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Abstract

When firms find that external finance is costly or rationed, they face financing constraints in their investment decisions. The financing constraints paradigm applies this idea empirically and supports the joint hypothesis that constrained firms can be identified and should display a stronger sensitivity of investment to cash flow. The first part of this paper shows that this paradigm is increasingly criticised, because some proxy variables used to identify constrained firms deliver contradictory results regarding this sensitivity. In addition, some of the firms that display a strong sensitivity have internal funds seemingly in abundance.

While this weakens, it does not render useless the financing constraints paradigm. In the second part of this paper, I propose a more comprehensive look at financing constraints in two stages. First, theoretical and applied research into corporate cash holdings suggest that firms react to informational problems in capital markets by specifying cash targets partially for the purpose of circumventing the brunt of future financing constraints. I argue that knowledge of such targets allows us to measure the amount of ‘free cash’ that firms have at their disposal, which is a clearer measure of the constrainedness of a firm than observed cash levels. Second, the simultaneous modelling of investment and cash management provides for a clearer assessment of the interplay between cash accumulation and investment.

Keywords: Corporate investment, financing constraints, corporate cash
JEL Classification: E41, G31, G32

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1. Introduction

The sensitivity of corporate investment to financial variables has been indicated long ago (e.g. Meyer and Kuh (1957)) and is by now an established fact. It is also well documented that this sensitivity is more pronounced for some firms than for others. For instance Fazzari et al. (1988) find that financial variables affect investment more for firms with low dividend payout rates; Hoshi et al. (1991) document a weaker sensitivity of investment to finance for Japanese firms belonging to a Keiretsu than for independent firms; Whited (1992) reports a stronger sensitivity for firms without a bond rating.

Current academic debate revolves around the interpretation of these findings. To the extent that firms face costly or rationed external finance, marginal investments may be sufficiently profitable when financed with internal funds, while these have been exhausted. The same marginal investments may not be sufficiently profitable to raise external finance for. The firm is then said to be financially constrained, the implication of which is that an increase in internal funds will generate an increase in investment unrelated to changes in investment opportunities. Fazzari et al. (1988) and related studies claim that the sensitivity of investment to increases in internal funds is driven by financing constraints resulting from informational problems in capital markets, which we will refer to as the financing constraints paradigm. This body of applied literature has so far not succeeded in developing a structural model of investment subject to financing constraints, however. Instead, it relies on ad hoc addition of financial variables – usually cash flow – to existing investment models.

Kaplan and Zingales (1997) do present a simple theoretical model of investment with costly external finance. They demonstrate that theoretically, the investment-cash flow sensitivity is not a useful indicator of financing constraints as it does not necessarily relate monotonically to the cost of external finance or the level of internal funds available. They also
show that firms seemingly rich in the amount of internal funds available nevertheless display a stronger sensitivity of investment to cash flow. Their explanation is that firms with healthy levels of internal funds have incentives to use additional earnings for financing excessive, unprofitable investments.

The explanation of the investment-cash flow sensitivity is important from an academic as well as a policy perspective. From an academic point of view, we want to know whether the sensitivity of investment to financial factors stems from unspecified financing channels, or simply from error in capturing financing constraints in combination with error in the measurement of investment opportunities. From a policy point of view, the existence of a financing channel can shed some light on the sources of the volatility in corporate investment behaviour. Moreover, if shown to exist, knowledge of the composition of the financing channel can guide policymakers in their attempts to alleviate the problems of corporates being unable to raise sufficient funding for profitable investment.

While Kaplan and Zingales (1997) propose to discard the use of investment-cash flow sensitivities in the empirical analysis of financing constraints, I propose not to throw out the baby with the bath water. The aim of this paper is to suggest fruitful avenues for research to explore more comprehensively the relevance of financing constraints, even though I do not pretend to build a structural model of investment subject to financing constraints. Instead, I propose a flexible reduced form model that allows for the truly simultaneous analysis of financial and investment decisions.

One such financial decision that is closely linked with the investment decision in an environment with informational imperfections and concomitant financing constraints is the cash management decision. Specifically, I consider how well cash holdings measure financing constraints when firms hold precautionary cash balances because of such constraints. In doing so, I sympathise with those who are concerned with endogeneity problems in the application
of observed cash holdings as measures of financing constraints and want to stress the importance of analysing what constitutes a constrained firm. Furthermore, the focus on cash management links up with some of the unresolved issues in the debate between Fazzari et al. ((1988), (2000)) and Kaplan and Zingales ((1997), (2000)). The connection between capital structure management and investment subject to financing constraints is also considered, but looks less promising.

The paper proceeds as follows. Section 2 presents the financing constraints paradigm, i.e. the analysis of financing constraints under the joint assumption that 1) firms can be distinguished into various degrees of constrainedness and 2) the investment-cash flow sensitivity conveys the impact of financing constraints. The weaknesses in modelling the financing channel in investment are discussed in conjunction with proposed solutions. The resulting reading of the literature suggests that financing constraints are relevant in the corporate investment decision, although the evidence is far from unambiguous. This provides an understanding of the penned up concern with the paradigm that revolves around the use of the joint hypothesis, as discussed in section 3. The contemporary debate revolves more around the identification of the constrained firm than about the interpretation of investment-cash flow sensitivities as measuring financing constraints. This has arisen from the limited degree of coherence in empirical results when we strictly believe that the investment-cash flow sensitivity signals the tightness of financing constraints. In section 4 I suggest the use of possible connections between cash management and investment, but also between debt management and investment to obtain clearer indications of when corporate investment is in fact subject to financing constraints. In addition, a simple and flexible empirical model for the simultaneous analysis of investment and these financial decisions is outlined. I conclude in section 5.
2. The financing constraints paradigm

The typical approach to the analysis of financing constraints in corporate investment relies on split sample analysis. The idea is to separate firms for which financing constraints are expected to be particularly relevant in investment decisions from firms for which they are not. A more prominent role for financial factors in the investment decision of a priori constrained firms relative to that of a priori unconstrained firms is then interpreted as evidence that financing constraints are relevant. In this section, we discuss two strategies to detect financing constraints in corporate investment. Q-models and reduced form investment equations rely on excess sensitivity tests, while Euler investment equations apply the misspecification approach. The pros and cons of both classes of models are addressed in the following two subsections.

2.1. Q-models and reduced form investment equations

Q-models and reduced form investment equations share their reliance on excess sensitivity tests to identify the role of financing constraints in corporate investment. Excess sensitivity refers to the sensitivity of constrained firms’ investment to financial factors over and above that of unconstrained firms.

2.1.1. The analysis of financing constraints

The typical empirical investment equation in this class of models looks like equation (1).

\[ I = f(Investment\ opportunities) + g(Internal\ funds) \]

Here Investment opportunities refers to a (sub)set of investment fundamentals which
includes but is not limited to $Q$, sales growth (of the firm or of the industry in which the firm operates), the user cost of capital, and sales-assets or sales-capital stock measures. *Internal funds* refers to a (sub)set of financial variables, wherein cash flow plays a predominant role in most of the applied work, but the stock of liquid assets is also used on occasion (e.g. Fazzari et al. (1988), Fazzari and Petersen (1993)).

Within a Q-model of investment, equation (1) is typically specified as

$$\frac{I}{K_i} = \beta_0 + \beta_1 Q_i + \frac{\beta_2 \text{Cf}}{K_i} + \epsilon_i$$

where $I$ measures gross investment expenditure, $K$ denotes the firm’s capital stock, $\text{Cf}$ stands for cash flow, $Q$ measures the market value of the firm’s assets divided by its replacement costs, and variables are indexed by firm ($i$) and year ($t$). $\epsilon_i$ is an error term that may include firm and time specific elements, in addition to a white noise component. Ideally, when financing constraints do not matter $Q$ is a sufficient statistic to characterise a firm’s investment level, whereas $E \epsilon_2 = 0$. That is to say, a firm can finance all profitable investment, regardless of whether it can finance this investment with internal funds or has to raise external finance. In contrast, when financing constraints do matter, firms sometimes feel compelled to reconsider investment decisions for lack of (reasonably priced) external finance, while internally available finance has been depleted. The timing of investment then coincides with increments in internal funds, i.e. $E \epsilon_2 = 0$.

In practice, estimates for $E \epsilon_2$ are positive regardless of whether we expect financing constraints to matter for a particular (sub)set of firms or not, while estimates of $E \epsilon_1$ – though typically positive and significant – are very low most of the time (e.g., Fazzari et al. (1988),
Devereux and Schiantarelli (1990), Oliner and Rudebusch (1992)). To illustrate the economic importance of such low estimates for $1_E$, assume the Summers (1981) adjustment cost function $\frac{k}{2} + \frac{1}{\alpha} a K_a^2$, where adjustment costs are convex in gross investment around some normal investment level $\alpha$. Applied to the Q-model, this adjustment cost function implies that the estimated value for $1_E$ reflects $\frac{1}{b}$, suggesting that low estimates of $1_E$ reflect (implausibly) large adjustment costs.

A specific characterisation of the adjustment cost technology greatly facilitates the empirical implementation of the Q-model. Of course, this also constitutes a serious limiting assumption on the analysis, as the exact adjustment cost technology may be difficult to capture in a simple functional form. The main advantage of using reduced form investment models is that one abstains from explicitly modelling the adjustment cost technology altogether. Instead, the empirical implication of costly adjustment is taken as a starting point in the sense that adjustment is assumed to take time and partial adjustment is expected.

For illustrative purposes, consider a simple autoregressive distributed lag (ADL) characterisation of the adjustment process. In the ADL model, the capital stock is a function of its own past (to reflect persistence due to adjustment costs) as well as present and past levels of the targeted capital stock (to reflect adjustment incentives):

$$k_t^* = \frac{L}{\sum_{l=1}^L} k_{t-l} + \frac{M}{\sum_{s=0}^M} k_{t-s}$$

where $L$ and $M$ capture the number of lags to be included for $k$ and $k^*$ (denoting the log of the actual and optimal capital stock, respectively). Empirical implementation requires the characterisation of the optimal capital stock $k^*$, which may result from a simple profit or sales maximisation problem. The impact of financing constraints is then analysed as in the Q-
When financing constraints are irrelevant, financial variables should not be able to increase the explanatory power of the investment model. In contrast, when financing constraints are relevant, the accumulation of internal funds plays a role in the investment decision in addition to expected profitability considerations. Hence, financing variables such as cash flow would then contribute meaningfully to the explanation of investment.

The main disadvantage of using reduced form models to characterise investment demand is that they may be particularly ill suited for determining the structural determinants of capital demand. This allows for variables that are not structural determinants of investment, yet are correlated with expected future profitability of the firm to appear with a significant parameter estimate in the estimated investment function. In particular, when current profits are a leading indicator for future profits, current profits will have significant explanatory power in the empirical investment equation, even though financing conditions pose no restrictions on the investment decision.²

Despite this drawback, the reduced form investment equation may still be useful in the analysis of financing constraints on investment and is in fact used in a variety of studies (e.g., Fazzari et al. (1988), Harris et al. (1994), Chirinko and Schaller (1995), Lamont (1997)). The validity of reduced form models in this regard depends on the sufficient condition that the mismeasurement of investment opportunities – and hence the informational content of the financial variables – is the same for constrained and unconstrained firms alike. If this is the case, the differences in the impact of financial variables on the investment demand of constrained and unconstrained firms still reflect the presence of binding financing constraints: constrained firms’ investment should display excess sensitivity to financial variables such as cash flow.³
2.1.2. *Main criticism*

For excess sensitivity tests to provide useful indications of the relevance of financing constraints it is required that the informational content of financial variables is the same for constrained and unconstrained firms alike. When there is the suspicion that investment opportunities are measured with more error for younger and smaller firms, financial variables may have greater informational content in the investment decisions of these firms and obtain greater empirical importance for that reason (cf. Poterba (1988)). As such, differential error in measuring investment opportunities may generate differential sensitivity of investment to financial variables and render up the excess sensitivity test as a useless indicator of financing constraints.

Two solutions to this issue can be identified from the literature. One solution is to attempt to control for the informational content of changes in internal funds, i.e. extract that part which correlates with innovations in investment opportunities. Subsequently, the sensitivity of investment to the pure liquidity content of changes in internal funds can be assessed. Gilchrist and Himmelberg (1995) and (1998) implement this strategy within a Q framework. Using information on observable fundamentals, the authors construct an expected value of $Q$. Cash flow is also included in the set of observed fundamentals, so that even in the situation where a shock to cash flow correlates with shocks to investment opportunities, this effect is incorporated in the expected value of $Q$. Therefore, the additional information contained in cash flow to which investment may or may not be sensitive refers only to its liquidity content. Gilchrist and Himmelberg find that even after controlling for the informational content in cash flow, constrained firms exhibit excess sensitivity to internal finance. Thus innovations in cash flow orthogonal on innovations in investment opportunities contribute positively to investment, a finding that is in line with the working of financing constraints and cannot be discarded as an anomaly of measurement error.
Another solution is to search for semi-natural experiments wherein changes in wealth are conceivably uncorrelated with the error in measuring investment opportunities. Lamont (1997), for instance, investigates the investment decision of segments that belong to a conglomerate that contains also a segment in the oil industry. The focus is on the impact of the oil price decline of 1986 – a negative shock to the oil segments’ cash flow – on the investment decision of the non-oil segments. The findings of the analysis clearly indicate responsiveness of non-oil investment to this exogenous fall in corporate net worth.\(^5\)

This far from settles the debate, however, as Erickson and Whited (2000) demonstrate that measurement error in \(Q\) can explain excess sensitivity results. Under the assumption of perfect measurement, they demonstrate that firms with a bond rating display excess sensitivity of investment to cash flow.\(^6\) Correcting for measurement error removes the cash flow sensitivity for both the unconstrained and the constrained subsets of firms. As the sources of error in measurement Erickson and Whited identify the possible inequality of marginal and average \(q\) (Hayashi’s (1982) sufficient conditions are not met), of average \(q\) and Tobin’s \(Q\) (the observed market value of the firm may diverge from management’s valuation), and the error in the measurement of Tobin’s \(Q\) using accounting data.

2.2. Euler equations

If errors in measuring \(Q\) cloud the usefulness of excess sensitivity tests in assessing the relevance of financing constraints, then Euler equations may offer a way around. The main advantage of Euler equations over Q-models is that one abstains from using noisy stock market information to characterise investment opportunities.\(^7\)
2.2.1. *The analysis of financing constraints*

An Euler equation can be derived from the same optimisation procedure that results in the standard Q model of investment. First order conditions are rearranged differently, however, so that the shadow value of an extra unit of capital drops out of the analysis. The analysis therefore no longer focuses on the market value of additional capital relative to its replacement value, but emphasises the intertemporal allocation of investment instead. Specifically, firms are expected to trade off the net benefits of investing today against the net benefits of postponing investment to the future. In the absence of costly external finance or restrictions to the amount of external finance available to the firm the marginal product of capital, net of its user costs and adjustment costs represents the net benefits of investment. When applied to the data, such standard Euler equations are properly specified when the assumption of no financing constraints is valid and specification tests should not reject the model.8

Financing restrictions can for instance be imposed by a nonnegativity constraint on dividend payments in combination with a debt-capacity constraint (e.g. Whited (1992) and Van Ees et al. (1998)) or more straightforwardly by considering the firm to face a higher discount rate when its nonnegativity constraint on dividends binds (Hubbard et al. (1995)). The idea is that such constraints, when they are binding, drive a wedge between firms’ expected returns to contemporary and future investments, so that the standard Euler equation is misspecified.

Empirical implementation of the alternative, financing constraints augmented Euler equation requires a characterisation of the shadow value of relaxing the external financing constraint by one unit. Whited (1992), for example, models this shadow value as a non-linear function of leverage and coverage. Hubbard et al. (1995) use firms’ cash flows and a measure of aggregate credit constraints. The augmented Euler equation can be applied to the
investment decisions of a priori constrained firms and specification tests subsequently evaluate whether the characterisation of the financing constraint is accepted by the data.

2.2.2. Main criticism

While the Euler approach does not require the use of noisy stock market information, this does not automatically shield the approach from any measurement problems. More specifically, the researcher must now estimate the marginal product of capital, net of marginal adjustment costs and the user cost of capital. It seems a bit optimistic to assume that this all works without error and it is not obvious that the marginal productivity of capital and its user cost should be measured with less error than the market value of the firm.

Furthermore, Euler equations may have difficulty in picking up the effects of financing constraints when they remain approximately equally tight over time. To illustrate, while firms may face financing constraints now and in the future, the Euler approach has difficulty detecting them when the restriction is a constant in an intertemporal sense. This issue can obviously be overcome by using data over a period of time long enough to include changes in the tightness of financing constraints. While typically panel data sets include many firms but a limited number of years, however, it is not clear to what extent this issue is sufficiently obviated in applied research.

Lastly, while the misspecification tests may reject the frictionless markets, standard Euler equation for a priori constrained firms, additional insight into the nature of the financing constraint can only be obtained when the financing constraint is actually modelled and its shadow value is empirically characterised. This leaves a degree of discretion to the researcher and results in ad hoc modelling that resembles the ad hoc inclusion of financial variables in the Q model and reduced form investment equations. Hence, the claim that Euler equations
are better equipped to identify the deep parameters of the investment model can be acknowledged in the financing constraints application only after we have identified theoretically the deep parameters of the financing constraints. This has shifted the playing field towards the main contemporary challenges faced by the financing constraints paradigm, discussed extensively in the next section.

3. Contemporary challenges for the paradigm

The two major contemporary challenges for the financing constraints paradigm have a methodological character. Specifically, the empirical implementation of the financing constraints hypothesis relies on the joint assumption that we can actually identify constrained and unconstrained firms and subsequently, that the investment-cash flow sensitivity (ICFS) indicates the relevance of financing constraints in the sense that tighter constraints imply a stronger sensitivity. These two assumptions have not received the same degree of attention in applied research. Starting with the seminal contribution by Fazzari et al. (1988), the emphasis has been on detecting excess sensitivity of investment to cash flow. We discuss this approach and some of its awkward results in section 3.1. It took years of growing unease with this approach before Kaplan and Zingales (1997) directed research attention towards our ability to mark a firm’s financial status as constrained or unconstrained. In section 3.2, we summarise their critique and discuss some of the main contributions sympathising with the spirit of what has become known as the Kaplan and Zingales critique.

3.1. When the ICFS measures financing constraints

Fazzari et al. (1988) cleared the way for the general belief that the investment-cash flow
sensitivity is a useful indicator of financing constraints. Their seminal contribution made the plausible case that US firms paying low dividends are the firms that face the highest cost of raising funds externally. In line with this conjecture, they show that low payout firms are also the ones that exhibited the highest ICFS. Devereux and Schiantarelli (1990) demonstrate that small and young UK firms were most sensitive to cash flow in their investment decision, claiming the conceivability that small and young firms are more prone to informational problems to invoke the financing constraints explanation. Subsequent contributions attributed informational problems to Japanese firms outside industry groups (Hoshi et al. (1991)) and US firms whose insiders trade relatively heavily in the firm’s own stock (Oliner and Rudebusch (1992)), to name just a few.9

This rapid initial success of the financing constraints paradigm created a tendency for subsequent studies to focus more heavily on demonstrating excess sensitivity results than on the in-depth analysis of what constitutes a constrained firm. As such, the maintained hypothesis that the ICFS is a useful indicator of financing constraints can be blamed for implementation of ad hoc sample splits. Pointing towards the obtained excess sensitivity results validates such splits afterwards.10 Hu and Schiantarelli (1998) provide a particularly clear illustration of this search for excess sensitivities. Their switching regression framework is specifically designed to discriminate investment observations displaying a strong ICFS from observations with no or only moderate ICFS.

To a certain extent, this maintained hypothesis can also explain the heavy reliance on uni-variate stratification procedures in the analysis of financing constraints, where firms are assigned the constrained or unconstrained status on the basis of a single variable only. Such procedure assumes not only that financing constraints are relatively easily identified, but also additionally assumes that they are simply and monotonically related to a single variable, say size, leverage or dividend payout. In combination with the maintained hypothesis that the
ICFS is a useful indicator of financing constraints, this produces some peculiar results with ad hoc interpretations. For instance, small firms are sometimes found to display excess sensitivity of investment to cash flow, which is interpreted by noting that small firms are "typically younger, less well-known, and hence more vulnerable to capital market imperfections induced by information asymmetries and collateral requirements" (Gilchrist and Himmelberg (1995), p. 551). Oliner and Rudebusch (1992), arguing that small firms are expected to face relatively high transaction costs for external finance due to fixed components in issuance costs, find no differential ICFS between small and large firms. These results lead the authors to conclude that size is unable to explain the financing hierarchy in their sample. Hu and Schiantarelli (1998) find that size increases the probability that firms face binding financing constraints. Their interpretation invokes agency problems associated with the dispersed ownership of large firms’ shares that outweighs the fact that these large firms may be older and well known to investors.

We shall discuss similarly conflicting findings on uni-variate splits using leverage and cash holdings later on. For now, let us stress that the discussion above suggests that size may not capture adequately the multiplicity of factors that influences a firm’s financial strength and ability to raise external finance after all. I must remark that Hu and Schiantarelli (1998) already adhere to this argument. Namely, their switching function incorporates other factors besides size. While their interpretation of the results treats size as an isolated factor, the possibility that size correlates with other variables in the switching function already suggests that the partial effect of size may not be comparable to the excess sensitivity results using size in a uni-variate stratification procedure. See Gomes (2001) for an illustration of the misleading results that may result from a stratification procedure using size. Van Ees et al. (1998) also argue for a multivariate analysis, where multiple unobserved factors associate with financing constraints. Specifically, they propose factor analysis, which discriminates the
data on the basis of unobserved factors. The joint loading of variables on the same factor can provide a clearer indication of the differential in access to and cost of external finance for different groups of firms.

The financing constraints paradigm is further brought under a cloud by findings that some of the firms that are classified as facing financing constraints actually appear to be quite rich in terms of the amount of internal funds they have. We are hard pressed to explain why these firms should behave constrained, when they appear unconstrained in the sense that they could have increased investment outlays considerable from their internal means, had they so chosen. Schnure (1997) makes this point for the firms that Lamont (1997) considers to be financially constrained. Kaplan and Zingales (1997) do so for the firms that Fazzari et al. (1988), the parent of this literature, consider to be financially constrained on the basis of dividend payout behaviour. Kaplan and Zingales press their argument even further by classifying the 49 low dividend firms according to the amount of investment increases they are able to finance with internal means. They show that firms that are most constrained by this definition actually display the lowest ICFS. Cleary (1999) provides a generalisation of this result, demonstrating that within a sample of 1,317 US firms, those which are most likely to face binding financing constraints actually display the lowest ICFS.

While these findings have not utterly eradicated the belief that ICFS are useful measures of financing constraints, they have succeeded in shifting attention towards new ways to identify whether firms suffer from such constraints and have stressed the need for theoretical models.

3.2. Identifying financing constraints accurately

The lack of thorough theoretical foundations of the ICFS combined with some of the peculiar
findings discussed above have paved the way for a new field of research, where the focus is on what identifies a constrained firm and the ICFS is no longer assumed to provide the answer.

As mentioned before, Kaplan and Zingales (1997), KZ97 hereafter, lead the vanguard of this attack on the entrenched research on investment and financing constraints with an in-depth investigation of the 49 firms characterised by Fazzari et al. (1988) as financially constrained. The strength of the KZ97 analysis is that it provides a very simple model of investment under financing constraints. The model shows that a non-monotonic relationship between the ICFS and informational problems may result directly from the underlying structure of the marginal cost of external finance and the curvature of the marginal product of capital function. The simple maximisation problem that KZ97 consider is given in (2),

\[
\begin{align*}
\text{(2)} \\
\max & \quad (I) \quad F(E \; k) \quad I \\
\text{s.t} & \quad I = W + E
\end{align*}
\]

where \((I)\) is the revenue function which is dependent only on the current investment level, \(I\), and \(F(E \; k)\) represents the premium paid on external finance, which depends positively on both the level of external funds acquired \((E)\) and the degree of informational problems \((k)\). Investment is financed by a combination of internal funds \((W)\) and external funds. Note that the model requires firms to exhaust internal funds before turning to external sources of finance. The possible implications of these highly simplifying assumptions are discussed shortly.

From the first-order condition of (2) the sensitivity of investment to changes in wealth can be derived:
where $Y_X$ represents the partial derivative of $Y$ with respect to $X$ and $Y_{XX}$ denotes $Y$ differentiated twice with respect to $X$. Assuming a concave revenue function ($\frac{\partial^2}{\partial X^2} Y < 0$) the sensitivity of investment to changes in wealth is shown by (3) to depend on the convexity of the cost of external finance with respect to the amount of external finance raised.

Since differential sensitivities are at the centre of attention in the empirical analysis of financing constraints, the partial derivatives of (3) with respect to wealth and the degree of informational problems are given in (4) and (5) below.

\[
\frac{I}{W} = \frac{\partial F_{EE}}{\partial W} Y_{XX} \frac{2}{\partial W} F_{EE}^2 \frac{2}{\partial W} F_{EE}^3
\]

\[
\frac{1}{W} \frac{\partial F_{EE}}{\partial k} = \frac{F_{EE} \frac{2}{\partial W} F_{EE}^2 + F_{E_k} F_{EE} \frac{2}{\partial W} F_{EE}^3}{F_{EE} \frac{2}{\partial W} F_{EE}^3}
\]

KZ97 focus on changes in wealth (4) in their critical review, which results theoretically in a positive and monotonic connection with the ICFS only if "there is a certain relationship between the curvature of the production function and the curvature of the cost function at the optimal level of investment" (KZ97, p. 175). Fazzari et al. (2000) stress that the empirical test should not explore the ICFS for firms with different levels of wealth, but rather subdivide firms based on their expected degree of informational problems, i.e. they suggest sorting firms on the basis of $k$. Hence they claim that equation (5) is an appropriate test of financing constraints. It follows from (5), however, that the ICFS is neither necessarily monotonic nor increasing in the degree of informational problems either (also see Kaplan and Zingales...
The single most important point of critique regarding the simple KZ97 investment model is that it may, in fact, be too simple to accurately analyse the problems at hand. The model is a static optimisation problem in which $W$ – interpreted as the amount of internal funds available for investment, or retained earnings – is given exogenously. In that sense, $W$ is like manna from heaven. It is unclear where it comes from and in addition, its value in a more dynamic setting is not recognised. In a more realistic setting, one might expect that the amount of $W_t$ with which the firm starts period $t$ is determined in the past and the need for a certain level of $W_{t+1}$ is also taken into account in the investment and financing decisions in period $t$. The value of $W_t$ and the decision over $W_{t+1}$ stems from the objective to inter-temporally minimise the cost of finance. Hence a firm with low $k_t$ but high expected $k_{t+1}$ has an incentive to finance current investment with more external finance than it would in a one-shot investment decision, since this avoids higher costs of external finance in period $t+1$.

To the extent that this critique applies, KZ97’s conclusion that the ICFS is not a useful measure of financing constraints is moderated. In fact, KZ97 assume that observed levels of internal wealth are useful measures of financing constraints and this assumption precisely allows them to interpret their empirical findings as saying that the ICFS is not. However, when observed levels of internal funds do not associate monotonically with financing constraints even though the ICFS does, it is unclear whether firms with lower levels of internal funds should display a stronger ICFS. In this regard, we should note that some of the more recent theoretical contributions to the debate include a dynamically optimal demand for internal funds in an environment with financing constraints. These contributions demonstrate that a non-monotonic relation between the level of internal funds and the degree of financing constraints is possible. Dasgupta and Sengupta (2001), for instance, develop a model in which the decision over the amount of internal funds to transfer to the future in the form of liquidity
depends on expected future profitability and expected future financing constraints. The result of this richer theoretical specification is that it is not unlikely "for more constrained firms to end up with higher cash endowment today and show greater cash flow sensitivity of investment" (Dasgupta and Sengupta (2001), p. 3), supporting the notion that observed levels of internal funds may not accurately reflect financing constraints.

Further theoretical evidence against the usefulness of the ICFS as a measure of financing constraints is provided by Almeida and Campello (2002), who illustrate that in an environment where financing constraints apply to the quantity of credit available, the ICFS is highest for firms that face the lowest degree of financing constraints and vice versa. The mechanism builds on a moral hazard problem that requires the firm to put up a minimum share of the necessary investment outlays to ensure diligent behaviour. Hence the least constrained firms have the largest equity multipliers, implying that any given increase in internal funds allows them to raise investment by a larger fraction than more constrained firms, who have smaller equity multipliers.15 Their model specifically provides a counterintuitive role for debt: firms with large amounts of debt are relatively unconstrained (these are the firms that have the largest equity multipliers).

Theoretically, therefore, there is no unambiguous, monotonic relationship between observed levels of internal funds and the incidence of financing constraints as captured by the ICFS. A similar result obtains with regard to observed leverage. In addition, the empirical testing of opposing theoretical views on the connection between internal funds and leverage on the one hand and the ICFS on the other hand is cumbersome, as financing constraints are inherently unobservable. Hence, one cannot identify constrained and unconstrained firms with certainty and check whether the ICFS is higher for the former group of firms, as would be required to test the validity of the ICFS as a useful measure of financing constraints.16 A way around is discussed extensively in the next section.
4. Managing finances and financing constraints

The investment decision is one of many financial decisions the firm has to make. Firms additionally decide on inventory holdings, liquidity holdings, the capital structure, and dividend payments, to name just a few decision variables. Clearly, these decisions are highly interrelated. While at any point in time a firm may strictly be able to increase investment expenditures, it may for instance feel reluctant about the required dividend cuts, because dividend cuts are perceived as bad news in the stock market (e.g. Lintner (1956) and Healy and Palepu (1988)). The aim of this section is precisely to consider such interdependencies of financial decisions that make the firm feel constrained in its investment decision in ways we cannot hope to capture by such factors as firm size, age, or connections to industry groups. At the same time, these interdependencies may deliver constrained investment in some years, but not in others. Thus, it allows us to identify a time-variant constrained or unconstrained financing status á la Hu and Schiantarelli (1998) that nevertheless does not rely on the assumption that the ICFS is a useful measure of financing constraints. We focus on debt (subsection 4.1) and cash holdings (subsection 4.2) only, because these variables have produced some of the more striking and contradicting results when applied as sample stratification devices to the financing constraints analysis. For the sake of expositional clarity, we also consider the debt and cash decisions as separate decisions, even though they are likely jointly determined. Connections of optimal cash and debt decisions with the analysis of investment subject to financing constraints are discussed in subsection 4.3, while the outline of an empirical model linking the cash and investment decisions is presented in subsection 4.4.
4.1. *Managing the capital structure*

The theoretical connection between leverage and the incidence of financing constraints is unclear and empirical evidence is mixed. These mixed conjectures and findings relate to our ability to proxy unobserved debt capacity constraints with observed debt levels. When comparing a cross-section of firms and assuming that firms have more or less similar debt capacity, firms with high debt levels more likely face binding debt constraints. For example Whited (1992) interprets low leverage a priori as sorting out relatively unconstrained firms, since they have the ability to incur further debts without immediately running into capacity constraints. Van Ees et al. (1998) acknowledge this reasoning, but at the same time note that low leverage is an ex post proxy for severe credit rationing. Their argument is that when looking at historical levels of corporate indebtedness, a history of low debt likely points to a low debt capacity. Hence, they suspect that firms with historically low levels of debt run into debt constraints more quickly and display constrained investment behaviour.

The issue is further complicated by noting that “the firm may [...] plan to cover part of normal investment outlays with new borrowing, but it tries to restrain itself enough to keep debt safe – that is, reasonably close to default-risk free. It restrains itself for two reasons: first, to avoid any material costs of financial distress, and second, to maintain financial slack in the form of reserve borrowing power [which] means that it can issue safe debt if it needs to” (Myers (1984), p. 589). Hence, a firm may rationally decide to maintain some precautionary spare debt capacity and target a level of indebtedness that lies below its debt capacity.

There is a broad literature on the management of the capital structure that we can refer to in an attempt to shed some light on this unclear connection between leverage and financing constraints. Myers and Majluf (1984) present the seminal model that rationalises pecking order behaviour in capital structure adjustment in an environment with asymmetric
information. Within this model, firms exhaust internal funds first, before they turn towards external sources of finance and when they do, they prefer safe debt to equity. They then issue safe debt up to the point where they no longer need further funding, or hit their debt capacity constraint, whichever comes first. What is important within the context of this section, is that in the Myers and Majluf world, firms do not perceive an optimal capital structure (cf. Modigliani and Miller (1958)) and they do not feel constrained in their investment decision until they actually hit their debt capacity constraints.

Opposed to this pecking order view is the static trade-off theory, in which firms are assumed to trade off the costs of an additional unit of debt in terms of increased cost of financial distress, against its benefits in the form of additional tax shield. Myers (1984) concludes that "[T]he static tradeoff story works to some extent, but [...] actual debt ratios vary widely across apparently similar firms. Either firms take extended excursions from their targets, or the targets themselves depend on factors not yet recognised or understood" (p. 589). Harris and Raviv (1991) provide an overview of capital structure models based on informational asymmetries, which defines a great many potential determinants of capital structure. Furthermore, the spirit of the static tradeoff theory for instance allows firms to trade off the net benefits of raising an additional unit of debt today against the net benefit of having the option to raise an additional unit of debt in the future. Thus within a static tradeoff world, firms may already feel constrained in their investment decision even though they did not hit their debt capacity constraints just yet.

The empirical evidence has so far failed to provide unambiguous support for either the pecking order or the static tradeoff theory. While the present paper does not intend to provide a platform for an in-depth analysis of the empirical literature on this topic, let us note some of the more important contributions. Rajan and Zingales (1995) provide international evidence on the determinants of capital structure that suggests that this structure is relevant to a firm’s
value. Shyam-Sunder and Myers (1999) find strong evidence of a pecking order in corporate capital structure adjustment. Target adjustment effects are also observed, but such effects would emerge even if the factual Data Generating Process were pecking order. Frank and Goyal (2003) report evidence contrary to the pecking order theory.

4.2. Managing corporate cash holdings

Lack of clarity also surrounds the theoretical and empirical connection between corporate cash holdings and financing constraints. For example Hu and Schiantarelli (1998) find that firms with low cash ratios are more likely to face a higher premium on external finance. This corresponds with the theoretical considerations of KZ97, who regard cash as part of a firm’s pool of internal means with which it might finance additional investment. As discussed above, however, it does not concur with KZ97’s empirical findings, which attach the lowest ICFS to the firms with the lowest levels of cash holdings. It also contrasts with Hovakimian and Titman (2003), who find that large cash holdings increase the probability that the firm faces a high premium on external finance. Hovakimian and Titman explain their findings by noting that "constrained firms have more incentive to hold large cash balances" (p. 13). Such an explanation suggests a precautionary motive for firms to hold cash and introduces restrictions in the access to external finance as one of its determinants.

While the number of studies exploring the determination of corporate cash holdings falls far short of that exploring the corporate capital structure, there is still sufficient evidence to support the view that a precautionary motive exists for corporates to hold cash. Kim et al. (1998) for example find evidence of a "tradeoff between low return on liquid assets and the benefit of minimising the need for costly external financing" (p. 335). Opler et al. (1999) stress the role of informational problems in determining optimal precautionary cash balances.

Contrary to the literature on debt targets, however, there is limited empirical evidence that suggests that firms do not care about their cash holdings. As an alternative to the active pursuit of cash targets, Opler et al. (1999) propose a passive stance wherein cash has no value for the firm and follows from the pursuit of a net debt target or pecking order behaviour in finance. While they find evidence of such passive cash adjustment, they also find that firms converge towards cash targets at an annual rate of about 20%. Related research by Bruinshoofd and Kool (2002) stresses that long-run cash targets allow for short-run buffer stock behaviour. Moreover, Bruinshoofd and Kool demonstrate that the annual rate of target convergence may rise to as high as 80% if allowance is made for unobserved heterogeneity in corporate cash targets. As such, we are on rather firm ground in claiming that firms formulate target cash holdings and deem such targets sufficiently important that they may reconsider investment plans when cash holdings so require.

4.3. Managing financing constraints

While financing constraints are inherently unobservable, we can exploit interdependencies in financial decisions to identify when firms actually run into such constraints. The informational content of debt and cash targets in this regard is discussed in succession.

As discussed above, when debt capacity constraints are relevant and alternative sources of external finance costly or hard to come by, firms may pursue the maintenance of spare debt capacity for precautionary purposes and hence target debt levels below their debt
capacity. By that rationale, firms that maintain the highest levels of precautionary spare debt capacity expect to face the strictest financing constraints. Hence, we might expect such firms to feel constrained in their investment decisions. However, firms with little need for debt financing – possibly because their investment plans are so modest that they can be realised entirely with retained earnings – also end up with substantial spare debt capacity. Nevertheless, we would not expect such firms to feel in any way constrained in their investment decision. The observational equivalence of supply-constrained and demand-constrained debt financing thus makes debt targets an imprecise measure of how constrained a firm perceives its own investment decision. Furthermore, since spare debt capacity matters most, even if we do find debt targets, that does not necessarily provide a useful measure of the spare debt capacity target. That is, unless we can quantify the debt capacity itself.

The latter issue is circumvented by using deviations of debt away from targeted levels as indicators of financing constraints. Provided that targeted debt levels mismeasure debt capacity by a fraction that is constant over time, deviations of debt from targeted levels provide information on changes in spare debt capacity. Nevertheless, it is difficult to demonstrate empirically the relevance of debt targets, given the substantial evidence in favour of the pecking order. By that token, even if we manage to compute meaningful debt target deviations which reflect deviations from targeted spare debt capacity, it is not clear that this makes firms feel particularly constrained in their investment decisions.

Complementary to or substituting for precautionary spare debt capacity firms may decide to hold precautionary cash balances. Theoretically, targeted levels of precautionary cash can provide an indication of how constrained the firm perceives its own future investment to be. All else equal, a firm that expects serious problems in raising the finance for its future investment has an incentive to hoard some additional cash. Thus firms with historically high cash targets are perceived to face substantial problems in raising external
finance. Of course, this assumes that our empirically estimated cash targets reflect the precautionary motive stemming from financing constraints mainly. We know, however, that an important additional motivation to hold cash is the transaction motive (e.g. Keynes (1936)). Empirically, the transaction motive may be difficult to separate from the precautionary motive. This is specifically so, because factors such as firm size likely affect both the transactions motive (through possible scale economies in cash management) and the precautionary motive (because large firms are less vulnerable to informational problems in capital markets). Furthermore, while spare debt capacity and cash holdings jointly provide a precaution against the brunt of future financing constraints, each one isolated may substitute for the other. On the one hand, higher levels of debt, to the extent that it is obtained from concentrated lenders, suggests a higher level of monitoring efforts (see Diamond (1984), (1991)), which reduces informational problems and concomitant precautionary cash motives. On the other hand, higher levels of precautionary cash reduce the incentive to invest in banking relationships and may in the limit even reduce borrowing capacity (cf. Myers and Rajan (1998)).

While for all of these reasons cash targets may measure perceived financing constraints with error, the deviations from such targets provide a much clearer indication of what constitutes a constrained firm. Shortfalls of cash relative to target imply that the firm has less cash available than it deems prudent for future transactions and precautionary needs. Since empirical evidence demonstrates that cash targets are important to firms (e.g. Kim et al. (1998), Opler et al. (1999)), shortfalls of cash likely constrain the firm in its investment decision.20 While this procedure is in the spirit of Kaplan and Zingales (1997) in using the availability of internal funds to measure financing constraints, it allows and controls for the firm’s pursuit of a cash target. It thus allows for a more precise test of the ICFS to reflect the tightness of financing constraints. In that regard it is particularly interesting to analyse how
firms respond to surpluses of cash relative to target. Such ‘free cash’ can be used to initiate additional investment and still take the targeted amount of precautionary cash balances into the future. Insofar as investment can be initiated more easily by using surplus cash holdings, it is expected to depend to a lesser extent on cash flow realisations, i.e. firms exhibit a lower ICFS. At least, that is the financing constraints reasoning. Kaplan and Zingales (1997) and Hadlock (1998) claim that the ICFS may point towards firms excessively investing in unprofitable investments (cf. Jensen (1986)). While Opler et al. (1999) find no evidence of agency problems in the explanation of levels of cash holdings, Almeida et al. (2002) find it in terms of a stronger sensitivity of cash accumulation to cash flow for unconstrained firms with low inside ownership. Applied to the impact of excess cash, the agency view therefore predicts that firms with excess cash are able to direct a larger share of cash flow to pet projects, increasing the ICFS.

4.4. Integrating the corporate investment and cash management decisions

The above suggests that much may be learned from integrating the analyses of corporate investment and the management of finances, specifically cash management. A very flexible tool to take the analysis in exactly that direction is provided by the following vector autoregressive investment model (VIM), which is adapted from Breitung et al. (2003):

\begin{align}
\text{(6a)} & \quad I_{t,t} = l(L)I_{t-1} + s(L)E_{t-1} + c_f(L)C_f_{t-1} + L^e(L)[L, L']_{t-1} + E_{t-1} + F_{t-1} + E_{t-1} \\
\text{(6b)} & \quad L_{t,t} = l(L)L_{t-1} + l(L)I_{t-1} + c_f(L)C_f_{t-1} + L^e(L)[L, L']_{t-1} + L_{t-1} + E_{t-1} + E_{t-1}.
\end{align}

Here \( I \) stands for investment in fixed assets, \( E \) denotes expected net return on capital,
\( C_f \) is cash flow, \( L \) is cash assets (cash and near cash items in the balance sheet), and \( L' \) is the cash target. Furthermore we assume that all variables are appropriately deflated. Lastly, is the first-difference operator, \((L)\) and \((L)\) are polynomials in the lag operator and the subscripts \( t \) and \( i \) indicate time periods and firms, respectively, with time and firm specific effects \( \tau \) and \( \iota \).

Equation (6a) relates investment to its own lagged levels (to capture persistence), expected net return on capital (to capture fundamentals) and cash flow and lagged deviations of cash holdings from targeted levels (to capture financial factors). Equation (6b) models cash dynamics, which depends on investment and cash flow (to capture the till function of cash holdings) and the lagged deviations of cash holdings from targeted levels (to capture the desire to converge to optimal cash levels), while persistence is represented by lagged cash dynamics.

Though the individual parameters in any VAR are difficult to interpret, impulse-response analysis can illustrate the impact of shocks to cash holdings, cash flow, or investment opportunities on the system. The single most important feature of this system of equations is that it allows deviations of liquidity holdings from targeted levels \([L L']\) to impact investment spending while also allowing for a lagged feedback effect from investment outlays to cash dynamics.

While simple and insightful as it is, the flexibility of the VIM allows us to go much further. For example the VIM in equations (6a) and (6b) embodies the assumption that observed cash dynamics exert no independent effect on investment, it is only the excess or shortage of cash relative to the target that affects investment spending. In a more general specification, \( ^{\iota}(L) L_{t,i} \) can be added to (6a) and its relevance assessed using impulse-response analysis. Asymmetric effects of cash shocks on investment may also be considered.
Then, $LL(L)$ can be conditioned on the sign or size of the deviations of observed from targeted cash holdings. Alternatively, Kaplan and Zingales (1997) hypothesise a link between excess and shortage cash and the sensitivity of investment to cash flow. In the VIM, this implies that $CF(L)$ is conditional on the sign or size of the deviations of observed from targeted cash holdings. Such issues can be analysed directly using an iterative maximisation procedure, or in a 2-step approach where cash targets are computed in the first step (eg. Bruinshoofd (2003)). Lastly, Breitung et al. (2003) consider a VIM with an investment and a cash flow equation. We have replaced the latter with the dynamic cash equation. Off course, a separate cash flow equation may be considered as an addition to (6a) and (6b). Such extension allows for feedback effects from constrained investment behaviour to the ability to generate cash flow in the future.

Taken together, the VIM presents a simple, flexible, and powerful tool to simultaneously analyse investment and financial decisions. Allowance for such simultaneity is the prerequisite for any irrefutable final verdict on the existence of a financing channel.

5. Summary and conclusions

The financing constraints paradigm builds on the joint assumption that firms facing financing constraints can be distinguished from firms that do not and when facing financing constraints, firms’ investment is expected to display excess sensitivity to financial variables. The heavy reliance of research within this paradigm on the ICFS as a measure of financing constraints has produced some contradicting results. For example, small firms are sometimes argued to face tighter financing constraints than large firms do, when this is suggested by excess sensitivity patterns. When excess sensitivity patterns suggest otherwise, however, large firms are argued to face tighter financing constraints.
Furthermore, for some firms displaying particularly strong sensitivity of investment to cash flow it is difficult to imagine that they are in any way constrained by the availability of internal funds when deciding on their investment outlays, as these funds seem available in abundance. The observation that such firms display a strong ICFS, whereas firms with considerably lower levels of internal funds display a considerably lower ICFS, has provided an important impetus to reduce the reliance on the ICFS as measuring financing constraints. Attention has instead shifted towards more direct measures of financing constraints as well as more solid theoretical foundations for the relationship between finance and investment for constrained firms.

Recent theoretical advances suggest that cash is a noisy measure of contemporaneous financing constraints, because it is affected by the expectation of future financing constraints. Empirical contributions focusing on corporate cash determination confirm this result: firms target cash holdings and the precautionary motive to hold cash relates to perceived future financing constraints. Hence, despite apparently abundant cash holdings, firms may constrain themselves in investment outlays to maintain a certain amount of precautionary cash. Using these new insights, I have made a strong recommendation to use information on optimal cash management policies to identify firms that face financing constraints. Specifically, knowledge of the corporate cash targets allows us to measure how much ‘free cash’ firms have and free cash is what firms can readily commit to new investments without having to walk to external capital markets. Firms with lots of free cash are therefore least likely to face financing constraints and vice versa.

The simultaneous analysis of optimal cash holdings and investment subject to financing constraints can thus shed light on whether constrained firms display stronger ICFS or not. Additionally, it can discriminate such excess sensitivity results from an agency explanation. The agency reasoning, namely, states that free cash is spent on excessive
investment in pet projects. Surely then, the connection of these two areas of research is worth exploring further.
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References


Activity, pp. 75-122.


Brookings Papers on Economic Activity, pp. 67-140.


1 We postpone the discussion of strategies to discriminate constrained from unconstrained firms to the next section.
2 The same measurement error argument applied to Q-models can explain the poor explanatory performance of the Q-model as well as the predominant role for cash flow in explaining investment (cf. Gilchrist and Himmelberg (1995), (1998)).
3 The same condition is required for the useful assessment of financing constraints within a Q-model wherein $Q$ is measured with error.
4 See Alti (2003) for a formal demonstration of this argument. Alti develops a model wherein young firms are assumed to face uncertainty regarding long term growth potential. This makes $Q$ a noisy measure of contemporary investment project quality as it includes the option value of long term growth potential. Cash flow contains news on these prospects and as such has informational content. As firms grow older, the project quality estimate becomes more precise and the option value of long term growth potential dissipates, making $Q$ more informative of contemporary investment plans and reducing the informational content of cash flow. Simulation analysis subsequently demonstrates that measurement error can account for excess sensitivity results of the same magnitude as Fazzari et al. (1988) report for their subset of low dividend payout firms.
5 Hovakimian and Titman (2003) propose the use of voluntary asset sales as an internal source of finance that is uncorrelated with future profitability. They demonstrate that constrained firms’ investment is more sensitive to the proceeds of such sales. Holtz-Eakin et al. (1994a) and (1994b) investigate the impact of inheritances on entrepreneurial activity. Holtz-Eakin et al. (1994b) obtain that the receipt of an inheritance contributes positively and significantly to the probability that the individual becomes an entrepreneur and Holtz-Eakin et al. (1994a) present a positive and significant impact of an inheritance on the probability that the entrepreneur remains in business.
6 Which in itself is an unexpected result in a financing constraints setting as rated firms are generally believed to suffer less from the incidence of asymmetric information than non-rated firms (e.g. Whited (1992), Carpenter et al. (1994), Gilchrist and Himmelberg (1995) and (1998)).
7 Furthermore, the strict assumptions required in the Q approach, namely constant returns to scale in the production and the adjustment cost functions as well as competitive markets, can be relaxed.
8 See for example Schiantarelli (1996) for a more formal discussion.
9 See for example Hubbard (1998) and Schiantarelli (1996) for more extensive overviews of relevant empirical studies.
10 Schiantarelli (1996) also points out the undesirable methodological feature of assigning firms a time-invariant constrained or unconstrained status, neglecting the possibility that the same firms may face binding constraints in some years, but not in others.
11 Specifically, their switching function additionally includes leverage, coverage, cash
holdings and year and industry dummies.
12 More generally, Gomes (2001) is highly critical of the necessity and sufficiency of excess sensitivity results to indicate financing constraints.
13 Specifically, Fazzari et al. (2000) assume a positive premium, one that increases in the amount of external finance (\( F_{EE} > 0 \)) and does so at a faster rate for firms with a higher degree of informational problems (\( E_{EE} > 0 \)). Furthermore, assuming diminishing returns to investment (\( F_{EI} > 0 \)), the denominator as well as the first term in the numerator of (5) are positive. Let \( F_{Ex} > 0 \) (the premium rises in the degree of informational problems). Then, for a revenue function that is quadratic in \( I (F_{III} > 0) \) and a premium function quadratic in \( E (F_{III} > 0) \), this second terms is zero and (5) overall is positive. However, when \( F_{III} > 0 \), the second term is negative and may outweigh the first, suggesting a lower ICFS when the degree of informational problems increases.
14 Also note how this argument runs parallel to the inter-temporal minimization of the capital stock adjustment costs within the Euler framework.
15 In the limit, the unconstrained firm need not put up any own funding, resulting in an infinite equity multiplier and the ability of the firm to apply all-debt financing of investment.
16 Gomes (2001) simulates a sample of firms that resembles observed first and second moments in observed data on such key financial variables as capital stock, investment rate and sales growth as well as the observed autocorrelation in investment rates. This provides a laboratory to investigate the role of financing constraints as it allows for the classification of the firms in his data set with 100% precision to the constrained and unconstrained subclasses. Gomes shows that ICFS patterns do not reflect this flawless stratification of the data.
17 See Chirinko and Singha (2000) for a critical comment.
18 Similar to Myers’ (1984) suggestion regarding leverage, firms are argued to constrain themselves to maintain a certain amount of precautionary cash. Also see Fazzari et al. (1996) and (2000) for similar reasoning.
19 Target adjustment rises even higher when we isolate large deviations (cf. Bruinshoofd and Kool (2003)).
20 Moreover, while this procedure focusses on whether the financing constraint binds and clearly accommodates that it may bind in some years, but not in others, it does not rely on ICFS results to do so (as in Hu and Schiantarelli (1998)).
21 The target may be a (historical) average, or a ‘sophisticated target’ à la Opler et al. (1999).
22 In a standalone analysis of (6b) Bruinshoofd and Kool (2003) assess the dependence of \( LL^E \) and find a range of inaction around the cash target while larger deviations trigger strong adjustment efforts.
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Corporate Investment and Financing Constraints: Connections with Cash Management

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Corporate Investment and Financing Constraints: Connections with Cash Management

Abstract

When firms find that external finance is costly or rationed, they face financing constraints in their investment decisions. The financing constraints paradigm applies this idea empirically and supports the joint hypothesis that constrained firms can be identified and should display a stronger sensitivity of investment to cash flow. The first part of this paper shows that this paradigm is increasingly criticised, because some proxy variables used to identify constrained firms deliver contradictory results regarding this sensitivity. In addition, some of the firms that display a strong sensitivity have internal funds seemingly in abundance.

While this weakens, it does not render useless the financing constraints paradigm. In the second part of this paper, I propose a more comprehensive look at financing constraints in two stages. First, theoretical and applied research into corporate cash holdings suggest that firms react to informational problems in capital markets by specifying cash targets partially for the purpose of circumventing the brunt of future financing constraints. I argue that knowledge of such targets allows us to measure the amount of ‘free cash’ that firms have at their disposal, which is a clearer measure of the constrainedness of a firm than observed cash levels. Second, the simultaneous modelling of investment and cash management provides for a clearer assessment of the interplay between cash accumulation and investment.

Keywords: Corporate investment, financing constraints, corporate cash
JEL Classification: E41, G31, G32

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1. Introduction

The sensitivity of corporate investment to financial variables has been indicated long ago (e.g. Meyer and Kuh (1957)) and is by now an established fact. It is also well documented that this sensitivity is more pronounced for some firms than for others. For instance Fazzari et al. (1988) find that financial variables affect investment more for firms with low dividend payout rates; Hoshi et al. (1991) document a weaker sensitivity of investment to finance for Japanese firms belonging to a Keiretsu than for independent firms; Whited (1992) reports a stronger sensitivity for firms without a bond rating.

Current academic debate revolves around the interpretation of these findings. To the extent that firms face costly or rationed external finance, marginal investments may be sufficiently profitable when financed with internal funds, while these have been exhausted. The same marginal investments may not be sufficiently profitable to raise external finance for. The firm is then said to be financially constrained, the implication of which is that an increase in internal funds will generate an increase in investment unrelated to changes in investment opportunities. Fazzari et al. (1988) and related studies claim that the sensitivity of investment to increases in internal funds is driven by financing constraints resulting from informational problems in capital markets, which we will refer to as the financing constraints paradigm. This body of applied literature has so far not succeeded in developing a structural model of investment subject to financing constraints, however. Instead, it relies on ad hoc addition of financial variables – usually cash flow – to existing investment models.

Kaplan and Zingales (1997) do present a simple theoretical model of investment with costly external finance. They demonstrate that theoretically, the investment-cash flow sensitivity is not a useful indicator of financing constraints as it does not necessarily relate monotonically to the cost of external finance or the level of internal funds available. They also
show that firms seemingly rich in the amount of internal funds available nevertheless display a stronger sensitivity of investment to cash flow. Their explanation is that firms with healthy levels of internal funds have incentives to use additional earnings for financing excessive, unprofitable investments.

The explanation of the investment-cash flow sensitivity is important from an academic as well as a policy perspective. From an academic point of view, we want to know whether the sensitivity of investment to financial factors stems from unspecified financing channels, or simply from error in capturing financing constraints in combination with error in the measurement of investment opportunities. From a policy point of view, the existence of a financing channel can shed some light on the sources of the volatility in corporate investment behaviour. Moreover, if shown to exist, knowledge of the composition of the financing channel can guide policymakers in their attempts to alleviate the problems of corporates being unable to raise sufficient funding for profitable investment.

While Kaplan and Zingales (1997) propose to discard the use of investment-cash flow sensitivities in the empirical analysis of financing constraints, I propose not to throw out the baby with the bath water. The aim of this paper is to suggest fruitful avenues for research to explore more comprehensively the relevance of financing constraints, even though I do not pretend to build a structural model of investment subject to financing constraints. Instead, I propose a flexible reduced form model that allows for the truly simultaneous analysis of financial and investment decisions.

One such financial decision that is closely linked with the investment decision in an environment with informational imperfections and concomitant financing constraints is the cash management decision. Specifically, I consider how well cash holdings measure financing constraints when firms hold precautionary cash balances because of such constraints. In doing so, I sympathise with those who are concerned with endogeneity problems in the application
of observed cash holdings as measures of financing constraints and want to stress the importance of analysing what constitutes a constrained firm. Furthermore, the focus on cash management links up with some of the unresolved issues in the debate between Fazzari et al. ((1988), (2000)) and Kaplan and Zingales ((1997), (2000)). The connection between capital structure management and investment subject to financing constraints is also considered, but looks less promising.

The paper proceeds as follows. Section 2 presents the financing constraints paradigm, i.e. the analysis of financing constraints under the joint assumption that 1) firms can be distinguished into various degrees of constrainedness and 2) the investment-cash flow sensitivity conveys the impact of financing constraints. The weaknesses in modelling the financing channel in investment are discussed in conjunction with proposed solutions. The resulting reading of the literature suggests that financing constraints are relevant in the corporate investment decision, although the evidence is far from unambiguous. This provides an understanding of the penned up concern with the paradigm that revolves around the use of the joint hypothesis, as discussed in section 3. The contemporary debate revolves more around the identification of the constrained firm than about the interpretation of investment-cash flow sensitivities as measuring financing constraints. This has arisen from the limited degree of coherence in empirical results when we strictly believe that the investment-cash flow sensitivity signals the tightness of financing constraints. In section 4 I suggest the use of possible connections between cash management and investment, but also between debt management and investment to obtain clearer indications of when corporate investment is in fact subject to financing constraints. In addition, a simple and flexible empirical model for the simultaneous analysis of investment and these financial decisions is outlined. I conclude in section 5.
2. The financing constraints paradigm

The typical approach to the analysis of financing constraints in corporate investment relies on split sample analysis. The idea is to separate firms for which financing constraints are expected to be particularly relevant in investment decisions from firms for which they are not. A more prominent role for financial factors in the investment decision of a priori constrained firms relative to that of a priori unconstrained firms is then interpreted as evidence that financing constraints are relevant. In this section, we discuss two strategies to detect financing constraints in corporate investment. Q-models and reduced form investment equations rely on excess sensitivity tests, while Euler investment equations apply the misspecification approach. The pros and cons of both classes of models are addressed in the following two subsections.

2.1. Q-models and reduced form investment equations

Q-models and reduced form investment equations share their reliance on excess sensitivity tests to identify the role of financing constraints in corporate investment. Excess sensitivity refers to the sensitivity of constrained firms’ investment to financial factors over and above that of unconstrained firms.

2.1.1. The analysis of financing constraints

The typical empirical investment equation in this class of models looks like equation (1).

\[ I = f(\text{Investment opportunities}) + g(\text{Internal funds}) \]

Here *Investment opportunities* refers to a (sub)set of investment fundamentals which
includes but is not limited to $Q$, sales growth (of the firm or of the industry in which the firm operates), the user cost of capital, and sales-assets or sales-capital stock measures. *Internal funds* refers to a (sub)set of financial variables, wherein cash flow plays a predominant role in most of the applied work, but the stock of liquid assets is also used on occasion (e.g. Fazzari et al. (1988), Fazzari and Petersen (1993)).

Within a $Q$-model of investment, equation (1) is typically specified as

$$\left( \frac{I}{K} \right)_t = \beta_0 + \beta_1 Q_t + \beta_2 \left( \frac{C_f}{K} \right)_t + \varepsilon_t,$$

where $I$ measures gross investment expenditure, $K$ denotes the firm’s capital stock, $C_f$ stands for cash flow, $Q$ measures the market value of the firm’s assets divided by its replacement costs, and variables are indexed by firm ($i$) and year ($t$). $\varepsilon_t$ is an error term that may include firm and time specific elements, in addition to a white noise component. Ideally, when financing constraints do not matter $Q$ is a sufficient statistic to characterise a firm’s investment level, whereas $E(\beta_2) = 0$. That is to say, a firm can finance all profitable investment, regardless of whether it can finance this investment with internal funds or has to raise external finance. In contrast, when financing constraints do matter, firms sometimes feel compelled to reconsider investment decisions for lack of (reasonably priced) external finance, while internally available finance has been depleted. The timing of investment then coincides with increments in internal funds, i.e. $E(\beta_2) > 0$.

In practice, estimates for $\beta_2$ are positive regardless of whether we expect financing constraints to matter for a particular (sub)set of firms or not, while estimates of $\beta_1$ – though typically positive and significant – are very low most of the time (e.g., Fazzari et al. (1988),
Devereux and Schiantarelli (1990), Oliner and Rudebusch (1992)). To illustrate the economic importance of such low estimates for $\beta_1$, assume the Summers (1981) adjustment cost function $\frac{K}{2} \left[ \left( \frac{1}{K} \right)^{\alpha} - a \right]^2 K$, where adjustment costs are convex in gross investment around some normal investment level $a$. Applied to the Q-model, this adjustment cost function implies that the estimated value for $\beta_1$ reflects $\frac{1}{\beta}$, suggesting that low estimates of $\beta_1$ reflect (implausibly) large adjustment costs.

A specific characterisation of the adjustment cost technology greatly facilitates the empirical implementation of the Q-model. Of course, this also constitutes a serious limiting assumption on the analysis, as the exact adjustment cost technology may be difficult to capture in a simple functional form. The main advantage of using reduced form investment models is that one abstains from explicitly modelling the adjustment cost technology altogether. Instead, the empirical implication of costly adjustment is taken as a starting point in the sense that adjustment is assumed to take time and partial adjustment is expected.

For illustrative purposes, consider a simple autoregressive distributed lag (ADL) characterisation of the adjustment process. In the ADL model, the capital stock is a function of its own past (to reflect persistence due to adjustment costs) as well as present and past levels of the targeted capital stock (to reflect adjustment incentives):

$$ k_t = \sum_{s=1}^{L} k_{t-s} + \sum_{s=0}^{M} k^*_t, $$

where $L$ and $M$ capture the number of lags to be included for $k$ and $k^*$ (denoting the log of the actual and optimal capital stock, respectively). Empirical implementation requires the characterisation of the optimal capital stock $k^*$, which may result from a simple profit or sales maximisation problem. The impact of financing constraints is then analysed as in the Q-
model. When financing constraints are irrelevant, financial variables should not be able to increase the explanatory power of the investment model. In contrast, when financing constraints are relevant, the accumulation of internal funds plays a role in the investment decision in addition to expected profitability considerations. Hence, financing variables such as cash flow would then contribute meaningfully to the explanation of investment.

The main disadvantage of using reduced form models to characterise investment demand is that they may be particularly ill suited for determining the structural determinants of capital demand. This allows for variables that are not structural determinants of investment, yet are correlated with expected future profitability of the firm to appear with a significant parameter estimate in the estimated investment function. In particular, when current profits are a leading indicator for future profits, current profits will have significant explanatory power in the empirical investment equation, even though financing conditions pose no restrictions on the investment decision.2

Despite this drawback, the reduced form investment equation may still be useful in the analysis of financing constraints on investment and is in fact used in a variety of studies (e.g., Fazzari et al. (1988), Harris et al. (1994), Chirinko and Schaller (1995), Lamont (1997)). The validity of reduced form models in this regard depends on the sufficient condition that the mismeasurement of investment opportunities – and hence the informational content of the financial variables – is the same for constrained and unconstrained firms alike. If this is the case, the differences in the impact of financial variables on the investment demand of constrained and unconstrained firms still reflect the presence of binding financing constraints: constrained firms’ investment should display excess sensitivity to financial variables such as cash flow.3
2.1.2. Main criticism

For excess sensitivity tests to provide useful indications of the relevance of financing constraints it is required that the informational content of financial variables is the same for constrained and unconstrained firms alike. When there is the suspicion that investment opportunities are measured with more error for younger and smaller firms, financial variables may have greater informational content in the investment decisions of these firms and obtain greater empirical importance for that reason (cf. Poterba (1988)). As such, differential error in measuring investment opportunities may generate differential sensitivity of investment to financial variables and render up the excess sensitivity test as a useless indicator of financing constraints.

Two solutions to this issue can be identified from the literature. One solution is to attempt to control for the informational content of changes in internal funds, i.e. extract that part which correlates with innovations in investment opportunities. Subsequently, the sensitivity of investment to the pure liquidity content of changes in internal funds can be assessed. Gilchrist and Himmelberg (1995) and (1998) implement this strategy within a Q framework. Using information on observable fundamentals, the authors construct an expected value of $Q$. Cash flow is also included in the set of observed fundamentals, so that even in the situation where a shock to cash flow correlates with shocks to investment opportunities, this effect is incorporated in the expected value of $Q$. Therefore, the additional information contained in cash flow to which investment may or may not be sensitive refers only to its liquidity content. Gilchrist and Himmelberg find that even after controlling for the informational content in cash flow, constrained firms exhibit excess sensitivity to internal finance. Thus innovations in cash flow orthogonal on innovations in investment opportunities contribute positively to investment, a finding that is in line with the working of financing constraints and cannot be discarded as an anomaly of measurement error.
Another solution is to search for semi-natural experiments wherein changes in wealth are conceivably uncorrelated with the error in measuring investment opportunities. Lamont (1997), for instance, investigates the investment decision of segments that belong to a conglomerate that contains also a segment in the oil industry. The focus is on the impact of the oil price decline of 1986 – a negative shock to the oil segments’ cash flow – on the investment decision of the non-oil segments. The findings of the analysis clearly indicate responsiveness of non-oil investment to this exogenous fall in corporate net worth.5

This far from settles the debate, however, as Erickson and Whited (2000) demonstrate that measurement error in $Q$ can explain excess sensitivity results. Under the assumption of perfect measurement, they demonstrate that firms with a bond rating display excess sensitivity of investment to cash flow.6 Correcting for measurement error removes the cash flow sensitivity for both the unconstrained and the constrained subsets of firms. As the sources of error in measurement Erickson and Whited identify the possible inequality of marginal and average $q$ (Hayashi’s (1982) sufficient conditions are not met), of average $q$ and Tobin’s $Q$ (the observed market value of the firm may diverge from management’s valuation), and the error in the measurement of Tobin’s $Q$ using accounting data.

2.2. Euler equations

If errors in measuring $Q$ cloud the usefulness of excess sensitivity tests in assessing the relevance of financing constraints, then Euler equations may offer a way around. The main advantage of Euler equations over Q-models is that one abstains from using noisy stock market information to characterise investment opportunities.7
2.2.1. The analysis of financing constraints

An Euler equation can be derived from the same optimisation procedure that results in the standard Q model of investment. First order conditions are rearranged differently, however, so that the shadow value of an extra unit of capital drops out of the analysis. The analysis therefore no longer focuses on the market value of additional capital relative to its replacement value, but emphasises the intertemporal allocation of investment instead. Specifically, firms are expected to trade off the net benefits of investing today against the net benefits of postponing investment to the future. In the absence of costly external finance or restrictions to the amount of external finance available to the firm the marginal product of capital, net of its user costs and adjustment costs represents the net benefits of investment. When applied to the data, such standard Euler equations are properly specified when the assumption of no financing constraints is valid and specification tests should not reject the model.8

Financing restrictions can for instance be imposed by a nonnegativity constraint on dividend payments in combination with a debt-capacity constraint (e.g. Whited (1992) and Van Ees et al. (1998)) or more straightforwardly by considering the firm to face a higher discount rate when its nonnegativity constraint on dividends binds (Hubbard et al. (1995)). The idea is that such constraints, when they are binding, drive a wedge between firms’ expected returns to contemporary and future investments, so that the standard Euler equation is misspecified.

Empirical implementation of the alternative, financing constraints augmented Euler equation requires a characterisation of the shadow value of relaxing the external financing constraint by one unit. Whited (1992), for example, models this shadow value as a non-linear function of leverage and coverage. Hubbard et al. (1995) use firms’ cash flows and a measure of aggregate credit constraints. The augmented Euler equation can be applied to the
investment decisions of a priori constrained firms and specification tests subsequently evaluate whether the characterisation of the financing constraint is accepted by the data.

2.2.2. Main criticism

While the Euler approach does not require the use of noisy stock market information, this does not automatically shield the approach from any measurement problems. More specifically, the researcher must now estimate the marginal product of capital, net of marginal adjustment costs and the user cost of capital. It seems a bit optimistic to assume that this all works without error and it is not obvious that the marginal productivity of capital and its user cost should be measured with less error than the market value of the firm.

Furthermore, Euler equations may have difficulty in picking up the effects of financing constraints when they remain approximately equally tight over time. To illustrate, while firms may face financing constraints now and in the future, the Euler approach has difficulty detecting them when the restriction is a constant in an intertemporal sense. This issue can obviously be overcome by using data over a period of time long enough to include changes in the tightness of financing constraints. While typically panel data sets include many firms but a limited number of years, however, it is not clear to what extent this issue is sufficiently obviated in applied research.

Lastly, while the misspecification tests may reject the frictionless markets, standard Euler equation for a priori constrained firms, additional insight into the nature of the financing constraint can only be obtained when the financing constraint is actually modelled and its shadow value is empirically characterised. This leaves a degree of discretion to the researcher and results in ad hoc modelling that resembles the ad hoc inclusion of financial variables in the Q model and reduced form investment equations. Hence, the claim that Euler equations
are better equipped to identify the deep parameters of the investment model can be acknowledged in the financing constraints application only after we have identified theoretically the deep parameters of the financing constraints. This has shifted the playing field towards the main contemporary challenges faced by the financing constraints paradigm, discussed extensively in the next section.

3. Contemporary challenges for the paradigm

The two major contemporary challenges for the financing constraints paradigm have a methodological character. Specifically, the empirical implementation of the financing constraints hypothesis relies on the joint assumption that we can actually identify constrained and unconstrained firms and subsequently, that the investment-cash flow sensitivity (ICFS) indicates the relevance of financing constraints in the sense that tighter constraints imply a stronger sensitivity. These two assumptions have not received the same degree of attention in applied research. Starting with the seminal contribution by Fazzari et al. (1988), the emphasis has been on detecting excess sensitivity of investment to cash flow. We discuss this approach and some of its awkward results in section 3.1. It took years of growing unease with this approach before Kaplan and Zingales (1997) directed research attention towards our ability to mark a firm’s financial status as constrained or unconstrained. In section 3.2, we summarise their critique and discuss some of the main contributions sympathising with the spirit of what has become known as the Kaplan and Zingales critique.

3.1. When the ICFS measures financing constraints

Fazzari et al. (1988) cleared the way for the general belief that the investment-cash flow
sensitivity is a useful indicator of financing constraints. Their seminal contribution made the plausible case that US firms paying low dividends are the firms that face the highest cost of raising funds externally. In line with this conjecture, they show that low payout firms are also the ones that exhibited the highest ICFS. Devereux and Schiantarelli (1990) demonstrate that small and young UK firms were most sensitive to cash flow in their investment decision, claiming the conceivability that small and young firms are more prone to informational problems to invoke the financing constraints explanation. Subsequent contributions attributed informational problems to Japanese firms outside industry groups (Hoshi et al. (1991)) and US firms whose insiders trade relatively heavily in the firm’s own stock (Oliner and Rudebusch (1992)), to name just a few.9

This rapid initial success of the financing constraints paradigm created a tendency for subsequent studies to focus more heavily on demonstrating excess sensitivity results than on the in-depth analysis of what constitutes a constrained firm. As such, the maintained hypothesis that the ICFS is a useful indicator of financing constraints can be blamed for implementation of ad hoc sample splits. Pointing towards the obtained excess sensitivity results validates such splits afterwards.10 Hu and Schiantarelli (1998) provide a particularly clear illustration of this search for excess sensitivities. Their switching regression framework is specifically designed to discriminate investment observations displaying a strong ICFS from observations with no or only moderate ICFS.

To a certain extent, this maintained hypothesis can also explain the heavy reliance on uni-variate stratification procedures in the analysis of financing constraints, where firms are assigned the constrained or unconstrained status on the basis of a single variable only. Such procedure assumes not only that financing constraints are relatively easily identified, but also additionally assumes that they are simply and monotonically related to a single variable, say size, leverage or dividend payout. In combination with the maintained hypothesis that the
ICFS is a useful indicator of financing constraints, this produces some peculiar results with ad hoc interpretations. For instance, small firms are sometimes found to display excess sensitivity of investment to cash flow, which is interpreted by noting that small firms are “typically younger, less well-known, and hence more vulnerable to capital market imperfections induced by information asymmetries and collateral requirements” (Gilchrist and Himmelberg (1995), p. 551). Oliner and Rudebusch (1992), arguing that small firms are expected to face relatively high transaction costs for external finance due to fixed components in issuance costs, find no differential ICFS between small and large firms. These results lead the authors to conclude that size is unable to explain the financing hierarchy in their sample. Hu and Schiantarelli (1998) find that size increases the probability that firms face binding financing constraints. Their interpretation invokes agency problems associated with the dispersed ownership of large firms’ shares that outweighs the fact that these large firms may be older and well known to investors.

We shall discuss similarly conflicting findings on uni-variate splits using leverage and cash holdings later on. For now, let us stress that the discussion above suggests that size may not capture adequately the multiplicity of factors that influences a firm’s financial strength and ability to raise external finance after all. I must remark that Hu and Schiantarelli (1998) already adhere to this argument. Namely, their switching function incorporates other factors besides size. While their interpretation of the results treats size as an isolated factor, the possibility that size correlates with other variables in the switching function already suggests that the partial effect of size may not be comparable to the excess sensitivity results using size in a uni-variate stratification procedure.11 See Gomes (2001) for an illustration of the misleading results that may result from a stratification procedure using size.12 Van Ees et al. (1998) also argue for a multivariate analysis, where multiple unobserved factors associate with financing constraints. Specifically, they propose factor analysis, which discriminates the
data on the basis of unobserved factors. The joint loading of variables on the same factor can provide a clearer indication of the differential in access to and cost of external finance for different groups of firms.

The financing constraints paradigm is further brought under a cloud by findings that some of the firms that are classified as facing financing constraints actually appear to be quite rich in terms of the amount of internal funds they have. We are hard pressed to explain why these firms should behave constrained, when they appear unconstrained in the sense that they could have increased investment outlays considerable from their internal means, had they so chosen. Schnure (1997) makes this point for the firms that Lamont (1997) considers to be financially constrained. Kaplan and Zingales (1997) do so for the firms that Fazzari et al. (1988), the parent of this literature, consider to be financially constrained on the basis of dividend payout behaviour. Kaplan and Zingales press their argument even further by classifying the 49 low dividend firms according to the amount of investment increases they are able to finance with internal means. They show that firms that are most constrained by this definition actually display the lowest ICFS. Cleary (1999) provides a generalisation of this result, demonstrating that within a sample of 1,317 US firms, those which are most likely to face binding financing constraints actually display the lowest ICFS.

While these findings have not utterly eradicated the belief that ICFS are useful measures of financing constraints, they have succeeded in shifting attention towards new ways to identify whether firms suffer from such constraints and have stressed the need for theoretical models.

3.2. Identifying financing constraints accurately

The lack of thorough theoretical foundations of the ICFS combined with some of the peculiar
findings discussed above have paved the way for a new field of research, where the focus is on what identifies a constrained firm and the ICFS is no longer assumed to provide the answer.

As mentioned before, Kaplan and Zingales (1997), KZ97 hereafter, lead the vanguard of this attack on the entrenched research on investment and financing constraints with an in-depth investigation of the 49 firms characterised by Fazzari et al. (1988) as financially constrained. The strength of the KZ97 analysis is that it provides a very simple model of investment under financing constraints. The model shows that a non-monotonic relationship between the ICFS and informational problems may result directly from the underlying structure of the marginal cost of external finance and the curvature of the marginal product of capital function. The simple maximisation problem that KZ97 consider is given in (2),

\[
\begin{align*}
\max & \quad \Pi(I) - F(E,k) - I \\
\text{s.t.} & \quad I = W + E,
\end{align*}
\]

where \( \Pi(I) \) is the revenue function which is dependent only on the current investment level, \( I \), and \( F(E,k) \) represents the premium paid on external finance, which depends positively on both the level of external funds acquired \( E \) and the degree of informational problems \( k \). Investment is financed by a combination of internal funds \( W \) and external funds. Note that the model requires firms to exhaust internal funds before turning to external sources of finance. The possible implications of these highly simplifying assumptions are discussed shortly.

From the first-order condition of (2) the sensitivity of investment to changes in wealth can be derived:
where \( Y_X \) represents the partial derivative of \( Y \) with respect to \( X \) and \( Y_{XX} \) denotes \( Y \) differentiated twice with respect to \( X \). Assuming a concave revenue function (\( \Pi_\mu < 0 \)) the sensitivity of investment to changes in wealth is shown by (3) to depend on the convexity of the cost of external finance with respect to the amount of external finance raised.

Since differential sensitivities are at the centre of attention in the empirical analysis of financing constraints, the partial derivatives of (3) with respect to wealth and the degree of informational problems are given in (4) and (5) below.

\[
\left( \frac{\partial I}{\partial W} \right) = \frac{\Pi_{\mu} F_{EE} + F_{EE} F_{EE} \Pi_{H}^2}{\Pi_{\mu} F_{EE} - \Pi_{H}^2 \Pi_{EE}}
\]

\[
\left( \frac{\partial I}{\partial k} \right) = \frac{F_{EE} \Pi_{H} (\Pi_{H} - F_{EE}) + F_{EE} (\Pi_{EE} \Pi_{H} - F_{EE} \Pi_{EE})}{(F_{EE} - \Pi_{H})^3}
\]

KZ97 focus on changes in wealth (4) in their critical review, which results theoretically in a positive and monotonic connection with the ICFS only if "there is a certain relationship between the curvature of the production function and the curvature of the cost function at the optimal level of investment" (KZ97, p. 175). Fazzari et al. (2000) stress that the empirical test should not explore the ICFS for firms with different levels of wealth, but rather subdivide firms based on their expected degree of informational problems, i.e. they suggest sorting firms on the basis of \( k \). Hence they claim that equation (5) is an appropriate test of financing constraints. It follows from (5), however, that the ICFS is neither necessarily monotonic nor increasing in the degree of informational problems either (also see Kaplan and Zingales
The single most important point of critique regarding the simple KZ97 investment model is that it may, in fact, be too simple to accurately analyse the problems at hand. The model is a static optimisation problem in which $W$ – interpreted as the amount of internal funds available for investment, or retained earnings – is given exogenously. In that sense, $W$ is like manna from heaven. It is unclear where it comes from and in addition, its value in a more dynamic setting is not recognised. In a more realistic setting, one might expect that the amount of $W_t$ with which the firm starts period $t$ is determined in the past and the need for a certain level of $W_{t+1}$ is also taken into account in the investment and financing decisions in period $t$. The value of $W_t$ and the decision over $W_{t+1}$ stems from the objective to inter-temporally minimise the cost of finance. Hence a firm with low $k_t$ but high expected $k_{t+1}$ has an incentive to finance current investment with more external finance than it would in a one-shot investment decision, since this avoids higher costs of external finance in period $t+1$.

To the extent that this critique applies, KZ97’s conclusion that the ICFS is not a useful measure of financing constraints is moderated. In fact, KZ97 assume that observed levels of internal wealth are useful measures of financing constraints and this assumption precisely allows them to interpret their empirical findings as saying that the ICFS is not. However, when observed levels of internal funds do not associate monotonically with financing constraints even though the ICFS does, it is unclear whether firms with lower levels of internal funds should display a stronger ICFS. In this regard, we should note that some of the more recent theoretical contributions to the debate include a dynamically optimal demand for internal funds in an environment with financing constraints. These contributions demonstrate that a non-monotonic relation between the level of internal funds and the degree of financing constraints is possible. Dasgupta and Sengupta (2001), for instance, develop a model in which the decision over the amount of internal funds to transfer to the future in the form of liquidity
depends on expected future profitability and expected future financing constraints. The result of this richer theoretical specification is that it is not unlikely "for more constrained firms to end up with higher cash endowment today and show greater cash flow sensitivity of investment" (Dasgupta and Sengupta (2001), p. 3), supporting the notion that observed levels of internal funds may not accurately reflect financing constraints.

Further theoretical evidence against the usefulness of the ICFS as a measure of financing constraints is provided by Almeida and Campello (2002), who illustrate that in an environment where financing constraints apply to the quantity of credit available, the ICFS is highest for firms that face the lowest degree of financing constraints and vice versa. The mechanism builds on a moral hazard problem that requires the firm to put up a minimum share of the necessary investment outlays to ensure diligent behaviour. Hence the least constrained firms have the largest equity multipliers, implying that any given increase in internal funds allows them to raise investment by a larger fraction than more constrained firms, who have smaller equity multipliers.¹⁵ Their model specifically provides a counterintuitive role for debt: firms with large amounts of debt are relatively unconstrained (these are the firms that have the largest equity multipliers).

Theoretically, therefore, there is no unambiguous, monotonic relationship between observed levels of internal funds and the incidence of financing constraints as captured by the ICFS. A similar result obtains with regard to observed leverage. In addition, the empirical testing of opposing theoretical views on the connection between internal funds and leverage on the one hand and the ICFS on the other hand is cumbersome, as financing constraints are inherently unobservable. Hence, one cannot identify constrained and unconstrained firms with certainty and check whether the ICFS is higher for the former group of firms, as would be required to test the validity of the ICFS as a useful measure of financing constraints.¹⁶ A way around is discussed extensively in the next section.
4. Managing finances and financing constraints

The investment decision is one of many financial decisions the firm has to make. Firms additionally decide on inventory holdings, liquidity holdings, the capital structure, and dividend payments, to name just a few decision variables. Clearly, these decisions are highly interrelated. While at any point in time a firm may strictly be able to increase investment expenditures, it may for instance feel reluctant about the required dividend cuts, because dividend cuts are perceived as bad news in the stock market (e.g. Lintner (1956) and Healy and Palepu (1988)). The aim of this section is precisely to consider such interdependencies of financial decisions that make the firm feel constrained in its investment decision in ways we cannot hope to capture by such factors as firm size, age, or connections to industry groups. At the same time, these interdependencies may deliver constrained investment in some years, but not in others. Thus, it allows us to identify a time-variant constrained or unconstrained financing status à la Hu and Schiantarelli (1998) that nevertheless does not rely on the assumption that the ICFS is a useful measure of financing constraints. We focus on debt (subsection 4.1) and cash holdings (subsection 4.2) only, because these variables have produced some of the more striking and contradicting results when applied as sample stratification devices to the financing constraints analysis. For the sake of expositional clarity, we also consider the debt and cash decisions as separate decisions, even though they are likely jointly determined. Connections of optimal cash and debt decisions with the analysis of investment subject to financing constraints are discussed in subsection 4.3, while the outline of an empirical model linking the cash and investment decisions is presented in subsection 4.4.
4.1. **Managing the capital structure**

The theoretical connection between leverage and the incidence of financing constraints is unclear and empirical evidence is mixed. These mixed conjectures and findings relate to our ability to proxy unobserved debt capacity constraints with observed debt levels. When comparing a cross-section of firms and assuming that firms have more or less similar debt capacity, firms with high debt levels more likely face binding debt constraints. For example Whited (1992) interprets low leverage a priori as sorting out relatively unconstrained firms, since they have the ability to incur further debts without immediately running into capacity constraints. Van Ees et al. (1998) acknowledge this reasoning, but at the same time note that low leverage is an ex post proxy for severe credit rationing. Their argument is that when looking at historical levels of corporate indebtedness, a history of low debt likely points to a low debt capacity. Hence, they suspect that firms with historically low levels of debt run into debt constraints more quickly and display constrained investment behaviour.

The issue is further complicated by noting that "the firm may [...] plan to cover part of normal investment outlays with new borrowing, but it tries to restrain itself enough to keep debt safe – that is, reasonably close to default-risk free. It restrains itself for two reasons: first, to avoid any material costs of financial distress, and second, to maintain financial slack in the form of reserve borrowing power [which] means that it can issue safe debt if it needs to" (Myers (1984), p. 589). Hence, a firm may rationally decide to maintain some precautionary spare debt capacity and target a level of indebtedness that lies below its debt capacity.

There is a broad literature on the management of the capital structure that we can refer to in an attempt to shed some light on this unclear connection between leverage and financing constraints. Myers and Majluf (1984) present the seminal model that rationalises pecking order behaviour in capital structure adjustment in an environment with asymmetric
information. Within this model, firms exhaust internal funds first, before they turn towards external sources of finance and when they do, they prefer safe debt to equity. They then issue safe debt up to the point where they no longer need further funding, or hit their debt capacity constraint, whichever comes first. What is important within the context of this section, is that in the Myers and Majluf world, firms do not perceive an optimal capital structure (cf. Modigliani and Miller (1958)) and they do not feel constrained in their investment decision until they actually hit their debt capacity constraints.

Opposed to this pecking order view is the static trade-off theory, in which firms are assumed to trade off the costs of an additional unit of debt in terms of increased cost of financial distress, against its benefits in the form of additional tax shield. Myers (1984) concludes that "[t]he static tradeoff story works to some extent, but [...] actual debt ratios vary widely across apparently similar firms. Either firms take extended excursions from their targets, or the targets themselves depend on factors not yet recognised or understood" (p. 589). Harris and Raviv (1991) provide an overview of capital structure models based on informational asymmetries, which defines a great many potential determinants of capital structure. Furthermore, the spirit of the static tradeoff theory for instance allows firms to trade off the net benefits of raising an additional unit of debt today against the net benefit of having the option to raise an additional unit of debt in the future. Thus within a static tradeoff world, firms may already feel constrained in their investment decision even though they did not hit their debt capacity constraints just yet.

The empirical evidence has so far failed to provide unambiguous support for either the pecking order or the static tradeoff theory. While the present paper does not intend to provide a platform for an in-depth analysis of the empirical literature on this topic, let us note some of the more important contributions. Rajan and Zingales (1995) provide international evidence on the determinants of capital structure that suggests that this structure is relevant to a firm’s
value. Shyam-Sunder and Myers (1999) find strong evidence of a pecking order in corporate capital structure adjustment. Target adjustment effects are also observed, but such effects would emerge even if the factual Data Generating Process were pecking order.\textsuperscript{17} Frank and Goyal (2003) report evidence contrary to the pecking order theory.

4.2. Managing corporate cash holdings

Lack of clarity also surrounds the theoretical and empirical connection between corporate cash holdings and financing constraints. For example Hu and Schiantarelli (1998) find that firms with low cash ratios are more likely to face a higher premium on external finance. This corresponds with the theoretical considerations of KZ97, who regard cash as part of a firm’s pool of internal means with which it might finance additional investment. As discussed above, however, it does not concur with KZ97’s empirical findings, which attach the lowest ICFS to the firms with the lowest levels of cash holdings. It also contrasts with Hovakimian and Titman (2003), who find that large cash holdings increase the probability that the firm faces a high premium on external finance. Hovakimian and Titman explain their findings by noting that "constrained firms have more incentive to hold large cash balances" (p. 13). Such an explanation suggests a precautionary motive for firms to hold cash and introduces restrictions in the access to external finance as one of its determinants.\textsuperscript{18}

While the number of studies exploring the determination of corporate cash holdings falls far short of that exploring the corporate capital structure, there is still sufficient evidence to support the view that a precautionary motive exists for corporates to hold cash. Kim et al. (1998) for example find evidence of a "tradeoff between low return on liquid assets and the benefit of minimising the need for costly external financing" (p. 335). Opler et al. (1999) stress the role of informational problems in determining optimal precautionary cash balances.

Contrary to the literature on debt targets, however, there is limited empirical evidence that suggests that firms do not care about their cash holdings. As an alternative to the active pursuit of cash targets, Opler et al. (1999) propose a passive stance wherein cash has no value for the firm and follows from the pursuit of a net debt target or pecking order behaviour in finance. While they find evidence of such passive cash adjustment, they also find that firms converge towards cash targets at an annual rate of about 20%. Related research by Bruinshoofd and Kool (2002) stresses that long-run cash targets allow for short-run buffer stock behaviour. Moreover, Bruinshoofd and Kool demonstrate that the annual rate of target convergence may rise to as high as 80% if allowance is made for unobserved heterogeneity in corporate cash targets.¹⁹ As such, we are on rather firm ground in claiming that firms formulate target cash holdings and deem such targets sufficiently important that they may reconsider investment plans when cash holdings so require.

4.3. Managing financing constraints

While financing constraints are inherently unobservable, we can exploit interdependencies in financial decisions to identify when firms actually run into such constraints. The informational content of debt and cash targets in this regard is discussed in succession.

As discussed above, when debt capacity constraints are relevant and alternative sources of external finance costly or hard to come by, firms may pursue the maintenance of spare debt capacity for precautionary purposes and hence target debt levels below their debt
capacity. By that rationale, firms that maintain the highest levels of precautionary spare debt capacity expect to face the strictest financing constraints. Hence, we might expect such firms to feel constrained in their investment decisions. However, firms with little need for debt financing – possibly because their investment plans are so modest that they can be realised entirely with retained earnings – also end up with substantial spare debt capacity. Nevertheless, we would not expect such firms to feel in any way constrained in their investment decision. The observational equivalence of supply-constrained and demand-constrained debt financing thus makes debt targets an imprecise measure of how constrained a firm perceives its own investment decision. Furthermore, since spare debt capacity matters most, even if we do find debt targets, that does not necessarily provide a useful measure of the spare debt capacity target. That is, unless we can quantify the debt capacity itself.

The latter issue is circumvented by using deviations of debt away from targeted levels as indicators of financing constraints. Provided that targeted debt levels mismeasure debt capacity by a fraction that is constant over time, deviations of debt from targeted levels provide information on changes in spare debt capacity. Nevertheless, it is difficult to demonstrate empirically the relevance of debt targets, given the substantial evidence in favour of the pecking order. By that token, even if we manage to compute meaningful debt target deviations which reflect deviations from targeted spare debt capacity, it is not clear that this makes firms feel particularly constrained in their investment decisions.

Complementary to or substituting for precautionary spare debt capacity firms may decide to hold precautionary cash balances. Theoretically, targeted levels of precautionary cash can provide an indication of how constrained the firm perceives its own future investment to be. All else equal, a firm that expects serious problems in raising the finance for its future investment has an incentive to hoard some additional cash. Thus firms with historically high cash targets are perceived to face substantial problems in raising external
finance. Of course, this assumes that our empirically estimated cash targets reflect the precautionary motive stemming from financing constraints mainly. We know, however, that an important additional motivation to hold cash is the transaction motive (e.g. Keynes (1936)). Empirically, the transaction motive may be difficult to separate from the precautionary motive. This is specifically so, because factors such as firm size likely affect both the transactions motive (through possible scale economies in cash management) and the precautionary motive (because large firms are less vulnerable to informational problems in capital markets). Furthermore, while spare debt capacity and cash holdings jointly provide a precaution against the brunt of future financing constraints, each one isolated may substitute for the other. On the one hand, higher levels of debt, to the extent that it is obtained from concentrated lenders, suggests a higher level of monitoring efforts (see Diamond (1984), (1991)), which reduces informational problems and concomitant precautionary cash motives. On the other hand, higher levels of precautionary cash reduce the incentive to invest in banking relationships and may in the limit even reduce borrowing capacity (cf. Myers and Rajan (1998)).

While for all of these reasons cash targets may measure perceived financing constraints with error, the deviations from such targets provide a much clearer indication of what constitutes a constrained firm. Shortfalls of cash relative to target imply that the firm has less cash available than it deems prudent for future transactions and precautionary needs. Since empirical evidence demonstrates that cash targets are important to firms (e.g. Kim et al. (1998), Opler et al. (1999)), shortfalls of cash likely constrain the firm in its investment decision. While this procedure is in the spirit of Kaplan and Zingales (1997) in using the availability of internal funds to measure financing constraints, it allows and controls for the firm’s pursuit of a cash target. It thus allows for a more precise test of the ICFS to reflect the tightness of financing constraints. In that regard it is particularly interesting to analyse how
firms respond to surpluses of cash relative to target. Such 'free cash' can be used to initiate additional investment and still take the targeted amount of precautionary cash balances into the future. Insofar as investment can be initiated more easily by using surplus cash holdings, it is expected to depend to a lesser extent on cash flow realisations, i.e. firms exhibit a lower ICFS. At least, that is the financing constraints reasoning. Kaplan and Zingales (1997) and Hadlock (1998) claim that the ICFS may point towards firms excessively investing in unprofitable investments (cf. Jensen (1986)). While Opler et al. (1999) find no evidence of agency problems in the explanation of levels of cash holdings, Almeida et al. (2002) find it in terms of a stronger sensitivity of cash accumulation to cash flow for unconstrained firms with low inside ownership. Applied to the impact of excess cash, the agency view therefore predicts that firms with excess cash are able to direct a larger share of cash flow to pet projects, increasing the ICFS.

4.4. Integrating the corporate investment and cash management decisions

The above suggests that much may be learned from integrating the analyses of corporate investment and the management of finances, specifically cash management. A very flexible tool to take the analysis in exactly that direction is provided by the following vectorautoregressive investment model (VIM), which is adapted from Breitung et al. (2003):

\begin{align}
(6a) \quad I_{t,j} &= \alpha^I(L)I_{t,j-1} + \alpha^S(L) E(\Pi)_{t,j} + \alpha^{CS}(L)C_{t,j} + \alpha^{II}(L)[L - L^*]_{t,j-1} + \eta^I + \lambda^I + \epsilon^I_{t,j} \\
(6b) \quad \Delta L_{t,j} &= \beta^{IL}(L)L_{t,j-1} + \beta^I(L)I_{t,j} + \beta^{CS}(L)C_{t,j} + \beta^{II}(L)[L - L^*]_{t,j-1} + \eta^L + \lambda^L + \epsilon^L_{t,j}.
\end{align}

Here \( I \) stands for investment in fixed assets, \( E(\Pi) \) denotes expected net return on capital,
$Cf$ is cash flow, $L$ is cash assets (cash and near cash items in the balance sheet), and $L^*$ is the cash target. Furthermore we assume that all variables are appropriately deflated. Lastly, $\Delta$ is the first-difference operator, $\alpha(L)$ and $\beta(L)$ are polynomials in the lag operator and the subscripts $t$ and $i$ indicate time periods and firms, respectively, with time and firm specific effects $\lambda_t$ and $\eta_i$.

Equation (6a) relates investment to its own lagged levels (to capture persistence), expected net return on capital (to capture fundamentals) and cash flow and lagged deviations of cash holdings from targeted levels (to capture financial factors). Equation (6b) models cash dynamics, which depends on investment and cash flow (to capture the till function of cash holdings) and the lagged deviations of cash holdings from targeted levels (to capture the desire to converge to optimal cash levels), while persistence is represented by lagged cash dynamics.

Though the individual parameters in any VAR are difficult to interpret, impulse-response analysis can illustrate the impact of shocks to cash holdings, cash flow, or investment opportunities on the system. The single most important feature of this system of equations is that it allows deviations of liquidity holdings from targeted levels $[L - L^*]$ to impact investment spending while also allowing for a lagged feedback effect from investment outlays to cash dynamics.

While simple and insightful as it is, the flexibility of the VIM allows us to go much further. For example the VIM in equations (6a) and (6b) embodies the assumption that observed cash dynamics exert no independent effect on investment, it is only the excess or shortage of cash relative to the target that affects investment spending. In a more general specification, $\alpha^I(L)\Delta L_{t-1}$ can be added to (6a) and its relevance assessed using impulse-response analysis. Asymmetric effects of cash shocks on investment may also be considered.
Then, \( \alpha^{U}(L) \) can be conditioned on the sign or size of the deviations of observed from targeted cash holdings.\(^{22}\) Alternatively, Kaplan and Zingales (1997) hypothesise a link between excess and shortage cash and the sensitivity of investment to cash flow. In the VIM, this implies that \( \alpha^{CF}(L) \) is conditional on the sign or size of the deviations of observed from targeted cash holdings. Such issues can be analysed directly using an iterative maximisation procedure, or in a 2-step approach where cash targets are computed in the first step (eg. Bruinshoofd (2003)). Lastly, Breitung et al. (2003) consider a VIM with an investment and a cash flow equation. We have replaced the latter with the dynamic cash equation. Of course, a separate cash flow equation may be considered as an addition to (6a) and (6b). Such extension allows for feedback effects from constrained investment behaviour to the ability to generate cash flow in the future.

Taken together, the VIM presents a simple, flexible, and powerful tool to simultaneously analyse investment and financial decisions. Allowance for such simultaneity is the prerequisite for any irrefutable final verdict on the existence of a financing channel.

5. Summary and conclusions

The financing constraints paradigm builds on the joint assumption that firms facing financing constraints can be distinguished from firms that do not and when facing financing constraints, firms’ investment is expected to display excess sensitivity to financial variables. The heavy reliance of research within this paradigm on the ICFS as a measure of financing constraints has produced some contradicting results. For example, small firms are sometimes argued to face tighter financing constraints than large firms do, when this is suggested by excess sensitivity patterns. When excess sensitivity patterns suggest otherwise, however, large firms are argued to face tighter financing constraints.
Furthermore, for some firms displaying particularly strong sensitivity of investment to cash flow it is difficult to imagine that they are in any way constrained by the availability of internal funds when deciding on their investment outlays, as these funds seem available in abundance. The observation that such firms display a strong ICFS, whereas firms with considerably lower levels of internal funds display a considerably lower ICFS, has provided an important impetus to reduce the reliance on the ICFS as measuring financing constraints. Attention has instead shifted towards more direct measures of financing constraints as well as more solid theoretical foundations for the relationship between finance and investment for constrained firms.

Recent theoretical advances suggest that cash is a noisy measure of contemporaneous financing constraints, because it is affected by the expectation of future financing constraints. Empirical contributions focusing on corporate cash determination confirm this result: firms target cash holdings and the precautionary motive to hold cash relates to perceived future financing constraints. Hence, despite apparently abundant cash holdings, firms may constrain themselves in investment outlays to maintain a certain amount of precautionary cash. Using these new insights, I have made a strong recommendation to use information on optimal cash management policies to identify firms that face financing constraints. Specifically, knowledge of the corporate cash targets allows us to measure how much ‘free cash’ firms have and free cash is what firms can readily commit to new investments without having to walk to external capital markets. Firms with lots of free cash are therefore least likely to face financing constraints and vice versa.

The simultaneous analysis of optimal cash holdings and investment subject to financing constraints can thus shed light on whether constrained firms display stronger ICFS or not. Additionally, it can discriminate such excess sensitivity results from an agency explanation. The agency reasoning, namely, states that free cash is spent on excessive
investment in pet projects. Surely then, the connection of these two areas of research is worth exploring further.
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References


Activity, pp. 75-122.


1 We postpone the discussion of strategies to discriminate constrained from unconstrained firms to the next section.

2 The same measurement error argument applied to Q-models can explain the poor explanatory performance of the Q-model as well as the predominant role for cash flow in explaining investment (cf. Gilchrist and Himmelberg (1995), (1998)).

3 The same condition is required for the useful assessment of financing constraints within a Q-model wherein $Q$ is measured with error.

4 See Alti (2003) for a formal demonstration of this argument. Alti develops a model wherein young firms are assumed to face uncertainty regarding long term growth potential. This makes $Q$ a noisy measure of contemporary investment project quality as it includes the option value of long term growth potential. Cash flow contains news on these prospects and as such has informational content. As firms grow older, the project quality estimate becomes more precise and the option value of long term growth potential dissipates, making $Q$ more informative of contemporary investment plans and reducing the informational content of cash flow. Simulation analysis subsequently demonstrates that measurement error can account for excess sensitivity results of the same magnitude as Fazzari et al. (1988) report for their subset of low dividend payout firms.

5 Hovakimian and Titman (2003) propose the use of voluntary asset sales as an internal source of finance that is uncorrelated with future profitability. They demonstrate that constrained firms’ investment is more sensitive to the proceeds of such sales. Holtz-Eakin et al. (1994a) and (1994b) investigate the impact of inheritances on entrepreneurial activity. Holtz-Eakin et al. (1994b) obtain that the receipt of an inheritance contributes positively and significantly to the probability that the individual becomes an entrepreneur and Holtz-Eakin et al. (1994a) present a positive and significant impact of an inheritance on the probability that the entrepreneur remains in business.

6 Which in itself is an unexpected result in a financing constraints setting as rated firms are generally believed to suffer less from the incidence of asymmetric information than non-rated firms (e.g. Whited (1992), Carpenter et al. (1994), Gilchrist and Himmelberg (1995) and (1998)).

7 Furthermore, the strict assumptions required in the Q approach, namely constant returns to scale in the production and the adjustment cost functions as well as competitive markets, can be relaxed.

8 See for example Schiantarelli (1996) for a more formal discussion.

9 See for example Hubbard (1998) and Schiantarelli (1996) for more extensive overviews of relevant empirical studies.

10 Schiantarelli (1996) also points out the undesirable methodological feature of assigning firms a time-invariant constrained or unconstrained status, neglecting the possibility that the same firms may face binding constraints in some years, but not in others.

11 Specifically, their switching function additionally includes leverage, coverage, cash
holdings and year and industry dummies.

12 More generally, Gomes (2001) is highly critical of the necessity and sufficiency of excess sensitivity results to indicate financing constraints.

13 Specifically, Fazzari et al. (2000) assume a positive premium, one that increases in the amount of external finance ($F_{kE > 0}$) and does so at a faster rate for firms with a higher degree of informational problems ($F_{kE > 0}$). Furthermore, assuming diminishing returns to investment ($\Pi_{II < 0}$), the denominator as well as the first term in the numerator of (5) are positive. Let $F_{kE > 0}$ (the premium rises in the degree of informational problems). Then, for a revenue function that is quadratic in $I$ ($\Pi_{III = 0}$) and a premium function quadratic in $E$ ($F_{III = 0}$), this second terms is zero and (5) overall is positive. However, when $\Pi_{III > 0}$, the second term is negative and may outweigh the first, suggesting a lower ICFS when the degree of informational problems increases.

14 Also note how this argument runs parallel to the inter-temporal minimization of the capital stock adjustment costs within the Euler framework.

15 In the limit, the unconstrained firm need not put up any own funding, resulting in an infinite equity multiplier and the ability of the firm to apply all-debt financing of investment.

16 Gomes (2001) simulates a sample of firms that resembles observed first and second moments in observed data on such key financial variables as capital stock, investment rate and sales growth as well as the observed autocorrelation in investment rates. This provides a laboratory to investigate the role of financing constraints as it allows for the classification of the firms in his data set with 100% precision to the constrained and unconstrained subclasses. Gomes shows that ICFS patterns do not reflect this flawless stratification of the data.

17 See Chirinko and Singha (2000) for a critical comment.

18 Similar to Myers’ (1984) suggestion regarding leverage, firms are argued to constrain themselves to maintain a certain amount of precautionary cash. Also see Fazzari et al. (1996) and (2000) for similar reasoning.

19 Target adjustment rises even higher when we isolate large deviations (cf. Bruinshoofd and Kool (2003)).

20 Moreover, while this procedure focusses on whether the financing constraint binds and clearly accommodates that it may bind in some years, but not in others, it does not rely on ICFS results to do so (as in Hu and Schiantarelli (1998)).

21 The target may be a (historical) average, or a ‘sophisticated target’ à la Opler et al. (1999).

22 In a standalone analysis of (6b) Bruinshoofd and Kool (2003) assess the dependence of $\beta^{12}$ and find a range of inaction around the cash target while larger deviations trigger strong adjustment efforts.
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