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On the Relationship between the Investment-Cash Flow Sensitivity and the Degree of Financing Constraints[*]

Alfonsina Iona[†], Leone Leonida[‡] and Aydin Ozkan[§]

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Abstract

We investigate whether the investment-cash flow sensitivity is monotonic in the degree of financing constraints. By using a large panel of publicly traded non-financial U.K. firms, we show that the investment-cash flow sensitivity is neither monotonically increasing nor decreasing in the most common proxies of financing constraints; on the contrary, an inverse U-shaped relationship is observed. Robustness exercises show that the parameter of interest displays, to some extent, a monotonic behavior with respect to size only; however, in contrast with much of the relevant literature, it is found to be greater for larger firms, whose characteristics would hardly lead the researcher to classify them as more financially constrained. If taken as a whole, our findings suggest that higher investment-cash flow sensitivities may hardly be used as evidence of greater financial constraints.

Keywords: Investment cash flow sensitivity, Financial constraints, Internal funds, Capital market imperfections.

JEL: E22, D92, G31.

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1 Introduction

It is known that capital market imperfections - asymmetric information and costly agency conflicts - lead to a positive correlation between the investment level of a firm and its internal wealth. It is generally thought that asymmetric information between insiders and outsiders about the firm's growth opportunities may drive a wedge between the cost of internal and external financing; hence, firms lacking sufficient internal funds to finance investment expenditures are adversely affected (Myers, 1977; Myers and Majluf, 1984; Greenwald, Stiglitz and Weiss, 1984; Stein, 1998). Therefore, the higher the firm's internal wealth, the smaller the impact of external finance on investment; for this reason, investment is expected to be positively related to internal wealth. There is also ample evidence to support such theoretical prediction which indeed shows that, in presence of capital market imperfections, cash flow or cash stocks are positively correlated to investment (see, e.g., Fazzari, Hubbard and Petersen, 1988; Bond and Meghir, 1994; Gilchrist and Himmelberg, 1998 among others).[1]

Empirical results from a large number of studies also suggest that the parameter measuring the sensitivity of investment to cash flow is higher for firms that suffer more from capital market imperfections - financially constrained firms. These studies typically split samples of firms according to some *a priori* proxies of financing constraints and compare the point estimates of the investment-cash flow sensitivity estimated across such sub-samples. At a first glance, the evidence seems to suggest that firms classified as more financially constrained tend to exhibit a greater sensitivity of investment to cash flow. Therefore, an higher investment-cash flow sensitivity has been traditionally taken as evidence of more severe financing constraints (Fazzari, Hubbard and Petersen, 1988; Whited, 1992; Hubbard, Kashyap and Withed, 1995; Gilchrist and Himmelberg, 1998).

However, this view is challenged by Kaplan and Zingales (1997). They argue that, while it is reasonable to expect that in presence of financial market imperfections firms display a positive investment-cash flow sensitivity, it does not necessarily follow that the magnitude of this parameter should monotonically increase with the degree of financing constraints. They combine balance sheet data with information collected from annual management statements about the financial status of firms for the sub-sample of 49 low-dividend paying firms classified

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[1] Apart from theoretical issues, such a correlation may depend on the informative contents of the proxies of the internal wealth that are usually employed in performing empirical exercises. In other words, if the average Q - which is usually employed as a proxy for the marginal one - is a poor proxy for investment opportunities, any financial variables may have explanatory power for investment. In this case, the cash flow sensitivity would merely capture a relationship between investments and expectations of profitability, not fully captured by the average Q. This point is of great importance and it has been largely debated. On the one hand, however, the excess sensitivity of investment to cash flow would still exist even after using more refined estimators (Gilchrist and Himmelberg, 1998). On the other hand, Hubbard (1998) suggests that such excess sensitivity would hardly depends on econometric issue only. For these reasons, and in line with much of the previous literature, in what follows we assume that the average Q is a good proxy for the marginal one.

as financially constrained by Fazzari, Hubbard and Petersen (1988). They find that 85 percent of these firms "could have increased their investment [...] if they had so chosen" (p.171). They also show that these firms, classified as less financially constrained, exhibit a greater investment-cash flow sensitivity than those classified as more financially constrained. Rather than increasing monotonically with the degree of financing constraints, the investment-cash flow sensitivity tends to decrease monotonically. This is the first piece of evidence as to the suggestion that a higher sensitivity of investment to cash flow may not be taken as evidence of greater financing constraints. Their small sample evidence is supported by Cleary (1999) that, by using a large sample of U.S. non-financial firms, shows that the cash flow sensitivity is lower for classes of firms which are, according to the sorting criteria proposed by Fazzari, Hubbard and Petersen (1988), more likely to be financially constrained.

Results from the two strands of literature are clearly in sharp contrast with each other, and the debate is still ongoing. On the one hand, some authors try to reconcile the two different findings in a unique theoretical framework (Almeida, 2000; Cleary, Povel and Raith, 2005). On the other hand, some researchers still use the investment cash flow sensitivity as a measure of the degree of financing constraints (just as examples, see Love, 2001; Giannetti and Himmelberg, 2002; Himmelberg, Hubbard and Love, 2002; Almeida and Campello, 2004; Pawlina and Renneborg, 2004; Mizen and Vermulen, 2005). In our opinion, the use of the empirical framework is still reasonable, because both Kaplan and Zingales (1997) and Cleary (1999) find a *monotonic* behavior of the investment-cash flow sensitivity. More precisely, their empirical results suggest that the parameter increases, instead of decreasing, as financial constraints relax. For this reason, *in the case that they have misclassified firms*, their results are not strictly against those of Fazzari, Hubbard and Petersen (1988). It is the case to observe that this is exactly the reason why the debate has moved from the magnitude of the estimated investment-cash flow sensitivity, to the ability of splitting criteria to capture the extent of financial constraints faced by firms (Fazzari, Hubbard and Petersen, 2000; Kaplan and Zingales, 2000).

The analysis in this paper suggests that the investment-cash flow sensitivity should not be used as a measure of the wedge between the cost of internal and external financing if it reveals to be non-monotonic in the most common proxies of financing constraints, *regardless of whether financial constraints monotonically increase or decrease across classes of firms.* To this aim, we provide a detailed analysis of the monotonicity characteristics of the investment-cash flow sensitivity.

Our starting point is the evidence that "being financially constrained" is an unobservable characteristic of firms, and that managers have a clear incentive not to disclose such information - actually this is exactly what makes, in principle, all splitting criteria questionable. Despite this consideration, both the results by Fazzari, Hubbard and Petersen (1988) and Kaplan and Zingales (1997) heavily rely upon the assumption that firms may be ordered according to the degree of financing constraints they face by means of some criteria - relying either on quantitative balance sheet variables, or on management statements, or even on the probability of belonging to a particular class of dividends as in Cleary (1999). In doing so, the validity of the entire procedure - splitting the available sample, estimating and comparing the investment-cash flow sensitivities across sub-samples - depends on whether the ordering criteria effectively capture the extent to which firms are constrained: in such frameworks, a monotonically increasing or decreasing investment-cash flow sensitivity may be used as a measure of the importance of financing constraints only if proxies of financing constraints successfully identify sub-samples of financially constrained firms.

In order to avoid the need of relying on statements about the severity of financial constraints we prefer, rather than proposing a new and possibly again arguable classification criterion, to analyze whether the investment-cash flow sensitivity displays a monotonic behavior in the most common proxies of financing constraints. Once having studied the empirical shape of the relationship between such proxies and the magnitude of the investment cash flow sensitivity, we attempt to investigate the empirical effectiveness of such variables in identifying the firm's financial status. Notice that, in the case the parameter of interest results to be non-monotonic, the entire procedure should be rejected: either the investment cash flow sensitivity is non-monotonic in the degree of financing constraints, or the proxy we use are unrelated to the presence of financing constraints. However, it is the case to highlight that, because we employ the standard model of investment behavior (Q model of investment), the most common econometric technique (a panel data framework) and the most common proxies of financing constraints (dividends, size, cash stocks and leverage), such a result would affect in both cases large part of the literature on the argument.

More specifically, we begin by estimating the investment-cash flow sensitivity for an unbalanced panel of 1,195 non-financial U.K. firms from 1984 to 2002 - for a total of 14,630 firm-year observations. Then, we order our sample using the dividend payout criterion and we progressively remove the lowest 5, 10, 15, 20, 25, 30, 35, 40, 45 and 50 percent of the observations, in such a way to obtain 10 sub-samples of firm-year observations displaying increasing dividend payout ratios. We estimate the investment-cash flow sensitivity for each of these classes and we test the null hypothesis that these parameters do not statistically differ from the parameter estimated for the entire sample.

Notice that we can perform such analysis without making any statement on the financial status of the firms. However, if the dividend payout ratio is inversely related to the degree of financing constraints *and* if the investment-cash flow sensitivity is higher for firms that are more likely to be financially constrained, one would then expect that the investment cash-flow sensitivity monotonically decreases across our classes of firms. Alternatively, if the dividend payout ratio is inversely related to the degree of financing constraints *but* the investment-cash flow sensitivity is higher for firms that are less likely to be financially constrained, it would be expected that the investment cash-flow sensitivity monotonically increases across our classes of firms. As a robustness exercise, we perform our analysis also by using other common proxies of financing constraints as ordering criteria, alternative estimation frameworks and different empirical specifications of the Q model.

The findings of this analysis suggest that the investment-cash flow sensitivity neither monotonically increases nor decreases with dividend payout ratios, size, leverage and cash holdings. Rather, we find evidence of an inverse "U-shaped" relationship between the investment-cash flow sensitivity and each proxy of financing constraints: as their average level in the sample increases, the investment-cash flow sensitivity increases first, and then decreases. Therefore, this first stage of the analysis suggest that either the sorting criteria we use are unrelated to financing constraints or that the magnitude of the investment-cash flow sensitivity does not depend on the degree of financing constraints only. If anything, robustness exercises show that size seems the only ordering criterion for which the parameter of interest is monotonic. However, and again in contrast with much of the relevant literature, the cash flow sensitivity result to be *higher* for larger firms, which we show that may hardly be considered as financially constrained with respect to smaller ones.

To shed further light on this, we also investigate the extent to which the proxies we use to build our classes of firms are related to financing constraints. It is again the case to underline that, since being financially constrained is normally not a directly observable characteristic of firms, the conclusions one could draw from this investigation are not expected to be as strong as those of the first stage of our analysis. Results from this additional evidence seems to suggest that, among the proxies we used, dividend payouts and leverage and cash policies are not driven by financing constraints only.

We believe that our analysis is original from several points of view. First, our testing procedure provides significant insights into the effectiveness of the investment-cash flow sensitivity as a measure of financing constraints. Second, we run the first stage of our analysis without making statements about the level of financing constraints faced by firms and, to the best of our knowledge, we are the first in doing so. Third, rather than just comparing point estimates of the investment-cash flow sensitivities across classes, we propose a formal testing procedure for the null hypothesis that they do not significantly differ. Fourth, we take into account the possibility that firms change status over time - it has been argued that it is unreasonable to hypothesize that a firm is constrained over long periods of time (Schiantarelli, 1995). Fifth, our results rely on a large sample of firms and hence the critique about the size and the heterogeneity of the sample, raised by Fazzari, Hubbard and Petersen (2000) to Kaplan and Zingales (1997) does not apply to our analysis. Finally the following exercise is first ones which uses U.K. observations for studying the monotonic behavior of the investment-cash flow sensitivity.

The remainder of the paper proceeds as follows. Section 2 presents the previous literature and motives our work. Section 3 presents our research design and describes the sample we use. Section 4 presents empirical results and discusses their main implications for previous literature. Section 5 gives some concluding remarks.

2 Background

2.1 Related Literature

Modigliani and Miller (1958) prove the irrelevance of the firm's capital structure for the investment decisions in a model of perfect and complete capital markets. However, since then it has been shown that in presence of capital market imperfections the firm's financial structure is relevant, and investment is sensitive to the availability of internal funds essentially because of the cost advantage of the internal over the external finance (Myers and Majluf, 1984; Myers, 1984).

Many empirical studies find that internal wealth - measured by liquidity, cash flow, or cash stocks - is significant in determining investment decisions, especially for those firms that are more likely to face capital market imperfections. Beginning with Fazzari, Hubbard and Petersen (1988) (hereafter FHP88), a large strand of the empirical literature provides empirical support for this hypothesis. The evidence also suggests that the investment-cash flow sensitivity is higher for financially constrained firms, which leads to the argument that this parameter represents a measure of the degree of financing constraints (Devereux and Schiantarelli, 1989; Hoshi, Kashyap and Scharfstein, 1991; Withed, 1992; Shaller, 1993; Bond and Meghir, 1994; Calomiris and Hubbard, 1995; Hubbard, Kashyap and Withed, 1995; Gilchrist and Himmelberg, 1998).

More specifically, FHP88 classify a large panel of 422 U.S. manufacturing firms into three groups according to their dividend payout ratios and argue that firms with lower dividend payout ratios (higher retained earnings) are more likely to be liquidity constrained. They find that investment decisions of these firms are more sensitive to changes in cash flows than other groups. A large number of subsequent studies also uses dividends as their classification criterion (Gilchrist 1991, Hubbard, Kashyap and Whited, 1995; Calomiris and Hubbard, 1995). Moreover, there are studies that use alternative proxies of financing constraints - size, group membership, age, ownership structure or debt ratings - and provides similar findings. For example, Devereux and Schiantarelli (1989), by classifying firms according to their size, find that the investment-cash flow sensitivity is higher in larger firms, which are more likely to be constrained because of agency problems. Hoshi, Kashyap and Scharfstein (1991) argue that being member of a large industrial group relaxes financing constraints to some extent and show that these firms exhibit a lower investment-cash flow sensitivity. By using a different set up - the Euler equation approach - Whited (1992) and Bond and Meghir (1994) find that investment expenditures of firms with no bond ratings and low dividend payout ratios reveal a higher sensitivity to internal funds.

The findings of these studies have been challenged by Kaplan and Zingales (1997) (hereafter KZ97) on the basis that there is no theoretical reason to expect that the investment-cash flow sensitivity necessarily increases with the degree of financing constraints. Moreover, they perform an in-depth analysis of the sub-sample of 49 firms classified as financially constrained in FHP88 by collecting information both from company annual reports about the financial position of firms and from balance sheet data. Then, they define firms as being financially unconstrained if there is no evidence "that the firms could not have invested appreciably more if their manager had so chosen" (KZ97:181), and find that financially constrained firms actually display the *lowest* investment-cash flow sensitivity. Such pattern is found for the entire sample period, sub-periods, and individual years, and it leads the authors to claim that the magnitude of the investment-cash flow sensitivity does not provide a valid measure of the strength of financing constraints.

Their small sample evidence is supported by Cleary (1999). By using a large and heterogenous sample of 1,317 U.S. firms for the period 1987-94, he defines three classes of firms: firms with increasing dividends and more likely not financially constrained; firms cutting dividends and likely financially constrained and, finally, firms not changing dividends. Then, by means of a multiple discriminant analysis - similar to Altman's Z-score - he uses a number of balance sheet variables that are likely to affect the characterization of a firm in one of the groups. Finally, by estimating the investment-cash flow sensitivity across the groups, the author shows that the investment decisions of firms with high creditworthiness are significantly more sensitive to the availability of internal funds than those which are less creditworthy.

2.2 Motivation

It is the case to notice that, despite the findings of both KZ97 and Cleary (1999) call into question both the analysis and the results of much of the relevant literature, investment cash-flow sensitivities are still used as a measure of financing constraints (see, for instance Almeida, 2000; Love, 2001; Giannetti and Himmelberg, 2002; and Himmelberg, Hubbard and Love, 2002; Mizen and Vermulen, 2004; Pawlina and Renneborg, 2004; Almeida and Campello, 2004). As said, the approach is reasonable, since it is easy to raise doubts about the sorting criteria used both by KZ97 and Cleary (1999). Indeed, such a practice heavily relies upon two assumptions, the first of which relates to the possibility of identifying the financial status of firms - it is necessary to identify which group of firms is more likely to be constrained.

However, "being constrained" is not, in the majority of cases, a directly observable characteristic, nor a good manager would tell an interviewer or write in the annual report that the firm he is managing is so. Hence empirical studies - and especially those using a large number of firm year observations - have to rely to some *a priori* criteria for discriminating between constrained and unconstrained firms. Clearly, none of these criteria are free of criticism. For example, Kaplan and Zingales (1995) criticize the dividend payout ratios as the most popular criterion of classification. They argue that, according to the corporate finance theory, firms should not pay dividends in the presence of taxes. They also point that the extant theories of dividends policy do not provide insights about the average level of dividends. On the other hand, Fazzari, Hubbard and Petersen (2000) criticize the use of managers' statements by claiming that they may not reflect the real economic status of the firm.

The criterion based on size of firms is also arguable. Devereux and Schiantarelli (1989) suggest that large firms are likely to face more financing constraints because of agency problems. Conversely, Schiantarelli and Sembenelli (1994) find that smaller firms tend to be relatively more constrained. Similar arguments hold for criteria based on cash stocks and leverage. Firms with low leverage may be classified, a priori, as relatively unconstrained because their large debt capacity allow them to obtain easily external funds (Hoshi, Kashyap, Scharfstein, 1991; Whited, 1992). However, other studies argue that these firms should, instead, be defined as more constrained, because it is possible that low leverage is due to the high cost of the external finance (Calomiris and Himmelberg, 1995). Similarly, high cash holdings may signal either that firms are relatively unconstrained - because of the possibility of financing investment by using cash (Kashyap, Lamont and Stein, 1994) - or that they are relatively constrained - because of the need of accumulating cash as precautionary saving in order to avoid future financing constraints (Calomiris, Himmelberg and Wachtel, 1995).

In sum, there is no consensus on how financially constrained firms should be identified in practice. The reason is that financing constraints are identified through their effects on financial indicators - as cash holdings, leverage, dividend payout ratio or size - but different firms respond in different ways to financing constraints. For example, financial indicators may signal not only financing constraints but also a particular managers' attitude. Clearly, if firms are misclassified, the reliability of the investment-cash flow sensitivity as a measure of financing constraints become questionable.

The second assumption is that the sensitivity of investment to cash flow is higher for firms which are more financially constrained - what has come to be known as the "monotonicity condition" (KZ97). Nevertheless, KZ97 shows that in a simple one-period model there are no theoretical reasons to expect that this is necessarily the case. More specifically, they show that, according to the assumptions made on the shape of the production and cost functions, it is possible to build up cases where the parameter of the investment-cash flow sensitivity decreases with financing constraints. Clearly, this issue becomes even more complicated in a multiperiod model, where *expected* rather than *actual* financing constraints may lead to precautionary financing policies. It is the case to notice that this is not only a theoretical issue: to some extent, both KZ97 and Cleary (1999) provide evidence that firms appearing less financially constrained exhibit significantly greater investment-cash flow sensitivities than those appearing more financially constrained. These results, conditional on correct splitting criteria, are in contrast with the findings and the explanations of the prior literature.

Hence, in addition to the theoretical explanation that KZ97 provide, there exist also evidence that a *negative* correlation between investment-cash flow sensitivity and degree of financing constraints may exist: a non-monotonic relationship (or even an inverse relationship) is not only theoretically possible, but is also empirically relevant. However, to the best of our knowledge, the question of whether a non-monotonic relationship is empirically relevant has not been tested. Indeed, what the results of both KZ97 and Cleary (1999) actually document is the existence of a *monotonic* inverse relationship between the investment-cash flow sensitivity and the degree of financing constraints, rather than the existence of a non-monotonic relationship. Hence, in the case they have misclassified firms, their results are not strictly in contrast with those of the prior literature: this is the reason why the debate is currently revolving about the effectiveness of the proxies, rather than on the magnitude of the investment cash flow sensitivity and the shape of the relationship between such parameter and the degree of financing constraints.

We believe that only if the investment-cash flow sensitivity is strictly non-monotonic in the proxies of financing constraints which are typically used by researchers - not always decreasing or increasing across classes of firms - we can claim that it should not be used as a measure of the differential cost between internal and external financing. Our aim is, therefore, to perform a test of the monotonicity condition without relying upon statements about the degree of financial constraints faced by firms.

3 Research Design and Sample

3.1 Empirical Strategy

We consider the following empirical model, which is the most common among those used to test for the presence of financing constraints (FHP88; KZ97; Cleary, 1999):

$$\left(\frac{I}{K}\right)_{it} = \beta_1 Q_{it} + \beta_2 \left(\frac{CF}{K}\right)_{it} + \mu_i + \lambda_t + \varepsilon_{it} \tag{1}$$

where I is investment, K represents a measure of the total capital stock, β_1 is the inverse of the marginal adjustment cost, Q is the Tobin's Q, which represents the market-to-book value of the firm, β_2 is the investment-cash flow sensitivity, CF is the cash flow, μ_i and λ_t are individual and year fixed effects and, finally, ε_{it} is a white noise disturbance term.

Under some regularity conditions (Hayashi, 1982), the average Q may be used to proxy for the marginal Q. Under the assumption that financial markets are perfect, the parameter

β_2 should not be statistically different from zero. According to the theory, a significant and positive value of β_2 would instead suggest the existence of asymmetric information and/or agency costs.

The first step of our research design involves the estimation of equation (1) using the entire sample. We then order our sample using the dividend payout criterion, and progressively remove the lowest 5, 10, 15, 20, 25, 30, 35, 40, 45 and 50 percent of the observations, in such a way to obtain 10 classes of firm-year observations displaying increasing dividend payout ratios. Having estimated the investment-cash flow sensitivity for each of these classes by means of equation (1), we use such parameters to test the null hypothesis that they do not statistically differ from the parameter estimated for the entire sample.

Notice that this analysis may be performed without making statements about the degree of financial constraints faced by the sub-sample of firms we are progressively left with: if the dividend payout ratio is inversely related to the degree of financing constraints and the investment-cash flow sensitivity is higher in more financially constrained firms, one would expect that the investment cash-flow sensitivity decreases across the sub-samples constructed as described above. Conversely, if the investment-cash sensitivity is higher in less financially constrained firms the estimated parameter is expected to increase. If one fails to observe such patterns, it would not be reasonable to make statements about the severity of financing constraints by relying upon the magnitude of the investment-cash flow sensitivity, regardless of whether financing constraints are increasing or decreasing with dividends.

As explained earlier, we repeat our investigation by using firms' total assets, taken as a proxy for firms' size. We obtain ten classes of firms for which size is progressively increasing. Next, we estimate equation (1) across our classes, and we test whether their estimated parameters statistically differ from the investment-cash flow sensitivity for the entire sample. If the degree of financing constraints is meaningfully related to firm size, the investment-cash flow sensitivity should either monotonically decrease or monotonically increase across classes. However, the investment-cash flow sensitivity may hardly be used as a measure of financing constraints if this relationship is found to be non-monotonic.

Additionally, we obtain our classes of firms by means of a joint sorting criterion of cash holdings and leverage. This is because there has been an ongoing debate as to whether firms with high cash balances and low leverages should be classified as more financially constrained or rather financially conservative (Fazzari, Hubbard and Petersen, 2000; Kaplan and Zingales 2000; Iona, Leonida and Ozkan, 2004). Hence, we remove all firm-year observations having cash holdings higher than 50 percent and leverage smaller than 10 percent. Next, we remove observations having cash stocks higher than 40 percent and leverage smaller than 20 percent, and so on to obtain classes where the average leverage increases and the average cash holdings decreases. Because of the use of a joint criterion, our classes of firms cannot be obtained, in this case, by removing a fixed number of observations. Moreover, the number of firm-year observations we are left tends rapidly to zero; for these reasons, we analyze 8 classes of firms rather than 10. In any case, we still can perform our empirical exercise without making statements about the degree of financing constraints of the sub-samples of firms we are left with.

The change the definition of sorting variable is not the only robustness exercise we perform. We change also the empirical model we use to recover our parameters - by adding present and past values of cash balances and leverage. Finally, we perform the analysis using several alternative estimation frameworks - namely, the LSDV, a pooled OLS estimator and an approach based on Fama and French (2002).

The approach we describe above has many advantages. First, in contrast to previous studies, we allow firms to change status over time. It is argued that in practice financial status changes continuously, especially when using panel data involving several years (see Schiantarelli, 1995 for a detailed discussion). Second, as in Cleary (1999), we use a large and heterogeneous sample of firms. Therefore, our results are not driven by the homogeneity of firms, which may be case for the KZ97 sample. Third, and more important, our results do not crucially rely on the hypothesis that financing constraints should relax or strengthen across our sub-samples. Hence, we can proceed without identifying relatively unconstrained or constrained classes of firms; we only need that the ordering criteria are related with financing constraints - to the best of our knowledge, we are the first in doing so. Finally our analysis represents the first investigation of the monotonicity condition using U.K. observations.

At this point, we should note that if the monotonicity condition is empirically violated we cannot strictly conclude that the magnitude of the investment-cash flow sensitivity is not driven by the severity of financing constraints. Rather such finding would suggest that the investment-cash flow sensitivity is non monotonic in the most common proxies of financing constraints - so adding a new piece of evidence against the use of the entire procedure. The correct conclusion that we may draw is that either the magnitude of the investment-cash flow sensitivity is not driven by the severity of financing constraints, or the ordering criteria are not related to the degree of financing constraints. At this stage of the analysis, it is impossible to distinguish which of these two alternatives holds.

Even in this case, because we employ the most common splitting criteria and the most common empirical model, our conclusions would affect anyway a large fraction of the related literature. However, to shed further light on this point, we provide additional evidence about the ability of the sorting criteria to proxy financing constraints. This allows us to draw some conclusions as to which of the two alternatives holds. Note again that, because "being financially constrained" is an unobservable characteristic of firms, such second step analysis is not expected to produce clear-cut conclusions, as in the case of our first step of the analysis.

3.2 Data

Our pool of firms includes an unbalanced panel of publicly traded UK firms, from 1984 to 2002. Our initial sample is the set of all firms for which data are available on Datastream. This database provides both accounting data for firms and market value of equity. The data set we use has been constructed as follows. We exclude financial firms from the sample; from these firms we choose only those with at least three continuous time series observations during the sample period. These criteria provide us with 1,195 firms, for a total of 14,630 firm-year observations.

We use standard accounting variables. We measure cash holdings as total cash and equivalent items, cash flow as pre-tax profit plus depreciation, leverage as total debt, investment is measured as capital expenditures. All variables, including dividends, are normalized by total assets, apart from the market-to-book ratio, which has been measured as the ratio of book value of total assets minus the book value of equity plus the market value of equity to book value of assets. We use total assets to proxy for the size of the firms. All financial variables are for the end of the fiscal year.

4 Discussion of Results

4.1 Preliminary Evidence on Financial Status and Financing Constraints

Table 1 reports descriptive statistics for the financial variables used in the analysis for the whole sample of 1,195 firms over the sample period. Results reported in this table show that the average cash holdings is 11 percent and the median is 6 percent. These values are in line with those reported for the US firms. For example, Kim, Mauer and Sherman (1998) report that the mean and median values of the cash ratio are 8.1 and 4.7 percent respectively.

<please insert Table 1 here>

Table 2 reports correlations among variables. Investment is positively correlated to market-to-book and cash flow; moreover, it displays a low correlation with the dividend payout ratio of firms. Market-to-book ratio is positively and highly correlated to cash holdings. These results suggest that firms are more likely to hold larger cash reserves as long as they have profitable investment opportunities.[2]

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[2] Following Cleary (1999), we have winsorized a number of firm-year observations. This procedure consists of assigning a cutoff value to observations displaying abnormal values of some variables. More specifically, we assign a value of -2 to 14 observations with abnormal negative values of cash flow, and a value of 2 to two observations with abnormal positive values of cash flow. This reduces the impact of outliers on regression results without reducing the sample size; however, because we are winsorizing a total of 12 firm-

<please insert Table 2 here>

Columns A and B in Table 3 report the mean and median values for two groups of firms - those firms that pay dividends and firms that do not. Clearly, observations belonging to the group of non-payer firms might be classified as more financially constrained in a FHP88 type of study, as they are supposed to finance their investments by retaining earnings. Apart from their behavior with respect to dividends, these firms are smaller than dividend-paying ones. This in turn suggest that they may be prevented from undertaking new investments possibly because of the presence of resource constraints in the external capital markets. Indeed, although having higher investment opportunities - as shown by the average market-to book ratio - these firms exhibit low levels of investment, negative cash flows, high leverage ratios and low cash holdings. The presence of financing constraints for this group of firms seems to be supported by their higher level of short term debt and lower level of long run debt with respect to the payers firms. It is worth noting that these firms would be defined as more financially constrained also in a KZ97 style-study, according to which non financially constrained firm-years tend to include financially healthy companies with low debt and high cash (KZ97). The median values reveal that non-payer firms have a lower (higher) level of cash holdings (leverage) compared to the dividend-payer firms.

<please insert Table 3 here>

In the same table, columns C to G report average values of variables regarding five groups of firm-year observations obtained by splitting the entire distribution using four quartiles. This exercise confirms that the dividend criterion is to some extent related to financing constraints. By moving across groups - i.e., from column C to G - financing constraints seem to relax both according to KZ97 and FHP88 criteria: cash holdings tend to increase, while the level of leverage decreases. However, for our analysis we do not need to make statements about the severity of financing constraints. Instead, we only need that financing constraints are to some extent related to dividend payout ratios.

Table 4 presents means of financial variables for six sub-samples of firm-year observations classified according to their size - proxied by the level of total assets. The evidence shows that, as long as size increases, both the dividend payout ratio and investment increase, and the market-to-book value decreases. This suggests that smaller firms, although they have greater investment opportunities, tend to invest less than larger ones. Furthermore, they have smaller cash flows, which may signal liquidity problems. So, according to FHP88,

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year observations, results still hold even after removing these observations from the dataset - to save space, results are not reported.

financing constraints would tend to decrease across increasing classes of size. Conversely, in a KZ97 style study, financing constraints would always increase through classes of size: the level of cash holdings decreases with the firm's size; instead, the leverage level increases. Hence, when the sample is ordered by means of size, it is unclear whether the degree of financing constraints increases or decreases across classes. This example makes particularly clear the advantage of our approach, i.e. regardless of whether they increase or decrease, financing constraints seem to be related to firm size, and this is the only information we actually need.

<please insert Table 4 here>

Table 5 reports the mean values of financial variables for classes of firm-year observations obtained by means of a joint criterion of increasing leverage and decreasing cash holdings. The evidence presented in this table suggests that smaller firms are more likely to be financially conservative. However, because cash holdings decrease and leverage ratios increase, as we move from column A to E, according to KZ97 financing constraints would increase across these classes. In addition, moving from class A to E, observations show lower market-to-book ratios; they also display higher levels of investment and dividend payouts, which according to the analysis of FHP88, would suggest that financing constraints tend to decrease across classes.

<please insert Table 5 here>

If anything, the discussion above shows that the criteria proposed by FHP88 - and used by much of the previous literature - lead often to opposite conclusions with respect to the criteria suggested by KZ97. As said, this reduces the importance of the differences between the results provided by FHP88 and KZ97. Indeed, if one of these papers has misclassified the financial status of some of the sub-groups of firms, *their empirical results are exactly the same*: *the cash flow sensitivity displays a monotonic empirical behavior when financing constraints change.*

4.2 Regression Results

Table 6 reports regression results of some standard investment models, obtained using the entire sample of firm-year observations. We present four regression models. In columns A and B we report parameters estimated by means of a within groups estimator, which follow closely the models proposed by FHP88, KZ97 and Cleary (1999). Results reported in column A show that, as expected, both investment opportunities and internal funds are positively and significantly correlated with investment. Moreover, they display the expected signs. Following FHP88, model B adds some lags of independent variables to the regressors set. Again, the estimated coefficients of lagged independent variables are positively and robustly correlated with investment. Models C and D provide results obtained by using a pooled OLS estimator - both models include sector and time dummies to account, to some extent, for the panel structure of the sample. Because of the upward bias due to the omission of the fixed effects, the values of estimated parameters increase with respect to the estimates obtained with the within groups framework. However, the main result remains unchanged: internal wealth is significantly correlated to investment. To sum up, the evidence points out that firm's investment decisions are sensitive to investment opportunities, and they are even more sensitive to cash flow. This is consistent with the empirical evidence provided by previous studies, which rejects the hypothesis of perfect capital markets (FHP88; KZ97; Cleary, 1999).

<please insert Table 6 here>

Figure 1 shows how we obtain our sub-samples of firms. As explained above, we remove from the total sample the first 5% of firm-year observations with lower dividend payout ratios (dotted lines), and estimate the investment-cash flow sensitivity on the sample we are left with (full line). We continue doing so in such a way to obtain 10 classes of firm-year observations displaying increasing dividend payout ratios. The same exercise is also performed for ten classes of size and, finally, eight classes of leverage and cash holdings.

<please insert Figure 1 here>

Table 7 presents regression results for these exercises which are performed, in line with the previous studies, by means of the most common model of investment. In particular, we split the firms in our sample into two groups only, namely dividends and non-dividends. Panel A reports results for the entire sample of firms and for the group of dividend-payer firms. Notice that when we remove non-payer firms, which would be classified as relatively financially constrained both by FHP88 and KZ97, the estimated investment cash-flow sensitivity increases. This result is consistent with KZ97 and Cleary (1999), but it contradicts FHP88. That is, if dividend payout ratio is used as an inverse proxy of financing constraints, the investment-cash flow sensitivity is significantly higher for relatively financially unconstrained firms. According to KZ97, such finding runs counter the monotonicity hypothesis, since it suggests an inverse relationships between degree of financing constraints and investment-cash flow sensitivity.

<please insert Table 7 here>

However, such a conclusion would be incorrect if non-payer firms were relatively unconstrained; in this case, empirical results would claim in favour of the monotonicity condition. This example is clearly extreme - one would not normally classify non-payers as relatively unconstrained - but illustrates our point: it is impossible to draw a clear conclusion from this evidence, as we need to know which of the sub-samples is constrained. Instead, our procedure allows us to test whether the direction of the relationship between degree of financing constraints and magnitude of the investment-cash flow sensitivity changes across sub-samples.

Panel B shows estimation results obtained from our first exercise. Class 1 is the sub-sample we are left with when we remove the lowest 5 percent of the observations from the entire sample ordered by increasing level of dividends. The findings clearly show that the investment-cash flow sensitivity estimated for this sub-sample is higher than that estimated for the entire sample. Class 2 is the sample we are left with when we remove the lowest 10 percent of the observations. As before, results show that the investment-cash flow sensitivity increases. However, our results show that the investment-cash flow sensitivity is not monotonically increasing nor decreasing: by repeating the same exercise up to the tenth sub-sample, the pattern of the estimated parameters shows a mixed evidence, which may lead to contrasting conclusions. If, for example, the sample was split at the first 5 percent and at the first 20 percent, the evidence would be in favour of KZ97: the investment-cash flow sensitivity increases as the dividend payout ratio increases (0.0163 vs 0.0276). However, if the first 10 percent and the first 45 percent were chosen, the evidence would instead be in favour of FHP88: the investment cash flow sensitivity decreases as the dividend payout ratio increases (0.0269 vs 0.0159).

Panel C reports results when the sample is ordered using firm size as the splitting criterion. As mentioned earlier, this ordering criterion would lead FHP88 to claim that the degree of financing constraints monotonically decreases across our classes, and the opposite would be argued by KZ97. However, regression results suggest that the monotonicity condition is again violated, independently of whether the severity of financing constraints is increasing or decreasing across classes. The same conclusion also holds when firms are ordered by increasing levels of leverage and decreasing levels of cash stocks (Panel D). As in the case of size, the estimated investment-cash flow sensitivity does not show a monotonic behavior in the degree of financing constraints.

It is worth noting that, in line with all previous literature, we compare cash-flow sensitivities which are obtained by using a different number of observations; for this reason, even if sensitivities differ from each other, it does not necessarily follow that they are *statistically* different. In order to perform a more formal exercise, we use the investment-cash flow sensitivities estimated for all classes to test the null hypothesis that these parameters do not statistically differ from the investment-cash flow sensitivity estimated for the entire sample.

Table 8 shows results from this testing procedure. In column A we report the level of the ordering criterion we are using to classify firms. Column B reports the estimated cash flow sensitivities for all sub-samples. Column C reports results from a test for equality of slopes, where the null hypothesis is that the investment-cash flow sensitivity estimated for the entire sample does not differ from the same parameter estimated for each sub-sample. When ordered by dividends, the null hypothesis is not rejected for classes 1, 9 and 10. All the remaining classes display a significantly higher investment-cash flow sensitivity. This evidence suggests that the relationship between dividend payout ratios and the magnitude of the investment-cash flow sensitivity is inverse "U-shaped". To further confirm this result, we use the investment-cash flow sensitivity estimated for the first class rejecting the null hypothesis - namely, class 2 - to test the hypothesis that this parameter does not differ from that of all other classes of firms. Results are reported in column D. Notice that the null hypothesis is rejected for classes 1, 9, 10 and for the whole sample. We repeat the same testing procedure for the investment-cash flow sensitivities estimated across classes of size and across classes of leverage and cash holdings. Also in these cases, an inverse "U-shaped" relationship between investment-cash flow sensitivity and size, or leverage-cash holdings, prevails.

<please insert Table 8 here>

Figure 2 summarizes our findings and describes the violation of the monotonicity condition in all three cases. We superimpose on figure 1 the estimated investment-cash flow sensitivities and a grey zone. This zone splits the picture in three areas: the first one, where the null hypothesis of equality of slopes between the parameter estimated for the entire sample and the one relative to each class is not rejected (zone I); the second area, where this null hypothesis is rejected (zone II) and, finally, the third one (zone III). In this last zone we report results from the procedure we use to test the null hypothesis that the parameter estimated for the first class which rejects the above null hypothesis differs from parameters estimated for the remaining classes (column D in table VIII). Note that when the sample is ordered by dividend and size, instead of monotonically increasing, the investment-cash flow sensitivity enters zone I from below and goes back in this zone from above. When observations are ordered by using cash stocks and leverage levels, the parameter goes in zone II from below and goes back from above in the same zone, which also supports the existence of an inverse "U-shaped" relationship between the degree of financing constraints and the magnitude of the investment cash flow sensitivity.

<please insert Figure 2 here>

4.3 Robustness Checks

Our results are robust to the classification schemes we use to order our sample of firms: a non-monotonic behavior arises regardless of whether we use dividend payout ratios, size or cash stocks and leverage as sorting criterion. However, this section reports additional evidence to examine the robustness of the empirical regularity we have just described.

Lang, Ofek and Stulz (1996) show that future growth opportunities and investment are negatively correlated to leverage, especially for less profitable firms. This implies that the pattern of the investment-cash flow sensitivity might be also driven by leverage levels because high debt burdens prevent companies from raising funds externally in order to invest, and consequently they lead to higher investment-cash flow sensitivities. The analysis by KZ97 suggests a similar argument for cash holdings. They argue that the effect of an extra dollar of funds should be the same for the firm, regardless of whether the firm gets it this period (as cash flow) or whether it was present in the firm at the beginning of the period. KZ97 therefore performs a robustness exercise including cash stocks in the estimating models. Accordingly, we repeat our entire exercise by adding current and past values of leverage and cash stocks to the regressors set. Results are reported in Figure 3.

<please insert Figure 3 here>

In all models independent variables are robustly correlated with investment, and all estimated parameters display the expected sign - to save space, the corresponding tables are not reported. When the sample is ordered by using dividends and cash and leverage levels, the monotonicity condition is still empirically violated, and the inverse “U-shaped” relationship between the investment-cash flow sensitivity and the severity of financing constraints prevails. Such violation is, however, much less evident when the sample is ordered by size; in this case, the investment-cash flow sensitivity tends to increase with size - even if for class VII the null hypothesis is only marginally not rejected.

A second concern arises from the fact that our classes are obtained by removing groups of firm-year observations. In doing so, we might loose the panel structure of some sub-samples. In our opinion, Tables 7 actually refutes this argument: in the last column of this table we report the number of firm-year observations and the number of firms composing each class; such figures, if taken together with the evidence that the entire time span is always present across our sub-samples, suggest that the panel structure is maintained. However, we perform an additional robustness check by repeating our testing procedure and estimating the investment-cash flow sensitivities by means of a pooled OLS framework - including time and sector dummies in each model (Figure 4). Conclusions do not qualitatively differ from results obtained from the previous robustness exercise: size is the only ordering criterion for which the investment-cash flow sensitivity tends to increase monotonically.

<please insert Figure 4 here>

This conclusion is further confirmed by means of a third robustness check, which we perform by using the Fama and French (2002) approach (Figure 5). More specifically, analyze the behavior of cash flow sensitivities across classes in each year separately - for this exercise, we use the OLS estimator and include sector dummies in all models. Then, we calculate the mean over years of the estimated investment-cash flow sensitivity for each class.

<please insert Figure 5 here>

4.4 Implications for Previous Studies

Although KZ97 claim that the violation of the non-monotonicity they find is pervasive and affects many of the results in this literature, what their results actually document is the presence of an inverse monotonic relationship between the investment-cash flow sensitivity and the degree of financing constraints. In this perspective our results document, instead, the existence of a non-monotonic investment cash-flow sensitivity in the degree of financing constraints. Our evidence goes to add to the results by Cleary, Povel and Raith (2005) who, using a different empirical framework and a sample of U.S. observations, suggests the existence of a non-linearity between investment and cash flow - they show that the squared value of the cash flow is robustly correlated to investment.

In our case, if a standard model of investment is used, the violation of the monotonicity condition prevails regardless of the criterion used to proxy for financing constraints; if models are augmented, or more robust estimation frameworks are used, such non-monotonic behavior holds for classification schemes based on dividends or leverage and cash stocks, while, the parameter of interest seems to monotonically increase with size only. However, in contrast with the main bulk of the relevant literature, financial indicator suggests that larger firms may hardly be considered the relatively constrained ones - at least in the sample we are using.

Our conclusions may be then summarized as follows: either 1. the criteria used to classify firms are unrelated to financing constraints, or 2. the magnitude of the investment-cash flow sensitivity does not depend on the strength of financing constraints only or, finally, 3. both statements are true. However, because we apply common splitting criteria, these conclusions call into question a relevant strand of the literature about the meaning of the relationship between sensitivity of investment to internal funds and financing constraints.

If 1. is true and 2. is false, the effort of researchers should be directed to find a valid criterion to identify the firms' financial status (see Angelini and Generale, 2005). However, as we have shown, financial indicators may be related to financing constraints. For example, Table 2 shows that dividend-non payer firms, which display a low investment-cash flow sensitivity, seem not to be financially distressed. Moreover, financial indicators do not exclude the possibility of some degree of financing constraints, and they show the highest market-to book ratio, the lowest level of investment and a negative cash flow. These characteristics might signal the difficulty of exploiting some profitable investment opportunities, possibly because of the lack of internal funds or the higher cost of external finance. Similar argument holds for the smallest group of firms - see columns B and C of Table 3.

Alternatively, if 1. is false and 2. is true, it is necessary to further investigate the sources of the investment-cash flow sensitivity. From this viewpoint, the non-monotonic behavior we find is partially consistent with theoretical models where financing constraints translate into quantitative credit constraints, rather than simply into higher costs of external finance (Almeida, 2000; Almeida and Campello, 2001) and it is also consistent with theoretical models where the relationship between the degree of financial constraints and the investment-cash flow sensitivity depends critically on whether the measures of financial constraints employed are more correlated with firm internal funds or capital market imperfections - Povel and Raith (2002) argue that this is possible because they measure different dimensions of financial constraints.

To shed further light on which of the two conclusions may be holding, tables from 9 to 11 report an analysis based on tests for difference in means across the sub-samples we have used in the previous analysis. This additional evidence may help in understanding whether financial indicators go in the same direction of that of the ordering criterion we have used to build our sub-samples. If one of the sorting criteria is related to financing constraints, we expect that all other indicators display a monotonic behavior - always increasing or decreasing.[3]

<please insert Table 9 here>

<please insert Table 10 here>

<please insert Table 11 here>

Table 9 shows results from this exercise when sub-samples are ordered by dividends. Notice that, while dividend payout ratios increase for both firm-year observations marked as A and B, this is not the case for some of the remaining indicators. For example, for

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[3] In these tables, the direction of the splitting criterion for both the observations we progressively remove (marked as A) and the sub-samples we are progressively left (marked as B) is of course the same.

firms marked as B, the level of cash holdings decreases for the classes from I to V and then increases for the remaining classes. The contrary holds for firms marked as A: the statistics increase first and decrease for classes from IV to IX, and so does the strength of rejection of the test. This suggests that dividends policy may not depend on financing constraints only, and that it may not be safe using it to classify samples of firms into constrained and unconstrained sub-samples. The same holds when firms are ordered by the joint criterion of cash and leverage (Table 11). For this criterion, even the size of firms is non-monotonic (see firm-year observations marked as B). Table 10 suggests instead that, as long as firm size increases, all financial indicators and rejection strengths show a monotonic behavior. This suggests that size is a safer sorting criterion, possibly because it is much less influenced by financial policies and managers' decisions than variables such as dividends, cash and leverage.

5 Concluding Remarks

In this paper the effectiveness of the investment-cash flow sensitivity criterion as a measure of financing constraints is empirically examined using a large sample of 1,195 UK non-financial firms over the period going from 1984 to 2002.

We study to which extent the monotonicity condition, according to which the estimated investment-cash flow sensitivity should always increase in the degree of financing constraints, is empirically relevant. To this aim, we order our sample of firms by increasing dividend payout ratios, increasing size and classes of increasing leverage and decreasing cash holdings, and we progressively remove the lowest classes from the sample we use to estimate empirical models, so that financing constraints should always go in the same direction - either increasing or decreasing - without making statements on whether financing constraints are decreasing or increasing through classes. Then, we compare the investment-cash flow sensitivities estimated across the residual samples, and we test the null hypothesis that these parameters do not statistically differ from the parameter estimated for the whole sample.

Our large sample evidence shows that the monotonicity condition is consistently empirically violated when a standard model of investment is used, regardless of the variable we use to order our sample. We find traces of an inverse "U-shaped" relationship between the sensitivity of investment to cash flow and the extent of financing constraints. Such results cast additional doubts on the common practice of splitting samples of firms according to a priori measures of financing constraints and taking the estimated investment-cash flow sensitivities as a measure of financing constraints faced by firms.

If anything, our results suggest that size seems to represent a good proxy for financing constraints. When more refined estimators are used, size is the only ordering criterion for which the investment cash-flow sensitivity displays a monotonic behavior. Moreover, all other financial indicators display a monotonic behavior with size - either always increase or decrease.

Conversely, financial variables such as dividend payout, leverage and cash stocks seem to be poor proxies of financing constraints. In our view, this happens because financial ratios are the result of a process where internal factors (firm characteristics, internal organization, and managers attitudes) and external influences (such as cost of external finance and access to the credit market) interact. It is plausible to hypothesize, for example, that managers respond in different ways to the presence of financing constraints, so that financial policies may or may not entirely depend on financing constraints: financing constraints may represent only *some* of the factors driving the investment-cash flow sensitivity. An alternative source may be the managers' behavior: the sensitivity of investment to cash flow may depend on a sort of excessive conservatism or non-optimizing behavior of managers (Hines and Thaler, 1995; Kaplan and Zingales, 2000). Studying the reasons behind the financial conservative policies may provide insights about the sources of such non-monotonicity, an issue that is left for future research (Minton and Wruck, 2001; Mikkelson and Partch, 2002; Iona, Leonida and Ozkan, 2004).

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Table 1

Summary Statistics for Total Sample (Averages 1984-2002)

Firms: 1,195. Firm year observations: 14,630. Time span: 1984-2002. Variables are normalized by total assets, except the market-to-book ratio. All variables are for the end of the fiscal year except for cash flow and investment, which represent firm cash flow and capital expenditures during period t.

Variables	Minimum	0.25	Median	Mean	0.75	Maximum
Size (log of Assets)	1.278	9.487	10.548	10.820	11.955	18.447
Market-to-book	0.188	0.999	1.305	1.629	1.804	9.894
Investment	0.000	0.032	0.059	0.082	0.102	1.160
Cash Flow	-2.000	0.050	0.092	0.069	0.133	2.000
Cash Holdings	0.000	0.015	0.061	0.110	0.148	0.997
Leverage	0.000	0.060	0.160	0.179	0.258	1.000
Short Term Debt	0.000	0.079	0.432	0.475	0.765	1.000
Long Term Debt	0.000	0.162	0.484	0.456	0.800	1.000
Dividends	-2.000	0.085	0.159	0.090	0.230	1.120
Retained Earnings	3.000	0.915	0.841	0.910	0.770	-0.120

Table 2

Correlations among Variables

Variables are normalized by total assets, except the market-to-book ratio. All variables are for the end of the fiscal year, except for cash flow and investment which represent firm cash flow and capital expenditures during period t. ** (*) stands for significance at 1% (5%) level.

	Cash Holdings	Leverage	Market-to-book	Cash Flow	Size (log of Assets)	Dividends	Long Term Debt	Short Term Debt	Investment
Cash Holdings	1.00								
Leverage	-0.30**	1.00							
Market-to-book	0.39**	-0.14**	1.00						
Cash Flow	-0.19**	-0.09**	-0.09**	1.00					
Size (log of Assets)	-0.16**	0.25**	-0.21**	0.24**	1.00				
Dividends	0.00	-0.01	0.00	0.04*	0.02	1.00			
Long Term Debt	-0.17**	0.38**	-0.17**	0.07**	0.38**	-0.01*	1.00		
Short Term Debt	-0.08**	-0.17**	-0.01*	-0.06**	-0.22**	0.00	-0.76**	1.00	
Investment	-0.09**	0.10**	0.06**	0.06**	0.01**	0.00**	0.13**	-0.12*	1.00

Table 3

Summary Statistics for Dividend Groups (Averages 1984-2002)

All variables are for the end of the fiscal year except for cash flow and investment, which represent firm cash flow and capital expenditures during period t. Column A and B report means and medians for the sample of dividend payers and non-payers respectively. Columns C to G report the means for classes of firms years observations for which dividend payout ratios are progressively increasing.

Variables	A (non-payers)		B (payers)		C	D	E	F	G
	Median	Mean	Median	Mean	Mean	Mean	Mean	Mean	Mean
Size (log of Assets)	9.417	9.607	10.822	11.116	9.630	10.823	11.118	11.421	11.106
Market-to-book	1.196	1.841	1.324	1.577	1.831	1.653	1.640	1.570	1.450
Investment	0.038	0.073	0.064	0.084	0.072	0.094	0.091	0.084	0.069
Cash Flow	-0.011	-0.092	0.103	0.108	-0.089	0.113	0.119	0.113	0.087
Cash Holdings	0.051	0.141	0.063	0.103	0.139	0.080	0.090	0.105	0.136
Leverage	0.189	0.230	0.155	0.166	0.231	0.189	0.166	0.161	0.146
Short Term Debt	0.576	0.547	0.405	0.457	0.368	0.481	0.511	0.493	0.428
Long Term Debt	0.300	0.367	0.516	0.478	0.547	0.478	0.444	0.444	0.460
Dividends	0.000	-0.450	0.183	0.222	-0.443	0.101	0.160	0.214	0.418
Retained Earnings	1.000	1.450	0.778	0.817	1.443	0.899	0.840	0.786	0.582
Firm-year obs.	2,878		11,752		2,926	2,926	2,926	2,926	2,926

Table 4

Summary Statistics per Total Sample and Classes of Size (Averages 1984-2002)

Column B to G report mean of variables for classes of increasing size. All variables are for the end of the fiscal year except for cash flow and investment, which represent firm cash flow and capital expenditures during period t.

Variables	Class of Size					
	A	B	C	D	E	F
	Less than £1,000	£1,000 - 5,000	£5,000 - 10,000	£10,000 - 250,000	£250,000 - 1,000,000	Over 1,000,000
Size (log of Assets)	6.293	7.957	8.882	9.682	10.769	13.116
Market-to-book	3.874	2.056	1.703	1.555	1.579	1.513
Investment	0.049	0.071	0.074	0.082	0.087	0.084
Cash Flow	-0.216	-0.013	0.043	0.077	0.085	0.087
Cash Holdings	0.221	0.163	0.134	0.106	0.100	0.097
Leverage	0.236	0.141	0.150	0.157	0.165	0.223
Short Term Debt	0.548	0.537	0.559	0.562	0.496	0.353
Long Term Debt	0.233	0.254	0.285	0.353	0.456	0.638
Dividends	-0.022	0.036	0.099	0.124	0.131	0.139
Retained Earnings	1.022	0.964	0.901	0.876	0.869	0.861
Firm-year obs.	146	1,237	1,433	2,983	4,220	4,611

Table 5

Summary Statistics for Classes of Cash Holdings and Leverage (Averages 1984-2002)

Columns A to E report mean of variables for classes of decreasing cash holdings and increasing leverage. Variables are normalized by total assets. All variables are for the end of the fiscal year except for cash flow and investment, which represent firm cash flow and capital expenditures during period t.

Variables	Classes of Cash Holdings and Leverage				
	A	B	C	D	E
	Cash Holdings ≥ 50% Leverage ≤ 10%	Cash Holdings ≥ 40% Leverage ≤ 20%	Cash Holdings ≥ 30% Leverage ≤ 30%	Cash Holdings ≥ 20% Leverage ≤ 40%	Cash Holdings ≥ 10% Leverage ≤ 50%
Size (log of Assets)	9.164	9.480	9.744	10.190	10.715
Market-to-book	3.092	2.814	2.559	2.306	1.978
Investment	0.043	0.051	0.061	0.067	0.073
Cash Flow	-0.046	0.006	0.043	0.065	0.078
Cash Holdings	0.665	0.565	0.470	0.366	0.246
Leverage	0.012	0.032	0.046	0.076	0.114
Short Term Debt	0.290	0.393	0.421	0.433	0.428
Long Term Debt	0.186	0.215	0.243	0.327	0.416
Dividends	-0.159	-0.002	0.070	0.102	0.130
Retained Earnings	1.159	1.002	0.930	0.898	0.870
Firm-year obs.	357	703	1,251	2,354	5,224

Table 6

Alternative Estimation Methods and Specifications for the Q Model

All variables are for the end of the fiscal year, except for cash flow and investment which represent firm cash flow and capital expenditures during period t. Capital expenditures divided by total assets is the dependent variable (I). Columns A and B report models estimated by using within groups estimator with time effects. Columns C and D report models estimated by using a pooled OLS estimator, using sector and time dummies. t statistics are reported in brackets; heteroschedasticity consistent t-statistics are reported in square brackets. *** (**) [*] stands for significance at the 1% (5%) [10%] level.

	A	B	C	D
Market-to-book	0.0057 (8.17)*** [4.61]***	0.0030 (3.80)*** [2.61]**	0.0062 (10.2)*** [6.13]***	0.0024 (2.89)*** [2.39]**
Market-to-book$_{t-1}$		0.0061 (7.82)*** [5.26]***		0.0053 (6.66)*** [5.27]***
Cash Flow/Total Assets	0.0138 (3.33)*** [2.17]**	0.0021 (0.53) [0.36]	0.0301 (7.59)*** [4.58]***	0.0116 (2.78)*** [1.95]*
Cash Flow/Total Assets$_{t-1}$		0.0346 (7.81)*** [5.24]***		0.0447 (9.85)*** [7.35]***
Time dummies significance	822.5***	627.8***	605.4***	489.4***
Sector dummies significance			6488***	5292***
Adjusted R^2	6.78%	7.15%	16.56%	17.55%

Figure 1
Construction of Sub-samples

Samples are build in such a way that dividend payout ratios and size are progressively increasing in going from Split I to Split X. The joint criterion of leverage and cash holding is such that laverage is increasing and cash holding is decreasing throughout classes.

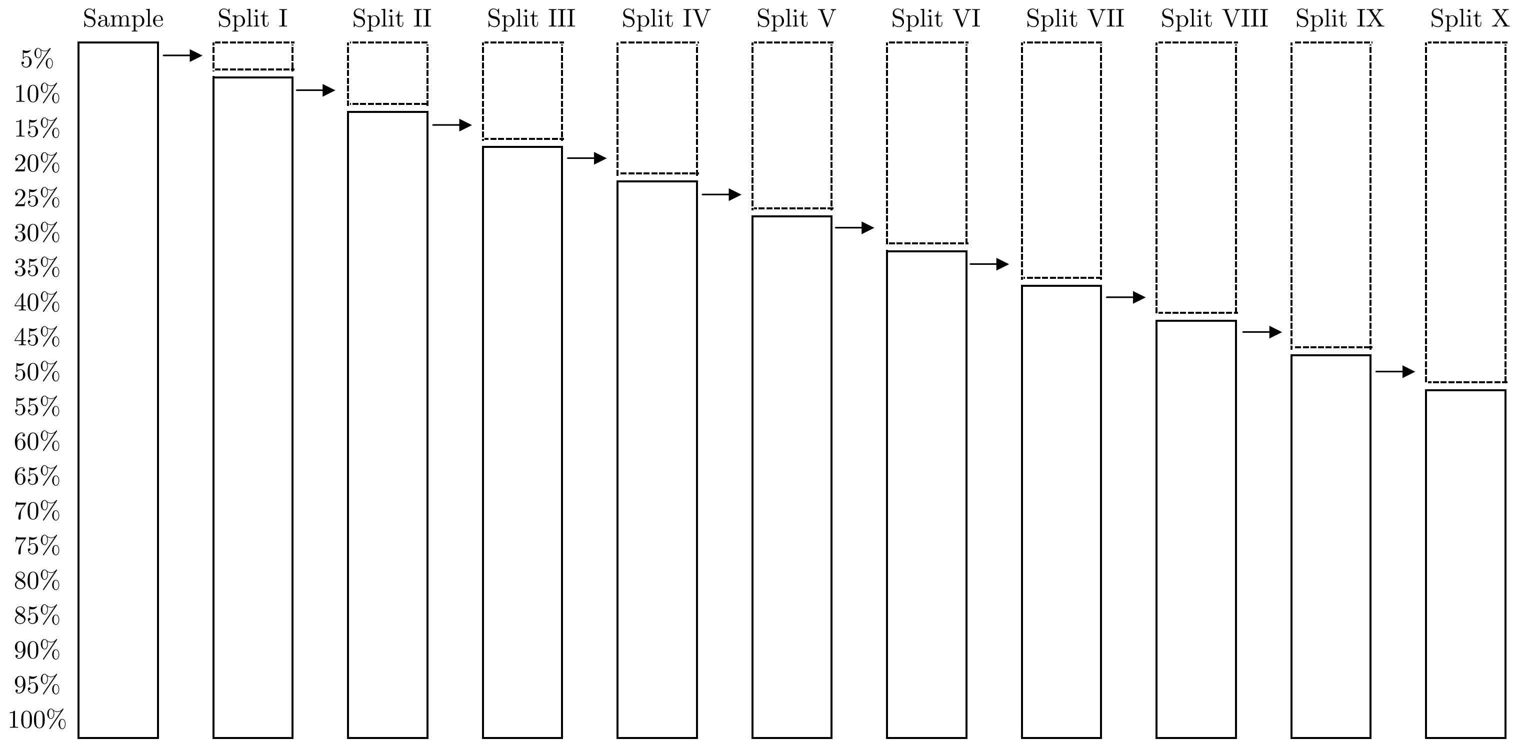


Table 7

Regression Results

All models are estimated using a *within groups* estimator. Panel A reports estimates for all firms and the group of firms with non-negative dividends. Panel B, C and D report the estimated coefficients for classes of dividends, size and leverage and cash holdings respectively, as shown in Fig I. Heteroschedasticity consistent t-statistics are reported in parentheses. *** (**) [*] stands for significance at the 1% (5%) [10%] level.

	Market-to-book	I-CF	Adj. R^2	# of obs.	# of firms
Panel A: All firms and dividends payer firms					
All Firms	0.0057 (4.61)***	0.0138 (2.17)***	6.78%	14630	1195
Payers	0.0087 (5.76)***	0.0250 (2.28)***	8.22%	11734	1092
Panel B: firms ordered by Dividends					
Class 1	0.0067 (5.51)***	0.0163 (2.11)**	7.15%	13765	1165
Class 2	0.0076 (5.71)***	0.0269 (3.49)***	7.89%	13026	1116
Class 3	0.0084 (6.22)***	0.0219 (3.66)***	8.15%	12300	1107
Class 4	0.0089 (5.88)***	0.0276 (1.75)*	8.12%	11570	1091
Class 5	0.0088 (8.74)***	0.0222 (1.86)*	7.86%	10835	1090
Class 6	0.0083 (5.56)***	0.0297 (1.69)*	7.54%	10103	1067
Class 7	0.0081 (5.05)***	0.0274 (1.70)*	7.33%	9376	1047
Class 8	0.0073 (4.26)***	0.0245 (1.88)*	6.48%	8641	998
Class 9	0.0069 (3.90)***	0.0159 (0.95)	5.87%	7917	976
Class 10	0.0060 (3.21)***	0.0095 (0.55)	5.47%	7160	954
Panel C: firms ordered by Size					
Class 1	0.0074 (6.68)***	0.0233 (3.11)***	7.50%	13888	1161
Class 2	0.0080 (6.79)***	0.0214 (2.50)**	7.77%	13163	1157
Class 3	0.0084 (6.79)***	0.0234 (2.68)***	8.39%	12423	1101
Class 4	0.0086 (6.42)***	0.0218 (2.23)**	8.56%	11686	1068
Class 5	0.0092 (6.33)***	0.0173 (1.79)*	8.65%	10944	1022
Class 6	0.0092 (5.76)***	0.0128 (1.66)*	8.52%	10215	971
Class 7	0.0093 (5.59)***	0.0073 (1.68)*	8.54%	9477	937
Class 8	0.0105 (6.03)***	0.0113 (0.64)	9.14%	8737	860
Class 9	0.0107 (5.98)***	0.0089 (0.59)	9.08%	8002	802
Class 10	0.0102 (5.74)***	0.0054 (0.34)	8.98%	7273	723
Panel D: firms ordered by Leverage and Cash holdings					
Class 1	0.0075 (6.45)***	0.0151 (2.29)**	7.29%	14237	1191
Class 2	0.0078 (6.61)***	0.0154 (2.32)**	7.54%	14270	1188
Class 3	0.0082 (6.42)***	0.0171 (2.44)**	7.68%	13921	1181
Class 4	0.0091 (7.01)***	0.0230 (3.28)***	7.94%	13379	1162
Class 5	0.0099 (6.80)***	0.0276 (3.56)***	8.07%	12278	1141
Class 6	0.0105 (5.79)***	0.0341 (3.92)***	8.51%	9409	1065
Class 7	0.0103 (3.94)***	0.0289 (2.69)***	8.57%	4731	713
Class 8	0.0065 (1.88)*	0.0224 (1.70)*	8.20%	3007	513

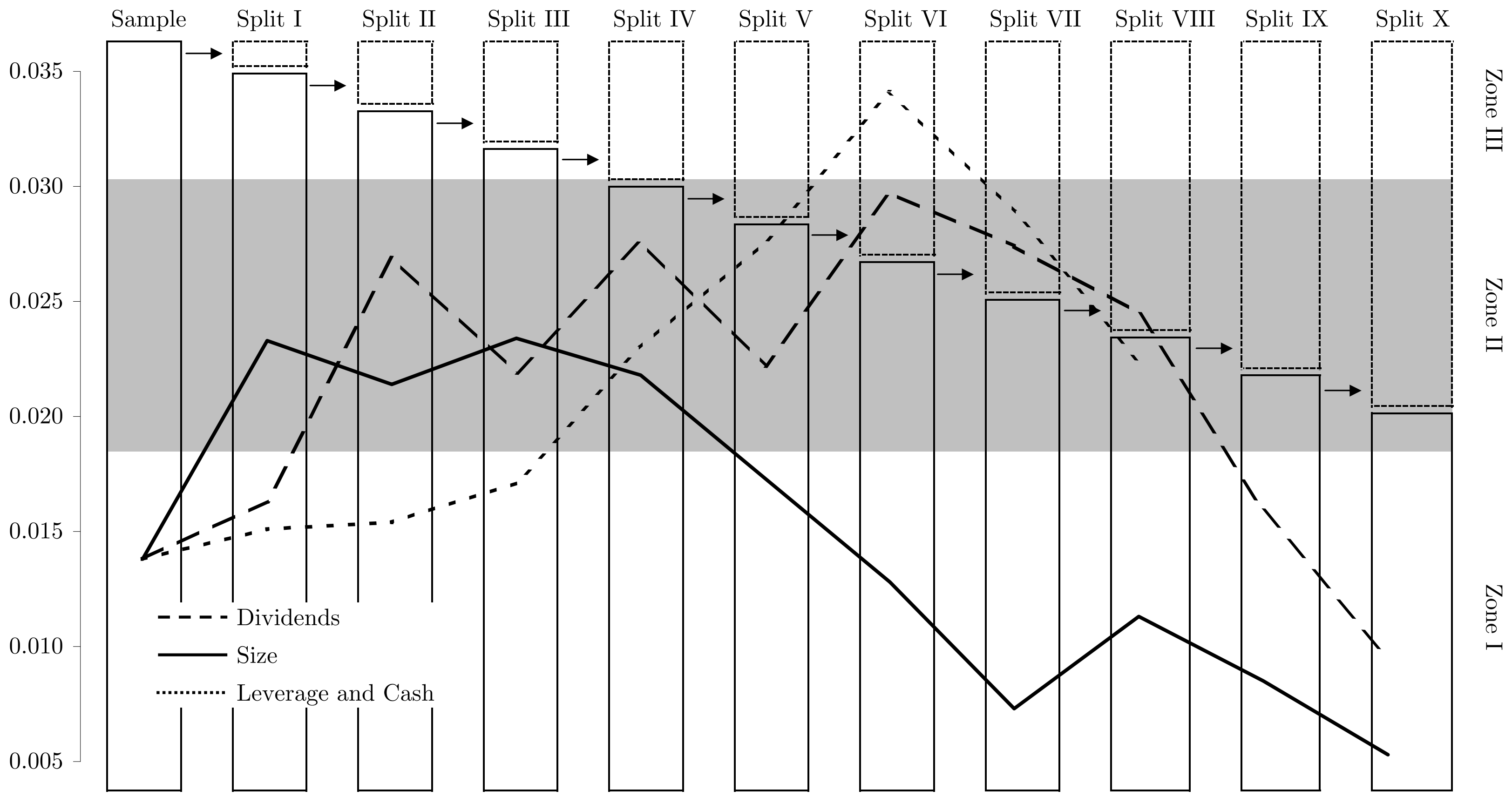
Table 8
Testing Procedure for Equality of Slopes

Column A reports the levelof the criteria we use to order the sub-samples. Column B reports the estimates of the investment-cash flow sensitivities across classes of firms ordered by alternative criteria. Column C reports results from our testing procedure. The null hypothesis is that the investment-cash flow sensitivity estimated for all sample equals the same parameter estimated for each class of firms. In column D the null hypothesis is that the investment-cash flow sensitivity estimated for the first class rejecting the null in column C equals the same parameter estimated for each class of firms. *** (**) [*] means that the null hypothesis is rejected at 1% (5%) [10%] significance level.

Ordering Criteria	A		B	C	D
Classes of Dividends	Dividends		I-CF	All Firms 0.0137	Class 2 0.0269
All Firms	0.090		0.0137	---------	6.66 (0.00)***
Class 1	0.188		0.0163	0.36 (0.64)	4.29 (0.03)**
Class 2	0.198		0.0269	10.02 (0.00)***	---------
Class 3	0.210		0.0219	3.83 (0.05)**	0.95 (0.32)
Class 4	0.223		0.0276	11.12 (0.00)***	0.02 (0.89)
Class 5	0.234		0.0222	4.12 (0.04)**	0.84 (0.35)
Class 6	0.243		0.0297	14.76 (0.00)***	0.30 (0.58)
Class 7	0.253		0.0274	10.80 (0.00)***	0.00 (0.92)
Class 8	0.263		0.0245	6.68 (0.00)***	0.22 (0.63)
Class 9	0.274		0.0159	0.26 (0.61)	4.62 (0.03)**
Class 10	0.286		0.0095	1.07 (0.30)	11.57 (0.00)***
Classes of Size	Size		I-CF	All Firms 0.0137	Class 1 0.0233
All Firms	10.82		0.0137	---------	3.45 (0.06)*
Class 1	11.00		0.0233	5.27 (0.02)**	---------
Class 2	11.15		0.0214	3.37 (0.06)*	0.14 (0.70)
Class 3	11.29		0.0234	5.38 (0.02)**	0.00 (0.99)
Class 4	11.43		0.0218	3.74 (0.05)*	0.09 (0.76)
Class 5	11.57		0.0173	0.72 (0.39)	1.36 (0.24)
Class 6	11.71		0.0128	0.06 (0.81)	4.12 (0.04)**
Class 7	11.86		0.0073	2.45 (0.12)	9.53 (0.00)***
Class 8	12.01		0.0113	0.37 (0.55)	5.38 (0.02)**
Class 9	12.17		0.0089	1.40 (0.24)	7.73 (0.00)***
Class 10	12.34		0.0054	4.11 (0.04)**	11.92 (0.00)***
Classes of Leverage and Cash holdings	Lev.	Cash	I-CF	All Firms 0.0137	Class 4 0.0230
All Firms	0.179	0.110	0.0137	---------	4.83 (0.02)***
Class 1	0.182	0.099	0.0151	0.10 (0.75)	3.81 (0.05)**
Class 2	0.183	0.096	0.0154	0.15 (0.69)	2.56 (0.10)*
Class 3	0.186	0.087	0.0171	0.64 (0.42)	1.55 (0.21)
Class 4	0.191	0.076	0.0230	4.94 (0.02)**	---------
Class 5	0.198	0.061	0.0276	11.12 (0.00)***	0.92 (0.33)
Class 6	0.214	0.035	0.0341	24.05 (0.00)***	5.39 (0.02)**
Class 7	0.239	0.011	0.0289	13.31 (0.00)***	1.52 (0.22)
Class 8	0.247	0.006	0.0224	4.32 (0.04)**	1.87 (0.19)

Figure 2

The Non-monotonicity Behavior of the Investment-Cash Flow Sensitivity: Basic Models

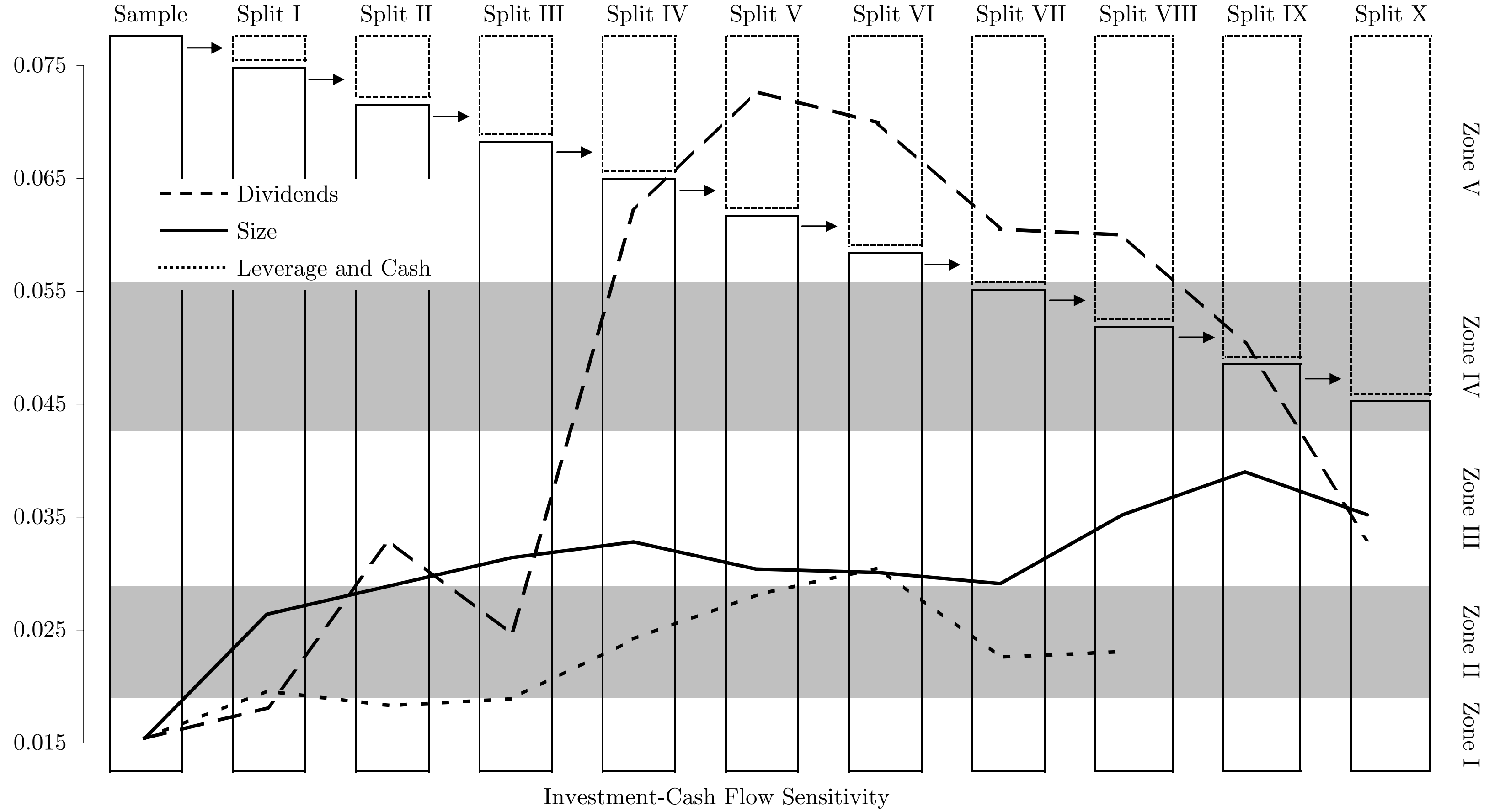


Investment-Cash Flow Sensitivity

- - -	0.0138	0.0163	0.0269	0.0219	0.0276	0.0222	0.0297	0.0274	0.0245	0.0159	0.0095
—	0.0138	0.0233	0.0214	0.0234	0.0218	0.0173	0.0128	0.0073	0.0113	0.0085	0.0053
⋯	0.0138	0.0151	0.0154	0.0171	0.0230	0.0276	0.0341	0.0289	0.0224		

Figure 3

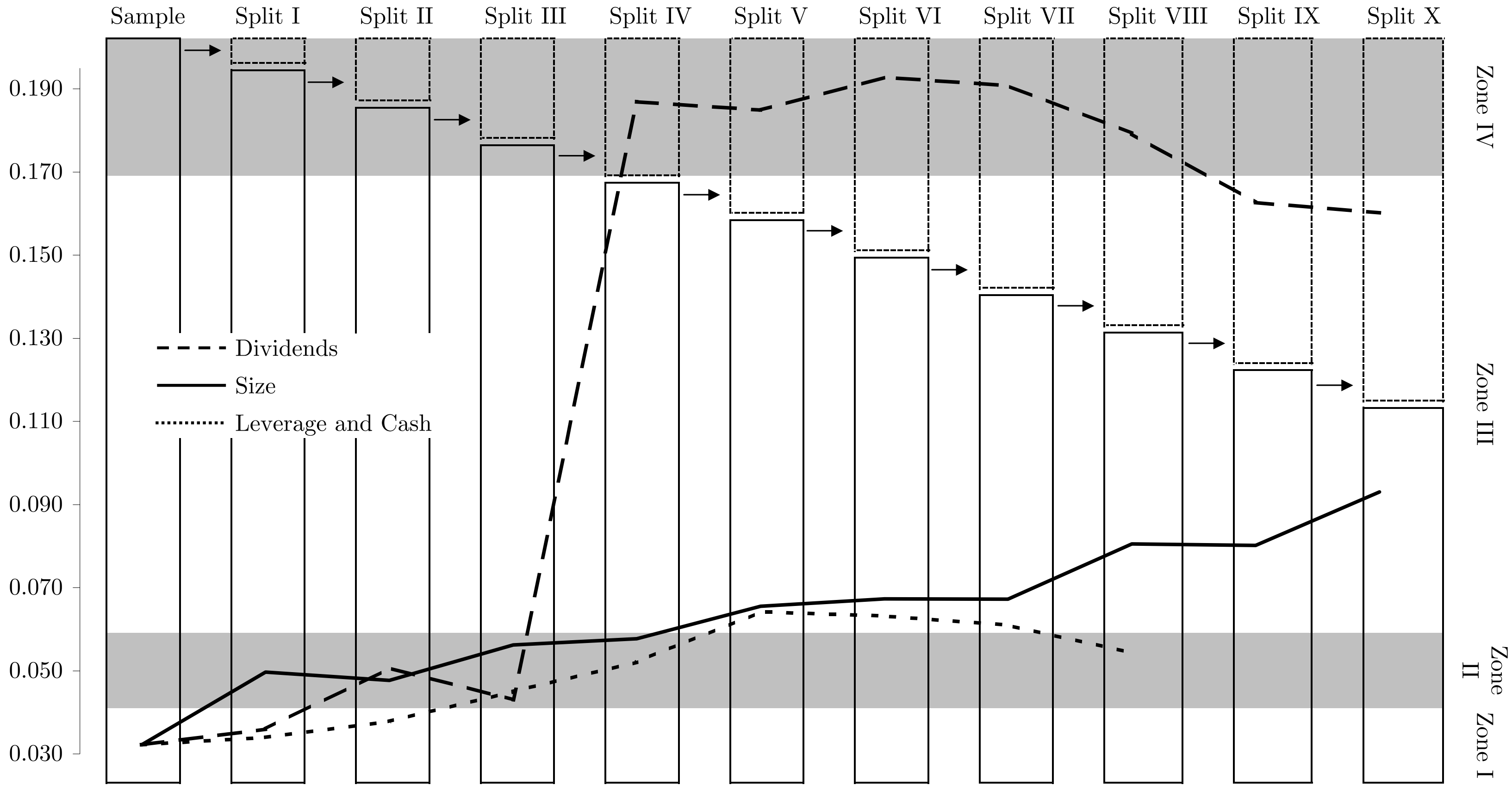
The Non-monotonicity Behavior of the Investment-Cash Flow Sensitivity: Augmented Models



– –	0.0154	0.0181	0.0329	0.0246	0.0621	0.0727	0.0699	0.0605	0.0600	0.0504	0.0330
—	0.0154	0.0264	0.0289	0.0314	0.0328	0.0304	0.0301	0.0291	0.0352	0.0390	0.0352
⋯⋯	0.0154	0.0196	0.0183	0.0189	0.0242	0.0281	0.0305	0.0226	0.0231		

Figure 4

The Non-monotonicity Behavior of the Investment-Cash Flow Sensitivity: Pooled OLS results

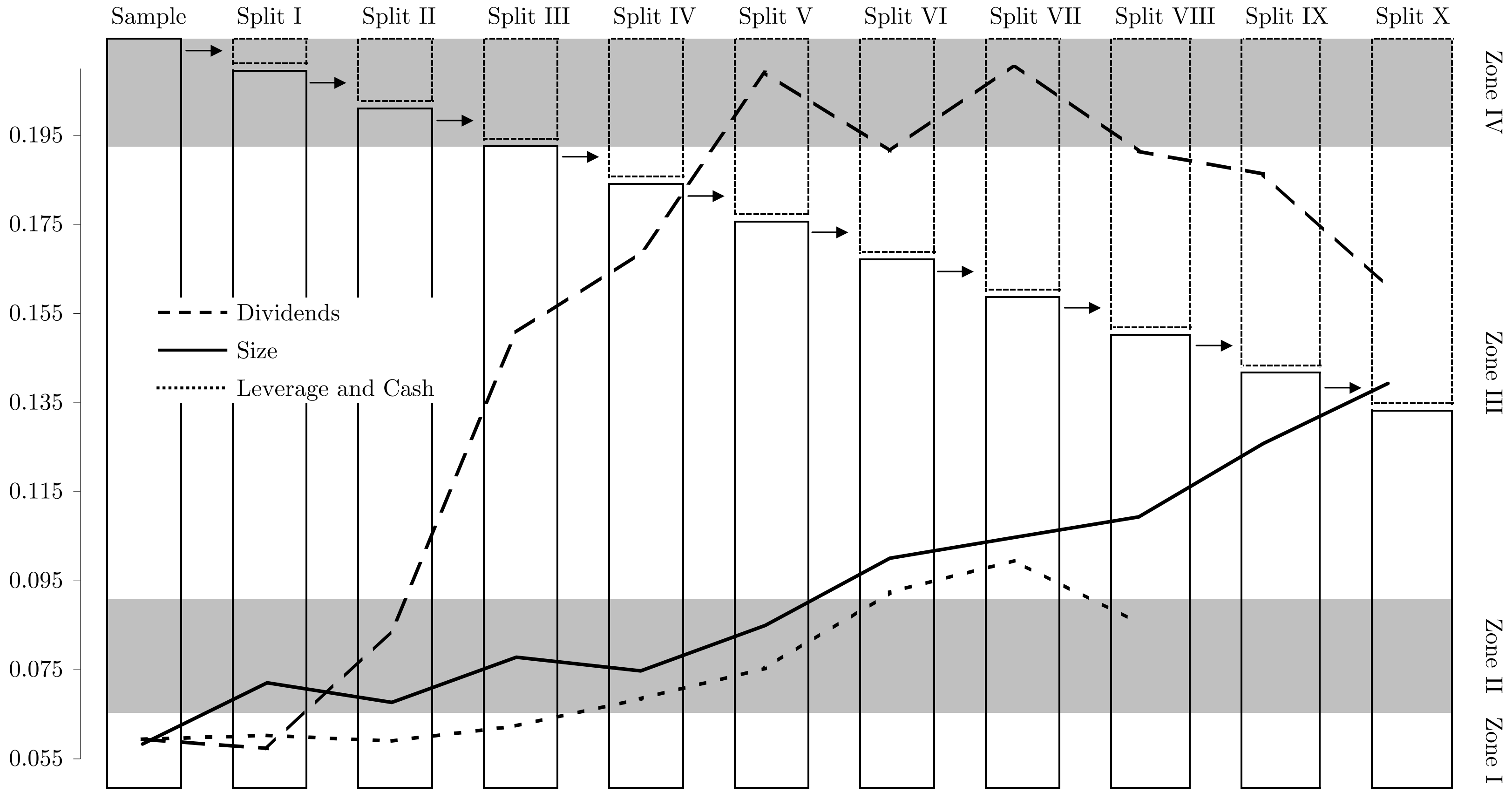


Investment-Cash Flow Sensitivity

- - -	0.0322	0.0360	0.0507	0.0430	0.1869	0.1849	0.1928	0.1908	0.1793	0.1627	0.1602
—	0.0322	0.0497	0.0477	0.0562	0.0577	0.0655	0.0673	0.0672	0.0805	0.0802	0.0930
⋯⋯	0.0322	0.0340	0.0378	0.0450	0.0521	0.0642	0.0632	0.0610	0.0543		

Figure 5

The Non-monotonicity Behavior of the Investment-Cash Flow Sensitivity: Fama and French Approach



Investment-Cash Flow Sensitivity

– –	0.059	0.057	0.084	0.151	0.169	0.209	0.192	0.211	0.191	0.186	0.161
—	0.058	0.072	0.068	0.078	0.075	0.085	0.100	0.105	0.109	0.126	0.139
⋯	0.059	0.060	0.059	0.062	0.068	0.075	0.092	0.100	0.085		

Table 9

Test for Difference in Means for Samples Ordered by Dividends

Financial indicators relating to the sub-samples of firms which are progressively removed are marked as A; financial variables relating to the sub-samples we are progressively left are marked ad B. ** (*) stand for rejection of the null hypothesis of equality of means at the 1% (5%) level.

Variables			Sub-samples								
			I	II	III	IV	V	VI	VII	VIII	IX
Cash Holdings	Group	A	0.108	0.113	0.132	0.140	0.127	0.119	0.114	0.110	0.107
	Means	B	0.110	0.110	0.106	0.103	0.105	0.106	0.108	0.110	0.113
	t-value		-0.4	0.8	7.8**	12.7**	8.1**	5.0**	2.4*	0.0	-2.7**
Leverage	Group	A	0.212	0.244	0.236	0.231	0.229	0.223	0.215	0.210	0.206
	Means	B	0.177	0.172	0.169	0.166	0.162	0.160	0.159	0.158	0.157
	t-value		6.1**	17.4**	19.6**	21.3**	23.9**	23.3**	21.8**	20.8**	20.2**
Market-to-book	Group	A	1.415	1.636	1.822	1.832	1.802	1.777	1.765	1.743	1.727
	Means	B	1.640	1.628	1.595	1.578	1.571	1.565	1.556	1.553	1.549
	t-value		5.0**	0.2	8.3**	10.4**	10.2**	9.9**	10.2**	9.5**	9.1**
Cash Flow	Group	A	-0.040	-0.066	-0.083	-0.090	-0.051	-0.024	-0.003	0.012	0.023
	Means	B	0.074	0.084	0.095	0.108	0.108	0.108	0.107	0.107	0.106
	t-value		-18.1**	-33.5**	-49.5**	-64.9**	-54.7**	-46.8**	-39.9**	-34.9**	-30.5**
Size	Group	A	9.699	9.581	9.537	9.624	9.834	10.003	10.136	10.225	10.321
	Means	B	10.879	10.957	11.046	11.118	11.148	11.169	11.187	11.215	11.227
	t-value		-16.1**	-26.3**	-34.9**	-39.1**	-37.0**	-34.6**	-32.3**	-31.2**	-28.9**
Dividends	Group	A	-1.775	-0.888	-0.592	-0.444	-0.343	-0.270	-0.215	-0.171	-0.137
	Means	B	0.188	0.198	0.210	0.223	0.234	0.244	0.253	0.264	0.275
	t-value		-14.8**	-11.2**	-9.8**	-9.2**	-8.6**	-8.1**	-7.7**	-7.3**	-7.0**
Capital Expend.	Group	A	0.081	0.078	0.077	0.072	0.076	0.079	0.081	0.083	0.085
	Means	B	0.082	0.083	0.083	0.085	0.084	0.083	0.083	0.082	0.080
	t-value		-0.3	-2.2*	-3.2**	-7.0**	-4.7**	-2.7**	-1.0	0.9	3.2**
# Obs.	Removed	A	731	1462	2193	2924	3655	4386	5117	5848	6579
	Others	B	13907	13176	12445	11714	10983	10252	9521	8790	8059

Table 10
Test for Difference in Means for Samples Ordered by Size

Financial indicators relating to the sub-samples of firms which are progressively removed are marked as A; financial variables relating to the sub-samples we are progressively left are marked ad B. ** (*) stand for rejection of the null hypothesis of equality of means at the 1% (5%) level.

Variables			Sub-samples								
			I	II	III	IV	V	VI	VII	VIII	IX
Cash Holdings	Group	A	0.345	0.313	0.299	0.282	0.266	0.253	0.240	0.232	0.223
	Means	B	0.171	0.165	0.158	0.154	0.150	0.148	0.147	0.144	0.143
	t-value		12.0**	14.1**	15.9**	16.3**	15.9**	15.2**	14.0**	13.7**	12.6**
Leverage	Group	A	0.410	0.399	0.385	0.367	0.349	0.334	0.322	0.310	0.304
	Means	B	0.196	0.185	0.175	0.167	0.160	0.153	0.145	0.138	0.128
	t-value		14.0**	19.4**	22.7**	24.4**	24.9**	25.3**	25.7**	25.9**	26.8**
Market-to-book	Group	A	2.602	2.229	2.052	1.961	1.888	1.827	1.780	1.755	1.728
	Means	B	1.578	1.562	1.554	1.546	1.543	1.544	1.547	1.545	1.547
	t-value		23.1**	20.7**	18.3**	17.1**	15.3**	13.3**	11.3**	10.5**	9.2**
Cash Flow	Group	A	-0.079	-0.030	-0.004	0.007	0.020	0.030	0.036	0.042	0.046
	Means	B	0.076	0.080	0.081	0.084	0.085	0.085	0.086	0.086	0.087
	t-value		-24.8**	-24.2**	-22.4**	-22.6**	-20.6**	-18.6**	-17.2**	-15.6**	-14.6**
Size	Group	A	7.332	7.822	8.132	8.374	8.574	8.744	8.898	9.040	9.172
	Means	B	11.004	11.153	11.294	11.431	11.568	11.708	11.853	12.005	12.165
	t-value		54.7**	72.6**	86.5**	98.1**	108.5**	118.5**	127.8**	136.5**	144.7**
Dividends	Group	A	-0.029	0.023	0.052	0.068	0.078	0.089	0.092	0.096	0.101
	Means	B	0.096	0.097	0.097	0.096	0.094	0.091	0.089	0.086	0.081
	t-value		-0.9	-0.8	-0.5	-0.4	-0.2	0.0	0.0	0.2	0.4
Capital Expend.	Group	A	0.064	0.069	0.071	0.072	0.073	0.076	0.076	0.077	0.077
	Means	B	0.086	0.084	0.084	0.085	0.085	0.085	0.085	0.086	0.086
	t-value		-5.8**	-6.4**	-6.7**	-7.5**	-7.3**	-6.0**	-6.1**	-6.4**	-6.3**
# Obs.	removed	A	731	1462	2193	2924	3655	4386	5117	5848	6579
	others	B	13907	13176	12445	11714	10983	10252	9521	8790	8059

Table 11

Test for Difference in Means for Samples Ordered by Leverage and Cash Holdings

Financial indicators relating to the sub-samples of firms which are progressively removed are marked as A; financial variables relating to the sub-samples we are progressively left are marked ad B. ** (*) stand for rejection of the null hypothesis of equality of means at the 1% (5%) level.

Variables			Sub-samples							
			I	II	III	IV	V	VI	VII	VIII
Cash Holdings	Group	A	0.703	0.665	0.565	0.470	0.366	0.246	0.158	0.139
	Means	B	0.099	0.096	0.087	0.077	0.061	0.035	0.011	0.007
	t-value		83.6**	96.1**	127.1**	150.6**	157.7**	123.8**	67.5**	50.4**
Leverage	Group	A	0.006	0.012	0.032	0.046	0.076	0.114	0.150	0.159
	Means	B	0.182	0.183	0.186	0.191	0.199	0.215	0.239	0.250
	t-value		-19.06**	-21.5**	-27.2**	-33.8**	-37.9**	-40.8**	-34.8**	-30.8**
Market-to-book	Group	A	3.203	3.092	2.814	2.559	2.306	1.978	1.751	1.701
	Means	B	1.600	1.592	1.569	1.542	1.499	1.435	1.373	1.368
	t-value		22.1**	24.1**	27.9**	29.9**	31.3**	27.2**	18.3**	14.1**
Cash Flow	Group	A	-0.061	-0.047	0.006	0.043	0.065	0.078	0.079	0.077
	Means	B	0.071	0.072	0.072	0.071	0.069	0.063	0.048	0.039
	t-value		-12.7**	-13.2**	-10.2**	-5.7**	-1.0	5.3**	10.5**	11.1**
Size	Group	A	9.055	9.164	9.480	9.745	10.190	10.715	11.031	11.020
	Means	B	10.852	10.862	10.888	10.921	10.941	10.879	10.379	10.096
	t-value		-15.0**	-16.5**	-18.9**	-20.8**	-17.4**	-4.9**	19.3**	24.2**
Dividends	Group	A	-0.261	-0.159	-0.002	0.070	0.103	0.130	0.131	0.098
	Means	B	0.096	0.096	0.095	0.092	0.088	0.068	0.005	0.062
	t-value		-1.86*	-1.3	-0.7	-0.2	0.2	1.0	2.0*	0.5
Capital Expend.	Group	A	0.038	0.043	0.051	0.061	0.067	0.073	0.081	0.082
	Means	B	0.083	0.083	0.084	0.084	0.085	0.087	0.085	0.083
	t-value		-8.7**	-9.0**	-10.0**	-9.5**	-9.6**	-9.5**	-2.8**	-0.3
# Obs.	removed	A	263	357	703	1251	2354	5224	9903	11475
	others	B	14375	14281	13935	13387	12284	9414	4735	3163