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## AUTHORS

Konstantinos Drakos  
Christos Kallandranis

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## Firm-specific Attributes of Financing Constraints: The Case of Greek Listed Firms

Konstantinos Drakos, Christos Kallandranis<sup>1</sup>

### Abstract

An 'excess sensitivity' of investment to internal funds (cash flow) is typically interpreted as evidence for the presence of financing constraints. Building on this, we empirically investigate the possibility of an asymmetric response of business fixed investment to the availability of internal funds related to firm specific characteristics. According to our results the magnitude of this 'excess sensitivity' differs in compliance with firm's age size, leverage and dividend paying respectively. In particular, our empirical findings confirm the imperfection of the Greek capital market and highlight the differential impact of financing constraints across young and highly levered firms. Size and dividend payout behaviour do not appear to be useful proxies for the degree of asymmetric information and consequently cannot be used in order to assess financing constraints.

**Key words:** Cash Flow, Investment, Panel Data.

**JEL:** C33; E22; G31.

### 1. Introduction

An extensive body of the empirical literature on business fixed investment spending has focused on the effects of deviating from the paradigm of perfect capital markets. This deviation is characterised by *ex ante* and *ex post* asymmetries of information between lenders and borrowers, leading to an equilibrium outcome where the assumed perfect substitutability between internal and external sources of finance breaks down (Greenwald *et al.*, 1984; Myers and Majluf, 1984). As a consequence, the otherwise irrelevant, financial profile of firms becomes a signalling device of their ability to repay externally provided loans. Furthermore, internally generated funds emerge as the primary choice of funding investment plans either due to firms' inability to access the capital market or due to the higher associated cost when accessing it<sup>2</sup>. This is an important issue, since the way investment responds to cyclical variations in profits relies on whether availability of internal funds constrains capital expenditure (Bond and Meghir, 1994).

In contrast, under perfect capital markets firms are indifferent to funding their investment programmes with internal or external funds, since external funds are a perfect substitute for internal capital. Therefore, investment will depend on variables that are assumed to have a structural effect on its path without any reference to firm financial profile. Along these lines, Jorgenson (1963) and Hall and Jorgenson (1967) developed the neoclassical theory of investment where investment is primarily governed by the user cost of capital. The *q* theory of investment (Tobin, 1969), offers a reformulation of the neoclassical theory, posits that the ratio of a firm's market value to its replacement cost is the major determinant of its investment decisions. Abel and Blanchard (1986) develop the Sales Accelerator model, which identifies sales growth as a determinant of firm investment.

The empirical question whether (or not) the level of investment depends on corporate liquidity has drawn considerable attention since the seminal paper by Fazzari *et al.*, (1988). The existing empirical studies however, have been heavily lopsided towards developed economies, leaving us with limited evidence regarding developing economies. One would expect capital market imperfections to be more pronounced and having longer lasting effects in less mature markets

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<sup>2</sup> Both phenomena are different versions of Credit Rationing. The former describes the case where lenders deny credit, while the latter describes the so-called External Finance Premium.

such as those in developing economies (Erol, 2005). Consequently, developing economies emerge as the natural 'laboratory' environment within which frictions in the form of capital market imperfections could be explored. In the present study we focus on investment decisions of firms listed at the Athens Stock Exchange (ASE hereafter) during the 1993-2001 period. Greece is associated with some characteristics that place her in a unique position from a research point of view: (a) it has been rated by international agencies as an emerging market up until mid 1999, (b) it is the first emerging market that adopted the Euro, and (c) its capital market is bank-oriented.

The principal aim of this work is not only to study the relationship between investment decisions and financing constraints but also to take an extra step by considering the role of firm characteristics such as age, size, leverage and dividend payout behaviour. Exploring the nexus between financing constraints and investment activity under the prism of variables capturing firm-specific characteristics, may provide additional evidence for the information asymmetry between lenders and borrowers. Our results indicate that many of the previously used a priori groupings are indeed effective in classifying financial constrained firms. However, we find that certain groupings are more effective than others. In particular, age and leverage seem to be useful proxies for the degree of asymmetric information, while size and dividend distribution cannot be used in order to assess financing constraints.

The remaining of the paper is organized as follows: Section 2 discusses the relevant literature, Section 3 illustrates the empirical methodology, Section 4 describes the dataset, Section 5 provides the estimation results and finally Section 6 concludes.

## 2. Investment under Informational Asymmetries

Early research on investment, especially the work of Meyer and Kyh (1957), stressed the significance of financing constraints for business investment. Most of the studies since the middle 1960s, has however isolated real firm decisions from financial factors, with Modigliani and Miller (1958) characteristically demonstrating the so-called Irrelevance Theorem. Their main conclusion was that a firm's financial structure will not affect its market value in perfect capital markets. Applied to capital expenditure, a firm's financial status is irrelevant for real investment decisions in a world of perfect and complete capital markets. In particular, the neoclassical theory of investment developed by Jorgenson (1963) and Hall and Jorgenson (1967) advocates that a firm's optimization problem could be solved without reference to financial factors qualifying the user cost of capital as the sole determinant of investment. In a world without frictions (i.e. symmetric information, no taxes, no transaction costs and no other capital market imperfections) investment decisions would solely depend on whether the project at hand had a sufficiently positive net present value, and therefore could be financed by any combination of equity and/or debt capital.

In contrast, the irrelevance hypothesis fails when the capital market is imperfect due to asymmetric information, taking the form of firm managers (borrowers) possessing superior information in comparison with investors (lenders). This asymmetry between lenders and borrowers generates an equilibrium characterised by credit rationing (Stiglitz and Weiss, 1981). Further research showed that without fully collateralized loans, the firm's balance sheet profile is used as a signal for its credit-worthiness, and in addition the perfect substitutability of external and internally generated funds breaks down (Greenwald *et al.* 1984; Myers and Majluf, 1984; Bernanke and Gertler, 1990; Gertler, 1992). Consequently, a cost differential, known as the External Finance Premium, exists between external and internal funds, with the former being more costly than the latter. This leads to the so-called Financial Hierarchy, which implies that firms' wishing to fund their investment plans turn initially to own (internal) resources. External funds (borrowing or issuing shares) are not sought, until own resources are exhausted. Mayer (1990) provides evidence for this hierarchy, showing that across industries in eight developed countries retentions (own funds) are the leading source of finance, followed by debt (borrowing), and finally equity (issuing new shares).

### 3. Empirical Methodology

#### 3.1. Investment and Internal Funds

Fazzari *et al.* (1988) explored the nexus between financing constraints and investment activity conditioning on the Neoclassical, Sales Accelerator and Tobin's  $q$  models. In particular, the null hypothesis is that under the absence of capital market imperfections, a firm's investment decision and cash flow should be unrelated. Consequently, if a positive and significant relationship between cash flow and investment was established, it would signify the presence of market imperfections.

Our empirical model is based on the Sales Accelerator model introduced by Abel and Blanchard (1986), which assumes that investment grows with past sales. In other words, past sales reflect expectations of future profitability of investment. We choose not to include Tobin's  $q$  and user cost of capital for the following reasons. The estimation of  $q$  models is problematic since it is rather difficult to correctly measure the replacement value of assets. Moreover, given the excessive stock market volatility during the sample period in the Greek market,  $q$  may not reflect market fundamentals but instead be influenced by 'bubbles' or factors other than the present discounted value of expected future profits (Goergen and Renneboog, 2001; Bond *et al.*, 2004). Additionally, the theoretical model requires the measurement of a project's marginal  $q$ , however typically data considerations allow the researcher to only calculate the average  $q$ . This is inherently flawed since it reflects the average return on a company's total capital, whereas it is the marginal return on capital that is relevant (Chirinko and Schaller, 1995). Finally, studies focusing on firm-level data report coefficients on  $q$ , which are often insignificant or, if significant, suggest an implausibly slow adjustment (see Bond *et al.*, 2004 for an excellent review). Regarding the user cost of capital, we do not include such a measure due to unavailability of data on firm level.

In the empirical model we also control for age, size, financial leverage and dividend payout ratio which are thought to be fundamental aspects of a firm's profile<sup>1</sup>. Given the discussion above, our empirical specification models the investment cash flow relationship controlling for sales, financial leverage, dividend payout ratio, size and age as shown below:

$$\begin{aligned} \Delta(IK)_{i,t} = & \theta_0 [\Delta(IK)_{i,t-1}] + \theta_1 [\Delta(SK)_{i,t}] + \theta_2 [\Delta(CF)_{i,t}] + \theta_3 [\Delta(LEV)_{i,t}] + \theta_4 [\Delta(DIV)_{i,t}] \\ & + \theta_5 [\Delta(AGE)_{i,t}] + \theta_6 [\Delta(SIZE)_{i,t}] + \sum_{t=1993}^{2001} \tau_t (\text{time dummies}) + \varepsilon_{it} - \varepsilon_{i,t-1} \end{aligned} \quad (1)$$

where,  $i$  identifies company,  $t$  refers to the time period,  $\Delta$  denotes the first difference operator,  $\theta$ 's,  $\tau$ 's are unknown parameters to be estimated, and finally  $\varepsilon$  is a white noise disturbance term. Investment expenditure is denoted by  $IK$ ,  $SK$  denotes sales,  $CF$  is the value of internal funds,  $LEV$  stands for financial leverage,  $DIV$  is the percentage of distributed profits,  $AGE$  is the (log) age of the firm defined as years old since foundation,  $SIZE$  is the (log) value of firm's total assets and  $K$  is the beginning-of-period capital stock<sup>2</sup>. Within this setting, we test the hypothesis that capital market imperfections are absent, hypothesis which translates that investment should be unrelated to cash flow,  $\theta_2 = 0$ .

Under the null hypothesis there is no relation between investment decisions and cash flow. Ever since the seminal paper of Fazzari *et al.* (1988) on the relation of financing constraints and investment activity, this hypothesis has played a prominent role in empirical studies.

#### 3.2. Firm-Specific Attributes as Proxies for the Severity of Asymmetric Information

In this section we extend our review in detail in order to underline the evidence on the impact of capital market imperfections on investment decisions. We organize this review around

<sup>1</sup> We defer the discussion regarding the direction in which these variables affect investment until section 3.2.

<sup>2</sup> A detailed description of the variables appears in the Data section.

the most commonly used criteria that have been employed to identify firms that are more likely to suffer from financial constraints, namely age, size, leverage and dividend payout ratio.

### 3.2.1. Attribute I: Firm Age

We dichotomize firms into ‘young’ and ‘old’. This decomposition of firms into more mature and less mature ones accommodates the investigation of potential asymmetries in the response of investment to cash flow across firms’ age. This is done by imposing and testing appropriate restrictions on the parameters of the following equation:

$$\begin{aligned} \Delta(IK)_{i,t} = & \lambda_0 [\Delta(IK)_{i,t-1}] + \lambda_1 [\Delta(SK)_{i,t}] + \lambda_2 [\Delta(CF)_{i,t} \times (YOUNG)_{i,t}] + \lambda_3 [\Delta(CF)_{i,t} \times (OLD)_{i,t}] + \\ & + \lambda_4 [\Delta(DIV)_{i,t}] + \lambda_5 [\Delta(LEV)_{i,t}] + \lambda_6 [\Delta(SIZE)_{i,t}] + \sum_{t=1993}^{2001} \tau_t (\text{time dummies}) + \eta_{i,t} - \eta_{i,t-1} \end{aligned} \quad (2)$$

where  $\lambda$ 's,  $\tau$ 's are unknown parameters to be estimated and  $\eta$  is a white noise disturbance term. Coefficients  $\lambda_2$  and  $\lambda_3$  measure the sensitivity of investment with respect to financing constraints for young and old firms respectively. If the sensitivity of investment to cash flow was symmetric across firms of different age then  $\lambda_2$  and  $\lambda_3$  would be of equal magnitude and same sign.

The effect of firms’ age has been investigated in several empirical studies. One may interpret firm age as an indicator of the firm’s quality, since the longer it has survived the more established it may be considered. Mueller (1972) has shown that young, dynamic firms with attractive investment opportunities are more likely dependent on external finance, while old firms are largely dependent on internal finance. Oliner and Rudebusch (1992) in a study for US listed firms find that investment is more closely related to cash flow for firms facing relatively more severe asymmetries of information and in most cases, these firms tend to be young. In addition, Schaller (1993) focusing on investment behaviour of Canadian firms reports evidence suggesting that young firms’ investment spending is more influenced by liquidity than that of older firms. This is compatible with capital market imperfection to the extent that age is related to the degree of informational asymmetries. Carpenter and Rondi (2000), find that young firms’ investment appears to be more sensitive to fluctuations in internal finance than mature firms. Finally, Beck *et al.* (2003), confirm the usefulness of age as a priori classification of financing constraints, since older firms report less financing obstacles.

### 3.2.2. Attribute II: Firm Size

Another dimension that may have a potential bearing on investment decisions in the presence of asymmetric information is firm size. Smaller firms are more likely to suffer from idiosyncratic risk and, in so far as size is positively correlated with age, firms are less likely to have been recognized in the capital market that helps investors to distinguish ‘good’ firms from ‘bad’ ones. Besides, smaller firms may have lower collateral than larger ones, relative to their liabilities, and unit bankruptcy costs are likely to decrease with size. The importance of size has been reported by Gertler (1988) who argued that information-based financial constraints are more likely to have a greater impact on small firms than large firms, partly because large firms tend to be more “mature” and have more established relations with providers of finance. Carpenter *et al.* (1994), find that the impact of internal finance on inventory investment is greater for smaller firms, although internal finance is still an important factor for the larger ones. Hu and Schiantarelli (1994), show that everything else equal, size is positively related to the probability for quoted companies to be financially constrained. Calomiris and Rizzo (1995) focusing on the US hospital industry show that liquidity is weakly related to investment in large, chain-affiliated hospital, while the opposite stands for small, free-standing hospitals. Gilchrist and Himmelberg (1998) stress that small companies, with presumably higher costs of obtaining external funds are more responsive to liquidity shocks than large ones. Carpenter and Rondi (2000), after controlling for age, find that size also appears to be an important factor in determining the severity of financing constraints. Small firms appear to face relatively large barriers to using external finance for investment. Audretsch and Elston (2002), support the hypothesis that smaller firms in Germany, tend to be disadvantaged relative to the lar-

ger ones, in terms of access to capital. In contrast, Devereux and Schiantarelli (1990) report that large firms are more sensitive than small ones to cash flow fluctuations using a sample of relatively large quoted firms. Oliner and Rudebusch (1992) report that firm size has an insignificant effect on investment cash-flow sensitivities. Besides, Vogt (1994) for a sample of US manufacturing firms finds that the sensitivity is larger for firms in the largest quintile compared to the smallest quintile. In addition, Athey and Laumas (1994) find that large Indian firms are more sensitive to cash flow than small firms and attribute this result to the Indian government credit policies for promoting small companies. Finally, Kadapakkam *et al.* (1998) segmenting firms into three-size classes, stress that cash flow-investment sensitivity is generally highest in the large firm size group and smallest for the smaller size group.

To sum it up, size will probably be a useful criterion for identifying financially constrained firms to the extent that the sample used includes at least a portion of the lower tail of the size distribution (Schiantarelli, 1996). Note that the empirical work in this article focuses on Greece's firms that are publicly traded and are expected to be associated with the lowest degree of informational symmetries, since even the small firms compared to the rest of them are the most pronounced in the market. Thus, we classify firms into two size categories according to the book value of their total assets obtained from their annual balance sheets. The relevant empirical version of that is:

$$\Delta(IK)_{i,t} = \beta_0 [\Delta(IK)_{i,t-1}] + \beta_1 [\Delta(SK)_{i,t}] + \beta_2 [\Delta(CF)_{i,t} \times (SMALL)_{i,t}] + \beta_3 [\Delta(CF)_{i,t} \times (LARGE)_{i,t}] + \beta_4 [\Delta(DIV)_{i,t}] + \beta_5 [\Delta(LEV)_{i,t}] + \beta_6 [\Delta(AGE)_{i,t}] + \sum_{t=1993}^{2001} \tau_t (\text{time dummies}) + u_{i,t} - u_{i,t-1} \quad (3)$$

where  $\beta$ 's,  $\tau$ 's are unknown parameters to be estimated and  $u$  is a white noise disturbance term. Coefficients  $\beta_2$  and  $\beta_3$  in equation (3), measure the sensitivity of investment with respect to financing constraints for small and large firms respectively. If the sensitivity of investment to cash flow was symmetric across firms of different size then  $\beta_2$  and  $\beta_3$  would be of equal magnitude and same sign.

### 3.2.3. Attribute III: Financial Leverage

Next, we examine the link between leverage and investment opportunities. Leverage is determined by the demand for funds in excess of limited internal resources. The higher a company's leverage is, the more of its total earnings are absorbed by paying debt interests, and the more fluctuating are the net earnings available for equity shareholders. Thus, a higher leveraged firm's investment decisions would possibly be more sensitive to cash flow. The impact of financial leverage on a firm's investment decision has been a topic of interest among academics. Under the Modigliani and Miller (1958) irrelevance theorem, leverage and investment should be unrelated. If a firm had profitable investment opportunities, it could obtain funding regardless of its balance sheet position. However, the capital structure literature has argued that leverage and investment opportunities are strongly related. Myers (1977), stresses that, in extreme cases, a firm's debt overhang can be large enough in order to prevent it from raising funds to finance positive net present value (NPV) projects because the returns from such investment may be captured by debtholders. Jensen (1986) and Stulz (1990) also predict a negative relation between leverage and investment but emphasize that this can be beneficial for shareholders of low growth firms because debt limits managerial wariness over free cash flows. Consistent with both views Lang *et al.* (1996) document a negative relation between leverage and subsequent investment, but only for firms with weak growth opportunities, i.e. with Tobin's Q less than one. On the contrary, McConnell and Servaes (1995) show that corporate value is negatively related with leverage for firms with strong growth opportunities (high Tobin's Q), and positively correlated with leverage for firms with weak growth opportunities (low Tobin's Q). In addition, Denis and Denis (1993) document significant reduction in capital expenditures following an increase in leverage. Finally Aivazian *et al.* (2003) following Lang *et al.* (1996), show that leverage has a significant negative

impact on investment for Canadian firms and that it has a stronger negative impact for firms with low growth opportunities.

It is apparent that several authors tried to link investment to leverage, but they reach to conflicting views. For example, Whited (1992) demonstrates that investment is more sensitive to cash flow in firms with high leverage than in firms with low leverage. Cantor (1990) shows that investment is more sensitive to earnings for highly leveraged firms. Finally, Sharpe (1994) presents that the effect of sales growth on employment depends on leverage. In particular, employment for highly leveraged firms is less sensitive to sales growth during recessions.

Therefore we also allow for an impact of firms' leverage operating via its interdependence with cash flow. Essentially, we dichotomize firms into 'high leveraged' and 'low leveraged'. This decomposition allows for the investigation of potential asymmetries in the response of investment to cash flow across firms' level of leverage. The specification is similar to the previous equations, but is extended by incorporating the effect of leverage on investment. Specifically, we estimate the following equation:

$$\Delta(IK)_{i,t} = \kappa_0 [\Delta(IK)_{i,t-1}] + \kappa_1 [\Delta(SK)_{i,t}] + \kappa_2 [\Delta(CF)_{i,t} \times (HLEV)_{i,t}] + \kappa_3 [\Delta(CF)_{i,t} \times (LLEV)_{i,t}] + \kappa_4 [\Delta(DIV)_{i,t}] + \kappa_5 [\Delta(SIZE)_{i,t}] + \kappa_6 [\Delta(AGE)_{i,t}] + \sum_{t=1993}^{2001} \tau_t (\text{time dummies}) + \xi_{i,t} - \xi_{i,t-1} \quad (4)$$

where,  $\kappa^1$ 's,  $\tau^1$ 's are unknown parameters to be estimated and  $\xi$  is a white noise disturbance term. Coefficients  $\kappa_2$  and  $\kappa_3$  measure the sensitivity of investment with respect to financing constraints for young and old firms respectively. If the sensitivity of investment to cash flow was symmetric across firms of different level of leverage then  $\kappa_2$  and  $\kappa_3$  would be of equal magnitude and same sign.

#### 3.2.4. Attribute IV: Dividend Payout Ratio

Finally, we study the relation between dividend payout and investment spending. There are two main reasons why firms may pay low dividends: the first is that they retain all the low-cost internal funds in order to finance their investment projects and the second one, is that they have not enough or no income to distribute to the shareholders. Both of these scenarios underline that a low distribution of net profits signifies a financially constrained firm. A number of researchers have extended conventional models of business fixed investment to incorporate the role of financing constraints in determining investment. Several studies have grouped firms using dividend payout ratio as a proxy of the severity of financing constraints. In the first study of this issue Fazzari, *et al.* (1988) argument that the dividend payment is a good indicator of whether a firm has availability of internal funds to invest in potential projects. Thus, firms with low dividend payouts are considered as being financially constrained, whereas high dividend paying firms are identified as less financially constrained. Gertler and Hubbard (1988) in a study for US firms find that fixed investment for high retention firms is more sensitive to cash flow fluctuations in recessions. In addition, Oliner and Rudebusch (1989) argue a more general point that a high retention ratio is more a signal that, a firm may face liquidity constraints. Investment by firms with high retention ratios would be expected to be more sensitive to cash flows under this hypothesis. Furthermore, Fazzari and Petersen (1993) following Fazzari, *et al.* (1988), split their sample into zero-dividend, which are most likely to face binding financial constraints and positive-dividend groups and use working capital as an additional source of liquidity that should be used to smooth fixed investment relative to cash-flow shocks if firms face finance constraints. They find that working capital is significantly and negatively related to fixed investment for low-dividend paying US firms. Bond and Meghir (1994) note that the same firms may be financially constrained in some periods and not in others and that the firm's current dividend and new share issuing behaviour would signify in which financial regime the firm is currently in. They find that excess sensitivity to financial variables is concentrated in periods when firms pay unusually low dividends, and issue no new shares. Hubbard, *et al.* (1995) test for the frictionless neoclassical model that assumes perfect capital mar-

kets which is easily rejected for firms with low dividend payout. Although the majority of these studies are in line with Fazzari, *et al.* (1988) results, however an important challenge to these findings came from Kaplan and Zingales (1997) who posit that higher sensitivities of investment to cash flow cannot be interpreted as evidence that firms are more financially constrained. Cleary (1999) extends this sample and shows that while all firms are sensitive to liquidity, consistent with previous evidence, firms that are more creditworthy exhibit greater investment-liquidity sensitivity than those classified as less creditworthy as Kaplan and Zingales (1997) advocate.

Essentially, we dichotomize firms into 'high dividend paying firms' and 'low dividend paying firms'. This classification for the percentage of distributed profits signifies which firms are identified as financially constrained and accommodates the investigation of potential asymmetries in the response of investment to cash flow across firms. This can be examined by testing the following equation:

$$\begin{aligned} \Delta(IK)_{i,t} = & \phi_0 [\Delta(IK)_{i,t-1}] + \phi_1 [\Delta(SK)_{i,t}] + \phi_2 [\Delta(CF)_{i,t} \times (HDIV)_{i,t}] + \phi_3 [\Delta(CF)_{i,t} \times (LDIV)_{i,t}] + \\ & + \phi_4 [\Delta(AGE)_{i,t}] + \phi_5 [\Delta(LEV)_{i,t}] + \phi_6 [\Delta(SIZE)_{i,t}] + \sum_{t=1993}^{2001} \tau_t (\text{time dummies}) + \zeta_{i,t} - \zeta_{i,t-1} \end{aligned} \quad (5)$$

where  $\phi$ 's,  $\tau$ 's are unknown parameters to be estimated and  $\zeta$  is a white noise disturbance term. Coefficients  $\phi_2$  and  $\phi_3$  measure the sensitivity of investment with respect to financing constraints for high and low-dividend payout firms respectively. If the sensitivity of investment to cash flow was symmetric across firms of different dividend behaviour then  $\phi_2$  and  $\phi_3$  would be of equal magnitude and same sign.

### 3.3. The GMM Estimation Technique

Equations (1), (2), (3), (4) and (5) are estimated by using the Generalised Method of Moments (GMM, hereafter) where lagged levels of the dependent variable and the independent variables are used as instruments (Arellano and Bond, 1991). Given that the errors  $\varepsilon_{i,t}$  are not serially correlated, the lagged levels dated  $t-2$  and earlier of the dependent variables and the independent variables are valid instruments. The estimation imposes the following linear moment restrictions<sup>1</sup>:

$$E \left[ (\varepsilon_{i,t} - \varepsilon_{i,t-1}) Z_{i,t-k} \right] = 0 \quad , \quad (6)$$

where  $k = 2, \dots, K$  and  $Z$  is a vector of instruments.

Arellano and Bond (1991) propose a test for examining first order,  $m_1$ , and second order,  $m_2$ , serial correlation of the differenced residuals. Also, we use the Sargan (1958) test to determine the validity of instruments, which is based on the over identifying restrictions appearing in equation (6). Under the null hypothesis of valid instruments, it is asymptotically distributed as  $\chi^2$ .

## 4. Data Description

We have collected the balance sheets of all firms listed in the ASE for the period of 1993-2001. The source is the Yearly Statistical Bulletin, published by the ASE<sup>2</sup>. A total of 273 firms have been traded during this period. The dataset consists of an unbalanced panel since the number

<sup>1</sup> Equivalent restrictions apply for the error terms in equations (1), (2), and (3).

<sup>2</sup> Banks, Leasing, Holding and Insurance companies were excluded from the sample. Four companies whose stock was under suspension were also excluded.



of listed firms varies from year to year. For each year we include the universe of firms in order to avoid introducing survivorship bias into our sample<sup>1</sup>.

Investment,  $IK$  is defined as the annual change in fixed assets, while  $CF$  represents internal funds, measured as the sum of net operating profits and depreciation ratio. The value of annual sales is denoted by  $SK$ , while  $LEV$  represents the financial leverage ratio, and  $SIZE$  is calculated as the logarithm of the value of total assets. Furthermore,  $AGE$  is defined as the logarithm of the number of years since foundation. Finally, the percentage of distributed profits is presented by  $DIV$ . All variables are divided by the beginning-of-period capital stock  $K$  (with the exceptions of leverage, dividend, age and size).

We define two size classes in terms of book value of total assets. In particular, for each year small firms ( $SMALL$ ) are defined as those placed below the 15<sup>th</sup> percentile of the cross sectional distribution. The remaining firms are defined as large ( $LARGE$ ). We further classify firms in terms of age, by defining young ( $YOUNG$ ) firms as those whose age is less than 20 years, while the remaining firms are defined as old ( $OLD$ )<sup>2</sup>. In addition, we divide firms in terms of payout behaviour, into Low Dividend ( $LDIV$ ) into those paying dividend-income ratio less than 0.2 as possible financially constrained firms, and the remaining firms are defined as High Dividend ( $HDIV$ ). Finally, we dichotomize firms into two groups according to the firm's leverage ratio as an indicator of the general indebtedness of the firm. We define low leveraged ( $LLEV$ ) firms as those with a ratio less than 1.0, while the remaining are considered as highly leveraged firms ( $HLEV$ ).

## 5. Empirical Results

Applying the GMM dynamic panel estimation technique we estimate the parameters of equation (1) and report the results in column 2 of Table 1.

Table 1

Investment on Cash Flow, Age, Size, Leverage and Dividend (period 1993-2001, cross sections 178, mean number of observations 4.09, total observations 729)

Regressor	Equation 1	Equation 2	Equation 3	Equation 4	Equation 5
$\Delta(CF_{it})$	0.36*** (0.15)	-	-	-	-
$\Delta(IK_{i,t-1})$	0.04* (0.02)	0.03* (0.02)	-0.01 (0.02)	0.03* (0.02)	0.03* (0.02)
$\Delta(SK_{i,t})$	0.11*** (0.03)	0.11*** (0.03)	0.13*** (0.02)	0.10*** (0.03)	0.12*** (0.03)
$\Delta(LEV_{i,t})$	-0.004** (0.002)	-0.004* (0.002)	-0.0005 (0.001)	-	-0.004*** (0.002)
$\Delta(AGE_{i,t})$	-0.18 (0.11)	-	-0.15 (0.12)	-0.18 (0.11)	-0.17 (0.11)
$\Delta(SIZE_{i,t})$	0.606*** (0.094)	0.61*** (0.10)	-	0.61*** (0.09)	0.57*** (0.09)
$\Delta(DIV_{i,t})$	0.023 (0.032)	0.02 (0.03)	0.01 (0.03)	0.021 (0.032)	-

<sup>1</sup> The only potential source of survivorship bias is due to disappearance of firms from our sample due to firms exiting the stock market. During the period under scrutiny the number of firms leaving the ASE was less than 0.5%.

<sup>2</sup> It should be noted that various alternative classifications of age and size were considered. However, the estimation results were not sensitive to the use of alternative classifications.

Table 1 (continuous)

Regressor	Equation 1	Equation 2	Equation 3	Equation 4	Equation 5
$[\Delta(CF)_{i,t} \times \Delta(YOUNG)_{i,t}]$	-	0.68* (0.41)	-	-	-
$[\Delta(CF)_{i,t} \times \Delta(OLD)_{i,t}]$	-	0.23 (0.16)	-	-	-
$[\Delta(CF)_{i,t} \times \Delta(SMALL)_{i,t}]$	-	-	-0.24*** (0.08)	-	-
$[\Delta(CF)_{i,t} \times \Delta(LARGE)_{i,t}]$	-	-	0.74*** (0.21)	-	-
$[\Delta(CF)_{i,t} \times \Delta(HLEV)_{i,t}]$	-	-	-	0.47*** (0.17)	-
$[\Delta(CF)_{i,t} \times \Delta(LLEV)_{i,t}]$	-	-	-	0.13 (0.14)	-
$[\Delta(CF)_{i,t} \times \Delta(HDIV)_{i,t}]$	-	-	-	-	0.34 (0.21)
$[\Delta(CF)_{i,t} \times \Delta(LDIV)_{i,t}]$	-	-	-	-	0.18 (0.12)
Time dummies	Included	Included	Included	Included	Included
Diagnostics					
$m_1$	-3.32***	-3.38***	-3.37***	-3.32***	-3.35***
$m_2$	0.12	0.18	-0.41	0.18	0.12
Sargan (27 Moment conditions)	31.88 (p-value: 0.23)	32.42 (p-value: 0.21)	35.07 (p-value: 0.13)	30.13 (p-value: 0.30)	32.55 (p-value: 0.21)

Notes: Values in brackets denote standard errors,  $m_1$  and  $m_2$  are first order and second order serial correlation tests, while Sargan stands for the over-identifying restrictions test (figure in parenthesis denotes degrees of freedom). One, two, three asterisks denote significance at the 10, 5, and 1% level respectively.

The residuals satisfy the over-identifying restrictions which are not rejected (see Sargan test) suggesting that the model is well specified, and furthermore there is no sign of second-order autocorrelation<sup>1</sup>. In terms of the estimated parameters, past investment emerges as a significant determinant of current investment, suggesting a temporal correlation of investment behaviour. In addition, sales growth exerts a significantly positive impact on investment, finding that is compatible with the Sales Accelerator model. Inspecting the remaining four conditioning variables, size affects investment significantly, with larger firms on average tending to exhibit a higher investment rate. The coefficient of age turns out to be negative, albeit marginally insignificant (at the 10% level). Finally, financial leverage is associated with a negative coefficient and dividend payout ratio appears to be a non-significant determinant of investment.

Moving now to the parameter of interest, our findings suggest that after conditioning on a wide set of firm-specific characteristics cash flow exerts a significantly positive impact on investment. Essentially, the rejection of no association (t-stat 2.37) between internal funds and investment spending, in favour of a positive association highlights the presence of imperfections in the Greek capital market. The high sensitivity of investment decisions of firms to liquidity is a recurring theme in the empirical literature, which is quite robust across different periods and countries (Fazzari *et al.*, 1988; Oliner and Rudebusch, 1992; Whited, 1992; Schaller, 1993; Bond and Meghir, 1994; Hubbard *et al.*, 1995; Goergen and Renneboog, 2001; Vermeulen, 2002; Vijverberg, 2004).

<sup>1</sup> The relevant test detects significant first-order autocorrelation in the residuals. This was expected given the fact that the model is formulated in first differences and consequently the resulting disturbance term exhibits first-order autocorrelation by construction.

We proceed with the presentation of the augmented version of the basic model, where we include the interaction terms between cash flow and age dummies. Column 3 in Table 1 summarises the estimation results. Our results regarding the sign and significance of the conditioning variables, as well as the behaviour of the residuals remain largely unchanged. Careful inspection of the estimated parameters reveals a clear asymmetric effect of cash flow over investment. This highlights a non-linear impact of cash flow on investment, where it is exacerbated for young firms. In terms of point estimates, our results suggest that the cash flow effect on investment, conditional on a firm being young, is about three times larger compared to the corresponding effect for old firms (0.72 and 0.21 respectively). Furthermore, the coefficient for old firms is insignificant, while for young firms it is significant at conventional levels. This finding was expected since information asymmetries are likely to be more severe for young firms given the lack of a substantial track record. This result is in line with previously reported evidence in the literature (Oliner and Rudebusch, 1992; Schaller, 1993).

The next version of our empirical model allows us to investigate the role of firm size. Column 4 in Table 1 reports the estimation results. Turning our attention to the effects of cash flow by size of listed firms, we are confronted with estimation results that do not conform to our priors. Provided that informational asymmetries were reflected on size, one would expect financial constraints to be expressed on the size dimension, and therefore smaller firms exhibiting higher sensitivity to internal funds. However, according to our results not only the inverse relationship between size and financial constraints is not established, but investment of small firms is found to depend negatively on internal funds. Without resorting to trivial explanations of this somewhat paradoxical finding, such as time period related issues, we make an attempt to explore an alternative interpretation. The alleged link between size and the severity of informational asymmetries is expected to hold when applied on a representative sample that covers the whole distribution of firms in a given economy. However, one should consider a serious conditionality of the sample under scrutiny in our analysis. Recall that we focus on firms listed in the ASE, fact which implies that these firms clearly do not constitute a representative sample as far as size is concerned. In order to be listed in any stock exchange, capitalization (size) should be above a certain threshold. In other words, what we usually refer to as small firms does not apply to listed firms in any country. The classification small/large adopted in our analysis is simply an ordering in terms of assets among a group of firms that are considered by common standards as large. The reader should keep in mind that the existing literature that has focused on listed firms has not succeeded in providing econometric evidence in favour of the hypothesis that size is an adequate proxy for the severity of financing constraints. For instance, Devereux and Schiantarelli (1990), Oliner and Rudebusch (1992) and Schiantarelli (1996) who investigate similar hypotheses to ours, do conclude that younger firms have higher investment cash-flow sensitivity. However, using size as attribute has led to mixed results. For example, Oliner and Rudebusch (1992) do not find significantly different investment-cash flow sensitivities for small and large firms, while Devereux and Schiantarelli (1990) even report a monotonic relationship between cash flow sensitivity and size.

Column 5 in Table 1 reports the regression results for the investment equation using the interaction terms between cash flows and leverage dummies. Our results regarding the sign and significance of the conditioning variables, as well as the behaviour of the residuals remain in principal unchanged. We find evidence that cash flow has a positive impact on investment, but only for the highly leveraged firms. Additionally, the estimated parameters reveal a clear asymmetric effect of cash flow over investment. The evidence supports the theory that leverage has a role in affecting firms' investment policy. However, contrary to previous findings (Lang *et al.*, 1996; Aivazian *et al.*, 2003) the estimated coefficients provide evidence supporting that investment for highly leveraged firms is found to depend positively on internal funds. The coefficient estimates imply that cash flow variable has a bigger and more significant effect on investment for firms with higher financial leverage and is almost four times larger compared to the corresponding insignificant effect for low leveraged firms (0.47 and 0.13 respectively). This finding was expected since information asymmetries are likely to be more severe for debt dependent firms. Our results are in line with previous studies (Cantor, 1990; Whited, 1992) supporting the sensitivity of investment to cash flow in firms with high leverage.

Finally, we examine the regression results of column 6 in Table 1, with respect to cash flow effects on investment across different retention classes. As we have argued above, the use of firms' dividend payout behaviour might be correlated with the firms' degree of financing constraints. Fazzari, *et al.* (1988) demonstrate that firms with low dividend payouts are considered as being more financially constrained than firms paying more dividends. The estimated results provide no evidence for a higher sensitivity of firms classified as constrained based on dividends. Given that informational asymmetries would be stricter for the more financially restrained firms, this result is clearly not supportive for a categorization based on dividend payout behaviour, as several previous empirical studies have concluded. Although the coefficient of cash flow suggests a positive response of investment for both groups, none of the parameters is significant. Furthermore, the absolute value of the coefficient associated with the financially constrained firms is about half compared to the corresponding coefficient of the unconstrained firms (0.18 and 0.34 respectively). A plausible explanation has been offered by Gilchrist and Himmelberg (1995) who suggest that the difficulty in identifying financially constrained firms based on their dividend policy might be driven by an entrapment on past dividend payout patterns. For instance, firms find it difficult switching to a higher retention policy by feeling a moral obligation to their shareholders, even if their cash flows are systematically falling.

## 6. Conclusion

Using a dataset comprising of a set of firms listed in the ASE for the period of 1993-2001 we addressed a set of research questions focusing on business fixed investment. Firstly, we tested for the presence of capital market imperfections, through the relationship between investment and cash flow. In addition, we investigated the possibility that this relationship varies across firms of different age, size leverage and dividend payout ratio. Our empirical findings confirm the imperfection of the Greek capital market and highlight the differential impact of financing constraints across young and highly leveraged firms. Size and dividend payout behaviour do not appear to be useful proxies for the degree of asymmetric information and consequently cannot be used in order to assess financing constraints.

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