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Financial reporting quality, debt maturity and investment efficiency

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ABSTRACT

This study, conducted with a sample of Spanish listed companies during the period 1998–2008, examines the role of financial reporting quality and debt maturity in investment efficiency. The results show that financial reporting quality mitigates the overinvestment problem. Likewise, lower debt maturity can improve investment efficiency, reducing both overinvestment and underinvestment problems. We further find that financial reporting quality and debt maturity are mechanisms with some degree of substitution in enhancing investment efficiency: firms with lower (higher) use of short-term debt, exhibit higher (lower) financial reporting quality effect on investment efficiency.

1. Introduction

A large body of literature shows that firms can reduce information asymmetries by enhancing financial reporting quality (Bushman and Smith, 2001; Healy and Palepu, 2001). One line of research (Biddle and Hilary, 2006; McNichols and Stubben, 2008; Biddle et al., 2009; Chen et al., 2011) suggests that reducing adverse selection and moral hazard and allowing managers to identify better investment opportunities, higher financial reporting quality increases investment efficiency. Several papers also propose that shorter maturities of debt can be used to mitigate information asymmetry problems (Flannery, 1986; Berger and Udell, 1998; Ortiz-Molina and Penas, 2008): from the perspective of the borrower, because firms signal that they are good firms and may obtain better price conditions in the subsequent renewals of the loans; and from the perspective of the lender, because shorter maturities enable a better control and monitoring of managers (Diamond, 1991, 1993).

Theoretical models (Myers, 1977; Childs et al., 2005) predict that the higher flexibility of shorter maturities is useful in improving investment inefficiencies, although there is limited evidence for this, especially in relation to overinvestment. Based on these premises, the main purpose of this paper is to combine these two mechanisms and analyze the effect of financial reporting quality (FRQ) and debt maturity on investment efficiency in the context of a code law country where FRQ is lower than in Anglo-Saxon countries (Leuz et al., 2003; Bhattacharya et al., 2003) and where short-term debt is the major source of external finance. Since Chen et al. (2011) examine "boundary conditions" for the effect of FRQ on investment efficiency, and find that FRQ influences investment efficiency in private firms in emerging countries, we also expect to find this association in a sample of listed firms in Spain, where FRQ is expected to be higher. In relation to the role of debt maturity in investment efficiency, to the best of our knowledge this is the first study that empirically examines its effect on both underinvestment and overinvestment. In this sense, Spain is an interesting setting for our research because, due to the less developed capital market than in U.S. and U.K. and the higher information asymmetry, private debt is the main source of finance for Spanish firms, where banks may play a role in alleviating capital market imperfections (García-Marco and Ocaña, 1999) and the monitoring role of short-term debt is higher (Barclay and Smith, 1995). Actually, the debt maturity structure of Spanish companies presents short-term orientation. For instance, whereas in our sample the average value of short-term debt to total liabilities is greater than 60%, in U.S. companies this percentage is around 22% (Datta et al., 2005). Since these shorter maturities in Spain play, from the lender's perspective, a role as a control device of management performance, and from the borrower's side they facilitate undertaking positive net present value projects (Myers, 1977), we also expect a positive association between shorter maturities and investment efficiency.

As an extension of our research, we examine how debt maturity moderates the effect of FRQ on investment efficiency, i.e., whether

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the effect of FRQ on investment efficiency is increasing or decreasing with the level of debt maturity. We could expect both effects: on the one hand, the reduction of information asymmetry and more reliable accounting numbers, due to higher FRQ, could add to better monitoring due to short-term debt and, as a consequence, the effect of FRQ on investment efficiency should be higher for firms with higher FRQ and shorter maturities. On the other hand, in firms with higher FRQ, lenders will have less need for shorter maturities to monitor managers' behavior (Bharath et al., 2008; García-Teruel et al., 2010), so under this assumption we would expect the importance of FRQ to reduce information asymmetries will increase with longer maturities and will decrease with shorter maturities.

In line with previous studies, we consider different proxies for FRQ that focus on the precision of accounting information: (1) the model of discretionary revenues developed by McNichols and Stubben (2008); (2) the model of discretionary accruals suggested by Kasznik (1999); (3) the Dechow and Dichev (2002) model of accruals quality; (4) finally, we use an aggregate measure that includes the previous three proxies. Our results show that FRQ reduces overinvestment, while shorter debt maturity mitigates overinvestment and underinvestment. Our findings also demonstrate that the effect of FRQ on investment efficiency decreases with shorter maturities, suggesting a substitutive role of FRQ and shorter maturities in reducing information asymmetries and monitoring managerial behavior to limit expropriation of creditors and minority shareholders.

Our paper contributes to a growing body of literature providing empirical evidence on FRQ and debt maturity roles in improving investment efficiency in a code law country where debt maturity is an important device in controlling managerial behavior. Our findings suggest that in this context the main concern of creditors is overinvestment, because it is through overinvestment that managers expropriate creditors and minority shareholders, and that this inefficiency can be reduced with both higher FRQ and shorter maturities. With regard to underinvestment, our results suggest that the positive effect of shorter maturities on reducing this inefficiency may be more associated to internal decisions of the firm (Myers, 1977) than to monitoring by creditors. Moreover, this is the first study that analyzes the interaction effect between FRQ and debt maturity on improving investment efficiency and our findings suggest that both mechanisms may play a substitutive role in reducing overinvestment, whereas, unlike previous studies in the U.S. and emerging markets (Biddle et al., 2009; Chen et al., 2011) that find that FRQ can solve underinvestment problems, in Spain, short-term debt is the main mechanism used to control underinvestment, and FRQ is only relevant when short-term debt level is low (higher maturities).

The remainder of the paper proceeds as follows. Section 2 reviews the existing literature on investment efficiency and the role of FRQ and debt maturity in investment decisions, and develops our testable hypotheses. Section 3 describes in detail the research design, with the models, measures of variables and the sample. Section 4 shows the results and the final section presents the main conclusions of this paper.

2. Previous literature and hypotheses development

2.1. Determinants of investment efficiency

Under neo-classical theory, firms invest until the marginal benefit equals the marginal cost of this investment in order to maximize their values (Yoshikawa, 1980; Hayashi, 1982; Abel, 1983). However, in the Keynesian framework (Gordon, 1992; Crotty, 1992), where expected investment will be determined by the preference for growth or for financial security, and in the agency framework (Myers, 1977), which considers information asymmetry problems, firms may deviate from their optimal investment levels and hence suffer from underinvestment (lower investment than expected) or overinvestment (greater investment than expected).

In perfect financial markets, all positive net present value projects (NPV) should be financed and carried out. Nevertheless, there is a significant body of literature that contradicts this assumption (for example, Hubbard, 1998; Bertrand and Mullainathan, 2003). Market imperfections, as well as information asymmetries and agency costs can lead to negative NPV projects being carried out (overinvestment) and to the rejecting of positive NPV projects (underinvestment). According to agency theory, both overinvestment and underinvestment can be explained by the existence of asymmetric information among stakeholders. Jensen and Meckling (1976), Myers (1977) and Myers and Majluf (1984) develop a framework for the role of asymmetric information in investment efficiency through information problems, such as moral hazard and adverse selection. With regard to moral hazard, discrepancy of interests between shareholders and a lack of monitoring of managers may lead to management trying to maximize its personal interests by making investments that may not be suitable for shareholders (Jensen and Meckling, 1976), with the consequence of managerial empire building and overinvestment (Hope and Thomas, 2008). Under adverse selection, better informed managers may overinvest if they sell overpriced securities and achieve excess funds. To avoid this, suppliers of capital can ration the capital or raise its cost, which will lead to the rejection of some profitable projects due to fund constraints (Stiglitz and Weiss, 1981; Lambert et al., 2007; Biddle et al., 2009) with subsequent underinvestment.

2.2. Investment efficiency and financial reporting quality (FRQ)

From the agency theory perspective, there are various control mechanisms to attenuate information asymmetries and information risk and to enable better supervision of managerial activity that mitigates the opportunistic behavior of managers, such as financial reporting quality and disclosure (Bushman and Smith, 2001; Healy and Palepu, 2001; Hope and Thomas, 2008). Several studies have analyzed some of these implications, such as the reduction of the cost of capital and cost of debt (Francis et al., 2004, 2005) and access to the debt market and the effect on its conditions (Bharath et al., 2008), i.e., lower cost, higher debt maturity and lower guarantees in bank financing.

Recently, a line of research has been developed on the effects of FRQ on investment efficiency. Since higher FRQ makes managers more accountable by allowing better monitoring, and it may reduce information asymmetries and, consequently, adverse selection and moral hazard, it could also diminish overinvestment and underinvestment problems. On the other hand, FRQ could also improve investment efficiency by allowing managers to make better investment decisions through a better identification of projects and more truthful accounting numbers for internal decision makers (Bushman and Smith, 2001; McNichols and Stubben, 2008). Empirically, prior literature argues and finds evidence that FRQ relieves investment-cash flow sensitivity (Biddle and Hilary, 2006) and that earnings management leads to overinvestment because it distorts the information used by managers (McNichols and Stubben, 2008). Based on this discussion, Biddle et al. (2009), for U.S. listed firms, and Chen et al. (2011), for private firms from emerging markets, examine the effect of FRQ on two inefficient scenarios, overinvestment and underinvestment, and report that higher FRQ helps underinvestment companies to make investments, and overinvestment companies to decrease their investment level. Consistent with this, García-Lara et al. (2010) find that conservatism reduces both overinvestment and underinvestment, because it reduces investment-cash flow sensitivity in overinvestment firms and facilitates access to external financing in underinvestment firms.

The institutional context in our sample is different from those of Biddle et al. (2009) and Chen et al. (2011), which affects the role played by FRQ. Previous studies have found that FRQ is higher in public firms than in private firms (Ball and Shivakumar, 2005; Burgstahler et al., 2006) and in countries with higher investor protection and enforcement (Leuz et al., 2003; Holthausen, 2009). Since Spain is a code law country with a less developed capital market than U.S., and where FRQ, enforcement and investor protection are lower, the level of FRQ in Spanish listed firms is lower than in the U.S. firms analyzed by Biddle et al. (2009) although Spain does show higher levels of enforcement (La Porta et al., 1998) and FRQ than the sample of private firms in emerging countries used by Chen et al. (2011). Besides, the Spanish case of listed firms constitutes an interesting set to study because, in contrast with the U.S., the main agency conflict is not the typical one between managers and shareholders, but that between managers controlled by majority shareholders on the one side and creditors and minority shareholders on the other. Moreover, the agency conflict with minority shareholders is more acute in our sample of listed firms than in the sample of private firms analyzed by Chen et al. (2011). Hence our study focuses on an institutional environment different from that of Biddle et al. (2009) and Chen et al. (2011). We investigate whether FRQ improves investment efficiency in this context, so our first hypothesis is as follows:

H1. Firms with higher FRQ will show higher investment efficiency.

Since we analyze the role of FRQ in reducing overinvestment and underinvestment, we also test the following two sub-hypotheses:

H1a. Firms with higher FRQ will mitigate overinvestment problem.

H1b. Firms with higher FRQ will mitigate underinvestment problem.

2.3. Investment efficiency and debt maturity

The role of debt in reducing managers' discretion and disciplining their investment decisions has been discussed in the literature (Myers, 1977; Jensen, 1986), and there is some evidence that supports that debt reduces overinvestment (D'Mello and Miranda, 2010). However, the literature has also emphasized the role played by debt maturity under information asymmetry, showing that the use of short-term debt is a mechanism that can attenuate informational asymmetries and agency costs between shareholders, creditors and managers. From the borrower's perspective, Flannery (1986) predicts that under information asymmetry firms with good projects will prefer shorter maturity to transmit signals to the market and mitigate these information asymmetry problems. From the lender's perspective, when asymmetric information is present, the use of short-term debt is more suitable than long term debt to monitor firms (Diamond, 1991, 1993; Rajan, 1992). A shortening of debt maturity permits better control of managers, because shorter maturities induce more frequent renegotiations; lenders have closer contact with the borrower and can ascertain firms' performance during the first period and then they can decide whether to renew or change the contract terms (Ortiz-Molina and Penas, 2008). Therefore, greater use of short term debt is expected to reduce information asymmetry and adverse selection.

As regards investment efficiency, debt maturity can be used to mitigate overinvestment and underinvestment problems; when there are positive NPV projects, firms can finance them with short-term debt and diminish underinvestment problems, because the debt will be liquidated in a short time and the profitability will be entirely for the company (Myers, 1977). In addition, due to the roll-over of short-term debt, debt holders may monitor borrowers better and thus reduce the agency conflict between creditors and borrowers that arises from investment opportunities (Barclay and Smith, 1995; Guedes and Opler, 1996; Parrino and Weisbach, 1999; and Lai, 2011). As regards overinvestment, Childs et al. (2005) predict further that the higher flexibility of short-term debt to be rolled over and priced according to deviations from a firm-value maximizing strategy can mitigate agency conflicts between stockholders and creditors and thus reduce both underinvestment and overinvestment.

In Spain, as mentioned above, the lower enforcement and development of the capital market with respect U.S. increases the role of shorter maturities to monitor managers (Barclay and Smith, 1995; Magri, 2010). According to La Porta et al. (1998) the index of creditor rights is not high (2 out of 4) even in comparison to the sample of emerging countries analyzed by Chen et al. (2011), which enhances the relevance of the monitoring of managers by creditors and the role played by debt maturity undertaking this. Thus, we expect the increased level of monitoring by the use of short term debt to be a key mechanism in Spain to reduce moral hazard problems and empire-building activities. Additionally, we expect that the higher financial flexibility for borrowers associated to lower maturities will also help control underinvestment.

Based on this, our second hypothesis and its sub-hypotheses are as follows:

H2. Firms with higher use of short term debt (lower maturities) will show higher investment efficiency.

H2a. Firms with higher use of short term debt (lower maturities) will mitigate overinvestment problem.

H2b. Firms with higher use of short term debt (lower maturities) will mitigate underinvestment problem.

2.4. FRQ effect on investment efficiency conditioned to the level of debt maturity

As well as checking the isolated effect of financial reporting quality and debt maturity on investment efficiency, we examine their interaction effect, i.e., we investigate whether the effect of FRQ on investment efficiency is increasing or decreasing with the level of debt maturity. In this sense, the effect of FRQ on investment decisions could be mitigated by the presence of short-term debt because through short-term debt creditors can exert their monitoring role on managers to reduce overinvestment and this short-term debt may also be beneficial for managers to carry out positive investments in underinvestment situations. According to this, the effect of FRQ on investment efficiency would be weaker in those firms with shorter maturities because the public information provided by FRQ and the closer and private relation with more frequent access to internal information provided by shorter maturities, are substitutive. In contrast, the effect of FRQ on investment efficiency could be greater for those firms with higher short-term debt if both beneficial effects of public and private information on investment efficiency are complementary.

Therefore, our third hypothesis is that the relation between FRQ and investment efficiency depends on the level of debt maturity. Since a priori we could expect either a stronger or a weaker effect of FRQ on investment efficiency according to the level of debt maturity, we pose two alternative hypotheses ($H3_1$ – shorter maturities and FRQ substitutive – and $H3_2$ – shorter maturities and FRQ complementary), as well as sub-hypotheses for the overinvestment (a) and underinvestment scenarios (b):

H3₁. The relation between FRQ and investment efficiency is stronger for those firms with lower use of short term debt (higher maturities).

H3₁a. In an overinvestment scenario, the relation between FRQ and investment efficiency is stronger for those firms with lower use of short term debt (higher maturities).

H3₁b. In an underinvestment scenario, the relation between FRQ and investment efficiency is stronger for those firms with lower use of short term debt (higher maturities).

H3₂. The relation between FRQ and investment efficiency is stronger for those firms with higher use of short term debt (lower maturities).

H3₂a. In an overinvestment scenario, the relation between FRQ and investment efficiency scenario is stronger for those firms with higher use of short term debt (lower maturities).

H3₂b. In an underinvestment scenario, the relation between FRQ and investment efficiency is stronger for those firms with higher use of short term debt (lower maturities).

3. Research design

3.1. Model specification

The model we propose to test the effect of FRQ and short-term debt on investment efficiency is the following:

$$InvEff_{i,t} = \beta_0 + \beta_1 FRQ_{i,t} + \beta_2 STDebt_{i,t} + \beta_3 LnSales_{i,t} + \beta_4 LnAge_{i,t} + \beta_5 Tang_{i,t} + \beta_6 StdCFO_{i,t} + \beta_7 StdSales_{i,t} + \beta_8 QTobin_{i,t} + \beta_9 Z_{i,t} + \beta_{10} Loss_{i,t} + \beta_{11} CFO\_ATA_{i,t} + \beta_{12} Opercycle_{i,t} + \sum_j \beta_j Industry\,dummies + \varepsilon_{i,t} \quad (1)$$

where *InvEff* represents investment efficiency. *FRQ* represents different proxies of FRQ; *STDebt* is an inverse proxy of debt maturity, the level of short-term debt over total debt (short- and long-term debt). Since our hypotheses predict that both *FRQ* and *STDebt* improve investment efficiency, we expect β_1 and β_2 to be positive and significant. The rest are control variables that may influence investment efficiency and innate determinants of FRQ: size, age, tangibility, standard deviation of cash flow and sales, Tobin's *Q*, Altman's *Z*-score, presence of losses, cash flow from operations, length of the operating cycle, and industry dummies. Following Petersen (2009), we estimate the model using *t*-statistics based on standard errors clustered at the firm and the year level, which are robust to both heteroskedasticity and within-firm serial correlation.

As shown in the literature review section, FRQ and the use of short-term debt can contribute to alleviating asymmetric information problems and thus improve investment efficiency. After testing the effects of FRQ and short-term debt on investment efficiency, we will extend the previous analysis to examine if the effect of FRQ on investment efficiency is increasing or decreasing with the level of debt maturity. To check this, we include an interaction effect between FRQ and a dummy variable for our inverse proxy of debt maturity ($DumSTDebt_{i,t}$) which takes the value 1 if the proportion of short-term debt over total debt is above the median and zero otherwise:

$$InvEff_{i,t} = \beta_0 + \beta_1 FRQ_{i,t} + \beta_2 STDebt_{i,t} + \beta_3 FRQ_{i,t} * DumSTDebt_{i,t} + \beta_4 LnSales_{i,t} + \beta_5 LnAge_{i,t} + \beta_6 Tang_{i,t} + \beta_7 StdCFO_{i,t} + \beta_8 Std\,Revenues_{i,t} + \beta_9 QTobin_{i,t} + \beta_{10} Z_{i,t} + \beta_{11} Loss_{i,t} + \beta_{12} CFO\_ATA_{i,t} + \beta_{13} Opercycle_{i,t} + \sum_j \beta_j Indutry\,dummies + \varepsilon_{i,t} \quad (2)$$

where *FRQ*DumSTDebt* represents the interaction effect. In this model, β_1 indicates the effect of FRQ on investment efficiency for firms whose level of short-term debt is lower than the median and the sum of the coefficients on the main and interaction effect, $\beta_1 + \beta_3$, represents the FRQ effect on investment efficiency for firms whose level of short-term debt is higher than the median. Therefore, if the effect of FRQ on investment efficiency is stronger for those firms with lower maturities (higher proportion of short-term debt), β_3 will be positive and significant, whereas if the effect of FRQ on investment efficiency is lower for those firms with shorter maturities, β_3 will be negative and significant.

3.2. Variable measures

3.2.1. Dependent variable: proxy for investment efficiency

Conceptually, investment efficiency means undertaking all those projects with positive net present value. Biddle et al. (2009), among others, use a model that predicts investment in terms of growth opportunities. Specifically, investment efficiency will exist when there is no deviation from the expected level of investment. However, companies that invest above their optimal (positive deviations from expected investment) overinvest, while those that do not carry out all profitable projects (negative deviations from expected investment) underinvest.

Following Biddle et al. (2009), to estimate the expected level of investment for firm *i* in year *t*, we specify a model that predicts the level of investment based on growth opportunities (measured by sales growth). Deviations from the model, as reflected in the error term of the investment model, represent the investment inefficiency.

$$Investment_{i,t} = \beta_0 + \beta_1 SalesGrowth_{i,t-1} + \varepsilon_{i,t} \quad (3)$$

where $Investment_{i,t}$ is the total investment of firm *i* in year *t*, defined as the net increase in tangible and intangible assets and scaled by lagged total assets. $SalesGrowth_{i,t-1}$ is the rate of change in sales of firm *i* from $t-2$ to $t-1$.

We estimate the investment model cross-sectionally for each year and industry. The residuals from the regression model reflect the deviation from the expected investment level, and we use these residuals as a firm-specific proxy for investment inefficiency. A positive residual means that the firm is making investments at a higher rate than expected according to the sales growth, so it will overinvest. In contrast, a negative residual assumes that real investment is less than that expected, representing an underinvestment scenario. Our dependent variable will be the absolute value of the residuals multiplied by -1, so a higher value means higher efficiency ($InvEff_{i,t}$).

3.2.2. Financial reporting quality (FRQ)

In order to estimate financial reporting quality we use three different proxies based on accounting precision with respect to fundamentals, according to previous research, as well as a summary

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statistic, by standardizing these three proxies and taking the average of the three measures ($Aggreg_{i,t}$).

The first measure is obtained following the model proposed by McNichols and Stubben (2008), who consider discretionary revenues as a proxy for earnings management.

$$\Delta AR_{i,t} = \beta_0 + \beta_1 \Delta Sales_{i,t} + \varepsilon_{i,t} \quad (4)$$

where $\Delta AR_{i,t}$ is the annual change in accounts receivable for firm *i* in the year *t*. $\Delta Sales_{i,t}$ represents the annual change in sales revenues for firm *i* in the year *t*. All terms are scaled by lagged total assets.

The model is estimated separately for each industry-year group. Discretionary revenues are the residuals from Eq. (4), which represents the change in accounts receivable that is not explained by sales growth. Our first proxy for FRQ will be the absolute value of the residuals multiplied by −1. Thus, higher values indicate higher FRQ, ($FRQ\_MNST_{i,t} = -|\hat{\varepsilon}_{i,t}|$).

The second measure for FRQ is obtained from the model of discretionary accruals developed by Kasznik (1999), based on Jones (1991):

$$TA_{i,t} = \beta_0 + \beta_1 \Delta Sales_{i,t} + \beta_2 PPE_{i,t} + \beta_3 \Delta CFO_{i,t} + \varepsilon_{i,t} \quad (5)$$

where $TA_{i,t}$ is total accruals, calculated as the change in non-liquid current assets minus the change in current liabilities plus the change in the short-term bank debt, minus depreciation. $\Delta Sales_{i,t}$ is the change in revenues; $PPE_{i,t}$ is property, plant and equipment; $\Delta CFO_{i,t}$ is the change in cash flow from operations. All terms are deflated by lagged total assets.

The model is estimated in its cross-sectional version for each year and industry. The second proxy for financial reporting quality will be the absolute value of residuals from Eq. (5) multiplied by −1, so a higher level represents higher FRQ, ($FRQ\_KASZ_{i,t} = -|\hat{\varepsilon}_{i,t}|$).

Our third proxy is based on the accruals quality model developed by Dechow and Dichev (2002). In this model, current working capital accruals are regressed on cash flow from operations of the previous year, the current year and the subsequent year.

$$WCA_{i,t} = \beta_0 + \beta_1 CFO_{i,t-1} + \beta_2 CFO_{i,t} + \beta_3 CFO_{i,t+1} + \varepsilon_{i,t} \quad (6)$$

where $WCA_{i,t}$ is working capital accruals, calculated as the change in non-liquid current assets, minus the change in current liabilities plus the change in short-term bank debt. $CFO_{i,t-1}$, $CFO_{i,t}$ *and* $CFO_{i,t+1}$ are the cash flow from operations, which are expressed by the difference between net income before extraordinary items and total accruals. All variables are deflated by average total assets.

As in the previous models, the estimation is carried out by year and industry. The residuals from Eq. (6) reflect the variation in working capital accruals unexplained by cash flow of the current year and adjacent periods. Therefore, the third measure of FRQ will be the absolute value of the residuals multiplied by −1. Thus a higher value represents higher FRQ, ($FRQ\_DD_{i,t} = -|\hat{\varepsilon}_{i,t}|$).

Finally, the fourth measure of FRQ, $Aggreg_{i,t}$, is calculated as the average of the standardized values of the three proxies. A higher value means higher FRQ.

3.2.3. Debt maturity

To verify the role of debt maturity in investment efficiency, we include the variable *STDebt*, measured as the ratio of short-term debt (debt that matures before one year) over total debt.

3.2.4. Control variables

Following previous studies (Biddle et al., 2009; Chen et al., 2011), we introduce several control variables in our models. As a proxy for size we use the natural logarithm of sales (*LnSales*); Age is measured as the natural logarithm of the years since the inception of the firm (*LnAge*); Tangibility (*Tang*) is the ratio of tangible fixed assets to total assets; we include the standard deviation of cash flow from t-2 to t (*StdCFO*), as well as the volatility of sales in the same period (*StdSales*); to measure growth options we include Tobin's Q (*QTobin*) as the ratio between the firm's market value of equity and debt over its total assets; to control for the financial solvency of the firm, we employ the firm's financial strength (*Z*), measured with Altman's Z-score (1968), where *Z* is defined as:

$$Z = 0.012 * X_1 + 0.014 * X_2 + 0.033 * X_3 + 0.006 * X_4 + 0.999 * X_5$$

where X_1 is the working capital/total assets; X_2 the retained earnings/total assets; X_3 the earnings before interest and taxes/total assets; X_4 the market value equity/book value of total debt; X_5 is the sales/total assets

We include a dummy variable (*Loss*) that takes the value 1 if net income before extraordinary items is negative, and zero otherwise, to control whether the firm reports losses; moreover, we include the ratio of cash flow to average total assets (*CFO_ATA*), to capture the cash effect on investment efficiency; *Opercycle* represents the length of the operating cycle, and, finally, we add dummy variables to control for industry effects (*Industry dummies*).

3.3. Sample

We have used three sources to collect our data. We obtained balance sheets and profit and loss accounts from the SABI database, made by Bureau Van Dijk. Market values of the company shares were extracted from the Daily Bulletin of the MSE (Madrid Stock Exchange) and interest rates for the robustness analysis were obtained from the Statistic Bulletin of the Bank of Spain.

The estimates of investment efficiency and financial reporting quality variables have been made from a sample of 13,500 firm-year observations from 1997 to 2008, which represent big companies with consolidated information in SABI.

The sample used in our research includes firms listed on the Madrid Stock Exchange from 1998 to 2008. Initially, we had a total of 1,039 observations for this period, but the estimates of investment efficiency and financial reporting quality reduced the number of observations considerably. In order to mitigate the influence of outliers we drop observations for 1 and 99 percentiles for all variables, so our final sample consists of an unbalanced panel of 576 firm-year observations from 1998 to 2008. For the accruals quality measure proposed by Dechow and Dichev (2002), a year ($t + 1$) is lost, so for analyses involving this variable our study is carried out with 500 firm-year observations.

4. Results

4.1. Descriptive statistics

Panel A of Table 1 presents the descriptive statistics for the continuous variables, including the mean, median, standard deviation, 10th percentile and 90th percentile. Panel B provides the frequency for the dichotomous variable *Loss*.

Investment efficiency (*InvEff*) in the sample has a mean of −0.086 and a median of −0.048. Separately, the overinvestment scenario shows a mean of −0.123 whereas in the underinvestment scenario the mean is −0.053. These values are consistent with previous studies (Chen et al., 2011). Likewise, all measures of FRQ have values according to earlier research (McNichols and Stubben, 2008; Biddle et al. 2009; Chen et al., 2011). As regards debt maturity, we observe that, on average, 61% of liabilities are short-term debt. This is consistent with the García-Teruel et al. (2010) study, which showed that Spanish firms hold around 60% of short-term debt, and contrasts with studies on U.S. firms, such as Barclay and Smith (1995) and Datta et al. (2005), where the use of short-term debt is much lower, 28.2% and 21.46%, respectively.

Table 1
Descriptive statistics.

	N	Mean	Median	Std. Dev.	Perc. 10	Perc. 90
(A) Continuous variables						
InvEff	576	−0.086	−0.048	0.135	−0.200	−0.010
Overinvestment	275	−0.123	−0.061	0.181	−0.322	−0.008
Underinvestment	301	−0.053	−0.041	0.053	−0.104	−0.011
FRQ_MNST	576	−0.038	−0.023	0.051	−0.082	−0.003
FRQ_KASZ	576	−0.050	−0.038	0.044	−0.112	−0.007
FRQ_DD	500	−0.034	−0.028	0.029	−0.069	−0.005
Aggreg	500	0.088	0.239	0.599	−0.645	0.670
STDebt	576	0.615	0.621	0.194	0.344	0.875
LnSales	576	13.388	13.344	1.634	11.273	15.610
LnAge	576	3.593	3.675	0.678	2.694	4.384
Tang	576	0.349	0.337	0.201	0.080	0.617
StdCFO	576	0.082	0.067	0.059	0.022	0.167
StdSales	576	0.075	0.060	0.063	0.016	0.159
QTobin	576	1.428	1.222	0.566	0.867	2.136
Z	576	2.538	2.056	1.599	1.110	4.678
CFO_ATA	576	0.098	0.096	0.101	−0.023	0.219
Opercycle	576	291.136	213.909	288.910	110.557	424.332
(B) Dichotomous variable						
	0			**1**		
Loss	526		91.32%	50		8.68%

InvEff is the absolute value of residuals of investment model multiplied by −1; *Overinvestment* is the positive residuals of investment model multiplied by −1; *Underinvestment* is the negative residuals of investment model; *FRQ_MNST* is the absolute value of residuals of the model proposed by McNichols and Stubben (2008), multiplied by −1; *FRQ_KASZ* is the absolute value of residuals of the Kasznik (1999) model, multiplied by −1; *FRQ_DD* is the absolute value of residuals of the model developed by Dechow and Dichev (2002), multiplied by −1; *Aggreg* is the summary measurement of FRQ computed as the standardized average of the three FRQ proxies; *STDebt* is the ratio of short-term debt to total debt; *LnSales* is the log of sales; *LnAge* is the log of age; *Tang* is the tangibility measure calculated as the ratio of tangible fixed assets to total assets; *StdCFO* is the standard deviation of cash flows from $t-2$ to t; *StdSales* is the standard deviation of sales from $t-2$ to t; *QTobin* is the ratio of firm's market value plus liabilities to total assets; *Z* is the degree of solvency; *CFO_ATA* is the ratio of CFO to average total assets; *Opercycle* is calculated as: (average accounts receivables/sales) $*$ 360 + (average inventory/cost of goods) $*$ 360; *Loss* is a dummy variable that takes the value 1 if the income before taxes and extraordinary items is negative, and 0 otherwise.

Table 2 provides the Pearson correlation matrix.

Three out of four FRQ measures show significant positive correlations with investment efficiency, indicating that higher level of FRQ is associated with higher level of investment efficiency. They also show positive and significant correlations with each other, and higher ones with the aggregate measure of FRQ. Likewise, debt maturity (*STDebt*) presents significant positive correlation with investment efficiency, showing that a higher proportion of short-term debt (debt that matures before one year) over total debt is also associated with higher investment efficiency. With respect to FRQ measures, *STDebt* has a negative correlation with these variables, a result which is also consistent with previous studies (Bharath et al., 2008; García-Teruel et al., 2010). Correlations between independent variables are not high, therefore, collinearity is not likely to be a problem in our study.

4.2. Regression results

Table 3 reports the results of the estimation of Eq. (1) using different FRQ measures. In the first column, we use as FRQ measure the model proposed by McNichols and Stubben (2008); in the second, the model developed by Kasznik (1999); in the third, the model defined by Dechow and Dichev (2002), and finally, in the fourth column, the aggregate measure of FRQ.

Except for the Dechow and Dichev (2002) model, which is not significant at conventional levels, the conclusion is that FRQ enhances investment efficiency, since all coefficients of quality measures are positive and significant ($p < 0.01$ for *FRQ_MNST* and

Table 2
Correlation matrix.

	InvEff	FRQ_MNST	FRQ_KASZ	FRQ_DD	Aggreg	STDebt	LnSales	LnAge	Tang	StdCFO	StdSales	Qtobin	Z	Loss	CFO_ATA	Opercycle
InvEff	1															
FRQ_MNST	0.361***	1														
FRQ_KASZ	0.199***	0.287***	1													
FRQ_DD	−0.004	0.077*	0.446***	1												
Aggreg	0.261***	0.610***	0.801***	0.738***	1											
STDebt	0.228***	−0.120***	−0.172***	−0.332***	−0.283***	1										
LnSales	−0.120***	−0.012	0.013	0.019	0.015	−0.243***	1									
LnAge	−0.040	−0.087**	0.001	−0.0401	−0.042	−0.065	0.265***	1								
Tang	−0.085**	0.214***	0.229***	0.240***	0.317***	−0.468***	0.050	−0.153***	1							
StdCFO	−0.078*	−0.221***	−0.283***	−0.282***	−0.364***	0.185***	−0.102***	−0.032	−0.319**	1						
StdSales	−0.142***	−0.162***	−0.031	0.007	−0.063	0.053	0.017	−0.012	−0.169***	0.173***	1					
Qtobin	0.073*	0.011	−0.120***	−0.342***	−0.205***	0.192***	0.040	0.019	−0.287***	0.157***	−0.049	1				
Z	0.200***	0.099**	−0.103***	−0.357***	−0.159***	0.442***	−0.128***	0.153***	−0.177***	0.123***	−0.028	0.692***	1			
Loss	−0.010	0.016	−0.040	−0.086**	−0.066	−0.099**	−0.168***	−0.015	−0.044	0.050	0.116***	−0.041	−0.138***	1		
CFO_ATA	0.072	0.080*	−0.033	−0.219***	−0.073	0.169***	0.171***	0.074*	0.030	−0.013	0.017	0.300***	0.377***	−0.276***	1	
Opercycle	0.063	0.028	−0.030	0.060	0.021	0.044	−0.374***	0.074*	−0.185***	0.031	−0.150***	0.034	−0.024	0.021	−0.212***	1

See Table 1 for definitions of variables.
*** Significance at the 1% level.
** Significance at the 5% level.
* Significance at the 10% level.

Table 3
Regression of investment efficiency on FRQ, debt maturity and control variables.

	1	2	3	4
FRQ_MNST	0.979***			
	(4.13)			
FRQ_KASZ		0.762**		
		(2.40)		
FRQ_DD			0.416	
			(1.21)	
Aggreg				0.086***
				(3.04)
STDebt	0.144***	0.134**	0.138**	0.175***
	(2.61)	(2.18)	(2.12)	(2.63)
LnSales	−0.005	−0.003	−0.006*	−0.005
	(−1.08)	(−0.71)	(−1.66)	(−1.26)
LnAge	0.007	0.004	0.005	0.007
	(0.93)	(0.67)	(0.80)	(0.90)
Tang	−0.065***	−0.059**	−0.058***	−0.082***
	(−2.97)	(−2.07)	(−3.84)	(−5.81)
StdCFO	−0.113	−0.132	−0.271	−0.060
	(−0.72)	(−0.97)	(−1.47)	(−0.47)
StdSales	−0.220**	−0.313***	−0.293**	−0.299***
	(−2.33)	(−2.62)	(−2.45)	(−2.65)
QTobin	−0.014*	−0.021***	−0.018**	−0.012*
	(−1.91)	(−4.05)	(−2.33)	(−1.72)
Z	0.011*	0.019***	0.019***	0.016***
	(1.74)	(3.89)	(3.05)	(2.58)
Loss	0.016	0.035*	0.032	0.040*
	(0.72)	(1.65)	(1.26)	(1.72)
CFO_ATA	-4.34×10^{-4}	0.041	0.021	0.026
	(−0.01)	(0.64)	(0.41)	(0.34)
Opercycle	6.23×10^{-6}	2.42×10^{-5} *	3.59×10^{-6}	1.13×10^{-6}
	(0.43)	(1.70)	(0.23)	(0.06)
Intercept	−0.073	−0.097	−0.063	−0.147
	(−0.83)	(−0.99)	(−0.75)	(−1.55)
Industry dummies	Yes	Yes	Yes	Yes
R^2	0.235	0.171	0.125	0.224
F	3.38	2.81	2.25	2.57
$p > F$	0.000	0.000	0.002	0.000
Obs.	576	576	500	500

See Table 1 for definitions of variables.
All the estimates have been carried out using pooled time-series cross-sectional regressions OLS coefficients.
t-Statistics clustered at the firm and year level (Petersen, 2009) robust both to heteroskedasticity and within firm serial correlation in brackets.
*** Significance at the 1% level.
** Significance at the 5% level.
* Significance at the 10% level.

Aggreg, and $p < 0.05$ for *FRQ_Kasznik*). These results are in line with those reported by Biddle et al. (2009) and Chen et al. (2011), and confirm our *H1* that higher FRQ improves investment efficiency.

Additionally, in Eq. (1) we test the debt maturity effect on investment efficiency. In all four models, the *STDebt* variable presents a positive and significant coefficient, showing that shorter maturities increase investment efficiency, which is consistent with *H2*.

In terms of the control variables, in all our models tangibility (*Tang*) has a significant and negative coefficient, showing that a higher volume of tangible assets leads to lower investment efficiency. Moreover, higher financial strength, measured by *Z*, is associated with higher investment efficiency, whereas higher sales volatility and Tobin's *Q* have a negative impact on investment efficiency. These findings are consistent with previous studies.

We perform our analysis of investment efficiency distinguishing two alternative scenarios, overinvestment and underinvestment, represented by positive and negative residuals in the investment efficiency model. We consider as dependent variables: (a) in the overinvestment scenario, the positive deviations (positive residuals) with regard to expected investment multiplied by −1 (higher values, i.e., closer to zero, indicate lower overinvestment, that is, higher efficiency); and (b) in the underinvestment scenario, the negative deviations with regard to expected investment (higher values, i.e., closer to zero, indicate lower underinvestment, that is, higher efficiency). Thus, our overinvestment and underinvestment variables are increasing in investment efficiency. Table 4 presents the results for investment efficiency in overinvestment and underinvestment scenarios. The first four models correspond to regressions using overinvestment as the dependent variable, while the remaining models (5–8) use underinvestment as the dependent variable.

In an overinvestment situation, FRQ contributes to decreasing investment excess. We note that all coefficients are positive and significant, indicating that higher FRQ reduces the overinvestment problem (we confirm *H1a*), that is, it is a mechanism that help firms to decrease their investment and so move towards their optimal level. These findings seem to support the view that higher FRQ helps control the overinvestment carried out by management in order to expropriate minority shareholders and creditors. However, in an underinvestment scenario, FRQ has no significant effect on enhancing efficiency, suggesting that in those firms with lower investment than expected FRQ is not effective in increasing the investment level. Regarding debt maturity, we obtain, in general, that lower debt maturity contributes to improving investment efficiency by decreasing both overinvestment (*H2a*) and underinvestment (*H2b*). This evidence is consistent with Childs et al. (2005).

4.3. Analysis extension

In this section we extend the previous analyses by testing whether higher use of short-term debt decreases or increases the FRQ effect on investment efficiency. We define *DumSTDebt*, as a dummy variable that takes the value 1 if short-term debt is higher than the median, and zero if it is lower than the median. In Table 5 we estimate Eq. (2) including the interaction effect between the aggregate measure of FRQ (*Aggreg*) and *DumSTDebt*.

As we have obtained in previous models, both *FRQ* and *STDebt* have positive and significant coefficients ($p < 0.01$) in the general model of investment efficiency. For those firms that have lower *STDebt*, the coefficient of FRQ is 0.168 ($p < 0.01$), whereas for those firms with higher short-term debt, the FRQ effect is lower ($\beta_3 < 0$), and its effect is given by $\beta_1 + \beta_3 = 0.023$ ($p < 0.01$). Therefore, for firms which have lower short-term finance, the FRQ effect (0.168) on investment efficiency is higher than for firms with a higher short-term debt level (0.023).

These findings prove that *FRQ* and *STDebt* are mechanisms with some degree of substitution in improving investment efficiency; a firm mitigates investment inefficiency by preparing information with higher quality or by using shorter maturities (we confirm $H3_1$).

If we divide our sample into overinvestment and underinvestment scenarios, the results show that *STDebt* improves investment efficiency in both contexts. As regards the association between *FRQ* and investment efficiency, in firms that overinvest and that have higher use of short-term debt, the FRQ effect on investment efficiency is given by $\beta_1 + \beta_3 = 0.048$ ($p < 0.05$), with $\beta_3 < 0$. Instead, for firms that have a lower short-term debt level (higher maturities), the FRQ effect is positive and significant (0.186) and it is higher than for firms with higher *STDebt*, (0.048). These conclusions in an overinvestment situation confirm the results obtained in the general model of investment efficiency and confirm our hypothesis $H3_1a$. With respect to the underinvestment scenario, we find that firms that have a higher use of short-term debt show a FRQ effect close to zero. For those firms with lower short-term debt level, *FRQ* is positive and close to be significant at conventional levels ($H3_1b$). This suggests that FRQ is more relevant for reducing overinvestment than underinvestment and that has a stronger effect when the short-term debt level is low, whereas debt maturity is effective

Table 4
Regression of overinvestment and underinvestment on FRQ, debt maturity and control variables, Overinvestment (1–4); Underinvestment (5–8).

	1	2	3	4	5	6	7	8
FRQ_MNST	1.265***				0.039			
	(6.26)				(0.30)			
FRQ_KASZ		1.008**				−0.037		
		(2.43)				(−0.41)		
FRQ_DD			0.925*				−0.074	
			(1.82)				(−0.87)	
Aggreg				0.128***				−0.001
				(5.79)				(−0.19)
STDebt	0.236**	0.200*	0.197**	0.247**	0.048	0.046	0.065**	0.067**
	(2.08)	(1.75)	(2.05)	(2.23)	(1.50)	(1.43)	(2.03)	(1.96)
LnSales	−0.004	−0.003	−0.011	−0.007	−0.005**	−0.005*	−0.004	−0.004
	(−0.35)	(−0.30)	(−0.91)	(−0.60)	(−2.00)	(−1.89)	(−1.38)	(−1.39)
LnAge	0.013	0.010	0.012	0.010	0.005*	0.005	0.004	0.004
	(0.74)	(0.49)	(0.72)	(0.44)	(1.68)	(1.56)	(1.25)	(1.29)
Tang	−0.094	−0.070	−0.129*	−0.136	0.026	0.029	0.034	0.034
	(−1.10)	(−0.76)	(−1.75)	(−1.44)	(1.03)	(1.34)	(1.25)	(1.26)
StdCFO	−0.458	−0.384	−0.706*	−0.378	−0.032	−0.047	−0.029	−0.027
	(−1.37)	(−1.21)	(−1.71)	(−1.37)	(−0.92)	(−1.38)	(−0.91)	(−0.86)
StdSales	−0.321	−0.467**	−0.490*	−0.464*	−0.007	−0.002	−0.001	−0.002
	(−1.64)	(−1.99)	(−1.75)	(−1.87)	(−0.12)	(−0.03)	(−0.01)	(−0.03)
QTobin	−0.027	−0.033	−0.063***	−0.019	0.001	0.001	0.003	0.003
	(−1.24)	(−1.40)	(−2.95)	(−0.68)	(0.22)	(0.38)	(0.65)	(0.75)
Z	0.018	0.024**	0.040***	0.022	0.002	0.002	6.84×10^{-5}	1.92×10^{-4}
	(1.47)	(2.24)	(3.41)	(1.58)	(0.60)	(0.70)	(0.02)	(0.07)
Loss	0.009	0.039	0.048	0.055	−0.010	−0.010	−0.001	-3.24×10^{-4}
	(0.20)	(0.77)	(0.73)	(0.87)	(−0.99)	(−0.97)	(−0.10)	(−0.03)
CFO_ATA	−0.044	0.111	0.126	0.097	0.056	0.055	0.037	0.037
	(−0.32)	(0.98)	(1.22)	(0.66)	(1.30)	(1.28)	(0.80)	(0.81)
Opercycle	1.68×10^{-5}	7.36×10^{-5} *	3.98×10^{-5}	4.88×10^{-5}	2.32×10^{-6}	3.33×10^{-6}	5.15×10^{-6}	4.68×10^{-6}
	(0.36)	(1.81)	(0.53)	(0.68)	(0.28)	(0.42)	(0.62)	(0.53)
Intercept	−0.123	−0.144	−0.004	−0.156	−0.049	−0.055	−0.082	−0.083
	(−0.62)	(−0.74)	(−0.02)	(−0.92)	(−0.88)	(−0.99)	(−1.46)	(−1.41)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.328	0.233	0.200	0.331	0.096	0.096	0.095	0.093
F	3.78	2.62	4.56	4.37	2.26	2.18	1.81	1.81
$p > F$	0.000	0.001	0.000	0.000	0.003	0.004	0.024	0.025
Obs.	275	275	230	230	301	301	270	270

See Table 1 for definitions of variables.
All the estimates have been carried out using pooled time-series cross-sectional regressions OLS coefficients.
t-Statistics clustered at the firm and year level (Petersen, 2009) robust both to heteroskedasticity and within firm serial correlation in brackets.
*** Significance at the 1% level.
** Significance at the 5% level.
* Significance at the 10% level.

reducing both overinvestment and underinvestment. There is some relation between our findings and those of Beatty et al. (2010), who examine the role of public and private information in investment decisions and find that accounting quality has a larger influence on investment-cash flow sensitivity for firms with less access to private information, i.e., those with public debt, than for firms with private (bank) debt. Our findings add to theirs the relevance of the debt term and suggest that the closer and frequent relation that allows short term debt with respect to long term debt enhances this monitoring through private information, especially in an environment like Spain where most financial resources proceed from private debt.

4.4. Robustness checks

In this section we conduct additional robustness tests of the reported results.

4.4.1. Alternative investment efficiency model

We reestimate the expected level of investment following the model developed by Chen et al. (2011). This model adds an independent dummy variable (*NEG*) because the authors consider that the relation between investment and sales growth could differ in the case of positive or negative growth.

$$Investment_{i,t} = \beta_0 + \beta_1 NEG_{i,t-1} + \beta_2 SalesGrowth_{i,t-1} + \beta_3 NEG_{i,t-1} * SalesGrowth_{i,t-1} + \varepsilon_{i,t} \quad (7)$$

where $NEG_{i,t-1}$ is a dummy variable that takes value 1 for negative sales growth, and 0 otherwise, and the rest of variables are defined as above.

The results of estimating Eq. (1) using this investment efficiency proxy are similar to those previously reported, as displayed in Table 6.

Higher *FRQ* enhances investment efficiency. For overinvestment firms, a higher *FRQ* reduces overinvestment, and for underinvestment firms, *FRQ* has no significant effect. *STDebt* increases investment efficiency in the two contexts: a greater use of short-term debt reduces overinvestment and underinvestment problems.

4.4.2. Investment efficiency model with 25 and 75 STDebt percentiles

In this section, we employ two alternative measures to interact FRQ and debt maturity: first, we divide our sample between those firms that have *STDebt* levels below percentile 25 (48%), in which case *DumSTDebt* takes value 1, and firms that have short-term debt levels above this percentile, in which case *DumSTDebt* takes value 0. Second, we separate the sample between those firms that present short-term debt levels above percentile 75 (77%), in which case the variable takes value 1, and firms below this level, in which case

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Table 5
Regression of investment efficiency on FRQ, debt maturity, and interaction (I).

	InvEff	Overinvestment	Underinvestment
FRQ	0.168***	0.186***	0.024
	(4.00)	(5.13)	(1.56)
STDebt	0.200***	0.238**	0.083**
	(3.36)	(2.49)	(2.26)
FRQ*DumSTDebt	−0.145***	−0.138***	−0.031**
	(−3.20)	(−2.63)	(−2.22)
LnSales	−0.007*	−0.009	−0.004*
	(−1.70)	(−0.71)	(−1.66)
LnAge	0.012	0.013	0.005**
	(0.96)	(0.50)	(2.07)
Tang	−0.102***	−0.160*	0.027
	(−4.36)	(−1.65)	(0.94)
StdCFO	−0.121	−0.415	−0.033
	(−0.85)	(−1.58)	(−0.85)
StdSales	−0.298***	−0.464*	−0.008
	(−2.66)	(−1.83)	(−0.13)
QTobin	−0.017***	−0.032	0.002
	(−2.76)	(−1.33)	(0.45)
Z	0.015**	0.024	2.36×10^{-4}
	(2.38)	(1.56)	(0.08)
Loss	0.040*	0.063	0.001
	(1.73)	(0.96)	(0.05)
CFO_ATA	0.014	0.072	0.036
	(0.18)	(0.40)	(0.86)
Opercycle	2.91×10^{-6}	5.22×10^{-5}	3.77×10^{-6}
	(0.15)	(0.77)	(0.40)
Intercept	−0.126	−0.119	−0.086
	(−1.30)	(−0.59)	(−1.39)
Industry dummies	Yes	Yes	Yes
Test $\beta_1 + \beta_3$	5.93***	4.63**	2.14
R^2	0.307	0.378	0.109
F	3.17	4.51	2.41
$p > F$	0.000	0.000	0.001
Obs.	500	230	270

See Table 1 for definitions of variables.
FRQ is the aggregate measure of the three proxies of FRQ (*FRQ_MNST; FRQ_KASZ; FRQ_DD*); *DumSTDebt* takes value 1 if short-term debt is higher than the median (0.62), and 0 otherwise. For the remaining variables see Table 1.
All the estimates have been carried out using pooled time-series cross-sectional regressions OLS coefficients.
t-Statistics clustered at the firm and year level (Petersen, 2009) robust both to heteroskedasticity and within firm serial correlation in brackets.
*** Significance at the 1% level.
** Significance at the 5% level.
* Significance at the 10% level.

Table 6
Regression of investment efficiency (model of Chen et al., 2011) on FRQ, debt maturity and control variables.

	InvEff	Overinvestment	Underinvestment
FRQ	0.085***	0.128***	-6.74×10^{-4}
	(3.13)	(5.91)	(−0.10)
STDebt	0.177***	0.244**	0.076**
	(2.71)	(2.22)	(2.10)
LnSales	−0.005	−0.007	−0.004
	(−1.20)	(−0.56)	(−1.45)
LnAge	0.006	0.008	0.002
	(0.68)	(0.36)	(0.69)
Tang	−0.077***	−0.136	0.042
	(−15.01)	(−1.48)	(1.50)
StdCFO	−0.058	−0.362	−0.029
	(−0.47)	(−1.31)	(−0.91)
StdSales	−0.287***	−0.463*	0.011
	(−2.62)	(−1.88)	(0.17)
QTobin	−0.013*	−0.018	0.002
	(−1.91)	(−0.65)	(0.51)
Z	0.016***	0.022	0.001
	(2.64)	(1.58)	(0.36)
Loss	0.042*	0.056	0.004
	(1.86)	(0.91)	(0.43)
CFO_ATA	0.027	0.108	0.031
	(0.38)	(0.76)	(0.77)
Opercycle	2.94×10^{-6}	4.54×10^{-5}	8.72×10^{-6}
	(0.15)	(0.66)	(1.07)
Intercept	−0.147	−0.152	−0.088
	(−1.53)	(−0.90)	(−1.54)
Industry dummies	Yes	Yes	Yes
R^2	0.226	0.330	0.113
F	2.64	2.50	2.06
$p > F$	0.000	0.001	0.008
Obs.	500	230	270

See Table 1 for definitions of variables.
FRQ is the aggregate measure of the three proxies of FRQ (*FRQ_MNST; FRQ_KASZ; FRQ_DD*).
All the estimates have been carried out using pooled time-series cross-sectional regressions OLS coefficients.
t-Statistics clustered at the firm and year level (Petersen, 2009) robust both to heteroskedasticity and within firm serial correlation in brackets.
*** Significance at the 1% level.
** Significance at the 5% level.
* Significance at the 10% level.

the variable takes value 0. In Table 7 we show the results for the estimation of equation (2) when adopting the percentile 25 as short-term debt dummy.

The results obtained confirm the previous analysis: *STDebt* improves investment efficiency, reducing both overinvestment and underinvestment, whereas *FRQ* reduces overinvestment and has a stronger effect with higher maturities. In the general model, for those firms that have lower short-term debt, the effect of FRQ on investment efficiency is determined by $\beta_1 + \beta_3 = 0.207$ ($p < 0.01$), whereas for firms that have a higher degree of short-term debt the FRQ effect on efficiency is smaller (0.042). For companies that overinvest and present lower short-term debt, the FRQ repercussion is $\beta_1 + \beta_3 = 0.225$ ($p < 0.01$), which is greater than for companies with higher short-term debt (0.064). With regards those companies that underinvest and have lower short-term debt, FRQ repercussion on reducing underinvestment is provided by $\beta_1 + \beta_3 = 0.025$, which is not significant, while for those companies with a greater degree of short-term debt the FRQ effect on underinvestment is close to zero.

In Table 8 we perform a similar analysis, but taking percentile 75 as a dummy variable of short-term debt.

We observe the same results as before: *STDebt* enhances investment efficiency and as firms increase the level of short-term debt, the effect of FRQ on investment efficiency decreases ($\beta_3 < 0$ in the general and overinvestment models). Hence, if the use of short-term debt is reduced, FRQ takes a more active role in efficiency, whereas if short-term debt increases, the role of FRQ declines. In short, we conclude that both mechanisms play a substitutive role in enhancing investment efficiency.

4.4.3. Endogeneity issues

In this section we consider the potential endogeneity issue between short-term debt and FRQ. Recently, Bharath et al. (2008) and García-Teruel et al. (2010) suggest that firms with higher FRQ can obtain a longer maturity than those firms with lower FRQ. To address this possible concern of endogeneity between debt maturity and FRQ, we employ several robustness checks. First, we estimate our models using a two-stage regression. With this procedure, we estimate, in the first stage, the short-term debt level for each firm and use this estimate in the general model of investment efficiency. We adopt the following model in the first stage:

$$\begin{aligned} STDebt_{i,t} = {} & \beta_0 + \beta_1 FRQ_{i,t} + \beta_2 Z_{i,t} + \beta_3 Z^2_{i,t} + \beta_4 QTobin_{i,t} \\ & + \beta_5 AM_{i,t} + \beta_6 LnSize_{i,t} + \beta_7 LnAge_{i,t} + \beta_8 Tax_{i,t} \\ & + \beta_9 Lev_{i,t} + \beta_{10} IntDif_{i,t} + \beta_{11} StdSales_{i,t} + \varepsilon_{i,t} \end{aligned} \quad (8)$$

where *STDebt* is the ratio of short-term debt over total debt. *FRQ* is the aggregate proxy of FRQ; *Z* is the financial strength; *QTobin* is

Table 7
Regression of investment efficiency on FRQ, debt maturity, and interaction (II).

	InvEff	Overinvestment	Underinvestment
FRQ	0.042***	0.064***	−0.004
	(2.80)	(3.71)	(−0.64)
STDebt	0.180***	0.210**	0.078**
	(3.35)	(2.37)	(2.15)
FRQ*DumSTDebt	0.165***	0.161***	0.029*
	(4.91)	(4.51)	(1.85)
LnSales	−0.008**	−0.009	−0.004
	(−2.01)	(−0.81)	(−1.60)
LnAge	0.006	0.008	0.004
	(0.56)	(0.35)	(1.60)
Tang	−0.116***	−0.189**	0.029
	(−7.03)	(−2.07)	(1.11)
StdCFO	−0.137	−0.429**	−0.037
	(−1.22)	(−1.96)	(−1.18)
StdSales	−0.278**	−0.461*	0.001
	(−2.11)	(−1.65)	(0.02)
QTobin	−0.017**	−0.039*	0.003
	(−2.44)	(−1.76)	(0.69)
Z	0.016**	0.028*	3.41×10^{-5}
	(2.19)	(1.87)	(0.01)
Loss	0.040	0.056	4.90×10^{-4}
	(1.45)	(0.73)	(0.05)
CFO_ATA	0.029	0.071	0.040
	(0.36)	(0.39)	(0.85)
Opercycle	-3.45×10^{-6}	3.30×10^{-5}	4.09×10^{-6}
	(−0.19)	(0.49)	(0.45)
Intercept	−0.074	−0.048	−0.077
	(−0.84)	(−0.27)	(−1.31)
Industry dummies	Yes	Yes	Yes
Test $\beta_1 + \beta_3$	36.35***	66.04***	1.98
R^2	0.315	0.393	0.102
F	3.04	3.38	2.05
$p > F$	0.000	0.000	0.007
Obs.	500	230	270

See Table 1 for definitions of variables.
FRQ is the aggregate measure of the three proxies of FRQ (*FRQ_MNST; FRQ_KASZ; FRQ_DD*); *DumSTDebt* takes value 1 if short-term debt is lower than the 25 percentile (0.48), and 0 otherwise. For the remaining variables see Table 1.
All the estimates have been carried out using pooled time-series cross-sectional regressions OLS coefficients.
t-Statistics clustered at the firm and year level (Petersen, 2009) robust both to heteroskedasticity and within firm serial correlation in brackets.
*** Significance at the 1% level.
** Significance at the 5% level.
* Significance at the 10% level.

Table 8
Regression of investment efficiency on FRQ, debt maturity, and interaction (III).

	InvEff	Overinvestment	Underinvestment
FRQ	0.117***	0.155***	−0.004
	(3.12)	(4.99)	(−0.33)
STDebt	0.164***	0.220**	0.067*
	(3.02)	(2.39)	(1.90)
FRQ*DumSTDebt	−0.098**	−0.114**	0.005
	(−2.36)	(−2.49)	(0.43)
LnSales	−0.007	−0.010	−0.004
	(−1.44)	(−0.72)	(−1.36)
LnAge	0.012	0.015	0.004
	(0.99)	(0.58)	(1.23)
Tang	−0.087***	−0.143	0.035
	(−5.65)	(−1.49)	(1.29)
StdCFO	−0.071	−0.345	−0.026
	(−0.56)	(−1.30)	(−0.85)
StdSales	−0.283***	−0.437*	−0.002
	(−2.81)	(−1.84)	(−0.03)
QTobin	−0.018***	−0.024	0.004
	(−2.72)	(−0.92)	(0.85)
Z	0.017***	0.022	2.66×10^{-5}
	(2.70)	(1.48)	(0.01)
Loss	0.047**	0.056	−0.001
	(2.12)	(0.87)	(−0.10)
CFO_ATA	0.040	0.108	0.036
	(0.58)	(0.69)	(0.79)
Opercycle	9.21×10^{-6}	6.14×10^{-5}	4.38×10^{-6}
	(0.58)	(0.97)	(0.50)
Intercept	−0.131	−0.123	−0.082
	(−1.55)	(−0.63)	(−1.39)
Industry dummies	Yes	Yes	Yes
Test $\beta_1 + \beta_3$	2.64*	4.54**	0.12
R^2	0.257	0.354	0.094
F	2.97	3.55	1.76
$p > F$	0.000	0.000	0.028
Obs.	500	230	270

See Table 1 for definitions of variables.
FRQ is the aggregate measure of the three proxies of FRQ (*FRQ_MNST; FRQ_KASZ; FRQ_DD*); *DumSTDebt* takes value 1 if short-term debt is higher than the 75 percentile (0.77), and 0 otherwise. For the remaining variables see Table 1.
All the estimates have been carried out using pooled time-series cross-sectional regressions OLS coefficients.
t-Statistics clustered at the firm and year level (Petersen, 2009) robust both to heteroskedasticity and within firm serial correlation in brackets.
*** Significance at the 1% level.
** Significance at the 5% level.
* Significance at the 10% level.

growth options, expressed by Tobin's *Q*; *AM* is asset maturity, calculated by Jun and Jen (2003)'s model; *LnSize* is firm size, measured by the log of market value; *LnAge* is the log of age; *Tax* is the corporate tax rate; *Lev* is the level of debt; *Int_Dif* is the interest rate differential between long (10 year) and short (1 year) debt; *StdSales* is the standard deviation of sales from $t-2$ to t. The results of the first stage confirm that higher FRQ is associated with a reduction of short-term debt. In the first column of Table 9 we present the results of our model, replacing the original short-term debt variable by its estimation in Eq. (8).

After controlling for the possible endogeneity of short-term debt and FRQ, our findings are not affected. The results corroborate the hypotheses that higher FRQ and higher use of short-term debt help to improve investment efficiency, and that the effect of FRQ on investment efficiency is higher for those firms with lower short-term debt ($\beta_3 < 0$), thus confirming our previous results about the substitution role of FRQ and short-term debt.

4.4.4. Main variables reestimation

Since discretionary accruals are the central components of FRQ, and positive discretionary accruals that overstate earnings in one year are followed by negative discretionary accruals due to the reversion process of accruals, we reconsider our aggregate measure of FRQ and calculate, following Hutton et al. (2009), a new measure of FRQ as the average, from $t-2$ to t, of the aggregate FRQ measure. With this approach, we aim to solve the reversion process of accruals and assess the robustness of results with a variable that reflects the tendency of the firm to manipulate earnings across a three-year horizon. Likewise, for homogeneity, we also calculate the other main variable of our study, *STDebt*, as the average from $t-2$ to t.

Taking these alternative specifications into consideration, the tabulated results in column 2 of Table 9 are similar to those previously reported. *STDebt* improves investment efficiency ($\beta_2 > 0$) and *FRQ* improves investment efficiency for those firms with higher maturities ($\beta_1 > 0$). However, in firms with higher use of short-term debt, the FRQ effect is not significant ($\beta_1 + \beta_3$ is not significantly different from zero).

4.4.5. Alternative estimation method

Finally, we repeat our analysis by using the generalized method of moments (GMM). We use the two-step system GMM, and since a minimum of 5 consecutive years is required, we lose some

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Table 9
Two-stage regression (1), Reestimation of variables (2).

	2SLS(1)	Reestimation of main variables (2)
FRQ	0.210***	0.144**
	(4.70)	(2.04)
STDebt	0.588***	0.099*
	(2.62)	(1.84)
FRQ*DumSTDebt	−0.164***	−0.135*
	(−4.45)	(−1.95)
LnSales	0.004	−0.009
	(0.49)	(−1.20)
LnAge	0.012	0.018
	(1.16)	(1.64)
Tang	0.045	−0.138***
	(0.51)	(−12.49)
StdCFO	−0.100	−0.325
	(−0.78)	(−1.27)
StdSales	−0.190**	−0.634***
	(−2.15)	(−3.51)
QTobin	0.012	−0.036*
	(0.84)	(−1.85)
Z	−0.009	0.028***
	(−0.53)	(3.66)
Loss	0.049**	0.050
	(2.19)	(1.49)
CFO_ATA	0.096*	0.108*
	(1.69)	(1.68)
Opercycle	3.58×10^{-5}***	-4.71×10^{-6}
	(2.74)	(−0.16)
Intercept	−0.597**	−0.035
	(−2.40)	(−0.58)
Industry dummies	Yes	Yes
Test $\beta_1 + \beta_3$	9.20***	0.10
R^2	0.303	0.200
F	2.58	1.97
$p > F$	0.000	0.010
Obs.	500	290

See Table 1 for definitions of variables.
The dependent variable in all models is investment efficiency; *FRQ* is the aggregate measure of the three proxies of FRQ (*FRQ_MNST; FRQ_KASZ; FRQ_DD*); *DumSTDebt* takes value 1 if estimated short-term debt is higher than the median (0.62), and 0 otherwise.
Model 1: STDebt is the estimated variable in the first stage.
Model 2: *FRQ* and *STDebt* variables are calculated as the mean from $t-2$ to *t*.
All the estimates have been carried out using pooled time-series cross-sectional regressions OLS coefficients.
t-Statistics clustered at the firm and year level (Petersen, 2009) robust both to heteroskedasticity and within firm serial correlation in brackets.
*** Significance at the 1% level.
** Significance at the 5% level.
* Significance at the 10% level.

observations and estimate the general model of investment efficiency with a sample of 363 observations:

$$InvEff_{i,t} = \beta_1 FRQ_{i,t} + \beta_2 STDebt_{i,t} + \beta_3 (FRQ_{i,t} * DumSTDebt_{i,t}) + \beta_4 LnSales_{i,t} + \beta_5 LnAge_{i,t} + \beta_6 Tang_{i,t} + \beta_7 StdCFO_{i,t} + \beta_8 Std\,Revenues_{i,t} + \beta_9 QTobin_{i,t} + \beta_{10} Z_{i,t} + \beta_{11} Loss_{i,t} + \beta_{12} CFO\_ATA_{i,t} + \beta_{13} Opercycle_{i,t} + \eta_i + \lambda_t + \upsilon_{i,t} \quad (9)$$

where the variables are defined as in Eq. (1), and η_i (unobservable heterogeneity) is designed to measure unobservable firms' characteristics that have a significant impact on investment efficiency. These attributes are different across firms but are constant for each firm. λ_t are temporary dummy variables that change over time, but are the same for all firms in each year considered. Finally, $\upsilon_{i,t}$ is the error term.

Our results, shown in Table 10, are similar to those previously reported, but with the addition that in these estimates FRQ may also reduce underinvestment: *FRQ* and *STDebt* are mechanisms that

Table 10
GMM regressions.

	InvEff	Overinvestment	Underinvestment
FRQ	0.154***	0.201***	0.078***
	(15.11)	(14.66)	(8.78)
STDebt	0.109**	0.172***	0.063**
	(2.30)	(3.22)	(2.29)
FRQ*DumSTDebt	−0.131***	−0.180***	−0.053***
	(−11.17)	(−9.22)	(−6.15)
LnSales	−0.002	−0.013**	-2.64×10^{-4}
	(−0.29)	(−2.29)	(−0.12)
LnAge	−0.002	0.025	−0.001
	(−0.06)	(1.12)	(−0.25)
Tang	−0.308***	−0.106*	−0.164***
	(−5.19)	(−1.71)	(−5.06)
StdCFO	−0.164	−0.192	−0.055
	(−1.61)	(−0.95)	(−0.75)
StdSales	−0.349***	−0.763***	−0.318***
	(−3.83)	(−9.81)	(−6.80)
QTobin	−0.076***	−0.083***	−0.046***
	(−3.77)	(−3.58)	(−4.23)
Z	0.047***	0.043***	0.021**
	(4.24)	(5.81)	(2.20)
Loss	0.048***	0.049**	−0.005
	(3.04)	(2.00)	(−0.48)
CFO_ATA	−0.020	−0.081	−0.165***
	(−0.29)	(−1.39)	(−7.97)
Opercycle	-7.23×10^{-6}	-1.14×10^{-4}***	8.21×10^{-6}
	(−0.26)	(−3.45)	(0.75)
Test $\beta_1 + \beta_3$	7.60***	5.88**	15.12***
Hansen	40.49 (159)	32.32 (127)	36.51 (130)
m2	0.685	0.476	0.335
Obs.	363	174	189

The estimations have been carried out using the 2-stage system-GMM estimator.
Hansen is the test for over-identifying restrictions distributed asymptotically under null hypothesis of validity of instruments as a chi-squared. Degrees of freedom in brackets.
m_2 is the the *p* value of the Arellano–Bond test for second-order serial autocorrelation in residuals in first differences under the null hypothesis of no serial correlation.
For definition of variables see Tables 1 and 5.
FRQ is the aggregate measure of the three proxies of FRQ (*FRQ_MNST; FRQ_KASZ; FRQ_DD*).
z-Statistics in brackets.

improve investment efficiency (β_1 and $\beta_2 > 0$) in all scenarios, and that present a substitutive effect ($\beta_3 < 0$), so the effect of *FRQ* is higher in those firms with lower *STDebt*. Nevertheless, since we use a reduced number of observations and the overinvestment and underinvestment regressions have been carried out without a minimum of 5 consecutive years in all firms, we prefer to be more cautious about the results for these scenarios.

5. Conclusions

In this paper we analyze the effect of FRQ and debt maturity on investment efficiency, using a representative sample of Spanish listed firms for the period 1998–2008. The results indicate that higher FRQ and higher use of short-term debt (lower debt maturity) increase investment efficiency. However, if we distinguish between overinvestment and underinvestment, FRQ plays a role in reducing overinvestment. In contrast, lower debt maturity is a mechanism that contributes positively to improving investment efficiency in both scenarios.

In addition, we find evidence that FRQ and lower debt maturity have a substitute relationship in improving investment efficiency: in those firms with lower short-term debt, the FRQ effect on investment efficiency is higher than for those firms with a higher degree of short-term debt. This suggests that in firms with lower FRQ, debt maturity is the main mechanism that is used by creditors to control managers' behavior and to avoid expropriation. On the other hand, in those firms that present higher FRQ, accounting information may be used to monitor investment inefficiency problems.

These results contribute to the literature of investment efficiency showing that, in a context where FRQ plays a less significant role than in Anglo-Saxon countries in reducing information asymmetries, the shorter maturity of debt is a valid alternative for monitoring managers and affect investment efficiency. Our findings also contribute to the literature on the role of public and private information in investment decisions, and they extend this research by suggesting that, from private information perspective, short term debt is relevant to increase the monitoring of managers and mitigates the importance of FRQ as a mechanism to reduce information asymmetries. This is a significant finding for institutional contexts like Spain, where private debt constitutes the main source of financing and public debt is almost absent, since they show that the choice of the debt term do have important implications with relation to investment. The findings also have relevant implications for creditors, managers and researchers since they help understand the economic consequences of corporate financial and accounting policies in investment decisions.

Our study has some limitations. First, as in other studies on FRQ and investment efficiency, these proxies are subjected to measurement error, and neither can the proxy for debt maturity be as refined as in studies with U.S. data. Second, the role of debt maturity and FRQ may differ according to institutional features, such as the level of creditor rights and enforcement, so these results may not be generalized to other contexts. Nevertheless, we think this also constitutes an opportunity to extend our research. In this sense, the economic implications on investment of accounting and financial policies could be examined in different frameworks of ownership (public and private firms), development of the market value, enforcement and investor protection, which would shed light on the role played by FRQ and the different corporate financial policy in firms' investment decisions. For instance, the role that debt maturity plays in a country with the characteristics of Spain may be different to that played in a country such as U.S., where debt maturity structure could be less important than debt ownership (private/public) to the efficient monitoring of managers, and even the demand of higher FRQ may reduce, in comparison to our sample, the need for private debt to undertake this. Thus, different corporate financial and accounting policies might be used to obtain the same target. We consider these interesting issues for future research.

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