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INVESTMENT,R&D AND LIQUIDITY CONSTRAINTS:

A CORPORATE GOVERNANCE APPROACH TO THE BELGIAN EVIDENCE

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The views expressed in this paper are those of the author and do not necessarily reflect the views of the National Bank of Belgium.

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Editorial

On May 27-28, 2002 the National Bank of Belgium hosted a Conference on *"New views on firms' investment and finance decisions"*. Papers presented at this conference are made available to a broader audience in the NBB Working Papers no 21 to 33.

Abstract

In this contribution, we present a novel instrument to control for investment opportunities in studying the investment-cash-flow sensitivity. More in particular we introduce the book value of R&D. We argue this instrument has advantages over other theories of investment, especially when focussing on the corporate governance aspects of the investment-cash-flow sensitivity. On the other hand, it implies the investment-cash-flow sensitivity can only be studied in high-tech environments. These have corporate governance problems of their own. To investigate their effect, a signalling model is extended for R&D induced investment opportunities, and estimated on a panel of Belgian data.

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1. INTRODUCTION

In the absence of capital market imperfections, finance and investment decisions can be separated completely. This implies among other things that external and internal funds are interchangeable for all purposes or that any particular type of investment can be financed by every financial source.

This so-called "separation theorem" has a long tradition in economics, see Fischer (1930). Yet, at least since Fazzari, Hubbard and Petersen (1988), (henceforth FHP), there has been a substantial empirical literature showing a significantly positive influence of cash-flow on firms' investment spending. This so called "investment-cash-flow sensitivity" has been explained by financial constraints. Firms simply cannot lend whatever they want for all purposes. Particular types or levels of investment spending can only be realised by internally generated cash-flows. Hence there is a wedge between the price of internal and external finance.

The literature has explained these financial constraints by pointing to capital market imperfections. Myers and Majluf (1984) argue that asymmetric information can cause firms being rationed in the issuance of equity. Stiglitz and Weiss (1981) indicate how the same kind of asymmetric information can make a firm fall short of credit, and hence disenabling it to finance all investment through debt. The next section provides a survey of the arguments that have been used to explain why particular types of firms are more financially constrained than others, and hence what factors explain the "investment-cash-flow sensitivity".

Few studies have investigated the existence and causes of a positive relationship between cash-flow and investment spending or company growth for Belgium, see however Barran and Peeters (1998), Deloof (1998), Van Cayseele and De Vil (1999) and Van Cayseele, Peeters, Webers and Van Herck (2001). The purpose of this paper is to shed further light on the "investment cash-flow sensitivity" for Belgium, by incorporating novel elements as an explanation.

More in particular, we introduce past R&D activity as a variable to control for investment opportunities. This implies for the empirical work presented that we focus on the "investment-cash-flow sensitivity" in high tech environments. Hence, we have to ask to

what extent the explanations offered previously are mitigated for companies who are active in R&D. While theoretical contributions have focussed on the effects of capital market imperfections and managerial discretion on investment in R&D, see Canoy, Riyanto and Van Cayseele (2000), as well as the references therein, the present paper focuses on the effects of such phenomena in the investment in physical assets in companies that have previously been engaged in building up new technology. While this is a different question, elements common to both types of investments certainly will prevail. For a comparison of both types of investment activities, see Cincera (2002).

To this extent, the paper is organised as follows: in the next section, a survey of the relevant literature is given. The third section derives the basic regression equation from theoretical arguments, while identifying testable propositions. The fourth section reports the empirical results while the fifth and last section concludes with further avenues for research, as well as policy implications.

2. REVIEW OF THE RELEVANT LITERATURE

In this section, a survey of the relevant literature is given. This is however done in a focused way, i.e. the contributions which are important for the extensions/modifications presented in this paper are discussed. The reason is that the extensive amount of work on the positive relationship between investment spending and cash-flow documented in the empirical literature is surveyed by one of the pioneering contributors, see Hubbard (1998). Another excellent survey is Schiantarelli (1996). Hence there is no need to replicate this work here.

Since the intention is to focus on the "investment-cash-flow sensitivities" by focussing on a panel of Belgian data, it is appropriate to discuss first the "generic" research contribution in this area (together with the critiques), and then to explain where and why a different approach could and/or should be taken. This implies that the economic environment, institutional setting, accounting standards, reporting obligations a.s.o. limit the possibilities to investigate the relationship, but equally that it offers opportunities to explore new avenues.

In general, the positive relationship between investment spending and cash-flow availability is documented in a regression equation in which the regression coefficient associated with cash-flow has a positive and significant sign for a sample of firms which is a priori classified as financially constrained. In the complementary sub-sample of firms not facing a financial constraint, the coefficient is seen to be not statistically significant from 0. Financial constraints are captured by a variety proxies, such as dividend policy (e.g. De Haan (1996)), size, a.s.o.

The initial approach, as taken by FHP was criticised by Kaplan and Zingales (1997). One important element of their critique is related to the way of testing just described. Since firms are identified as constrained by using proxies, one needs a monotonic relationship between the investment - cash-flow sensitivity and the factors determining whether and why a firm is financially constrained. Kaplan and Zingales show that the necessary conditions for guaranteeing this monotonicity involves signing expressions in the third derivatives of the production function and the cost function of external funding. They also indicate why this is quite demanding. Further, they introduce a different empirical research strategy, by not using proxies to identify financially constrained firms. They rather directly tackle the issue of financial constraints, by looking at company statements on the matter.

Fazarri, Hubbard and Petersen (2000) replied by pointing to a wide range of cases where one can sign unambiguously the derivative of the investment-cash-flow sensitivity w.r.t. the parameters causing a firm to be financially constrained. Nonetheless, it remains hard to be sure of such a relationship in general, see Kaplan and Zingales (2000). This implies one has to be very careful in laying down the theoretical insights in a regression model, as well as in testing these implications.

In addition, one always has to be careful in interpreting the coefficient in a regression analysis in a split sample approach. Where possible, the approach should be complemented by other econometric practices. In the present contribution, we will focus on an alternative, using interaction terms.

In all of the empirical work, one has to control for investment opportunities. This typically is done by including Tobin's Q in the regression equation. As compared to the U.S. environment for which most studies have been done, Belgium has a continental European financial system. This has immediately a few implications. More in particular, only a minority of the firms in the sample are listed on a stock exchange. This first of all implies

that correcting for investment opportunities cannot be done by including Tobin's Q unless one is willing to loose a substantial amount of information by not including a vast amount of firms. Moreover, Erickson and Whithed (2000) have pointed out that measurement error in Q could explain for a positive correlation between cash-flow and investment. Hence other ways for controlling for investment opportunities will be needed. One approach could consist of relying on an accelerator theory of investment, see Haid and Weigand (1998) or Mulkay, Hall and Mairesse (2000) for a recent discussion of this theory and empirical results in high tech environments.

The second implication of Belgium having a European continental financial system has to do with the form external finance takes. Mostly, and again because relatively few firms are stock listed companies, external finance comes in the form of debt, and even more precisely from bank loans. This implies banking relationships are important for whether or not a firm faces financial constraints. Hoshi, Kashyap and Scharfstein (1991) divide Japanese firms on the basis of whether or not they belong to a keiretsu. This means they have financial backing within the group, where they are known. As such, this reduces asymmetric information problems, and hence the keiretsu members should be less financially constrained. However, other theories argue that a banking relationship can be exploited by the bank. A firm then can be squeezed out by its main bank, increasing the cost of external finance, and hence making the keiretsu members more financially constrained. For a survey of the banking relationship literature, see Berger, Saunders, Scalise and Udell (1998), Boot (2000) or Ongena and Smith (2000). For Belgium, Degryse and Van Cayseele (2000) have tested whether a main bank relation enables firms to raise external funding at a lower cost. The findings are that over time, banks indeed exploit the captivity of their clients, as predicted by Greenbaum, Kanatas and Venezia (1989), Rajan (1992) and Sharpe (1990). On the other hand, the main bank as defined by the bank who handles the majority of the payment traffic or who sells many products to the firm offers finance more cheaply, in line with the predictions of the Boot and Thakor (1994) model.

The implications of all this are that banks could alleviate the cash-flow dependency of investment. Having a bank relationship then implies that the firm is less dependent on cash-flow to invest, and that it possibly will divert less cash-flow into non-productive investments, that is to the extent the bank monitors the manager in this respect. A recent strand of research investigates the role of different stakeholders in dealing with agency problems, see Yafeh and Yosha (2002) and Franks, Mayer and Renneboog (2001).

Other but related differences between the Belgian system and the U.S. concerning corporate governance are described by Degryse and de Jong (2001) for the Netherlands, and largely carry over to Belgium. Large block holdings, limited shareholder influence, and to a lesser extent takeover defences are all present. This implies that there is substantial scope for managerial discretion, and hence that the point raised in Degryse and de Jong (2001), i.e. that the free cash-flow theory by Jensen (1986) equally could explain a positive sensitivity of investment on cash-flow, also is valid for Belgium. In general, corporate governance characteristics of firms are used to classify them as financially constrained or not. They however may be of a different nature, for example they may relate to moral hazard problems with managers operating in an environment of weak control, but also to the intangible nature of some types of investment such as R&D and the problem to seize collateral when things go wrong.

From a theoretical perspective, the article by Canoy, Riyanto and Van Cayseele (2000) shows that these corporate governance problems carry over to R&D environments, tough for different reasons. Hence high-tech environments can be characterised both by over – and under-investment as well. In the next section, where the research outlay is explained, we will go into the details of the argument as well as the implications for econometric testing.

3. ANALYTICAL FOUNDATIONS AND TESTABLE PREDICTIONS

3.a. Some further reflections on the economic foundations of an investment cash-flow dependency

3.a.1. Financial constraints

Kaplan and Zingales (1997) cast the developments in the literature by formulating an optimisation problem for the firm in which the cost of attracting external finance is introduced into the objective function. This cost function in fact is nothing else but a reduced form of the financing process of the firm. It is parameterised on a set of firm characteristics. A few caveats prevail when such an approach is brought to empirical testing.

First, good theory should map observables into observables, see Sutton (2000). But the cost of external finance function does not represent the fact that a firm is financially constrained in an appropriate way. Either the firm can borrow, and then there will be no relation between cash-flow and investment, or it can't, and then there will be an identity between the two variables. Hence the equilibrium value of investment predicted by such a model will not be the realised level of investment. The cost of external finance function then at best is an attempt to pick up the lending decisions by banks in a reduced form. But for any particular firm asking for external finance to carry out an investment decision, the best loan rate it gets either is below the return of the investment project, and then the firm can borrow, or it isn't. In the latter case, the project will need to get financed internally, see also Almeida and Campello (2002).

Second, by parameterising only on firm characteristics, the approach misses the idea that specialized players, viz. financial intermediaries are involved in the external finance process. When a firm applies for a loan to engage in an investment project, the bank will ask whether this particular project can be monitored at a cost generating a sufficient profit margin for the bank. Otherwise the bank will deny funding. The core competence of a bank is monitoring and screening clients (borrowers). So the bank, after having geared liquidity and keeping in mind regulation (capital adequacy rules) ranks the loan applications and chooses those generating the highest profits, that is those loans for which the asymmetric information projects can be controlled at least costs.

Since we expect the firm to apply for the loan with its house bank, if this particular bank denies, the firm will be deprived of the funds since any other financial intermediary only has a worse technology to monitor this particular borrower. For an elaboration of this argument, the reader again should consult Boot (2000), Ongena and Smith (2000) or Degryse and Van Cayseele (2001).

In addition, one should note the theories on credit rationing. At least since the introduction of adverse selection into the economic literature, it is known that higher interest rates could induce firms with riskier project to apply for a loan, see also Stiglitz and Weiss (1981). Hence, increasing the interest rate or the cost of external funding in Kaplan and Zingales will not imply that the firm gets a loan.

All this may imply that in order to raise finance, the firm in the end only has left over one final possibility: sell its stock. This can be done by obtaining a listing on a stock market, and then selling it to the public, or by selling it to another company. The first channel, also

known as an IPO, again relies on well-established stock markets, either in the county of origin, or abroad. For Belgian companies, there was the "new market" in Brussels, and afterwards the alliance of the "new" markets of Amsterdam, Brussels, Frankfurt, Paris and Milan, in an initiative called Euro.nm. There also is the possibility of obtaining a listing on Nasdaq. Botazzi and Da Rin (2002) however notice that higher venture capital activity does not necessarily corresponds to more stock market listings, as experienced in Sweden, Belgium and the Netherlands. One possible explanation for this phenomenon is trade sales which frequently occur in high tech companies, see also Kohers and Kohers (2001). Trade sales typically take place when a relatively young high tech company is sold to a larger competitor, see again Botazzi and Da Rin (2002).

The model tested in the present contribution therefore relies on the following set of maintained assumptions:

1) We investigate the investment cash-flow dependency in a continental European setting where the main source of external finance are bank loans.
2) In such a system, firms have several banking relationships, one however playing the role of the "main" bank. This player is the financial intermediary with the best monitoring technology given this particular firm. Hence applying for funds elsewhere (= with another bank) is useless, also in view of termination stigmata effects.
3) When asymmetric information problems are too important, raising the interest rate even when dealing with one's house bank will not resolve the credit rationing problems.
4) The firm then will have to rely on internally generated cash-flows to carry out the investment plans, or sell its stock.
5) Given the relatively few new stock market listings, the most frequent transaction will be to sell stock to another company, that is to engage in a trade sale.

Therefore, if we can identify in a proper way some of the characteristics of the cost of monitoring a loan to a bank, we can identify those firms for which investment will show a dependency on cash-flows. Furthermore, we should focus on the transaction mechanism underlying the exchange of stock, and especially on its implications regarding the financial constraints it puts on investment.

In order to identify the costly factors in monitoring bank loans, we have to be careful. Indeed, above we argued that banks are financial intermediaries *specialised* in solving

asymmetric information problems. This means that firms one could a priori classify as being prone to credit rationing - say small firms - are not constrained because they can turn to a player who is a specialised intermediary in dealing with loans for small companies. This precisely underlies the empirical findings of Audretsch and Elston (2002) for Germany. In this study, it turns out that the smaller firms have relatively fewer liquidity constraints because they benefit from the specialized institutional structure present in German financial markets. Similar findings are reported by Mulkay, Hall and Mairesse (2000) who find that the relatively smaller French companies face less financial constraints than their larger American counterparts, again due to the different organisation of capital markets. From a theoretical angle, this introduces the question of endogenising the specialization of the banking industry, a topic well beyond the scope of the present paper.

At this point, it again is important to stress that we do not focus on the activities of venture capitalists, and hence that the "specialization" mentioned above does not relate to what venture capitalists do. The reasons for it are twofold. First, venture capitalists, when designing an optimal contract typically will use a combination of debt and equity. Since therefore they need to monitor both their loans and assets, all the factors that we identify as important regarding the monitoring of loans and transactions of stock also will be important when a venture capitalist is the external source of finance. The other reason why we do not directly identify the "house bank" to be the same as the venture capitalist is that we focus on substantial investment in physical assets, hence on companies well beyond the seed finance, start-up finance and expansion stage finance, see Botazzi and Da Rin (2002) for a discussion of these activities involved in each of these stages. Typically, the focus is on the so called, "Later Stage Finance" where investments are made to help the firm become a market leader and unleash its earning potential. Here the firm either will have established a banking relationship, enabling it to obtain a loan, or it will be prepared for a trade sale or IPO. The venture capitalist here will only remotely help to make the deal. For a survey of the activities of venture capitalists in four countries, see Mayers, Schoors and Yafeh (2002).

It therefore seems appropriate to conclude this section by elaborating somewhat more on the monitoring costs that exist for the specialised financial intermediaries. The relevant aspects of the exchange of assets will become apparent in section 3.b., where an extension of a signalling model first introduced by Hadlock (1998) is presented. The level of monitoring costs is a function of the design of the monitoring technology. The latter defines:

- what is monitored

- when it is monitored
- the degree of accuracy with which it is monitored.

In addition, we feel one should add at least two other elements. Indeed, one should also ask how the monitoring is done and which other stakeholders are involved, together with the compatibility of their goals.

For example, a bank could decide to monitor collateral (what), after the loan contract is signed but before the loan expires (when), by accurately updating the value of the collateral on a monthly basis (accuracy). It could do this because it is a bank specialised in mortgaged loans given its excellent knowledge of real estate (how), knowing other banks also have lend money for which this particular asset serves as collateral (with whom).

In general, search and selection costs prior to concluding the loan contract, all the cost of monitoring the target variables during the duration of the contract and finally the costs for verifying and inspection subsequently are all induced by the use of the best available monitoring technology. For each of these variables, other banks, shareholders, creditors, their banks, a.s.o. are other investigating parties and hence their behaviour might reveal information as well, hence allowing it to be used in the monitoring of the client.

This approach allows for the selection of many variables that could determine the monitoring cost of a firm and hence determine whether or not it is financially constrained. In the following section, we identify a particular set of these variables given the data availability.

3.a.2. Controlling for investment opportunities

In analysing the data in order to detect whether or not liquidity constraints are binding, one should control for investment opportunities. Usually this is done by including Tobin's Q in the regression. Higher values for Q, in particular those exceeding unity indicate that a firm's market value is more than the value of the assets in the books. Hence the firm must invest in order to maximise shareholder value. One of course should take into account that it is marginal Q that provides the appropriate incentives for investment, not average Q which is measured. But in the present setting, where Belgian data are used, only a minority of firms is listed on a stock exchange.

In addition, the use of Q might be problematic in that it may be low not because of the firm having few investment opportunities, but instead due to agency problems. In the takeover market, Rau and Vermaelen (1998) identify "glamour bidders" by looking at firms with a

low book-to-market ratio. They argue that these firms tend to buy other firms for hubris reasons rather than because they have the managerial skills to run the acquisition. Of course, the same critique might be used against R&D when spending on R&D would be an activity which yields utility to managers but not to shareholders. High R&D then could point to managerial discretion rather than investment opportunities. But a priori, there probably exist many other forms of spending money that managers undoubtedly prefer above paying the salaries of R&D personal which seemingly will not add a lot to the utility or prestige of the manager. Indeed, Yafeh and Yosha (2002) present evidence that managerial discretion problems explain for R&D spending, but to a far lesser extent than advertising, company gifts, a.s.o. Canoy, Riyanto and Van Cayseele (2000) show that managers might overinvest in R&D to attract takeover bidders, especially if their bargaining position vis-à-vis their own share-holders and the acquirer is strong.

Despite these possible caveats, it is argued that past R&D expenditures are a good indicator for the growth potential of firms. We will not go into the details here but it can easily be shown that innovation will create investment opportunities. In a simple neo-classical growth model, only a few conditions are needed to assure that R&D expenditures focused at process innovation will, if successful, lead the firm to invest in new physical equipment. Also in the case of product innovation, unless the innovating firm decides to licence its new technology, it is sensible to expect investment in new production lines, manufacturing equipment or even the set up of an entirely new plant. The variable moreover has been used to explain sales growth of Belgian companies, see Van Cayseele, Peeters, Webers and Van Herck (2001).

3.b. A model

In this subsection, we extend the model by Hadlock (1998) to incorporate the takeover behaviour typical in high-tech sectors. This model both incorporates imperfections in the capital market (asymmetric information) and managerial discretion. The feature added is that we focus on trade sales. For a description of these features in a theoretical setting, see Canoy, Riyanto and Van Cayseele (2000). For empirical evidence, see Kohers and Kohers (2001). The essential element common to the above studies is that some technology firms decide to acquire others, while some others prefer to be acquired. Essential in this takeover process is the determination of the value of the target and the method of payment. By the second is meant whether cash, own stock, or a combination of both is used to pay the shareholders of the target.

The problem of the "intermediate" determination of the value of the stock involved in the exchange can be tackled in a straightforward way. All the features of the bargaining process between the different parties are documented in Canoy, Riyanto and Van Cayseele (2000). The implications for the role of cash-flow in determining the investment behaviour of a target company follows straightforwardly from Hadlock (1998). Indeed, a company with a high value of its stock will prefer not to invest, because it has to finance itself externally. This is done by selling stock which is perceived by the market to be of "average" quality. By undertaking a costly action, i.e. not investing in interesting opportunities, it reduces its dependency on external funds which are too costly to his (high asset value) type. The unique equilibrium induces separation between high and low asset value companies, as well as an influence of cash-flow on investment for the high asset value types.

In the present paper we extend the Hadlock model by using it to focus on the investment behaviour of acquiring firms. The distinguishing feature comes from the above mentioned method of payment. Just in the same way that a firm who knows it has assets of high value dislikes to hand them over for external funds (cash) at an average price, the acquiring firm will not like to pay for the target with shares when they are of high value and prefers to give cash instead. The cash comes from cutting back on profitable investment opportunities.

Since many of the features of the Hadlock model (e.g. the time line) carry over to the present setting, we will not replicate those details here. The general idea is that a high tech firm buys a target worth V. It does this by paying in cash (m) and a fraction of his shares σ. The value of his shares perceived by the market is $\mu(m)A_h + (1-\mu(m))A_l$ where $A_h > A_l$ are the value of the assets of the acquiring company when it is respectively an high/low type, and $\mu(m)$ is the belief of the target that the assets of the acquirer are high, given the amount of cash it proposes.

The acquirer thus buys a target of value V for cash and own stock or

$$V = m + \sigma\left[uA_h + (1-\mu)A_l + g(r)i\right] \tag{1}$$

where g(r)i are the gross returns from investing at a level $i \leq i_e$, where i_e denotes some upper level of investment beyond which no return can be earned, as in Hadlock (1998). These returns are dependent on past R&D, r. Finally, the optimisation problem for the

manager of the acquiring firm who earned an amount of free cash-flow c and has to decide on its investment then becomes

$$\max_{i} \left(1-\sigma\left(m/\mu\right)\right)\left[A_j + g(r)i\right] \tag{2}$$

where $\sigma(m/\mu)$ is given by (1).

It can be shown that under the unique separating equilibrium, see also Riley (2001), which will emerge in this game - for a proof the reader should note that the model specification is analogous to Hadlock, and hence that the arguments provided there carry on -, the following condition will hold:

$$g(r)\left(i^e - \bar{i}\right) = \left(V - c + \bar{i}\right)\left(\frac{A_h - A_l}{A_h + g(r)\bar{i}}\right) \tag{3}$$

where $\bar{i}$ denotes the investment level chosen by the high type firm.

Equation (3) allows for some interesting comparative statics. As in Hadlock (1998), it can easily be shown that higher cash-flows will lead to more investment, i.e. $i_c > 0$. Novel effects include the effect of R&D on investment. As r increases g, we should investigate what happens with (3) when g increases. Clearly, LHS (3) will go up while RHS (3) decreases. Hence, in order to restore the equality, $\bar{i}$ has to increase (this reduces LHS (3) while increasing RHS (3)). Hence we have $i_r > 0$. (Note that the low types already invest at the maximum level i_e, so for these firms we have $i_r = 0$).

Finally, there is the interaction term i_{cr}. Signing it is more involved and the derivations can be obtained from the author. Within a reasonable range of parameters values, we have $i_{cr} < 0$. Since a negative coefficient of the interaction term of investment opportunities with cash-flow is interpreted as evidence in favour of managerial discretion, see section 3.c. below, one should take into account that besides this corporate governance explanation, also an effect from R&D enhancing the profitability of investment is present.

3.c. Testable predictions

In this section, we first indicate how a regression model is specified given that the elements explained above are plausible for the identification of financially constrained firms. The basic specification employed is:

$$\frac{I}{K} = \alpha + \beta \frac{\text{controls for investment opportunities}}{K} + \gamma \frac{\text{Cash} - \text{flow}}{K} + \delta \frac{\text{int eractions with Cash} - \text{flow}}{K} + \varepsilon \qquad (4)$$

In equation (4), I denotes investment in physical assets and K is the stock of physical assets at the end of the previous period. Regarding the sign of the investment opportunity control variables, we expect them to be positive. This also holds for the coefficient of cash-flow, if signalling in the high-tech takeover market goes on.

As an alternative to the split sample approach, Vogt (1994) argued that the interaction of cash-flow with investment opportunities can be used to test whether a firm is constrained because it faces capital market imperfections. He argues that the method he proposes allows to go even one step further. By looking at the coefficient of the interaction variable: cash-flow multiplied by investment opportunities, one is able to "discriminate" between two different explanations why cash-flows induce investment[1]. One explanation, the so called Imperfect Capital Market Hypothesis (ICMH) has already been explained at length in the previous sections. Due to asymmetric information, the firm cannot lend from the bank the amount it needs to carry on with the investment project. We classify this hypothesis as a "the demand-pull" explanation for the cash-flow-investment dependency, for it is the level of economically justified investments that soak up the cash-flow generated within the firm.

There however exists a second explanation for the dependency. This hypothesis is the Managerial Discretion Hypothesis (MDH). We classify the MDH as a "supply induced" explanation of the dependency, since it are the free cash-flows that are available to the managers that should be paid out as dividends to the shareholders that are used in investments which are not necessarily economically justified but please the manager for some reason or another.

[1] In fact, one is only able to conclude which theory dominates the other, since both explanations could prevail at the same time. In the rest of this contribution, we will not distinguish between the possibility that one theory prevails and the possibility that both are present but one dominates the other.

Whenever the coefficient of the interaction variable is positive (negative), the influence of cash-flow is more important when investment opportunities are substantial (absent). Hence in the case a positive (negative) estimate is found, this supports the ICMH (MDH).

In the context of the discussion of the first part of this section on the theoretical foundations of the dependency, we emphasised the monitoring technology available to the specialised financial intermediaries *and* the coalitions with other stakeholders having *similar* goals. Especially the alignment of preferences, as measured by the degree of concentration of shareholdings, will influence both of the explanations for the observed dependency. Because in a tightly held company, management will be watched more closely by the shareholder, the manager will be less able to divert away cash-flows that should have been paid out as dividends to the shareholders. This implies that there will be less scope for the MDH. The initial paper by Hadlock precisely focuses on these issues, deriving testable hypothesis. We replicate some of these tests below. Yet, our empirical strategy also is different from Hadlock in that we not only focus on the interaction between cash-flow and corporate governance aspects (as measured by shareholder concentration). Additionally, we focus on the interaction between cash-flow, corporate governance and investment opportunities.

As such, we combine the research strategy introduced by Vogt (1994) and the one introduced by Hadlock (1998), and investigate how the ICMH and MDH are mitigated for companies with resp. a widely dispersed shareholdership and closely held companies. A priori, few clearcut predictions as to the direction of this influence can be made, as becomes clear from the next two paragraphs.

In environments characterised by high opportunities but substantial levels of asymmetric information, the banker might feel safer because he is not the only one who has to monitor the manager. On the contrary, given the pecking order where debt is serviced before equity in case of a bankruptcy, a large shareholder will loose substantial amounts of wealth. Therefore, closely held companies *might* be less costly to monitor to a bank, because others have the proper incentives to watch over closely as well. This implies that closely held companies have a better access to external finance, reducing the dependency of investment on cash-flow.

But antagonistic objectives exist too. For example, the manager might ask a very costly but perfectly safe loan to invest in unproductive assets, because good investment opportunities simply are not available. The banker and manager will benefit, the

shareholder will loose. This is likely to happen when shareholder concentration is low, and investment opportunities are low as well.
We can summarize these expectations regarding the estimates in the table below:

Table 1 - Expected sign of coefficients in the investment regression

Coefficient	Variable	Prediction	
β	Investment Controls (R&D and Value Added)	+	
γ	Cash-flow	+	
δ_1	Interaction Cash-flow and Value Added	+	if ICMH } (As in Vogt)
		-	if MDH
δ_2	Interaction Cash-flow and R&D	+	if ICMH } (As in Vogt)
		-	if MDH
δ_3	Interaction Ownership and Cash-flow	+	if ICMH } (As in Hadlock)
		-	if MDH
δ_4	Interaction Ownership, Cash-flow and R&D	-	if coalition shareholder banker
		+	if coalition manager banker

4. EMPIRICAL RESULTS

In this section, we briefly describe the data set used. We then present the results of estimating a number of equations by using Generalised Least Squares on a panel of data for Belgian firms. The panel is composed of firms who all hold the same legal statute. More in particular, we have companies with limited liability and equity beyond a certain limit, where many (anonymous) shareholders may participate. This group of firms has the statute of a NV ("anonymous corporation"). Other legal forms such as BVBA's and CV's in general serve a different purpose. They either are smaller (implying less observations on R&D) or they serve a particular purpose, treating every shareholder in the same way, hence reducing the scope of shareholder concentration as an element of corporate governance.

All data are obtained from Belfirst. We have limited the period of research to five years, more in particular the period extending between January 1 of 1994 up to December 31 of 1998. All variables are scaled by dividing them by the book value of physical assets at t-1. Cash-flow and R&D can be downloaded directly. Cash-flow is defined in the usual way and R&D is the book value of expenditures on R&D activities at the end of the previous year. So they include boxpenditures on technology that is "made" and technology that is "bought". Since the choice whether or not to report R&D activities in Belgium is voluntary, it is important to understand the motives of companies for doing so. In addition, we focus on the sample of Belgian companies who decide to capitalise on R&D rather than to disclose (report) it as an expenditure. Gaeremynck and Veugelers (2002) show that development rather than research activities are more likely to be capitalized, because these activities have a more pronounced link with future revenues. Also R&D activities leading to product innovations are more capitalized, and precisely these will lead to more investments in new product likes, plants, machinery a.s.o. Hence, it seems appropriate to use the lagged outstanding book value of capitalized R&D as a variable capturing investment opportunities. When firms tend to smoothen their investment activities over the years, as they amortize the capitalized R&D, this approach will moreover be the appropriate one. If on the contrary the physical investment is carried out entirely and immediately after that R&D has been brought to the balance sheet, one should use increased capitalisation as a proxy of investment opportunities. We also include the results of that approach.

Concentration of shareholding is defined as the percentage of equity held by the largest shareholder. Since this variable has some critical benchmarks, for instance less that 10 percent could imply there is no real important single shareholder ("widely held"), we introduce dummies to capture different "regimes".

Initially, we start out by regressing on all the firms for which data were available. The data set was cleaned for outliers in terms of investment behaviour (investing more that 600 percent of the existing capital stock in one single year) as well as negative cash-flow. When cash-flows are negative, there seems already a priori few possibilities to divert the free cash-flow away into non-productive investments, hence the MDH would be ruled out a priori. We control for investment opportunities by including both R&D and value added creation effects, see also Konings, Rizov and Vandenbussche (2002).

Finally, we include year dummies to control for specific macro-economic factors in the investment decision process such as the general level of interest rates, expectations, a.s.o.

As none of these dummies was statistically significant, in any of the regressions we ran, we do not include the estimates of these coefficients in the results.
All of this leads us to follow 899 companies who on average are slightly above 2,5 years in the sample, which extends over a 5-year period. This unbalanced panel can be described statistically in terms of the key variables used in the regressions by means of table 2 below, where the median, mean, minimum and maximum of the variable are reported. As mentioned already, New Tangibles, R&D, cash-flow and value added are normalised vis-à-vis the stock of physical assets in the previous year.

Table 2 - Summary Statistics of the Panel

	Median	Mean	St.Dev.	Min.	Max.
NTANG	0.16	0.42	0.70	0.00	5.93
R&D	0.01	0.17	0.57	0.00	6.11
VAC	0.11	0.89	0.75	-0.97	28.41
CF	0.32	0.58	0.74	0.00	4.49
CR	71.50	64.53	34.03	0.01	100.00

A few final remarks regarding the representativeness of the subsample are the following two. First, in terms of value added, the firms in the panel on average account for 1,95 percent of Belgian GDP, with a lowest value in 1996 (1,89 percent) and an highest value for 1995 (2,04 percent). Second, in terms of R&D, Gaeremynck and Veugelers (2002) show that in a sample of 321 Flemish R&D-spending firms in 1993, about 30 percent discloses their R&D activity, and that for those firms disclosing, R&D activities, 68,3 percent prefers to capitalize.

If there findings carry over to the 899 Belgian firms present in our sample, this implies that about 20,5 percent of R&D activity is covered. If we add up all the R&D activity reported by the companies in the sample for 1995 and divide by non-government R&D, we apparently capture more, viz. 34,1 percent. Finally, in terms of the investment activity considered, we capture, again for 1995, about 28,2 percent of the new physical assets of the companies in the Belfirst dataset.

The fixed effects GLS estimates are reported in table 3 below, where t-statistics are in parenthesis.

Table 3 - GLS Regression of Investment, Fixed Effects, Book Value of Lagged R&D

Specification	1	2	3	4	5
CONS	.047	-0.73	.040	-.08	-.076
	(1.66)	(-2.08)	(1.42)	(-2.30)	(-2.14)
RD	.142	.406	.154	.418	.400
	(2.92)	(4.15)	(3.15)	(4.30)	(4.09)
VAC	.035	.053	.035	.053	.053
	(9.34)	(9.74)	(9.40)	(9.80)	(9.81)
CF	.203	;297	.393	.483	.475
	(8.29)	(10.18)	(7.03)	(8.41)	(5.08)
CF * RD		-.100		-.101	-.253
		(-3.36)		(-3.40)	(-2.44)
CF * VAC		-.006		-.006	-.003
		(-4.59)		(-4.63)	(-.90)
CF * CL10			-.378	-.400	-.408
			(-3.20)	(-3.42)	(-2.39)
CF * CM50			-.216	-.210	-.201
			(-3.59)	(-3.52)	(-2.05)
CF * RD * CL10					.131
					(.74)
CF * RD * CM50					.160
					(1.54)
CF * VAC * CL10					-.001
					(-.20)
CF * VAC * CM50					-.003
					(-.70)
N.OBS	2294	2294	2294	2294	2294
N.FIRMS	899	899	899	899	899
R SQUARE	.12	.13	.12	.13	.13

Equation 1 is the basic regression, showing that both R&D, value added creation and cash-flow predict investment activity. Indeed, we find that the investment control variables do well in forecasting investment. The coefficient of cash-flow is seen to be positive and significantly different from zero, indicating a positive dependency of investment on cash-flow. Without further investigation, this equation would replicate the previous findings rejecting the separation theorem.

In *Equation 2*, the methodology introduced by Vogt (1994) has been followed. The interaction between cash-flow and investment opportunities has been introduced and the findings point to the prevalence of the MDH, since the coefficient of cash-flow decreases as value added creation is important. At the same time, the negative coefficient of the interaction between cash-flow and investment opportunities as measured by R&D confirms this conclusion. The more important magnitude of the coefficient associated with CF*RD could be the result of R&D opening up more profitable investment opportunities, as in the theoretical model of section 3 above.

Equation 3 looks at the interaction between cash-flow and concentration of shareholdings, as done also by Hadlock (1998). It turns out that both in closely held and widely dispersed environments, cash-flow has a negative influence on investment. This is as one would expect for CM50, a dummy variable indicating that the single largest shareholder has more than 50 percent of the shares of the company. In that case, it is clear that the manager will be controlled closely by the main shareholder, who will monitor that no free cash-flow is directed away into non-productive investments. For CL10, the same conclusion holds, which is surprising, because here we have widely dispersed firms.

In *Equation 4*, we show that all conclusions reached remain valid when all the interactions terms are estimated within one equation. The Vogt-interaction terms are negative, indicating that the cash-flow dependency is less important in environments where opportunities are abundant. The Hadlock-interaction terms are also negative, indicating that cash-flow generates relatively less investment in extremely closely and extremely widely held compromis.

Finally, *Equation 5* looks at a combination of the Vogt and Hadlock research strategies by including interactions between cash-flow, investment opportunities and shareholder-manager (dis)congruencies. A first result is that the MDH now only is found w.r.t. R&D as a control for investment. Given the fact that in the modified Hadlock model presented, i_{cr} will be negative for a wide range of cases, it could be that there is no evidence at all for

the MDH. However, the coefficients of the interaction between CF and CM50 remain significantly negative, indicating that when the managers and shareholders interests coincide, investments are less sensitive to cash-flows.

The result that this also holds for widely dispersed companies persists. The explanation we put forward is that companies probably attract the attention of other stakeholders whose interests are in line with those of the minority shareholders. One could think of regulators (CBF), or analysts who provide an assessment of the stock.

Finally, none of the triple interaction terms is statistically significantly different from 0, indicating that the cash-flow - investment dependency does not change when for example opportunities present themselves within a closely controlled environment. Equally, the absence of opportunities for a company with widely dispersed shareholdership does not affect the way in which the company was going to use its cash-flow.

Last but not least, since we have the opportunity to work with panel data, the error term ε in equation (4) can be decomposed in a fixed firm specific component and the usual noise term. The Hausmann test points to the existence of fixed effects, hence only those regressions have been reported here.

Previously, we argued that using the lagged book value of R&D as an instrument for investment behaviour implied that investment spending is smoothened, for instance over a period that the R&D brought on the balance sheet is amortized. It could equally be the case that investment immediately and entirely follows the decision to capitalize R&D. In that case, the increase in the book value of R&D will be the appropriate instrument.

In table 4 below, we present the results of the estimation of the five equations discussed above. We will not discuss these results equation by equation, but rather we focus on the most important differences. Before doing so, it is worthwhile taking some time to make a conjecture regarding the nature of the companies that we capture in this sample. Only 261 companies can be identified. On average, they remain for 1.64 years in the sample, indicating we capture both firms who activate R&D in a particular year, as well as firms who increase their book value of R&D for subsequent years. Focussing only on the last group, by for example requiring that R&D increases for 4 subsequent years in the sample leaves us with few observations. Qualitatively, the results, as far as significant, do not change much. But although they are not numerous, we should keep in mind that these companies are present in the sample, as will become clear when discussing the results.

The most important difference between the results reported in table 3 and these reported in table 4 are related to the R&D-variable used for instrumenting investment. Whereas the book value of R&D performed very well in all equations, the increase in RD (DRD) is statistically less significant. Probably the view that investment is smoothened and done over a period coinciding with RD being amortized is the more accurate view of the world.

While at first sight, by only looking at equation 2′, the MDH also prevails in this sample, a different picture emerges from equation 3′. The cash-flow dependency of investments vanishes, only coming in again for very closely held firms. Further statistical analysis not reported here points to the possibility that the shareholder concentration dummies in this sample to some extent capture size effects. Indeed, those companies in the sample increasing year after year their book value of R&D either are very large companies, who structurally engage in R&D activities in many area's or are very small companies, mainly focussing on R&D and less on production, i.e. the typical "targets" discussed in section 3.b. CL10 then is a proxy for size, as the giants will be widely held, and indeed to those companies, cash-flows do not matter for investment. CM50 captures the small, tightly held firms who specialize in R&D, for whom the capital market imperfections are severe. Hence the positive coefficient of CF * CM50. Equation 4′, except for the significance of cash-flow tells the same as equation 4. Again, the triple interaction coefficients are not statistically significant except for CF * VAC * CM50, which is difficult to explain. The fact that the coefficient of cash-flow is not significant, CF * VAC is significantly negative and CF * CM50 is significantly positive, can be seen as further evidence of the co-habitation of two very different kinds of firms in this subsample. On the one hand, there are the giants with widely dispersed shareholders for whom the MDH holds. Although they year after year increase the book value of R&D, they direct free cash-flow into non-productive activities (maybe unvaluable R&D) as seen from the increased dependency of investment on cash-flow in low opportunity environments (CF*VAC). For the tightly held, small R&D firms, truly some capital market imperfection limit their investment behavior as indicated by a positive coefficient associated with CF*CM50.

Table 4 - GLS Regression of Investment, Fixed Effects, Increasing Book Value of Lagged R&D

Specification	1'	2'	3'	4'	5'
CONS	-.159	-.481	-.325	-.535	-.714
	(-1.99)	(-4.49)	(-3.89)	(-4.64)	(-4.64)
DRD	1.689	1.806	.766	1.776	.919
	(1.54)	(1.03)	(0.73)	(1.05)	(.52)
VAC	.046	.157	.128	.200	.270
	(2.24)	(4.79)	(4.45)	(4.98)	(5.31)
CF	.450	.557	-.106	.167	-.018
	(4.94)	(6.12)	(-.74)	(.94)	(-.10)
CF * RD		-.372		-.863	-1.622
		(-.29)		(-.96)	(-.95)
CF * VAC		-.025		-.017	-.016
		(-4.09)		(-2.36)	(-2.15)
CF * CL10			-1.025	-1.191	.553
			(-2.47)	(-2.87)	(.34)
CF * CM50			.637	.366	.666
			(4.18)	(1.98)	(2.95)
CF * DRD * CL10					-2.925
					(-.17)
CF * DRD * CM50					2.185
					(1.28)
CF * VAC * CL10					-.040
					(-1.04)
CF * VAC * CM50					-.039
					(-2.25)
N.OBS	429	429	429	429	429
N.FIRMS	261	261	261	261	261
R SQUARE	.13	.12	.09	.09	.11

5. CONCLUSIONS AND SUGGESTIONS FOR FUTURE RESEARCH

The present paper has shed further light on the investment cash-flow sensitivity by focussing on Belgian data. It has introduced a few novel elements. First, past R&D activity as a control for investment opportunities has been introduced. Second, and from a theoretical perspective, the sensitivity was shown to exist from signalling in a "growth by acquisition framework", where the target is paid in cash and the stock of the acquirer, and R&D activity increases the rate of return of physical investment. Finally, corporate governance elements mitigating the cash-flow sensitivity of investment have been investigated.

The first contribution probably is the most original, and deserves further elaboration in the future. The hitherto used controls for investment opportunities, such as Tobin's Q, encounter serious problems. For example, the just mentioned Q theory of investment runs into a variety of problems when properly investigating the investment - cash-flow dependency. First, one needs the data on the market value of the firm, hence the necessity to limit the analysis to the small fraction of stock listed companies in the economy. In the same vein, the difficult task to find marginal Q, and the heroic assumptions to approximate it by average Q.

Next, the problem that the observed value of Q might already incorporate elements of corporate governance (such as firms having a lot of agency problems having low values of Q), while one precisely tries to capture these elements by the other variables included. And finally, the recently shown spurious correlation that has been shown to occur due to measurement errors in Q. The R&D theory of investment suggested by the present contribution undoubtedly also will face shortcomings. The problems with the Q theory of investment just suggested seem none the less so important that the novel R&D theory at least merits further exploration.

The next contribution consisted of slightly changing the Hadlock model on the cash-flow sensitivity. Here, the task to improve was much harder. The Hadlock model indeed incorporates both the ICMH (through signalling to a competitive stock market) and the MDH (through a parameter incorporating the different utility of investment for managers and shareholders). In the present contribution, this setting was extended to investigate the sensitivity of investment on cash-flow for firms who want to grow by acquisition, and need

to pay for the stock of the target by cash and own stock. The model moreover was extended to allow for the fact that R&D could enhance the rate of return of physical investments. As an important result, we were able to show how within the context of this model, this implies within reasonable ranges of the parameter value a negative second order cross partial derivative of investment w.r.t. cash-flow and R&D. In the research strategy pioneered by Vogt, such a negative sign is interpreted as evidence in favour of the MDH. Yet in the present model, such a negative sign comes about in the separating equilibrium of the signalling game capturing asymmetric information in the capital market.

This does not imply that we hesitate to conclude that one cannot reject the MDH. On the contrary, in the perspective of the third research avenue explored in this paper, that is the role of corporate governance, we tend to conclude in favour of the MDH. Within the more likely model of physical investment depending on the (lagged) outstanding book value of R&D, this conclusion comes about both within the context of exploring the specifications put forward by Vogt *and* Hadlock. The last research strategy however suggests that the agency problems are most severe "in the middle". That is within extremely closely held companies, or extremely dispersed shareholdership, the manager tends to invest less free cash-flow than in companies with a few "average sized" shareholders. This suggests that also in the market for corporate control, a "stuck in the middle" syndrome might exist.

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