the previous, current and subsequent periods. Therefore, the absolute value of the residual for each firm-year observation is an inverse measure of accruals quality ($AQ\_DD_{it} = \mid \hat{\varepsilon}_{it} \mid$ (the higher the residual, the lower the accruals quality)).

Control variables

To control for the effect of credit quality we use the firm's *financial strength (Z)*, measured with one of the usual models used to predict firm insolvency. A bankruptcy model attempts to measure the financial capacity and degree of solvency of a firm. The result can be considered a *proxy* for its financial situation. Specifically, we use the

model developed by García, Calvo-Flores, and Arqués (1997) for Spanish firms, where Z is defined as follows.

$$Z_A = -0{,}835 + 0{,}950 \times R_1 + 0{,}272 \times R_2 - 11{,}848 \times R_3 + 2{,}422 \times R_4 + 6{,}976 \times R_5$$

Where

$$R_1 = \frac{\text{Receivables} + \text{Cash and equivalents}}{\text{Current liabilities}}; \qquad R_2 = \frac{\text{Fixed Assets} + \text{Current assets}}{\text{Fixed liabilities} + \text{Current liabilities}};$$

$$R_3 = \frac{\text{Financial expenses}}{\text{Sales}}; \qquad R_4 = \frac{\text{Annual depreciation}}{\text{Intangible fixed assets} + \text{Tangible fixed assets}};$$

$$R_5 = \frac{\text{Earnings before taxes}}{\text{Total liabilities}}$$

To capture the nonlinear relation predicted by Diamond (1991) we introduced Z_A and its square.

To measure growth options (GROWP) we used Tobin's q calculated as the ratio between the firm's market value and its replacement value of capital. Since firms with more growth opportunities have more agency problems, we expect a negative relationship with the dependent variable.

Following Myers (1977), we controlled for asset maturity (AM). In this case we measured the asset maturity using the following expression (Jun and Jen, 2003):

$$AM = p1 \times \frac{\text{Net Fixed Assets}}{\text{Annual depreciation}} + p2 \times \frac{\text{Receivables}}{\text{Sales}} + p3 \times \frac{\text{Inventories}}{\text{Sales}} + p4$$

where p1, p2, p3, and p4 are, respectively, the proportion of net fixed assets, receivables, inventories, and other current assets (excluding cash) to total assets.

Net fixed asset maturity is measured by annual depreciation rates. Receivables and inventories are estimated by the length of the time they take to be converted into cash. Cash and cash equivalents are considered to be liquid immediately and other

current assets are assumed to have a one-year maturity. We expect this variable to relate positively to the level of long-term debt.

As a proxy for size (SIZE) we used the log of market value of the firm. Larger firms have less difficulty in obtaining long-term debt financing. Consequently we expect a positive relation between the level of long-term debt and the firm's size.

We used as a proxy of corporate tax rate the ratio of total tax charged to total taxable income to analyse the tax effects. From a tax perspective, we expect a negative relationship with LTDEBT (Kane, Marcus and McDonald, 1985).

Finally, the level of debt (LEV) is measured as the ratio of total debt over total assets. Consistent with the argument of Diamond (1991) that firms with a high level of debt are likely to prefer longer maturity debt, a positive relationship between LEV and LTDEBT is expected.

In Table I we present the descriptive statistics of the variables.

INSERT TABLE I

In Table II we present the matrix of Pearson correlations. Correlations between independent variables are not high, suggesting that multi-collinearity is not likely to be a problem in our study.

INSERT TABLE II

MODEL SPECIFICATION

The model we proposed to test the effects of accruals quality on debt maturity is

the following:

$$LTDEBT_{it} = \beta_1 AQ\_DD_{it} + \beta_2 Z_{it} + \beta_3 Z_{it}^2 + \beta_4 GROWP_{it} + \beta_5 AM_{it} + \beta_6 SIZE_{it} + \beta_7 TAX + \beta_8 LEV_{it} + \eta_i + \lambda_t + \upsilon_{it} \quad (2)$$

where $LTDEBT_{it}$ measures long-term debt; AQ_DD is an inverse proxy for information quality; Z_{it} measures financial strength; $GROWP_{it}$ growth options; AM_{it} asset maturity; $SIZE_{it}$ firm size; TAX_{it} the corporate tax rate, LEV_{it} the level of debt the firm has; η_i individual unobservable effects for each particular firm; λ_t temporary effects; and υ_{it} random disturbances.

η_i (unobservable heterogeneity) is designed to measure unobservable characteristics of the firms that have a significant impact on the firm's debt maturity. These vary across firms but are assumed to be constant for each firm. Examples include attributes of managers like ability and motivation. They could also include industry-specific effects such as entry barriers or market conditions. The parameters λ_t are temporary dummy variables that change over time, but are equal for all firms in each period considered. Theses parameters are designed to capture the influence of economic variables that could affect the firm's debt maturity decisions, but which they can not control (interest rates and prices, for example).

Panel data models present important benefits. For instance, they allow individual heterogeneity to be controlled for. Panel data suggest that individuals, firms, states or countries are heterogeneous. Time-series and cross-section data studies which do not control for this heterogeneity run the risk of obtaining biased results. Furthermore, panel data give more informative data, more variability, less collinearity among variables, more degrees of freedom and more efficiency (Baltagi, 2001).

Estimating models from panel data requires the researchers to determine first whether there is a correlation between the unobservable heterogeneity η_i of each firm and the explanatory variables of the model. If there is a correlation (fixed effects), it would be possible to obtain the consistent estimation using the within-group estimator. Otherwise (random effects) a more efficient estimator can be achieved by estimating the equation by Generalized Least Squares (GLS). The normal strategy to determine whether the effects are fixed or random is to use the Hausman (1978) test under the null hypothesis $E(\eta_i/x_{it}) = 0$. If the null hypothesis is rejected, the effects are considered to be fixed, and the model is then estimated by OLS. If the null hypothesis is accepted, there will be random effects, and the model is then estimated by GLS. In this way the analysis achieves a more efficient estimator of β.

However, both estimators are biased when endogenous variables are included in the model. Therefore, in order to control for the possible endogeneity problems we also estimate the model using the generalized method of moments (GMM), which allows us to control for endogeneity by using instruments. Specifically, we follow the estimation strategy proposed by Arellano and Bond (1991), which consists of using all the right-hand side variables lagged twice or more as instruments. This GMM estimation is not only consistent but also more efficient than other consistent estimators, such as the one proposed by Anderson and Hsiao (1982).

This approach assumes that there is no second-order serial correlation in the errors in first differences. For this reason, in order to test the consistency of the estimations, we used the test for the absence of second-order serial correlation proposed by Arellano and Bond (1991). Likewise, we employed the Hansen test for over-identifying restrictions, which tests for the absence of correlation between the instruments and the error term.

RESULTS

Preliminary Analysis

Firstly, to ensure the validity of the measure of accruals quality (AQ_DD), we classified the sample by AQ_DD quintiles. Next, for each quintile, we regressed current cash flows on lagged cash flows and net income, controlling for firm effects. The results (Table III) show that the highest fit of the regressions is for the firms with the lowest values of AQ_DD (higher accruals quality), Q_1, and that the fit decreases when the values of AQ_DD increase (accruals quality decreases). In this way, the lower predictability of future cash flows for higher values of AQ_DD supports the idea that the variable AQ_DD is a good proxy for measuring accounting quality.

INSERT TABLE III

In addition, we have calculated the mean value of LTDEBT by quintiles of AQ_DD (Table IV). In general, we observe that the mean value of LTDEBT is higher for lower values of AQ_DD (higher accruals quality). Specifically, to test if there are significant difference between the fifth quintile and the first, we carried out a test of difference of means based on Student's t. The value obtained (3.127, significant at $p<0.01$) verifies the significant difference.

INSERT TABLE IV

These findings indicate that in Spain changes in accounting quality have important effects on debt maturity, which gives support to the interest of our study. Thus, the mean value of long term debt for firms with the worst accounting quality (quintile 5 in table IV) is 22%, and it increases to 30% for firms with the highest accounting quality

(quintile 1 in table IV). That is, the increase in long term debt from quintile 5 to quintile 1 is around the 36%. For US firms, the length of debt maturity increases from 37.8 months in the lowest accounting quality firms to 41.8 months in the highest accounting quality firms (Bharath et al, 2008). That is, an increase of around 10%.

These preliminary results indicate the relevance of the measure of accruals quality used, and also suggest that there is a significant relationship between long term debt and information quality, which implies that deeper study of the relationship is of interest.

Multivariate Analysis

Table V shows the results of the estimation of Equation 2. In Column 1, we present the results of the fixed effects estimation and, in Column 2, the results for the GMM estimation. In this case, we used the 2-stage GMM estimator, since the 1-stage estimation can present problems of heteroskedasticity, as is revealed by the rejection of the null hypothesis of the Hansen test. As instruments, we used up to the third lagged level of the independent variables.

The results for both estimations (Columns 1 and 2) present some differences. For instance, the size variable, which could affect the quality of accruals, is positive and significant in the fixed-effects model whereas it is significantly negative after controlling for endogeneity in the GMM model. These differences point to the fact that the fixed effects estimations, in this case, are not valid since they are biased in the presence of endogeneity problems. The variables are calculated from balance sheet information, and it is very difficult to accept that they are exogenous. We therefore consider that GMM is more appropriate for the estimation of Equation 2.

INSERT TABLE V

We find that AQ_DD has a negative and significant effect ($p<0.01$) on long term debt, i.e., firms with higher value of AQ_DD (poorer accounting information quality) have lower debt maturity than those with higher information quality. These findings confirm that firms with higher accruals quality can obtain a longer maturity debt than those firms with lower accruals quality and are consistent with our hypothesis that accounting quality reduces information asymmetry and adverse selection problems. In contrast, those firms with poor accounting quality will have more difficulties getting long term financing because creditors, in particular banks, and owners will prefer shorter terms to monitor the management. This result is consistent with previous research which has shown that accounting quality matters in improving economic and financial aspects of firms, such as investment efficiency (Biddle and Hilary, 2006; Biddle et al., 2008; García-Lara, García-Osma and Penalva, 2009), cost of debt and equity (Francis et al., 2004; Francis et al., 2005) and debt contract terms (Bharath et al., 2008).

As regards the other variables which explain debt maturity, we find that the variable Z and its square (Z^2) are both significant at the 1% level, with positive and negative signs respectively. This indicates that the relationship between the dependent variable and credit quality is concave, in such a way that the firms with more and less credit quality are those which use more short term debt. This confirms the non-linear relationship between debt maturity and credit quality predicted by Diamond (1991).

The coefficient on the variable GROWP is negative and significant at the 10% level. This confirms that firms use less long term debt (and more short term debt) when their growth opportunities rise. Firms with major growth opportunities have greater agency problems and one mechanism to mitigate these problems is to use short-term debt. This is consistent with Myers' (1977) argument.

Asset maturity does not appear to affect debt maturity, since the estimated coefficient is not significant. Consequently, we cannot accept that firms match the maturity of their assets and liabilities.

Contrary to our initial expectations, the variable SIZE is negatively related to the dependent variable ($p<0.05$). Our results show that larger firms use more short term debt. A similar result was found in Guedes and Opler (1996) and Scherr and Hulburt (2001). As Guedes and Opler (1996) indicate, this effect is consistent with the liquidity risk explanation of debt, because larger firms are less likely to default.

To analyze the tax effect on debt maturity we have included the variable TAX in the model, whose coefficient is positive and significant at the 1% level. This result, consistent with previous evidence (for example, Ozkan, 2000), shows that the tax hypothesis does not seem to be relevant in explaining debt maturity decisions.

For the leverage variable (LEV) the estimated coefficient is positive and significant at the 1% level. This result shows that firms with more leverage prefer long term debt to short term debt in order to control their risks.

Robustness of results to different measures of accounting quality

In order to assess the robustness of the results obtained with the Dechow and Dichev (2002) measure of accruals quality, we consider here other proxies for accruals quality to replicate the results presented in the previous section.

Our first proxy for accruals quality, following Francis et al. (2005), is the Dechow and Dichev's (2002) model modified by McNichols (2002), which also includes as explanatory variables the change in revenues and property, plant and equipment (*PPE*).

$$WCA_{it} = \beta_0 + \beta_1 CFO_{i,\,t-1} + \beta_2 CFO_{i,t} + \beta_3 CFO_{i,\,t+1} + \beta_4 \Delta REV_{it} + \beta_5 PPE_{it} + \varepsilon_{it} \quad (3)$$

where ΔREV is change in revenues and PPE is gross level of property, plant and equipment. The model is estimated in its cross-sectional version for each industry-year combination. The residual vector reflects the variation in working capital accruals unexplained by cash flows of the previous, current and subsequent periods, changes in revenues and PPE. The absolute value of the residual for each firm-year observation is an inverse measure of accruals quality ($AQ\_McN_{it} = \mid \hat{\varepsilon}_{it} \mid$).

Our second proxy for accruals quality is calculated following the Ball and Shivakumar (2006) model, which includes three additional variables in the Dechow and Dichev (2002) model:

$$WCA_{it} = \beta_0 + \beta_1 CFO_{i,\,t-1} + \beta_2 CFO_{i,t} + \beta_3 CFO_{i,\,t+1} + \beta_4 \Delta CFO_{it} + \beta_5 D + \beta_6 D\Delta CFO_{it} + \varepsilon_{it} \quad (4)$$

Where ΔCFO is the change in the cash flow from operations used as a proxy for gain or loss, D is a dummy variable which takes the value 1 if ΔCFO is negative and 0 otherwise, and $D\Delta CFO_{it}$ is the interaction between these two variables. This model tries to incorporate the asymmetry that can be recognised between gains and losses into the conventional linear accruals models. As in the previous models, the Ball and Shivakumar model is estimated in its cross-sectional version for each industry-year combination, and the absolute value of the residual for each firm-year observation is an inverse measure of accruals quality ($AQ\_BS_{it} = \mid \hat{\varepsilon}_{it} \mid$).

The third additional proxy for accruals quality is calculated based on the Margin model proposed by Peasnell, Pope and Young (2000). We estimated the following cross-sectional regression for each year and industry:

$$WCA_{it} = \beta_0 + \beta_1 REV_{it} + \beta_2 CR_{it} + \varepsilon_{it} \quad (5)$$

where *REV* is total sales, and *CR* is total sales minus change in trade debtors. The absolute value of the residual for each firm-year observation is our third inverse measure of accruals quality ($AQ\_Margin_{it} = \mid \hat{\varepsilon}_{it} \mid$).

The fourth proxy we used, following Francis et al. (2005), was based on the standard deviation of the residuals from the industry-year estimations of the Dechow and Dichev (2002) model estimated in equation (1). Instead of the absolute value of the residuals for each firm, in this case we computed an inverse measure of accruals quality for firm i in year t as the standard deviation of firm i's residuals from the industry-year regressions, $\hat{\varepsilon}_{it}$, calculated over periods t-4 to t, $AQ\_sdDD_{it} = \sigma(\hat{\varepsilon}_i)_t$. Larger standard deviations of residuals indicate poorer accruals quality.

Similarly, our last proxy for accruals quality was the standard deviation of the residuals from the industry-year estimations of the McNichols (2002) model estimated in equation (3). We computed an inverse measure of accruals quality for firm i in year t as the standard deviation of firm i's residuals from the industry-year regressions, $\hat{\varepsilon}_{it}$, calculated over periods t-4 to t, $AQ\_sdMcN_{it} = \sigma(\hat{\varepsilon}_i)_t$. Again, larger standard deviations of residuals indicate poorer accruals quality.

The results are presented in Table VI. In all the estimations the proxies for accruals quality are negative and significant at the 1% level. This confirms the expected effect of information quality in debt maturity decisions. In general, the sign and significance of the other variables are consistent with the previous estimation, except for the variables AM and GROWP. The former is significant in these models but has a similar coefficient to the previous results (very close to zero), which indicates the small effect that this variable has on debt maturity structure. In addition, the variable GROWP shows contradictory results, and therefore the effect on debt maturity is not clear.

INSERT TABLE VI

Additionally, following Francis et al. (2005) and Liu and Wysocki (2007), in columns 6 and 7 (table VI) we include the innate determinants of accruals identified by Dechow and Dichev (2002) as control variables: operating cycle, firm size, standard deviation of sales, standard deviation of cash from operations, and percentages of years in which earnings are negative. According to Liu and Wysocki (2007) and Francis, Olsson and Schipper (2008), these variables reflect a different underlying construct to that of total accruals quality: whereas innate determinants derive from the operating environment, discretionary determinants are associated to discretionary choices, implementation decisions, enforcement and so on[1]. Hence, the accruals quality constructs we have used in the previous analyses proxy for total accruals quality, whereas in columns 6 and 7 of table VI, since we control for the innate determinants, we check the effect of discretionary accruals quality on debt maturity. Our results confirm that higher discretionary accruals quality also increases debt maturity.

Finally, in columns 8 and 9 we present results including the cost of debt (COST) as explanatory variable of debt maturity. The results show that after controlling for cost of debt, the effect of accruals quality on debt maturity does not change. This supports the choice of debt maturity as a relevant debt contracting term in Spain. Indeed, the non significant relationship between LTBEDT and COST reveals the importance of studying both variables separately.

CONCLUSIONS

Financial literature has emphasized the importance of asymmetric information in determining firms' debt maturity and has found that larger information asymmetries are related to shorter maturities. The accounting literature has also investigated that

accounting information quality may be useful in solving information asymmetries and agency conflicts, together with the economic consequences of higher accounting quality. In this context, the aim of the present research was to examine the effect of borrower accounting quality on debt maturity structure in a bank-based financial system in a representative sample of the Spanish stock market for the period 1995 to 2001. We use a panel data model and employ GMM methods of estimation which allow us to control for unobservable heterogeneity and potential endogeneity problems.

The results suggest that firms with higher accruals quality can obtain a longer maturity of their debt than those firms with lower accruals quality, and they are consistent with the hypothesis that accounting quality reduces information asymmetry and adverse selection problems between the firm and creditors, which from the lenders' perspective justifies better contracting conditions, in particular longer maturity of loans. These findings are also in agreement with the hypothesis that higher accounting quality provides better monitoring of management, which from the borrower's perspective implies a lower need for short term debt to monitor managers. These findings are robust to controlling for the innate determinants of accruals, showing that higher discretionary accruals quality also increases debt maturity, and even to including the cost of debt as explanatory variable. The relevance of our results is confirmed by the more short term debt oriented maturity structure of Spanish firms in comparison to US firms, and the very significant effect of accounting quality on debt maturity in Spain (an increase of 36% in long term debt from the lowest quality quintile to the highest quality quintile) which could be exploited by firms.

Our results also provide support for the existence of a non-monotonic relationship between debt maturity structure and credit risk, which has previously been described in the literature. In addition, we find that firms use more long term debt when

they are smaller and more leveraged, and that they take decisions about debt maturity without considering tax effects.

NOTES:

[1] Liu and Wysocki (2007) argue that after controlling for the innate determinants in the regression, accruals quality displays insignificant associations with cost of capital and cost of debt because the primary source of the associations between accruals quality and cost of capital is operating volatility.

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Table I: Descriptive statistics

$LTDEBT_{it}$ measures long-term debt; AQ_DD accruals quality; Z_{it} financial strength; $GROWP_{it}$ growth options; AM_{it} asset maturity; $SIZE_{it}$ firm size; TAX_{it} the corporate tax rate, and LEV_{it} the level of debt.

	Mean	Std. Dev.	Perc 10	Perc 90
LTDEBT	0.2914	0.2245	0.0244	0.6358
AA_DD	0.0146	0.0156	0.0010	0.0361
Z	0.7054	1.2217	-0.5000	1.9636
Z^2	1.9882	6.8269	0.0310	3.9586
GROWP	1.2323	0.7467	0.7022	2.0452
AM	41.1103	142.3641	2.4731	36.6621
SIZE	11.6961	1.7263	9.5716	13.9031
TAX	0.1659	1.9652	0.0000	0.3735
LEV	0.4913	0.1719	0.2407	0.7212

Table II: Correlation Matrix

$LTDEBT_{it}$ measures long-term debt; AQ_DD accruals quality; Z_{it} financial strength, $GROWP_{it}$ growth options; AM_{it} asset maturity; $SIZE_{it}$ firm size; TAX_{it} the corporate tax rate, and LEV_{it} the level of debt.

	LTDEBT	**AQ_DD**	**Z**	**Z^2**	**GROWP**	**AM**	**SIZE**	**TAX**	**LEV**
LTDEBT	1								
AQ_DD	-0.1591***	1							
Z	-0.3395***	0.1419***	1						
Z^2	-0.0899**	0.0645	0.7437***	1					
GROWP	-0.2722***	0.0846**	0.2397***	0.0638	1				
AM	0.1689***	-0.0531	0.2634***	0.3964***	-0.1651***	1			
SIZE	0.377***	-0.2986***	-0.1722***	-0.0302	0.0734**	0.0855**	1		
TAX	0.0314	0.0068	0.0043	0.0114	0.0018	0.0172	0.0203	1	
LEV	-0.0269	-0.1141***	-0.5683***	-0.4268***	-0.004	-0.4325***	0.0609*	-0.0146	1

***, **, * denotes significance at the 1%, 5% and 10% level, respectively.

Table III: Predictability of future cash flow

For each quintile of AQ_DD, current cash flows have been regressed on lagged cash flows and net income, controlling for firms effects. L.CFLOW is the lagged cash flow and L.NI is the lagged net income.

	Q1	Q2	Q3	Q4	Q5
L.CFLOW	-0.9323***	-0.3196**	-0.3656***	-0.3913**	-0.2372**
	(-5.90)	(-2.16)	(-2.76)	(-2.42)	(-2.20)
L.NI	1.1462**	2.0762***	0.3112	0.7422**	0.1137
	(2.29)	(4.28)	(0.79)	(2.26)	(0.37)
C	0.009	-0.0368**	0.019	0.0174	0.0493***
	(0.52)	(-2.22)	(1.41)	(1.47)	(4.04)
R^2	0.3603	0.2252	0.1103	0.0995	0.0586

***, **, * denotes significance at the 1%, 5% and 10% level, respectively.

Table IV: LTDEBT by quintiles of AQ_DD

	Q1	Q2	Q3	Q4	Q5
LTDEBT	0.3074	0.334	0.3024	0.3005	0.2219
t					3.127***

*** denotes significance at the 1% level

Table V: LTDEBT and accruals quality

$LTDEBT_{it}$ is the dependent variable calculated as long term debt to total debt; AQ_DD measures accruals quality; Z_{it} financial strength; $GROWP_{it}$ growth options; AM_{it} asset maturity; $SIZE_{it}$ firm size; TAX_{it} the corporate tax rate, and LEV_{it} the level of debt. Column 1 presents the results for the fix effect estimation, and column 2 for the 2-stage GMM estimation.

	1 (FE)	**2 (GMM)**
AQ_DD	-0.7162**	-0.8187***
	(-2.19)	(-12.09)
Z	0.0296***	0.0260***
	(2.87)	(18)
Z^2	-0.0039***	-0.0033***
	(-3.23)	(-23.12)
GROWP	-0.0359***	-0.0090*
	(-3.41)	(-1.77)
AM	-0.0001	0.0000
	(-0.98)	(-1.20)
SIZE	0.0496***	-0.0135**
	(3.19)	(-1.96)
TAX	-0.0001	0.0073***
	(-0.04)	(9.91)
LEV	0.6349***	0.7702***
	(9.23)	(22.80)
P-Hausman	0.00	
Hansen		42.06 (116)
m2		1.60
Obs.	603	536

z statistic in brackets.

***, **, * denotes significance at the 1%, 5% and 10% level, respectively.

P-Hausman is the p-value in Hausman's (1978) test. If the null hypothesis is rejected, only the within-group estimation will be consistent. If it is accepted, the estimation for random effects will be the best alternative, not only because it is consistent, but also because it is more efficient than the within-group estimator.

Hansen Test is test of over-identifying restrictions distributed asymptotically under null hypothesis of validity of instruments as Chi-squared. Degrees of freedom in brackets.

m_2 is test for second-order serial autocorrelation in residuals in first differences, distributed asymptotically as N(0,1) under null hypothesis of no serial correlation.

Table VI: LTDEBT and accruals quality (II)

$LTDEBT_{it}$ is the dependent variable calculated as long term debt to total debt; AQ_DD, AQ_McN, AQ_BS, AQ_MARGIN, AQ_sdDD, and AQ_sdMcN are alternative proxies to measure information quality; Z_{it} financial strength, $GROWP_{it}$ growth options; AM_{it} asset maturity; $SIZE_{it}$ firm size; TAX_{it} the corporate tax rate, LEV_{it} the level of debt. COST is calculated as interest expenses over interest-bearing debt. Finally, following Francis et al. (2005) and Liu and Wysocki (2007), σ(CFO) is the standard deviation of CFO, σ(Sales) the standard deviation of Sales, Opercycle the operating cycle and NegEarn the percentage of years in which earnings are negative. All the estimations have been carried out using the 2-stage GMM estimator.

	1	2	3	4	5	6	7	8	9
AQ_DD						-0.6519***		-0.8359***	
						(-5.32)		(-5.36)	
AQ_McN	-0.8284***						-1.2065***		-1.7938***
	(-10.57)						(-10.09)		(-6.34)
AQ_BS		-0.5744***							
		(-6.66)							
AQ_MARGIN			-0.5890***						
			(-8.23)						
AQ_sdDD				-5.4699***					
				(-12.75)					
AQ_sdMcN					-0.9175***				
					(-5.41)				
Z	0.0243***	0.0261***	0.0234***	-0.0085***	-0.0087***	0.0754***	0.0705***	0.0922***	0.0894***
	(31.34)	(26.40)	(14.28)	(-7.36)	(-11.04)	(8.62)	(7.67)	(12.41)	(9.52)
Z^2	-0.0032***	-0.0034***	-0.0029***	-0.0011***	-0.0011***	-0.011***	-0.0117***	-0.0172***	-0.0144***
	(-52.46)	(-45.45)	(-18.96)	(-12.53)	(-19.41)	(-6.91)	(-7.83)	(-10.09)	(-6.55)
GROWP	-0.0044	-0.0074	0.0008	0.0185***	0.0066***	-0.0304***	-0.0302***	-0.0538***	-0.0411***
	(-0.81)	(-1.57)	(0.14)	(4.21)	(2.96)	(-4.90)	(-4.87)	(-7.19)	(-4.56)
AM	0.0001***	0.0001*	0.0001***	0.0001**	0.0001**	0.0021***	0.0020***	0.0001	0.0022***
	(-5.59)	(-1.94)	(3.47)	(-2.29)	(2.20)	(3.34)	(3.76)	(0.22)	(3.05)
SIZE	-0.0115**	-0.0045	-0.0219***	-0.0438***	-0.0448***	-0.0001	0.0233	0.0475**	0.0489*
	(-2.05)	(-0.87)	(-2.74)	(-7.81)	(-5.54)	(-0.00)	(1.44)	(2.27)	(1.71)
TAX	0.0013	0.0061***	0.0081***	-0.0018	-0.0012*	0.0062***	0.0039***	0.0032**	0.0022
	(1.45)	(5.09)	(4.98)	(-1.35)	(-1.81)	(3.58)	(4.08)	(2.02)	(1.43)
LEV	0.6869***	0.7748***	0.7287***	0.0259	0.0596**	0.7358***	0.6797***	0.7319***	0.6863***

	(30.22)	(29.19)	(22.84)	(1.41)	(2.51)	(9.83)	(13.19)	(9.69)	(8.52)
COST								0.0033	0.0300
								(0.05)	(0.58)
σ(CFO)						-0.7204***	-0.6998***	-1.0403***	-1.1630***
						(-6.74)	(-5.26)	(-7.45)	(-10.48)
σ(Sales)						0.3125**	0.3791***	0.2802**	0.5595***
						(2.40)	(4.87)	(2.16)	(3.65)
Opercycle						0.0001***	0.0001***	0.0001***	0.0001***
						(21.30)	(15.40)	(15.65)	(13.04)
NegEarn						-0.0764**	-0.0223	-0.0400	0.0014
						(-2.43)	(-0.65)	(-1.07)	(0.05)
Hansen	40.82 (116)	44.35(116)	44.64 (140)	50.53 (53)	46.88 (53)	47.60 (132)	39.69 (132)	34.91 (143)	34.47 (143)
m2	2.20	1.97	2.06	-1.11	-0.83	-0.50	0.27	-.012	0.82
Obs.	536	536	670	268	268	378	378	330	330

z statistic in brackets.

* Significant at 10%. ** Significant at 5%. *** Significant at 1%.

Hansen Test is test of over-identifying restrictions distributed asymptotically under null hypothesis of validity of instruments as Chi-squared. Degrees of freedom in brackets.

m_2 is test for second-order serial autocorrelation in residuals in first differences, distributed asymptotically as N(0,1) under null hypothesis of no serial correlation.