CASH HOLDING POLICY AND ABILITY TO INVEST: HOW DO FIRMS DETERMINE THEIR CAPITAL EXPENDITURES? NEW EVIDENCE FROM THE UK MARKET

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ABSTRACT

The aim of this paper is to investigate how cash-holding policy influences the firms' ability to invest of a large sample of UK non-financial listed firms over the period 1989-2002. The first step of our study estimates firms' optimal cash holdings, by emphasizing those firm-specific characteristics that may be relevant in determining the capacity for external finance in the presence of transaction costs, agency conflicts and asymmetric information problems. Second, we identify those firms that are persistently below (PLC) and above (PHC) their estimated target cash reserves and we investigate whether these firms have different ability to invest. Our findings show that those firms displaying a persistently low cash policy invest less in capital expenditures and do not rely on liquid assets to finance their investments. Further investigations tend to support the interpretation that PLC companies prefer to use cash flow to increase their cash reserves rather than investing it in capital expenditures, in an attempt to get closer to their target cash. They also provide more evidence that these firms generally tend to keep the hoarded cash and spend it, at most, in intangible assets. On the other hand, the results report that being a cash-rich firm has no significant impact on capital expenditures. Nonetheless, a persistently high cash policy seems to reinforce the investment sensitivity to cash flow. Further investigations seem to suggest that this is not caused by managerial entrenchment problems. Instead, the positive investment cash flow sensitivity of PHC firms occurs because positive excess of cash serves goals other than increasing the amount of fixed assets, such as investing in high growth projects and increasing the dividend payouts.

JEL Classification: G31, G32

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1. Introduction

To the extent that the Modigliani and Miller (1958) proposition on the irrelevance of financial factors to firm value holds, firms' investment decisions are independent of financial decisions. Under the assumption of perfect capital markets, in fact, external funds provide a perfect substitute for internal capital. Firms can obtain from investors the necessary capital to implement profitable investments opportunities without paying an extra premium. Their responses to changes in the cost of capital or tax-based investment incentives differ only because of differences in investment demand (Fazzari *et al*., 1988). In other words, firms decide how much to invest on the basis of their growth opportunities only regardless of the sources of capital. This implies an insignificant relationship between investment expenditures and internal funds.

Under the assumption of imperfect capital markets, on the contrary, internal and external funds are no longer substitutes. The difference between them is generally interpreted as the result of a premium on external finance arising from contracting and asymmetric information problems between insiders and outside investors. As modelled by Jaffee and Russell (1976) and Stiglitz and Weiss (1981) for the debt market, and by Greenwald et al. (1984), Myers (1984) and Myers and Majluf (1984) for the equity market, investors do not have as much information about a company as its managers. Even if managers act in the shareholders' interests, for investors it is very costly, and in some cases even impossible, to assess firm quality. The cost of capital, therefore, increases with agency and asymmetric information problems, and, as a result, firms needing external resources to invest will pass up some projects with positive NPV (*debt or equity rationing*). In such conditions, investment ability is hampered because firms are forced to base their expenditures not only on the quality of growth opportunities, but also on the availability of internal capital. According to this view, the greater the capital markets imperfections, the stronger the sensitivity of investment to internal resources.

Since the seminal work by Fazzari et al. (1988), the empirical literature has identified different classes of firms that are more (or less) likely to face higher costs of capital in the attempt to document how investment cash flow sensitivities change as the costs of external finance raise (see, e.g., Devereux and Schiantarelli, 1990; and Bond and

Meghir, 1994, for the UK; Hoshi et al., 1991, for Japan; Chirinko and Schaller, 1995, for Canada; Elston, 1998, for Germany).

The investment model supporting these empirical studies predicts that, for firms with high agency and asymmetric information problems, changes in net worth affect investment. Most previous research used a firm's cash flow as a proxy for the change in net worth. Although cash flow is recognized to be an imperfect proxy for net worth, it should make it possible to identify shifts in net worth that are not correlated with changes in investment opportunities. Therefore, a significantly positive value of the estimated coefficient of cash flow would correspond to the suggestion that financing constraints are present (see Hubbard, 1998).

However, since Kaplan and Zingales' (1997) paper, an ongoing debate has raised doubts about and criticism of the validity of this approach, arguing that investment-cash flow sensitivity may be higher for firms that do not face greater costs of external funds (e.g., Cleary, 1999; Kaplan and Zingales, 2000).

Very recently, Almeida et al. (2004) proposed a new perspective in their analysis of the cash flow sensitivity of cash holding. They emphasize the link between firms' demand for liquidity and financial constraints, and suggest that this may help to identify whether financial constraints are an important determinant of firm behaviour. In line with Keynes's (1936) explanations, they argue that liquid assets, in particular cash holding, may be an instrument that enables firms to secure their ability to invest in imperfect capital markets. This argument implies that the cash holdings of firms are determined by their capacity to raise external finance. Hoarding cash may curtail, in fact, the transaction costs of accessing outside markets, while providing a buffer in case of cash flow shortfalls, and shielding against agency costs of debt (asset substitution and underinvestment).

Therefore, to consider cash flow alone as a proxy for internal funds, as the earlier literature does, may involve a partial representation of firms' behaviour in imperfect capital markets. As Almeida et al. (2004) argue, in a dynamic framework, where firms have both present and future investment opportunities, and in which cash flows from assets in place may not be sufficient to fund all positive NPV projects, corporate demand for liquid assets

would ensure the firm's ability to invest. In other words, depending on the firm's capacity for external finance, hoarding cash may facilitate future investments.

We take these motivations as our starting point, and we aim to investigate how cash holding policy influences firms' investment decisions, in order to evaluate more thoroughly the importance of financial constraints.

The first step of our study estimates firms' optimal cash holdings, by emphasizing those firm-specific characteristics that may be relevant in determining the capacity for external finance in the presence of transaction costs, agency conflicts and asymmetric information problems. The lower the capacity of a firm to raise external funds, the larger its cash holdings are expected to be. This would, in turn, facilitate the firm's ability to invest.

The second step in our analysis investigates whether firms have indeed this ability. That is, we measure the ability by checking firms' liquidity position relative to their target cash. We argue that, if the motivations given above hold, firms that persistently deviate from their target cash holdings in a certain way should exhibit different investment behaviours. More specifically, we identify two groups of firms that deviate from their target cash holdings. Low cash firms are those that are persistently below their estimated target cash reserves (*undershooting*). They are considered less able to invest because, if the desired cash holdings are determined by the firms' capacity to raise external finance, and firms hold less than the desired amount, then their ability to invest will be hampered. Their investment expenditures are therefore predicted to be lower in level and more sensitive to cash flows than those of their counterparts.

High cash firms, on the other hand, have cash holdings persistently higher than their estimated target (*overshooting*). Given the argument above, they are expected to be more able to invest. By holding larger amounts of cash firms may reduce, in fact, some of the costs associated with external funds, and invest in valuable projects whenever they arise. We predict that the investments of such firms will be higher in level and less sensitive or insensitive to cash flows.

Our contributions to the literature lie on several grounds. Our work is an original attempt to systematically analyse the effects of cash holding policies on the investment decisions of firms. In the investment literature, to the best of our knowledge, only Fazzari et

al. (1988), Devereux and Schiantarelli (1990) and Kadapakkam et al. (1998) include liquidity stock variables in their investment models. They find in general a positive and significant impact of cash stock on capital expenditures for sub-samples of firms that are *a priori* assumed, on the basis of selected observable characteristics, to have less access to external capital markets. Their main objective, however, is to analyse how investment-cash flow sensitivity changes across these sub-samples. The *a priori* classification of firms in different financial *regimes* is analytically and empirically convenient (Hubbard, 1998). Nonetheless, it does not take into account a firm's ability to change its regime depending on the availability of internal funds. Consequently, the focus of our paper concerns investment and cash holding policies jointly: firms may accumulate liquidity, according to their capacity for external funds, in an attempt to improve their ability to invest. Therefore, we examine empirically the impact of distinct cash holding *status* on investment cash flow sensitivity.

Another strand of the literature provides some evidence of how large amounts of cash stock are spent by companies. In particular, Opler et al. (1999) show that firms with large cash reserves, at a particular point in time, tend to keep the liquidity instead of investing it in capital expenditures. This reflects a precautionary financial policy. In contrast, both the event study by Blanchard et al. (1994), on the uses of cash windfalls, and Harford's (1999) work on acquisition attempts by cash-rich firms, support the agency view of managerial behaviour, in which managers seek to maximize their own profits when considerable amounts of liquid assets are available in the firm. However, when persistent rather than transitory large cash holdings are examined, there is no evidence of such adverse incentives for cash-rich firms (Mikkelson and Partch, 2003).

It should be noted that these studies generally focus on high cash firms. However, we believe that it is important to provide a more comprehensive analysis of both low and high cash firms, because different firms' cash holding policies may have distinct effects on their investment patterns. Furthermore, in order to avoid our results being affected by temporary or exceptional lack or abundance of liquid assets, we explore the behaviour of those firms over time in order to capture the persistency of cash holding policies, in line with Mikkelson and Partch's (2003) argument.

Moreover, in estimating the target cash holding, we take into account two important issues that may affect the target computation: the endogeneity among variables, and the evolution of the target over time. On the one hand, endogeneity may arise for various reasons, such as shocks that affect both cash and the determinants of cash, cross-causality and, to a certain extent, the presence of unobservable firm-specific characteristics. On the other hand, a time-variant target is viewed as a more appropriate representation of the behaviour of firms that revise their targets year by year, depending on changes either in macro or industry conditions or within the firm itself. In order to mitigate these two problems, we adopt two techniques: cross-sections average (CSA) and Generalized Methods of Moments (GMM). GMM methodology has the advantage of being able to deal with potential endogeneity and individual heterogeneity problems simultaneously, but it does not allow us to compute time-variant adjustment factors, because it would provide fixed coefficients over the entire estimation period. The alternative technique, CSA, would enable us to deal with the time-variant target issue and, to a certain extent, also with endogeneity problems, as Rajan and Zingales (1995) argue. We therefore refer to the results of both CSA and GMM, requiring them to be concordant, in an attempt to compute more accurate target cash figure for each company each year.

We conducted an analysis of a large sample of UK non-financial listed firms over the period 1989-2002. We hand-collected detailed information on ownership by directors and external shareholders, and board composition, on an annual basis for a sample of 1100 UK non-financial listed firms. Economic and market variables are from Datastream. Thanks to the availability of these data sets, we are able to estimate the influence of ownership characteristics both in the target cash and investment models in a panel data framework, which represents our work's other original contribution to the literature. In addition, our study may shed more light on the relation between cash holding policy and investment expenditures in the UK market. To the best of our knowledge, Ozkan and Ozkan (2004) is the only study providing evidence on the determinants of cash holdings for UK companies, while Dittmar et al. (2003) and Kalcheva and Lins (2004) conduct a similar investigation using a cross-country analysis. On the other hand, Devereux and Schiantarelli (1990) and Kadapakkam et al. (1998) include cash stock variables in their investment models for

the UK, but their main aim is to analyse investment-cash flow sensitivity as a proxy for financial constraints. In addition, they do not take into account the ownership effect.

Our findings show that those firms displaying a persistently low cash policy invest less in capital expenditures. In addition, these companies do not rely on liquid assets to finance their investments, and this is reflected in their decreasing investment cash flow sensitivity. Robustness checks tend to support the interpretation that PLC firms prefer to use cash flow to increase their cash holdings rather than investing it in capital expenditures, in an attempt to get closer to their target cash. They also provide more evidence that these companies generally tend to keep the hoarded cash and spend it, at most, in intangible assets.

On the other hand, the results report that being a cash-rich firm has no significant impact on capital expenditures. Nonetheless, a persistently high cash policy seems to reinforce the investment sensitivity to cash flow. Further investigations seem to suggest that this is not caused by managerial entrenchment problems. Instead, the positive investment cash flow sensitivity of PHC firms occurs because positive excess of cash serves goals other than increasing the amount of fixed assets. We find that accumulated cash may allow firms to invest in high growth projects, and also help them to build a positive reputation with external investors through larger dividend payouts.

The rest of the work is organized as follows. In the next section we develop the main hypotheses tested in the target cash and investment models. In Section 3 we present the methodology adopted in our work. Section 4 is dedicated to the presentation of data. Section 5 reports the summary statistics and regressions results. Section 6 includes robustness checks. Conclusions are in Section 7.

2. Hypotheses

As mentioned above, the first part of our analysis investigates the determinants of cash holdings, in order to estimate the optimal level of cash for each firm (target cash holding). The presence of financial market imperfections increases the cost of capital, and this may limit firms' capacity for external funds. Firms are, then, induced to accumulate more liquid assets in the attempt to mitigate two major problems: being short of liquidity

and foregoing valuable projects. The literature suggests that transaction costs and precautionary motives are the main reasons to hold cash (Keynes, 1936).

Further, the agency costs of managerial discretion may be another explanation of cash accumulation, as the free cash flow theory implies (Jensen, 1986). Entrenched managers would accumulate cash to pursue their own projects at the shareholders' expense. At the same time, they could also avoid the discipline of capital markets.

Following the arguments by both Keynes (1936) and Jensen (1986), we consider four different market imperfections that may affect cash holding policy: transaction costs, asymmetric information, agency costs of debt and managerial discretion. Definitions for all variables are presented in Table 1.

2.1 Transaction costs

Firms can procure prompt liquidity in different ways, such as raising funds on external markets, cutting dividends or investment, or selling liquid assets. Nevertheless, all of these are costly. As a consequence, cash might be used as a buffer against the possibility of having inadequate funds to implement valuable projects. The higher the cost of being short of liquidity, the larger the amount of hoarded cash will be. Keynes (1936) defined this situation as the transaction costs motive to hold cash.

Leverage is the first cash substitute we include in our cash model. The amount of debt in a firm's capital structure may represent its capacity to raise external funds or, in other words, its aptitude for accessing capital markets (John, 1993). From another perspective, Baskin (1987) argues also that a higher proportion of debt to total assets amplifies the costs of investing in liquid assets. All these rationales lead to the prediction of a negative relationship between cash holding and leverage.

Nonetheless, at higher levels of debt the probability of financial distress becomes more likely and, thus, the costs of being short of liquidity also increase. Firms with large amounts of debt may therefore save more cash, to reduce their financial distress probability. In order to take into account both of these competing effects of debt on cash policy, we expect the relationship between cash holding and leverage to be U-shaped.

Cash flow is another liquid asset that the literature defines as a cash substitute. Firms with high cash flows have lower costs of liquidity shortage and, consequently, they have fewer incentives to hold large amounts of cash. Therefore, we predict that cash flow is negatively related to cash. Nonetheless, in line with the view that firms may prefer internal to external capital, we might also expect companies with higher cash flows to accumulate more cash.

On the other hand, if cash flows are uncertain and variable over time, the expected costs of liquidity constraints may become more severe, and lead firms to renounce valuable investment opportunities. There is some empirical evidence that companies with higher cash flow volatility permanently forgo investments, rather than use external capital markets (Minton and Schrand, 1999). Then, cash flow variability is expected to be positively related to cash reserves.

We also consider dividends as an alternative source of liquid funds. Firms that pay dividends can curtail them to generate funds at lower costs than non-dividend paying companies. In consequence, we predict that the relationship between dividends and cash is negative. Nonetheless, it is also maintained that dividends may be regarded as an efficient instrument to mitigate managers-shareholders conflicts (Easterbrook, 1984). Therefore, cutting dividends may prove costly, by creating a negative reputation amongst external investors. This may imply further difficulties in raising funds in capital markets. To the extent that this argument holds, firms with positive payouts would prefer to accumulate cash rather than reduce payments to shareholders.

Finally, firms with increasing growth opportunities face a higher probability of having to give up better projects under liquidity constraints. So, cash holding is predicted to be positively related to in investment opportunities.

2.2 Asymmetric information

Asymmetric information problems increase the costs of raising funds from external markets. Investors do not have the same information about a company as its managers do. As a result, they want to be sure to buy securities that are not overpriced. Even if managers are acting in the shareholders' interests, outsiders will tend always to discount the securities

price. A higher cost of external capital will thus induce managers not to sell securities and not to invest in some profitable projects (*debt/equity rationing*). The models based on asymmetric information (e.g., Stiglitz and Weiss, 1981; Myers and Majluf, 1984) predict that underpricing problems are more relevant when securities are more information-sensitive, and when information asymmetries are more acute.

We consider two types of firms with important asymmetric information problems: firms with high investment opportunities, and small companies. Growth opportunities are likely to increase a firm's value when they are realized. However, if the cost of external capital becomes higher, firms may be forced to pass up some of these investments. Therefore, they may tend to accumulate more cash, in the attempt to avoid limitations on the realization of their projects. Another reason to hoard cash stock may be that firms with higher growth opportunities are more likely to suffer higher bankruptcy costs (Harris and Raviv, 1990). This is because growth opportunities are basically intangible assets, and their value may substantially decrease in case of bankruptcy or financial distress. So, as argued before, firms will tend to reduce such a risk by hoarding a larger amount of cash.

It has been suggested that small companies are more *opaque* than larger ones (Petersen and Rajan, 1994). Therefore, they may suffer more borrowing constraints and higher costs of external funds. In addition, smaller firms are less diversified and, consequently, more likely to experience financial distress (Titman and Wessels, 1988). To the extent that size is an inverse proxy for asymmetric information, we would expect a negative relationship with cash.

2.3 Agency costs of debt

Agency costs of debt arise when there is a conflict of interest between shareholders and bondholders. From contracting-cost theory, we derive that managers maximizing shareholders' value may have incentives to choose riskier projects than those agreed with bondholders. This would generate a transfer of value from bondholders to shareholders, because the latter would not pay any of the gains from riskier ventures to creditors, yet bondholders would bear part of the risk of failure (*asset substitution problem*, Jensen and Meckling, 1976). In this way there arises the bondholders' incentive to increase the cost of capital through interest rates,

bond indentures or other legal devices. Conversely, a transfer of value from shareholders to bondholders may occur in the presence of outstanding debt in the capital structure of firms. In some states of nature, the benefits accruing to debtholders from a profitable investment project would not give normal returns to shareholders. The higher the outstanding debt, the more selective the managers may be in choosing certain projects. Hence, it is possible for firm to reject positive NPV projects at the expenses of the firm value itself (*underinvestment problem*, Myers, 1977; Barnea et al., 1980).

Companies with high growth opportunities are more likely to be subject to greater agency costs of debt. Therefore, in order to maintain a certain financial flexibility, they will tend to accumulate more cash. Even in the case of asymmetric information problems, a positive relationship between cash and investment opportunities is expected.

As before, since small firms are less diversified and have limited access to capital markets, they may suffer more severe agency costs of debt (Titman and Wessel 1988). We therefore predict an inverse relation between cash and firm size.

2.4 Managerial discretion

In the presence of managers-shareholders conflicts, managers would tend to accumulate as much cash as possible to pursue their own projects, in line with the free cash flow theory (Jensen, 1986). Cash might be spent in perquisites, but also in projects that market investors would be unwilling to finance. In so doing, managers would embezzle private benefits and avoid market discipline.

In addition, managers may also hold excess cash because of their risk aversion. As Friend and Lang (1988) argued, the expected costs of higher liquidity or bankruptcy risk may induce managers to choose suboptimal amounts of leverage, since the risk of financial distress may increase the likelihood of managers losing their jobs. In an attempt to reduce such a risk, therefore, managers would also have incentives to accumulate more liquid assets than optimal.

2.4.1 Managerial ownership

In their seminal work, Jensen and Meckling (1976) maintain that insider shareholding helps to align the interests of shareholders and managers. Jensen (1993) also argues that "many problems arise from the fact that neither managers nor non-manager board members typically own substantial fractions of theirs firm's equity". In other words, managers without shares would obtain all the private benefits derived from an expropriation, while managers with a positive amount of equity would receive the private benefits minus the expropriation costs in proportion to their shareholding. Therefore, to the extent that accumulated cash is costly, managers with ownership in the firm would tend to stockpile less cash. In addition, aligned managers would be less risky from the external investors' point of view and this, in turn, would lower the cost of capital. This could explain, in turn, lower cash holdings. Our prediction is that the relationship between cash holdings and managerial ownership will be negative.

Nonetheless, based on some theoretical predictions by Fama and Jensen (1983) and some empirical evidence on ownership and performance by Morck et al. (1988), part of the previous literature on cash holding has suggested the possibility of a non-linear relationship between cash and managerial ownership. In particular, Opler et al. (1999) and Ozkan and Ozkan (2004) propose a cubic relationship. At a certain point of their shareholding, managers with increasing voting power and effective control over the firm may become entrenched, and start to accumulate excess liquidity. However, at a very high level of ownership, managers would decrease the amount of cash because, as majority shareholders, they would bear all the costs of expropriating actions.

The theoretical literature does not provide robust motivations about which of these effects would prevail. Opler et al. (1999) find no significant evidence for a non-linear relationship, while Ozkan and Ozkan (2004) provide evidence, for the UK, of a significant cubic relationship. For robustness purposes, we investigate whether the impact of managerial ownership on cash in our model is also non-linear.

2.4.2 Large shareholders

Managerial discretion is stronger when shareholding is highly dispersed. In a dispersed company, in fact, there are greater free riding problems amongst shareholders: for

each atomistic non-managerial owner, the difference between the costs and the benefits of monitoring the incumbent management is so significant that no small shareholder has the incentive to monitor managers and to take the necessary actions to remove them. As Stiglitz (1985) and Shleifer and Vishny (1997) argue, larger shareholders have greater incentives to be involved in the control process than smaller ones, because they can more easily bear the high fixed costs of collecting information on management behaviour. In line with this argument, we would expect a negative relationship between cash holding and direct equity ownership by the largest non-managerial owner.

Nonetheless, the presence of a large non-managerial shareholder could in turn also generate other agency costs. Large shareholders, in an attempt to maximize their own wealth, may actively expropriate minority investors (Shleifer and Vishny, 1997), or even collude with managers (Pound, 1988), by pursuing projects that would subtract funds from valuable investments or dividend redistribution. This could also have a negative impact on the cost of capital, because external investors, concerned about holding shares in a majority-controlled company, would demand a higher risk premium. As a result, the effect of ownership by the largest shareholders on cash holding would be positive.

2.4.3 Board composition

Due to the separation between ownership and control, the board of directors is supposed to act on behalf of shareholders, as an important mechanism to monitor top management discretionary behaviour and to ratify important decisions (Hart, 1995). As a consequence, board structure regulation becomes more and more significant. In the UK, in particular, there has been much emphasis on the view that a board of directors becomes more independent as the number of non-executives increases. Non-executive directors should be independent advisors and act as monitors delegated by shareholders. With this in mind, we predict that an increasing ratio of non-executives relative to the total number of directors may ensure a better monitoring of management and, in turn, reduce inefficient accumulations of cash.

However, previous literature has also pointed out possible failures of the internal corporate control mechanisms. Hart (1995) considers that non-executives do not have sufficient financial interests (i.e., a significant stake of the firm's shareholding) to make

them concerned about the company's performance. In addition, the reputation effect in the management labour market may even work in the opposite direction. For instance, non-executives may owe their position to management. Moreover, Jensen (1993) points out that non-executive directors may lack the necessary expertise to efficiently participate in planning the financial aspects that affect corporate value. This could lead to higher managerial discretion in the firm and, consequently, higher level of cash holdings.

2.5 Persistent low cash firms

In this analysis, we identify persistent low cash firms (PLC) as those firms that persistently hold lower levels of cash holdings than their target balances (*undershooting*).[1] We hypothesize that their ability to invest in imperfect capital markets is limited. This is because, to the extent that desired cash holdings are determined by the firm's capacity to raise external finance, lower than target cash holdings could mean that firms will find it difficult to invest. In other words, these firms may not be able to accumulate the necessary cash to overcome the strong constraints they experience from external investors. As a consequence, their ability to invest would be hampered. Therefore, we expect that, *ceteris paribus*, such companies will show a lower level of investment spending relative to others.

Moreover, in the earlier literature the sensitivity of investments to cash flow was used to assess the degree of capital market imperfections (Fazzari et al., 1988; Hoshi et al., 1991; Devereux and Schiantarelli, 1990; among many others). However, there is no consensus on the validity of this approach. Following Kaplan and Zingales (1997, 2000), another stream of research shows that the firms able to access capital markets are those with stronger investment-cash flow sensitivity, and that the relationship between investments and internal funds may be biased by measurement problems associated with Tobins'q (Cleary, 1999; Erickson and Whited, 2000).

To the extent that investment cash flow sensitivity indeed contains information about financial imperfections, then this sensitivity should increase in PLC firms. This is

[1] In the following methodological section, we explain in more detail how we proceed in determining the target. The main point here regards the hypotheses on the impact of persistently low (high) cash firms on investment decisions.

because these companies may be likely to be more exposed to asymmetric information and contracting problems in the markets.

Nonetheless, one could also argue that low cash firms are those that do not need to save cash because they are, in the first place, more capable of raising external funds. This could be the case, for instance, for firms that show considerable amounts of new debt or equities issues. As long as the arguments above hold, we should detect, therefore, a positive impact on investment levels and a decrease in the investment cash flow sensitivity for PLC firms.

2.6 Persistent high cash firms

Persistently high cash firms (PHC) are those with cash holdings higher than their target (*overshooting*). We suppose that their ability to invest in imperfect capital markets increases. Holding larger amounts of cash means reducing the costs of raising external finance, and having the necessary funds to invest in valuable growth opportunities, whenever they occur. Hence, we predict that capital expenditures for such firms should be higher.

Furthermore, similar to the argument given above regarding PLC firms, we maintain that investment cash flow sensitivity should decrease for PHC companies, because they are more likely to reduce the impact of capital market imperfections.

In contrast to the view that large cash holdings serve shareholders' interests, we consider also the possibility, as stated earlier, that higher accumulation of cash may be driven by managerial discretion. In line with the free cash flow theory, entrenched managers would spend the available internal funds to maximize their own utility function, either consuming perquisites or investing in projects with high private benefits. If this is the case, then it is difficult to unambiguously predict the effect of a persistently high cash policy on the amount of capital expenditures. It could be that managers are more interested in on-the-job perks than in fixed assets investment, so that the impact on capital expenditure of being a PHC firm may be negative. Conversely, it may also be that managers purchase some assets in order to acquire the private benefits that these generate, with the result that the impact on capital expenditure may be positive. (See Bebchuck et al., 2000, and Shleifer and Vishny, 1997, for some anecdotal evidence of this.)

Nevertheless, to the extent that the managerial discretion hypothesis holds, in both cases investment cash flow sensitivities should increase for PHC firms. This may be interpreted as evidence for *overinvestment* problems, and for conflicts with financial markets.[2] Indeed, the presence of managerial discretion may increase the cost of outside capital, because external investors do not know whether management is raising cash to increase firm value or to pursue its own objectives. Therefore, this asymmetric information cost should be reflected in an increasing investment cash flow sensitivity.

If managerial discretion influences investment decisions, we would expect firms to feature lower growth opportunities and lower leverage. This is because the conflicts between managers and shareholders are more acute in firms that have few valuable investment opportunities (Jensen, 1986; Vogt, 1994), or are less subject to monitoring by capital markets. In addition, such firms should be characterized by highly dispersed shareholding, and a lower number of non-executive directors sitting in the board. Table 2 summarizes all the empirical predictions for both cash and investment models.

3. Methodology

From the arguments given earlier, we derive that deviations from the desired cash holding represent, in our study, the ability of companies to invest. Therefore, in the first step, we look at the difference between the actual and the desired cash holding of companies in order to identify low (high) cash firms.

Previous work suggested fixed classification rules for distinguishing between low and high cash firms. For instance, Mikkelson and Partch (2003) define cash-rich firms as those having more than 25% of total assets in cash and cash equivalents. Nonetheless, this approach has some drawbacks that make the classification of firms less accurate. First, it does not account for possible changes of the firms' target over time: for the same firm, a

[2] Since Hoshi et al. (1991), a number of works in the literature on investment have highlighted the fact that a positive investment cash flow sensitivity may be driven not only by underinvestment, but also by overinvestment problems. They have tried to find ways to discriminate between them. A common approach consists in using economic characteristics, such as the distribution of Q or firm size (Devereux and Schiantarelli, 1990; Hoshi et al., 1991; Vogt, 1994; Hubbard et al., 1995). Others adopt ownership and corporate governance characteristics (Oliner and Rudebusch, 1992; Hadlock, 1998; Goergen and Renneboog, 2001b; Gugler, 2003; Broussard et al., 2004; Pawlina and Renneboog, 2005). The empirical results are mixed.

fixed cut-off value may be too high in certain years and too low in others. Second, this approach does not consider the possibility of different targets across firms. As a consequence, a firm with a target above the cut-off rule and another firm with a target below the same cut-off would both be classified as low cash only because the amount of the observed cash of the second company is lower than the cut-off rule but higher than the target.

In order to estimate the deviations from the target cash, we need to specify the target itself. There are several different ways to reckon target cash holdings. One option is to define the target as the time average of the relevant variable (Opler et al., 1999, for cash holding; Shyam-Sunders and Myers, 1999; Hovakimian and Titman, 2001, for capital structure, in a different context from ours). Another alternative is to obtain the target for each firm from the fitted values of a specified model for cash holding (Opler et al., 1999). Using this second method, the target is more accurate and is more directly related to those factors that are relevant in determining the firm's capacity for external finance.

However, previous research that adopted this technique does not take into account two important issues that can affect the target computation: the endogeneity among variables and the annual changes in the firm's target.[3] We adopt a similar approach to Ozkan and Ozkan's (2004) paper, which proposes cross-section averages and GMM methodology to reduce the endogeneity issues in the determination of cash holdings.

The endogeneity arises because shocks that affect cash holding are also likely to affect such regressors as cash flow, growth opportunities and leverage choices. Furthermore, this problem may also derive from cross causality. For instance, the amount of debt in the firm's capital structure may influence its cash holding policy; it may also be the case that leverage itself is also determined by corporate cash stock. A further source of endogeneity arises if there are unobservable firm-specific characteristics that are correlated with the regressors. In addition, firms may not be able to adjust immediately to changes in their target cash holdings, due to transaction or adjustment costs (Ozkan and Ozkan, 2004). As a result, the actual level of cash may be different from the desired one. (For a discussion on the adjusting behaviour of companies to targets in capital structure refer to Jalilvand and

[3] To the best of our knowledge, only Ozkan and Ozkan (2004) acknowledge the presence of endogeneity issues in the determination of cash holdings and adopt two different techniques, cross-section averages and GMM, to reduce this problem.

Harris, 1984.) By specifying a partial adjustment model for cash, we introduce another source of endogeneity through the lagged dependent variable. In Appendix 1 we explain how we derive a partial adjustment model.

Due to these endogeneity issues, both OLS and Within Group (WG) estimators are known to be inconsistent and biased in opposite directions (upward bias for OLS and downward bias for WG). Even if the latter eliminates firm fixed effects by transforming the original observations into deviations from the time mean of each variable, this does not eliminate the issue of endogenous regressors. Arellano and Bond (1991) developed a more efficient method of estimating a model with severe endogeneity problems, such as a partial adjustment model. Instead of using the WG estimators, they apply first-differencing transformation (FD), which eliminates the unobserved firm effect. In this context, consistent estimates of the coefficient of the lagged dependent variable and all endogenous regressors can then be obtained using suitable lags as instruments.[4] In particular, the higher efficiency of Arellano-Bond estimators over other IV methods is due to the application of the Generalized Method of Moments procedure (GMM): that is, the inclusion of all available moments of the lagged dependent variable and the other regressors in the instrument set.

The other relevant issue that arises when estimating a target cash holding is the possibility of an evolution of the target over time or, in other words, the existence of a time-variant target. In a recent survey of capital structure decisions, Graham and Harvey (2001) report that 37% of their respondents have a flexible target of debt, 34% have a somewhat tight range target and only 10% have a strict target.[5] Although their study refers to a different firm policy from the scope of this work, we can reasonably assume that, even for cash-holding decisions, firms tend to change their targets and the adjustment to the targets

[4] Valid instruments are those that are both correlated with the FD of the lagged dependent variable, Δy_{it-1} , and orthogonal with the FD of the error term, Δv_{it}. Given this assumption and the absence of serial correlation of the disturbances v_{it}, the first available instruments for Δy_{it-1} and all the other endogenous regressors are y_{it-2} and x_{it-2} respectively. The validity of the instruments used to estimate our model can be tested using the standard GMM test for overidentifying restrictions or Sargan test. The null hypothesis of this test is the orthogonal condition of the instruments with respect to the disturbances. The rejection of the null casts doubt on the validity of the instruments used in the model.

[5] Similar conclusions are reached in a different survey conducted for seventeen European countries by Bancel and Mittoo (2002).

year by year, depending on changes either in macro or industry conditions or in the firm's life. This means that the magnitude of the estimated coefficients in the cash model may change annually.

Consequently, the GMM methodology in a panel data framework would not allow us to compute time-variant adjustment factors, because it would provide fixed coefficients over the entire estimation period. In the partial adjustment model, these coefficients would already include an adjustment factor.

The cross-section average estimation (hereinafter CSA) was proposed by Rajan and Zingales (1995). It is an alternative technique that enables us to deal with the time-variant adjustment factor issue and also, to a certain extent, with endogeneity problems. The explanatory variables are averaged over the years preceding the year of the dependent variable. Average values are used in order to moderate the effect of short-term fluctuations or extreme values in one year, and lagging regressors help to partially control for the endogeneity. In particular, CSA may mitigate the effect of contemporaneous correlations between cash and other characteristics of the firm. Moreover, estimating a CSA mode for each year enables us to compute a time-variant target for each firm.

Nonetheless, this method has two major shortcomings. First, we cannot implement a partial adjustment behaviour for cash holding policy, as we can with GMM procedure. Second, the averaged regressors in CSA reduce the variability of data. Consequently, some coefficients may become statistically insignificant.

Bearing all these arguments in mind, we decided to employ both techniques with static and dynamic settings, model 1 for CSA and model 2 for GMM respectively, in order to compute an annual target as robust as possible to all the issues highlighted above. The models are as follows:

$$\begin{aligned} CASH_i = {} & \alpha + \beta_1 LEV_i + \beta_2 LEV_i^2 + \beta_3 CASHFLOW_i + \beta_4 CFLOWVAR_i + \\ & \beta_5 SIZE_i + \beta_6 MTBV_i + \beta_7 DIV_i + \\ & \beta_8 MAN_i + \beta_9 LARGEST_i + \beta_{10} RATIO_i + u_i \end{aligned} \qquad (1)$$

where the dependent variable is in level for each year of the estimation period; all the explanatory variables are averaged over the two years preceding the year of the dependent variable; u_{it} is the error term; industry dummies are included.

$$CASH_{it} = \delta CASH_{it-1} + \sum_{k=1}^{k} \gamma_k X_{kit} + \eta_i + \eta_t + \nu_{it} \qquad (2)$$

where $CASH_{it-1}$ is the lagged dependent variable to implement the partial adjustment model as illustrated in Appendix 1; $\sum_{k=1}^{k} X_{kit}$ are the same explanatory variables of model (1) in level; η_i is an unobserved firm specific time-invariant effect, η_t is a time specific firm-invariant effect and, finally, ν_{it} is a disturbance term which is assumed to be serially uncorrelated with mean equal to zero.

Our criteria for estimating the time-variant target are the follows. From GMM estimations we obtain information on the statistical significance of the variables to be included in the target computation, while, to the extent that the results are reasonably in line with GMM, we rely on CSAs to calculate time-variant targets. In other words, once the results are obtained from both models, we include the significant variables in estimating the target cash equation for each firm each year, and we estimate each target equation by plugging the CSA estimated coefficients of the variables.

After that, we calculate the deviation from the target as the difference between the actual and the estimated target level of cash holding. For each year, negative deviations show that firms are undershooting their target, while positive deviations identify overshooting firms. We compute the ratio of each (negative and positive) deviation to the corresponding target, in absolute value for standardization purposes. By considering the distribution of this ratio, we identify as *low cash* those firms that are above the 25th percentile of the distribution for undershooting firms. Vice versa, *high cash* firms are above the 25th percentile of the distribution for overshooting firms.

Finally, for a firm to be defined as a *persistently low (high)* cash firm, we require that it be identified as a *low (high)* cash firm either for two or three consecutive periods prior to the investment decision year. Table 3 Panel A provides an example of how we define *persistently low cash* firms. To be defined as *persistently low cash* for capital expenditures made in 1994, a firm has to be *low cash* either in each year between 1991 and 1993 or in 1992 and 1993. However, a firm is not *persistently low cash* if it is *low cash* in 1991 and 1992 only.

As far as the investment analysis is concerned, the estimation period is divided into four sub-panels (Table 3 Panel B). Having defined the cash holding status dummies within each sub-panel, we run four distinct CSA estimations for investment decisions, as illustrated in Table 3 Panel C.

The empirically testable models in the corporate investment literature can be classified into four broad classes: the neoclassical model, the sales accelerator model, the Tobin's q model and the Euler-equation model. Each of these approaches is subject to criticism. However, most of the testing has been conducted in the context of q-models, in which average Q is used to control for the investment opportunities available to firms.

For comparison purposes with previous work, we decided to adopt the investment model used by Devereux and Schiantarelli (1990) and Bond et al. (2004), augmented by cash holding status variables. That is, capital expenditures are regressed on Tobin's q and cash flow. Moreover, instead of partitioning the sample into different groups of firms, and running separate regressions for each of them, we create dummies for each cash-holding policy *status*. We include them in the model both as regressors on their own and interacted with cash flow, in the attempt to investigate whether firms with persistent deviations from their target cash in a certain way have indeed different investment expenditures. Therefore, the augmented models for investment spending become as follows:

$$IK_i = \alpha + \delta_1 CFK_i + \delta_2 Q_i + \delta_3 CASHSTATUS_i + \delta_4 CASHSTATUS_i \times CFK_i + u_i \qquad (3)$$

where the dependent variable is estimated in the year following each sub-panel; all the explanatory variables are averaged over the years of each sub-panel; $CASHSTATUS_i$ generally refers to both PLC and PHC dummies; u_{it} is the error term; industry dummies are included.

We are aware that estimating q-models is not without problems. A potentially serious issue is that Tobin's q will only include future expectations if the conditions indicated by Hayashi (1982) to approximate marginal q with average q hold: firms are price takers in perfectly competitive industries; there are constant returns to scale and the stock market value correctly measures the fundamental expected present value of the firm's future net cash flows. In practice, these conditions may not be fulfilled. For instance, because of a bubble in stock market prices,

Tobin's q would not capture all relevant information about the expected future profitability of current investment. Therefore, cash flow would be positive because of the expectations not captured by Tobin's q. We try to control for this problem by employing a CSA technique that controls, to certain extent, for individual and time effects. In addition, as a robustness check of our findings, we also provide GMM results in a dynamic framework similar to that proposed by Devereux and Schiantarelli (1990) and Bond et al. (2004). For GMM estimations, the cash holding *status* dummy is computed for the three years prior to each year in which investment decisions are analysed.

$$IK_{it} = \delta IK_{it-1} + \gamma_1 CFK_{it-1} + \gamma_2 Q_{it} + \gamma_3 CASHSTATUS_{it-1} + \gamma_4 CFK_{it-1} \times CASHSTATUS_{it-1} + \eta_i + \eta_t + \nu_{it} \quad (4)$$

where IK_{it-1} is the lagged dependent variable to implement the partial adjustment model for capital expenditures, as illustrated in Appendix 1 for cash model; the other regressors are the same explanatory variables of model (4) in level; η_i is an unobserved firm specific time-invariant effect, η_t is a time specific firm-invariant effect and, finally, v_{it} is a disturbance term which is assumed to be serially uncorrelated with mean equal to zero.

Here cash flow and growth opportunities are defined differently from cash models, in an attempt to mitigate the potential endogeneity issue that may occur by using cash holding *status* variables as sample-splitting criteria in the investment estimations (Schiantarelli, 1996).[6]

4. Data

The sample used in this analysis is constructed as follows. In the initial stage, a random sample of around 1100 listed non-financial firms was selected from Datastream constituent lists. Ownership data were hand-collected from the Price Waterhouse Corporate Register (December issue) for the period 1991-2001. Economic and market data were downloaded from Datastream for 1989 to 2002. However, in order to compute the capital stock on a replacement cost basis we needed to collect information even before 1989. This is because we employed a standard perpetual inventory method that requires the first available

[6] They are standardized to capital stock rather than total assets.

information in each time series of total net fixed assets as a proxy for the starting replacement value of capital stock.

To be able to follow companies over time from two different datasets, a huge effort went into tracking all the name changes (and also defunct companies) in the period. This information was collected mainly from the London Stock Exchange Yearbook, which reports systematic information on name changes, entries removed from the companies section, companies in liquidation, and companies in receivership and in administration. Moreover, as a further check, the Companies House website was used. This is an online facility that provides various types of information on companies (including name changes).

In order to run the empirical analysis, a number of steps were then undertaken. First, the dataset was cleaned of outliers. The ownership part of the dataset was thoroughly inspected in several directions. For example, we double-checked that the sum of all the shares collected did not sum to more than 100. In such cases, we tried to crosscheck the information with other issues of the Hemscott volumes (using either the September edition of the same year or the March edition of the following year) and/or with the London Stock Exchange Yearbook, which also contains some ownership information. When it proved impossible to find coherent information from the different sources of data, this observation was dropped from the sample. After running these tests for the ownership side of the dataset, we also checked for outliers in the "economic" variables as reported in *Datastream*. There is no fixed rule for dealing with outliers, so as a general rule of thumb, data were trimmed to the 99% percentile. The trimmed data were then always benchmarked with descriptive statistics reported in other papers.

When the issue of outliers had been addressed, firms in the public utilities were excluded because of the peculiarities in their operational and regulatory conditions. Also, all missing observations were dropped. Finally, only firms that had a certain number of consecutive observations (depending on the methodology) were kept, in order to implement both CSA and GMM estimations.[7] The sample contains 652 firms and 6018 observations, although usable observations vary according to the estimation method.

[7] In order to run GMM estimations, firms were required to have a minimum of 5 consecutive years of observations. This is necessary to retrieve asymptotically efficient *m2* tests (Arellano and Bond, 1991), which

5. Results

Table 4 shows the descriptive statistics for the main variables used in our analysis. It reveals that the average and the median firms have 10.4% and 6.4%, respectively, of total assets in cash reserves. This is similar to Ozkan and Ozkan (2004), who report 9.9% and 5.9% in the period 1995-1998. It is possible that the differences in our statistics occur because in the first half of the 1990s UK firms seemed to experience a significant increase in their cash holdings, as appeared from some preliminary investigation conducted on our sample. However, for the UK companies in Kalcheva and Lins (2004) the mean ratio is 15%, and in Dittmar et al. (2003) the median cash ratio is 8.1%. The higher mean and median values in these cross-country analyses are most probably due to normalizing cash and marketable securities by total assets minus cash and equivalents, instead of total assets. The same argument holds for the statistics reported by Opler et al. (1999) for US companies: that is, a mean value of 17%.

As reported in Table 4, the average capital expenditures (IK) are about 13% of the replacement value of fixed assets, which is similar to the reports by Devereux and Schiantarelli (1990) and Bond et al. (2004), at 11.56% and 15% respectively. As far as the other variables in the investment model are concerned, we use two proxies for cash flow and growth opportunities (CFK and Q), which are different from those we employ in the cash model (CFLOW and MTBV) in an attempt to reduce endogeneity issues. CFK and Q show mean and median values significantly higher than the corresponding cash flow and market-to-book ratios in the cash model because of the different standardization: they are normalized to the replacement value of fixed assets rather than to total assets.

As far as the ownership variables are concerned, the average ownership held by executive directors is 8.61% (the median is 1.48%). On average, UK firms in the 1990s had 4.1 executive and 4.2 non-executive directors. Consequently, non-executives are 43.2% of the total number of directors on the board. In addition, in the average firm, the largest non-

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are crucial for assessing the validity of the estimations. As far as CSAs are concerned, a less restrictive criterion was used, as firms with a minimum 3 years were allowed to enter the sample. Robustness checks were also performed, in which we replicated all the following estimation with the same sample. The results were virtually unaltered.

managerial shareholder owns 10.96% of shares. These figures correspond to the findings of previous studies for the UK at some point in time (Faccio and Lasfer, 1999; Peasnell et al., 2003).

5.1 Cash model

We start our analysis by estimating a cash model with CSA and GMM methodologies, in order to compute a time-variant target for each firm. Table 5 shows the results. The estimation period for the CSA is 1989-2001. Regressors are averaged over the two years preceding the year in which the dependent variable is measured. Therefore, we estimate 11 cross-section averages from 1991 to 2001. For instance, cash holdings in 1991 (cs91) are regressed on the independent variables averaged in 1990 and 1989, and so on.[8] Industry dummies are included in CSA and standard errors are robust to heteroskedasticity. On the other hand, for GMM estimations we report five test statistics: (1) Wald test 1 is a Wald test of joint significance of the estimated coefficients, which is asymptotically distributed as chi-square under the null of no relationship; (2) Wald test 2 is a Wald test of the joint significance of the time dummies; (3) Sargan test of overidentifying restrictions, which is asymptotically distributed as chi-square under the null of instrument validity; (4) First order autocorrelation of residuals, which is asymptotically distributed as standard normal N(0,1) under the null of no serial correlation; and (5) Second order autocorrelation of residuals, which is distributed as standard normal N(0,1) under the null of no serial correlation.[9] GMM estimation reveals that the coefficient of the lagged cash holding is positive and significantly different from zero. The reported adjustment coefficient λ is about 0.41, which seems to provide evidence that the dynamic nature of our model is not rejected and that firms adjust their cash holdings relatively quickly in an attempt to reach the desired cash. Nonetheless, because the coefficient of the lagged dependent variable is rather close to the half way between 0 and 1, it is reasonable to argue also that the adjustment costs are high.

Comparing CSA and GMM results, we can see a certain degree of consistency among coefficients in terms of signs and significance. The only exceptions are SIZE and

[8] Due to the availability of ownership data only from 1991, ownership variables are not included in cs91 and are simply lagged of one period in cs92.
[9] All CSA estimations were carried out using STATA 8, while GMM estimations were carried out with the DPD program written for PC-GIVE.

DIV, which are significant in both estimations, although with opposite signs. Despite this, we decided to follow strictly the criterion described in the previous section: that is, including SIZE and DIV in the computation of the annual target using the estimated coefficients from CSA regressions. The other exception is LARGEST, which is insignificant in GMM and significant in 5 out of 11 cross-section averages, although its estimated coefficients are relatively low. On the basis of the criteria illustrated in the methodological section, LARGEST is not included in the computation of the target. Nonetheless, as a robustness check, we ran the same analyses again with an alternative definition of target that includes LARGEST. These checks show that the results are virtually unchanged, suggesting that the criterion consistency between CSA and GMM may be valid to correctly compute a time-variant target.

We also conducted a number of robustness checks to investigate further the functional form of managerial ownership. We ran models with a quadratic and cubic relationship in GMM. Executives' ownership is consistently insignificant in all the estimations. This contrasts with the evidence in Ozkan and Ozkan (2004), which provides a significant cubic relationship between board ownership and cash. Nonetheless, Opler et al.'s (1999) results are similar to ours. In addition, we substituted board ownership for executives, but this left the significances unchanged.[10] This difference may be due to the fact that previous works have ownership information for one single cross-section and, therefore, they are not able to explore the impact of ownership characteristics on cash policy with an intertemporal perspective.

In line with our criterion, we include in the target computation LEV, LEV2, MTBV, SIZE, DIV and RATIO.

As far as the interpretation of coefficients is concerned, we detect a significant non-linear relationship between cash and debt in line with our predictions. At lower levels leverage seems to play a substitute role for cash, because it may approximate an increasing firm's capacity for external funds. A negative relationship with LEV is also consistent with the managerial discretion hypothesis, which argues that less leverage implies less control from external markets and, thus, higher managerial discretion on firms' resources. Nonetheless, higher levels of debt may lead to an increasing probability of financial

[10] The results are not reported for reasons of space, but are available from the author upon request.

distress, which makes liquidity shortage a very expensive condition for firms. Calculations of the estimated turning point of the quadratic form of LEV reveal that over time firms start hoarding cash when the amount of debt is above 36% of total assets.

The positive relationship between MTBV and CASH is in line with all the hypotheses we illustrated earlier, except for managerial discretion. In particular, for firms with greater growth opportunities the costs of being short of funds are expected to be significant. At the same time, raising finance from external markets is very expensive, due to the higher asymmetric information and debt agency costs problems that characterized companies with high investment opportunities. Consequently, firms need to accumulate more cash in order to exploit their valuable opportunities.

In CSA results, SIZE is positively related to CASH. This may be in line with the managerial discretion hypothesis. Larger firms tend to have more highly dispersed ownership. However, GMM results show the opposite sign for SIZE, possibly suggesting a prevailing effect of asymmetric information and debt agency costs. This leads us to be cautious in interpreting this relationship. The same argument holds for dividends (DIV). A positive relation with CASH might indicate that reducing dividends is a very costly decision in terms of signalling to the market and, in turn, raising external funds. Nonetheless, the negative result in GMM would advocate the hypothesis of dividends as a valuable substitute for cash.

CFLOW is insignificant in most of the regressions. This is in contrast to the findings of previous studies. Nonetheless, when it is significant, cash flow is positively related to cash in our sample. This would be in line with the argument that cash holding is accumulated out of cash flow, rather than the argument that they are substitutes for each other. The same results are provided by Opler et al. (1999) for the US and by both Dittmar et al. (2003) and Kalcheva and Lins (2004) in their cross-country analyses.

In addition, variability of cash flow (CFLVAR) does not seem to play any role in cash determination, as Kim et al. (1998) and Ozkan and Ozkan (2004) also find.

Finally, as far as ownership is concerned, RATIO is negative and significant in all the estimations. The findings suggest that the number of non-executives on the board seems to lead to more effective internal monitoring, which produces an efficient reduction in cash reserves. This figure is consistent with other work in the literature on ownership and performance

that shows that an increasing number of non-executive directors positively influences the reaction in the market (Rosenstein and Wyatt, 1990, for US companies) and firm value (Yermack, 1996, for US; Peasnell et al., 2003, Dahya et al, 2002, amongst others, for the UK).

On the other hand, LARGEST, when significant, is positive. This may be in line with the expropriation hypothesis by blockholders at the expenses of minority investors. Nonetheless, in GMM estimation the estimated coefficient is negative. This may lead us to be cautious in interpreting this relationship.

5.2 Persistently low (high) cash firms

In the second step of our analysis, after computing the time-variant target for each firm, we calculate the deviation of the actual level of cash to the desired one, and the ratios of the deviation to the corresponding target for both undershooting and overshooting firms. Table 6 shows some descriptive statistics. The average firm in our sample exhibits hold an optimal level of cash equal to 5.4% of its assets. Nonetheless, the mean value for the deviation reveals that firms overshoot their target by 4.6% of total assets. This is consistent with the statistics reported in Table 4, where the observed average level of cash (CASH) is about 10%. In addition, our calculations show that 37% of firms in our sample undershoot the target. Among undershooting companies, firms hold on average 63.3% less of their desired cash (ratio of deviation to the target for undershooting firms). In contrast, firms that overshoot their target seem to retain twice their estimated optimal level of cash, or 122% of their target (ratio of deviation to the target for overshooting firms).

From the distributions of these two ratios we identify *low (high) cash* firms, and we then define *persistently low (high)* cash firms following the criteria discussed in the methodological section: a firm has to be identified as a *low (high)* cash either for two or three consecutive periods prior to the investment decision year. Table 7 shows some statistics on the number of firms classified as persistently low cash (PLC) or high cash (PHC) in each sub-panel. For instance, Panel A shows that in our sample there are 159 PLC firms in the first sub-panel (PLC1), while 198 firms are defined PHC in the same period (PHC1). In each period (with the exception of period 2) there are more PHC firms than PLC ones. Furthermore, the figures in Panel A reveal that PHC firms seem to maintain their

cash holding status for a longer period than PLC companies do. For example, 11 companies remain *persistently high cash* firms for all 4 sub-panels (PHC1-PHC4), while no firm retains PLC status for the same period (PLC1-PLC4). Sixty-seven firms remain PHC for at least 3 sub-panels ([PHC1-PHC3]+[PHC2-PHC4]), but only 14 continue to be PLC for the same period ([PLC1-PLC3]+[PLC2-PLC4]).

As a further investigation of these observations, in Panel B we provide the number of firms that changed their cash holding status across all the periods. Consistent with the previous description, more PLC firms become PHC at some point in time than the opposite. For instance, consider those companies that change their status from one period to the next: 89 firms switch from PLC to PHC status ([PLC1, PHC2] + [PLC2, PHC3] + [PLC3, PHC4]), while only 22 do the opposite ([PHC1, PLC2] + [PHC2, PLC3] + [PHC3, PLC4]). The same trend holds when we consider firms that maintain one status for two or three periods and then switch to the other status: 42 PLC firms become PHC ([PLC1-PLC2, PHC3] + [PLC2-PLC3, PHC4] + [PLC1-PLC3, PHC4]), whereas only 3 PHC become PLC ([PLC1-PLC2, PHC3] + [PLC2-PLC3, PHC4] + [PLC1-PLC3, PHC4]). In summary, those firms that decide to hold more cash than their needs seem to maintain the same cash policy persistently over time. Opler et al. (1999) and Mikkelson and Partch (2003) reach similar conclusions for US cash rich firms.

Table 8 presents tests for differences in mean values of the main variables used in our analysis, for each group of firms in each sub-panel and across the entire estimation period. In addition, we provide the same tests for other variables that can help us to describe the characteristics of both PLC and PHC firms.

In line with the prediction that PLC firms may have facilitated access to external markets, PLC firms seem to use alternative forms of finance to cash more than the control firms, as evidenced by the significantly higher value of new debt and new equity issues. Moreover, in line with predictions, PHC firms seem to have better growth opportunities than the other group of companies, as indicated by the higher value of market-to-book ratio. This is further confirmed by their significantly lower (higher) amount of tangible (intangible) assets.

Size seems not to vary significantly across groups, even if PHC firms seem to be larger than PLC over the entire period. This is in contrast with the view that larger firms face less severe

asymmetric information problems and hence accumulate less cash. On the other hand, consistent with our predictions, PHC companies seem to suffer higher cash flow uncertainty.

Finally, there is mixed evidence in the ownership characteristics. On the one hand, in line with the managerial discretion hypothesis, PHC companies show significantly lower managerial ownership and a larger board of directors than PLC firms, which may provide the executive directors with greater discretion. On the other hand, they exhibit a significantly higher concentration of non-managerial ownership and a higher number of non-executives on the board, probably suggesting more closely monitoring actions.

5.3 Investment model

We now move on to the investment model estimations, to verify whether firms with different cash holding policies indeed have different abilities to invest in capital expenditures. Table 9 includes CSA estimations for each sub-panel (cs94-cs02) and each different group of companies, namely PLC and PHC. GMM results for the 1994-2002 period[11] are included as a robustness check.

In general, growth opportunities are significantly related to investment decisions, while cash flow itself does not seem to play a relevant role. This is in contrast to the findings of previous work. The reason for this may lie in the different methodology we adopt. In fact, when we attempt to replicate the same model using OLS and Within Group methodologies, as in Fazzari et al. (1988) or Vogt (1994), we detect a statistically significant relation between capital expenditures and cash flow. Further, when we replicate the model as estimated by Bond et al. (2004) in GMM with the same instruments set, our results are in line with theirs. However, in their work, Bond et al. (2004) consider Q an exogenous variable. On the contrary, in the context of our work, we believe that it is a sensible assumption to consider all the regressors as endogenous. Therefore, estimating the investment model without the inclusion of our cash holding *status* dummies shows that allowing Q to be endogenously determined is the reason why CFK becomes then insignificant.

[11] The difference in the estimation period for GMM regressions is due to the "cash holding status" dummies, which, to be computed, need at least two consecutive years of observations prior to the year in which the investment decision is made.

As far as the other results are concerned, Panel A reports the estimations for PLC companies in more detail. Following our arguments, these companies are expected to have a lower ability to invest. In CSA estimations, we find that a policy of persistent low cash holdings has indeed a negative impact on capital expenditures, as evidenced by the significant negative relationship between PLC and investment ratio.

Nonetheless, we find that the investment cash flow sensitivity is significantly lower for PLC firms (INTER). This is in contrast with our predictions: to the extent that investment cash flow sensitivity contains information about financial imperfections, then INTER should be positive and significant, because PLC firms are more likely to be exposed to asymmetric information and contracting problems.

This result may be consistent with the hypothesis that this particular group of firms has better access to external funds. The decreasing sensitivity of investment to cash flow may indicate, therefore, that these firms do not rely on liquid assets to finance their investments. The results on debt and equity issues in Table 8 provide some support for this. Nonetheless, this argument cannot explain the negative impact of PLC status on investment expenditures itself.

An alternative interpretation of our results may be that PLC firms use cash flow to increase their cash holdings, rather than to invest in capital expenditures, in an attempt to get closer to their target. This could justify the negative impact of being a cash-poor firm on both the investment ratio and investment cash flow sensitivity.

On the other hand, Panel B provides some evidence on the investment patterns of PHC firms. This group of companies is expected to be more able to invest. However, it seems that being cash-rich has no significant impact on the firms' capital expenditures. Conversely, the sensitivity of investments to cash flow seems to significantly increase when it interacts with PHC status (INTER_OV). This result seems to be in line with the prediction suggesting that entrenched managers tend to accumulate more cash than optimal, in order to pursue their own projects. This produces, at the same time, the perverse effect of higher costs of capital. An increasing investment cash flow sensitivity for PHC firms may, therefore, indicate not only overinvestment, but also increased conflicts of interest between management and external investors.

To ensure the consistency of our results for both types of cash holding status, we formed also 9 overlapping sub-panels, beginning with 1991-1993, followed by 1992-1994 and ending with 1999-2001. As before, for each sub-panel we identified the PLC and PHC companies and we analysed their investment decisions in the subsequent year. That is, sub-panel 1991-1993 refers to the capital expenditure in 1994, sub-panel 1992-1994 to capital expenditure in 1995 and so on. CSA estimations in Table 10 for each sub-panel provide evidence in line with the results presented above.

It seems therefore that different cash holding policies indeed provide firms with different incentives regarding investment in capital expenditures.

Although it is beyond the scope of this work, we conduct some robustness checks and additional analyses in an attempt to corroborate the interpretations of our results and to lay the foundations for future research. Through some preliminary investigations of the behaviour of both PLC and PHC companies, we seek to shed some light on the following questions: do PLC firms really aim to approach their target cash by using cash flow, rather than investing in capital expenditure? Do they accumulate cash holding today in order to be able to invest in capital expenditures in the future? Is the increased investment cash flow sensitivity of PHC firms truly driven by managerial discretion? How do PHC firms employ their positive excess of cash?

6. Robustness Checks

In the following sections we describe the preliminary analyses we carried out and the results obtained so far, holding over more robust and proper examinations for future research.

6.1 PLC firms

If PLC firms prefer to accumulate more cash out of cash flow at the expense of investments in fixed assets, then we should verify whether firms, identified as PLC in one period, approach or overshoot their targets in the following years. Previous descriptive statistics (Table 7) show that a number of PLC companies become PHC (that is, persistently overshoot their target) from one period to another. To have a more complete picture of the PLC firms' behaviour, we also looked at the deviations of PLC firms from

their target in each year after having been identified as PLC. In line with our expectations, we detect that on average PLC firms show gradually less negative deviations over time up to positive excesses of cash (Table A.1).

After having verified that PLC firms accumulate cash flow at the expense of current investments, we investigated whether PLC firms trade off current with future capital expenditures. In addition, we analysed how these firms alternatively spend the accumulated cash. Preliminary descriptive statistics (Table A.2) show that, in the years after having been classified as PLC, these companies generally experience a decrease in capital expenditures and dividend payouts despite their increase in cash holding. On the other hand, in the same years in which we estimate their investment decisions in fixed assets, and at some point in time after that, PLC firms show a sharp increase in their average expenditures on intangible assets (these observations are obtained by averaging the values for intangible assets, capital expenditures and dividends pay-out respectively across the four sub-panels).

Overall**,** these further investigations seem to corroborate the interpretation that PLC firms prefer to accumulate more cash at the expense of capital expenditures, in an attempt to get closer to their target. They also provide further evidence that these companies generally tend to keep the hoarded cash and spend it, if at all, in intangible assets.

6.2 PHC firms

We also examined whether the increase in investment cash flow sensitivity for PHC firms is really driven by entrenched managers. If this is so, then we should detect a decreasing effect on cash flow sensitivity for PHC firms with reduced managerial discretion. To do this, we analysed PHC firms with aligned managers. In particular, we interacted the cash flow sensitivity of PHC companies with the amount of shares held by their executive directors. To the extent that managerial ownership is a proxy for alignment, this interaction term is expected to be negative. This test was conducted with the same CSA and GMM methodologies we employed earlier. Estimations show weak evidence supporting the managerial discretion hypothesis (Table A.3). In only one period are the results consistent with our predictions, while in the others they are either insignificant or with the wrong sign. We included also managerial ownership in a non-linear fashion, but

those results were also weak. Further, we tried alternative definitions of limited managerial discretion, but the results were always insignificant. It seems, therefore, that entrenchment effects do not cause higher investment cash flow sensitivity for PHC firms. This would also be in line with the descriptive statistics in Table 8, which show higher growth opportunities for this group of companies. Generally, the agency costs of managerial discretion are less important, and may be trivial for firms with valuable investment opportunities, because the objectives of management and shareholders are more likely to coincide.

We therefore explored how the accumulated cash of PHC companies is invested. We conducted some descriptive analyses of the industry distribution that characterizes these companies. Most of them are distributed in high growth and service sectors (Table A.4). We examined, then, the types of investments undertaken by these companies. Preliminary investigations reveal that, when they are identified as PHC and in the years after that, these firms generally increase their expenditures in intangible assets, while there is no evidence of higher capital expenditures (these observations are obtained by averaging the values for intangible assets and capital expenditures respectively across the four sub-panels). In addition, contrary to PLC firms, we detect also that on average these companies increase their dividend payouts (Table A.5).

Based on these results, we may argue that the positive investment cash flow sensitivity of PHC firms is driven by the fact that positive excess of cash aims other than increasing the amount of fixed assets. Instead, accumulated cash allows firms to invest in high growth projects that the capital market would not be willing to finance. In addition, it may help them to build a positive reputation with external investors through the signal of larger dividend payouts.

7. Conclusions

This work has empirically investigated how cash holding policies influence investment decisions in a large sample of publicly traded UK companies from 1989-2002, on the assumption that cash holdings facilitate firms' ability to invest in imperfect capital markets.

Our study contributes to the literature on corporate investment on several grounds. First, we measure the ability of companies to invest by assessing their liquidity position

with respect to their target cash. Then, we investigate how deviations from the targets affect both the amount of investment expenditures and the sensitivity of investments to cash flow. Contrary to previous research, we aim to provide a more comprehensive analysis of the investment behaviour of both cash-rich and cash-poor companies.

Second, in estimating the target cash holding, we take into account two important issues that may potentially bias the target computation: the endogeneity among variables and the evolution of the target over time. Therefore, we adopt two techniques, cross-sections average (CSA) and dynamic GMM, in an attempt to mitigate such problems and calculate more accurate targets.

Third, thanks to the availability of a rich data set of both economic and ownership variables, we are able to estimate the influence of ownership characteristics on the target cash computation and investment models in a panel data framework.

Finally, our study may shed more light on the relation between cash holding policy and investment expenditures for UK firms.

The results reported in our work suggest that those firms showing a persistently low cash policy invest less. Furthermore, the decreasing investment cash flow sensitivity for this group of firms may suggest that these companies do not rely on liquid assets to finance their investments. The robustness checks we conducted in this study provide support to the interpretation that PLC firms prefer to use cash flow to increase their cash holdings rather than investing it in capital expenditures, in an attempt to get closer to their target cash. Additionally, they show that these companies prefer to retain the accumulated cash or, at most, spend it in intangible assets.

On the other hand, our analysis reveals that being a cash-rich firm has no significant impact on capital expenditures. Nonetheless, a persistently high cash policy seems to increase the investment cash flow sensitivity. Further investigations, however, seem to indicate that this is not caused by managerial discretion issues. Instead, this increase for PHC companies seem to be justified by the fact that positive excess of cash accomplish different tasks than increasing the amount of fixed assets. Our robustness checks reveal, in fact, that accumulated cash may allow firms to invest in high growth projects, and also help them to build a positive reputation with external investors through larger dividend payouts.

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Tab.1. Variables definitions.

	Panel A. Economic variables
CASH	Ratio of total cash and equivalents to total assets
LEV	Ratio of total debt to total assets
CFLOW	Ratio of operating profits before tax, interest and preference dividends plus depreciation to total assets
CFLVAR	Standard deviation of cash flows over the 6 preceding years divided by average total assets calculated in the same 6 years
SIZE	Natural logarithm of total assets
MTBV	Ratio of book value of total assets minus book value of equity plus market value of equity to book value of assets
DIV	Ratio of total payment dividend to total assets
DEBT ISSUE	Ratio of net debt issued in each year to total assets
EQUITY ISSUE	Ratio of net equity issued in each year to total assets
TANG	Ratio of fixed assets to total assets
R&D	Ratio of expenditure in intangible assets to total assets
I	Expenditure in fixed assets. Due to changes in company accounts definitions in 1991, until 1991 it is equal to the total new fixed assets; from 1991 it is equal to the sum of payments for fixed assets and the net of fixed assets of subsidiaries.
K	Capital stock is measured on a replacement cost basis. For the first observation, the replacement cost is assumed equal to the historic cost of total net fixed assets, adjusted for inflation. For the following observations, a standard perpetual inventory method process is adopted as follow: $K_{it} = K_{it-1}(1-\delta) + I_{it}$, where δ is the rate of depreciation assumed to be 0.08.
IK	Capital expenditure to capital stock
CFK	Ratio of Operating profits before tax, interest and preference dividends plus depreciation of fixed assets to capital stock
Q	Ratio of market value of equity plus total debt total cash and equivalents to capital stock
PLC	Dummy equal to 1 if a company is identified as persistently low cash firm and 0 otherwise
PHC	Dummy equal to 1 if a company is identified as persistently high cash firm and 0 otherwise
INTER	PLC *CFK
INTER_OV	PHC *CFK
	Panel B. Ownership variables
MAN	Percentage of ownership held by executive directors
LARGEST	Percentage of ownership held by first non-managerial shareholder
TOTEXEC	Total number of executives directors
TOTNONEX	Total number of non-executive directors
BOARD	Total number of directors on the board
RATIO	Proportion of non-executives to total number of directors

This table includes the definitions of all variables adopted in our analysis. Economic and market data come from *Datastream*, while ownership data from PriceWaterHouse *Corporate register*.

Table 2. Summary of empirical predictions.

Panel A. Cash model hypotheses

Control variables	Transaction costs	Asymmetric information	Agency costs of debt	Managerial discretion
LEV	negative			negative
LEV^2	positive			
CFLOW	negative/positive			
CFLVAR	positive			
SIZE		negative	negative	positive
MTBV	positive	positive	positive	negative
DIV	negative/positive	negative		negative
MAN				positive
LARGEST				negative/positive
RATIO				negative/positive

Panel B. Investment model hypotheses

		Low ability to invest	High ability to invest	High ability to invest	High managerial discretion
PLC firms	*IK*	negative	positive		
	ICFS	positive	negative		
PHC firms	*IK*			positive	negative/positive
	ICFS			negative	positive

This table shows the empirical predictions of the major theories tested in the paper and the proxy variables used to test the predictions. Panel A include all the predictions for the cash model; Panel B summarizes the expected impacts of "cash holding status" dummies (PLC/PHC) on both the amount of capital expenditures (IK) and the investment cash flow sensitivity (ICFS). LEV is measured by the ratio of total debt to total assets; LEV^2 is LEV squared; CFLOW is defined as the ratio of operating profits before tax, interest and preference dividends plus depreciation to total assets; CFLVAR is the ratio of standard deviation of cash flow divided by average total assets; SIZE is equal to the natural logarithm of total assets in 1989 prices; MTBV is the ratio of book value of total assets minus book value of equity plus market value of equity to book value of assets; DIV is the ratio of total payment dividend to total assets; MAN is equal to the percentage of ownership held by executive directors; LARGEST is the percentage of ownership held by the first non-managerial shareholder; RATIO is equal to the proportion of non-executives to total number of directors; PLC is a dummy equal to 1 if a company is identified as persistently low cash firm; PHC is a dummy equal to 1 if a company is identified as persistently high cash firm; IK is defined as the ratio of investment to capital stock; ICFS is the investment cash flow sensitivity.

Table 3. Examples for "cash holding *status*" dummy and structure of the estimation period used in the analysis for investment model in CSA.

A. "Cash holding status" dummy: an example

	1991	1992	1993	√ = low cash firm ; PLC dummy = 1
Firm A	√	√	√	PLC = 1
Firm B	X	√	√	PLC = 1
Firm C	√	√	X	PLC = 0

B. Sub-panels

Sub-panels	1	2	3	4
Years	1991 – 1993	1994 – 1996	1997 – 1999	2000 – 2001

C. Estimation periods for investment model in CSA

	Obs	IK_i	$\sum \delta X_i$
Firm A	1	1994	1991 – 1993
	2	1997	1994 – 1996
	3	2000	1997 – 1999
	4	2002	2000 – 2001

This table includes an example of how we build the "cash holding status" dummies and the structure of the estimation periods for the investment model regressions. Panel A illustrates three different examples of the construction of persistently low cash dummy (PLC). √ represents a dummy equal to 1 if a firm in a particular year is low cash, that is, it is above the 25% percentile of the distribution of the ratio of deviation to the target for undershooting firms, and 0 otherwise; PLC is a dummy equal to 1 if a firm is low cash for two or three consecutive years, as shown in the table, and 0 otherwise. Panel B presents the structure of the 4 sub-panels used for the CSA estimations of the investment model. Panel C illustrates how we indeed implement the CSA for the investment model for a company with a complete time series of observations. IK is defined as the ratio of investment to capital stock; $\sum \delta X_i$ represents all the regressors entering the estimated investment models.

Table 4. Descriptive statistics.

Variable	Mean	Std.Dev.	25th Percentile	Median	75th Percentile
CASH	0.104	0.122	0.018	0.064	0.145
LEV	0.174	0.133	0.066	0.161	0.253
CFLOW	0.113	0.112	0.066	0.117	0.173
CFLVAR	0.068	0.057	0.031	0.051	0.084
SIZE	11.287	1.850	9.975	11.040	12.453
MTBV	1.530	0.882	0.998	1.294	1.767
DIV	0.027	0.022	0.013	0.025	0.037
DEBT ISSUE	0.001	0.068	-0.019	-0.001	0.012
EQUITY ISSUE	0.019	0.081	0	0.001	0.004
TANG	0.351	0.204	0.204	0.321	0.461
R&D	0.023	0.070	0	0	0.011
IK	0.129	0.128	0.059	0.111	0.180
CFK	0.384	0.445	0.180	0.284	0.457
Q	3.6	4.475	1.192	2.032	3.958
MAN	8.614	14.019	0.154	1.483	11.199
LARGEST	10.961	10.964	0	9.58	15
TOTEXEC	4.153	1.722	3	4	5
TOTNONEX	3.210	1.654	2	3	4
BOARD	7.364	2.504	6	7	9
RATIO	0.432	0.146	0.333	0.429	0.5

This table shows the sample characteristics for 652 firms over the period 1989-2002. CASH is defined as the ratio of total cash and equivalents to total assets; LEV is measured by the ratio of total debt to total assets; CFLOW is defined as the ratio of operating profits before tax, interest and preference dividends plus depreciation to total assets; CFLVAR is the ratio of standard deviation of cash flow divided by average total assets; SIZE is equal to the natural logarithm of total assets in 1989 prices; MTBV is the ratio of book value of total assets minus book value of equity plus market value of equity to book value of assets; DIV is the ratio of total payment dividend to total assets; DEBT ISSUE is equal to the ratio of net debt issued in each year to total assets; EQUITY ISSUE is the ratio of net equity issued in each year to total assets; TANG is defined as the ratio of fixed assets to total assets; R&D is the ratio of total intangible assets to total assets; IK is defined as the ratio of investment to capital stock; CFK is measured by the ratio of cash flow to capital stock; Q is equal to the market value of assets to capital stock; MAN is equal to the percentage of ownership held by executive directors; LARGEST is the percentage of ownership held by the first non-managerial shareholder; TOTEXEC is equal to the total number of executives directors; TOTNONEX is the total number of non-executive directors; BOARD represents the total number of directors on the board; RATIO is equal to the proportion of non-executives to total number of directors.

Table 5. CSA and GMM results for cash model.

	cs91	cs92	cs93	cs94	cs95	cs96	cs97	cs98	cs99	cs00	cs01	GMM
LEV	-0.728***	-0.730***	-0.671***	-0.466***	-0.434***	-0.528***	-0.538***	-0.719***	-0.574***	-0.522***	-0.574***	-0.190**
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.044]
LEV^2	1.203***	1.096***	0.991***	0.730***	0.666***	0.727***	0.570***	0.888***	0.737***	0.697***	0.817***	0.275*
	[0.000]	[0.000]	[0.001]	[0.000]	[0.002]	[0.007]	[0.006]	[0.000]	[0.002]	[0.001]	[0.000]	[0.095]
CFLOW	0.035	0.164*	0.013	0.155*	0.042	-0.045	-0.099	-0.039	-0.109	-0.025	-0.047	0.082
	[0.668]	[0.061]	[0.825]	[0.070]	[0.570]	[0.425]	[0.152]	[0.559]	[0.197]	[0.736]	[0.530]	[0.354]
CFLVAR	0.223	0.037	0.014	0.229*	0.066	0.11	-0.03	0.051	0.171	-0.098	0.042	-0.150
	[0.149]	[0.762]	[0.908]	[0.073]	[0.518]	[0.281]	[0.767]	[0.580]	[0.108]	[0.325]	[0.667]	[0.111]
SIZE	0.011***	0.010**	0.008**	0.007**	0.009**	0.009***	0.007**	0.007**	0.004	-0.001	-0.001	-0.028**
	[0.000]	[0.013]	[0.014]	[0.044]	[0.011]	[0.004]	[0.044]	[0.030]	[0.238]	[0.747]	[0.859]	[0.034]
MTBV	0.027*	0.031*	0.039***	0.021**	0.035***	0.022**	0.031***	0.023***	0.016**	0.014***	0.007*	0.011*
	[0.070]	[0.072]	[0.003]	[0.044]	[0.000]	[0.038]	[0.001]	[0.001]	[0.019]	[0.009]	[0.083]	[0.094]
DIV	0.848*	0.607	0.725	0.666	0.846	0.876*	0.546	0.166	0.497	0.338	0.772**	-0.794*
	[0.081]	[0.181]	[0.177]	[0.130]	[0.108]	[0.069]	[0.234]	[0.648]	[0.162]	[0.341]	[0.033]	[0.078]
MAN		0	0	0	0	0	0	0.001	0.001	0	0.001	-0.000
		[0.855]	[0.576]	[0.306]	[0.458]	[0.535]	[0.693]	[0.151]	[0.176]	[0.480]	[0.373]	[0.788]
LARGEST		0	0.001	0.001***	0.001*	0	0.001	0.001*	0.001*	0.001	0.002**	-0.001
		[0.634]	[0.209]	[0.009]	[0.057]	[0.333]	[0.121]	[0.071]	[0.075]	[0.183]	[0.027]	[0.844]
RATIO		0.005	-0.037	-0.033	-0.031	-0.068**	-0.066*	-0.038	-0.077*	-0.033	-0.001	-0.088*
		[0.879]	[0.301]	[0.378]	[0.337]	[0.042]	[0.085]	[0.338]	[0.065]	[0.475]	[0.992]	[0.084]
$CASH_{t-1}$												0.588***
												[0.000]
Const	-0.031	-0.01	0.024	0.003	-0.034	0.013	0.056	0.056	0.088	0.142**	0.104*	
	[0.426]	[0.847]	[0.609]	[0.949]	[0.470]	[0.754]	[0.245]	[0.224]	[0.117]	[0.023]	[0.074]	
Obs	504	504	542	567	593	621	652	614	529	465	427	4801
R-2	0.22	0.3	0.29	0.25	0.27	0.24	0.23	0.23	0.19	0.15	0.19	
Wald test1												257.9***
Wald test2												22.23***
Sargan test												$84.97_{(88)}$

m1												-9.06***
m2												-0.140
λ												0.412
Tp	0.302	0.330	0.338	0.319	0.325	0.363	0.47	0.40	0.389	0.374	0.351	0.345

This table presents cross-sectional and GMM regressions predicting cash holdings. The estimation period for CSA is 1989-2001 with a total of 11 cross-section averages. The dependent variable is CASH, measured in each year from 1991 to 2001, while the regressors are averaged over the two years preceding the year of the dependent variable. In all CSA industry dummies are included. The estimation period for GMM is 1991-2001 depending on the availability of ownership data. In GMM estimations all the regressors are dated at time [t], except for the lagged dependent variable at [t-1]. GMM is the model in the first differences with levels dated [t-2] of all regressors as instruments. In GMM model time dummies are included. Asymptotic standard errors robust to heteroskedasticity are used in all the estimations. P-values are reported in parentheses. CASH is defined as the ratio of total cash and equivalents to total assets; LEV is measured by the ratio of total debt to total assets; LEV2 is LEV squared; CFLOW is defined as the ratio of operating profits before tax, interest and preference dividends plus depreciation to total assets; CFLVAR is the ratio of standard deviation of cash flow divided by average total assets; SIZE is equal to the natural logarithm of total assets in 1989 prices; MTBV is the ratio of book value of total assets minus book value of equity plus market value of equity to book value of assets; DIV is the ratio of total payment dividend to total assets; MAN is equal to the percentage of ownership held by executive directors; LARGEST is the percentage of ownership held by the first non-managerial shareholder; RATIO is equal to the proportion of non-executives to total number of directors.

Wald test 1 is a Wald test of joint significance of the estimated coefficients which is asymptotically distributed as chi-square under the null of no relationship; Wald test 2 is a Wald test of the joint significance of the time dummies; Sargan test is a test of overidentifying restrictions, distributed as chi-square under the null of instrument validity; *m1* and *m2* are test statistics for first and second order autocorrelations in residuals, respectively, distributed as standard normal N(0,1) under the null of no serial correlation; λ is the adjustment factor calculated from the estimated coefficient of the lagged dependent variable; tp is the estimated turning point for the quadratic relation of leverage. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6. Descriptive statistics for target, deviations.

Variable	**Mean**	**Std.Dev.**	**25th Percentile**	**Median**	**75th Percentile**
Target	0.054	0.073	0.007	0.057	0.101
Deviation	0.046	0.112	-0.029	0.031	0.103
Ratio of deviation to target for undershooting firms	0.633	0.314	0.374	0.687	0.943
Ratio of deviation to target for overshooting firms	1.221	44.135	0.134	0.404	1.591

This table shows the descriptive statistics of target and deviations for 652 firms over the period 1991-2001. Target is the target cash that we calculate from the annual CSA estimations, including in the equation LEV, LEV^2, SIZE, MTBV, DIV and RATIO. Deviation is the difference between the actual level of cash and the target cash. Negative deviations represent *undershooting* firms, while positive deviations indicate *overshooting* firms. Ratio of deviation to target for undershooting firms is defined as the ratio of deviation to the target when deviation is negative (*undershooting* firms). Vice versa, Ratio of deviation to target for overshooting firms is the ratio of deviation to the target when deviation is positive (*overshooting* firms).

Table 7. Number of PLC and PHC firms.

Panel A

	num. firms		*num. firms*
PLC1	159	**PHC1**	198
PLC2	203	**PHC2**	161
PLC3	42	**PHC3**	262
PLC4	3	**PHC4**	162
PLC1-PLC4	0	**PHC1-PHC4**	11
PLC1-PLC3	14	**PHC1-PHC3**	51
PLC2-PLC4	0	**PHC2-PHC4**	16
PLC1-PLC2	103	**PHC1-PHC2**	99
PLC2-PLC3	23	**PHC2-PHC3**	80
PLC3-PLC4	0	**PHC3-PHC4**	71

Panel B

	num. changing firms		*num. changing firms*
PLC1, PHC2	6	**PHC1, PLC2**	16
PLC2, PHC3	74	**PHC2, PLC3**	5
PLC1-PLC2, PHC3	34	**PHC1-PHC2, PLC3**	3
PLC3, PHC4	9	**PHC3, PLC4**	1
PLC2-PLC3, PHC4	5	**PHC2-PHC3, PLC4**	0
PLC1-PLC3, PHC4	3	**PHC1-PHC3, PLC4**	0

This table summarizes the number of firms classified both as PLC and PHC. PLC firms are those companies that have persistently low cash, that is, low cash for two or three consecutive years preceding the year in which investment decisions are made. Vice versa, PHC firms are those companies that show high cash for two or three consecutive years preceding the year in which their investment decisions are made. Panel A shows how many PLC (PHC) companies are in each sub-panel and through the overall period. For instance, PLC1 indicates the number of PLC firms in the first sub-panel. On the other hand, [PLC1-PLC4] represents the number of PLC firms in each sub-panel from the first to the fourth one. Panel B illustrates how many firms have changed their cash holding status during the estimation period. For example, [PLC1, PHC2] indicates the number of PLC companies in the first sub-panel that become PHC in the second sub-panel. On the other hand, [PLC1-PLC2, PHC3] represents those PLC firms in the first and second period that become PHC in the third period. The same criteria hold for PHC firms.

Table 8. Test for difference in means between PLC and PHC firms.

		1991-1993	p-value	**1994-1996**	p-value	**1997-1999**	p-value	**2000-2001**	p-value	**1991-2001**	p-value
LEV	*PHC*	0.167	0.019 **	0.143	0.003 ***	0.136	0.979	0.223	0.765	0.163	0.129
	PLC	0.184		0.162		0.135		0.204		0.169	
DEBT ISSUE	*PHC*	-0.006	0.005 ***	-0.002	0.072 *	0.003	0.082 *	0.003	0.174	-0.001	0.022 **
	PLC	0.003		0.003		0.013		0.033		0.004	
EQUITY ISSUE	*PHC*	0.025	0.941	0.020	0.058 *	0.011	0.474	0.003	0.081 *	0.015	0.001 ***
	PLC	0.025		0.027		0.003		0.038		0.024	
MTBV	*PHC*	1.584	0.000 ***	1.720	0.000 ***	1.677	0.446	1.313	0.000 ***	1.588	0.000 ***
	PLC	1.331		1.502		1.779		2.932		1.465	
TANG	*PHC*	0.324	0.000 ***	0.280	0.000 ***	0.310	0.000 ***	0.391	0.003 ***	0.323	0.000 ***
	PLC	0.432		0.395		0.411		0.108		0.410	
R&D	*PHC*	0.026	0.000 ***	0.023	0.016 ***	0.033	0.035 ***	0.038	0.815	0.030	0.000 ***
	PLC	0.008		0.016		0.017		0.027		0.013	
SIZE	*PHC*	11.385	0.000 ***	11.497	0.029	11.084	0.515	11.130	0.707	11.260	0.042 **
	PLC	10.979		11.281		11.210		10.856		11.150	
CFLVAR	*PHC*	0.029	0.932	0.031	0.011 **	0.033	0.778	0.026	0.001 ***	0.068	0.000 ***
	PLC	0.025		0.028		0.039		0.038		0.061	

Table 8. Test for difference in means between PLC and PHC firms. (continued)

		1991-1993	p-value	**1994-1996**	p-value	**1997-1999**	p-value	**2000-2001**	p-value	**1991-2001**	p-value
MAN	*PHC*	9.578	0.013 **	7.153	0.008 ***	9.131	0.278	7.487	0.320	8.553	0.000 ***
	PLC	11.794		9.080		10.831		0.118		10.284	
LARGEST	*PHC*	11.098	0.015 **	11.815	0.003 ***	12.165	0.000 ***	11.207	0.235	11.629	0.000 ***
	PLC	9.527		9.906		7.948		7.287		9.584	
BOARD	*PHC*	7.519	0.001 ***	7.555	0.108	7.246	0.005 ***	7.155	0.715	7.386	0.128
	PLC	7.038		7.360		7.958		6.667		7.280	
RATIO	*PHC*	0.394	0.044 **	0.431	0.158	0.430	0.245	0.452	0.259	0.423	0.001 ***
	PLC	0.378		0.422		0.447		0.542		0.407	

This table shows the tests for difference in means between PLC and PHC companies over a number of variables that characterized these two groups of firms. Tests are run for each sub-panel and for the entire estimation period. PLC firms are those companies that have persistently low cash, that is, low cash for two or three consecutive years preceding the year in which investment decisions are made. Vice versa, PHC firms are those companies that show high cash for two or three consecutive years preceding the year in which their investment decisions are made. Cash and equivalents to total assets; LEV is measured by the ratio of total debt to total assets; DEBT ISSUE is equal to the ratio of net debt issued in each year to total assets; EQUITY ISSUE is the ratio of net equity issued in each year to total assets; MTBV is the ratio of book value of total assets minus book value of equity plus market value of equity to book value of assets; TANG is defined as the ratio of fixed assets to total assets; R&D is the ratio of total intangible assets to total assets; SIZE is equal to the natural logarithm of total assets in 1989 prices; CFLVAR is the ratio of standard deviation of cash flow divided by average total assets; MAN is equal to the percentage of ownership held by executive directors; LARGEST is the percentage of ownership held by the first non-managerial shareholder; BOARD represents the total number of directors in the board; RATIO is equal to the proportion of non-executives to total number of directors

***, **, * means that the test for difference in mean rejects the null hypothesis of equality of means at 1%, 5% and 10% significance level, respectively.

Table 9. CSA and GMM results for investment model.

Panel A. PLC firms

IK	**cs94**	**cs94**	**cs97**	**cs97**	**cs00**	**cs00**	**cs02**	**cs02**	**GMM**	**GMM**
CFK	-0.006	0.041	-0.029	-0.017	-0.01	0.001	0.02	0.019	-0.001	0.019
	[0.887]	[0.421]	[0.458]	[0.711]	[0.637]	[0.970]	[0.418]	[0.409]	[0.976]	[0.680]
Q	0.014***	0.013***	0.012***	0.012***	0.006**	0.006**	0.005***	0.005***	0.008**	0.010**
	[0.000]	[0.000]	[0.000]	[0.000]	[0.010]	[0.014]	[0.002]	[0.001]	[0.029]	[0.020]
INTER		-0.075*		-0.026		-0.047**		-0.061**		-0.032*
		[0.097]		[0.459]		[0.014]		[0.044]		[0.096]
PLC	-0.032***	-0.01	-0.022*	-0.012	-0.065**	0.014	-0.031	0.055	-0.001	-0.001
	[0.001]	[0.552]	[0.053]	[0.463]	[0.019]	[0.629]	[0.365]	[0.394]	[0.689]	[0.711]
IK $_{t-1}$									0.130***	0.123***
									[0.000]	[0.000]
Const	0.099***	0.086***	0.104***	0.099***	0.095***	0.091***	0.070***	0.070***		
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]		
Obs	516	516	574	574	393	393	358	358	3905	3905
R-2	0.14	0.15	0.1	0.1	0.1	0.11	0.15	0.15		
Wald(joint)									30.14***	38.70***
Wald(time)									49.47***	54.23***
Sargan test									78.75 $_{(65)}$	96.32 $_{(81)}$
m1									-9.948***	-9.533***
m2									-0.01489	-0.1478
λ									0.870	0.877

Table 9. CSA and GMM results for investment model. (continued)

Panel B. PHC firms

IK	cs94	cs94	cs97	cs97	cs00	cs00	cs02	cs02	GMM	GMM
CFK	-0.009	-0.025	-0.025	-0.049	-0.012	-0.023	0.021	0.028	-0.011	-0.002
	[0.841]	[0.518]	[0.521]	[0.231]	[0.587]	[0.293]	[0.406]	[0.351]	[0.820]	[0.962]
Q	0.014***	0.013***	0.012***	0.012***	0.006***	0.006**	0.005***	0.005***	0.007**	0.008**
	[0.000]	[0.000]	[0.001]	[0.001]	[0.009]	[0.013]	[0.002]	[0.002]	[0.048]	[0.030]
INTER_OV		0.099*		0.100*		0.041*		-0.025		0.021*
		[0.081]		[0.052]		[0.066]		[0.485]		[0.092]
PHC	0.014	-0.012	0.005	-0.034	0.007	-0.014	0.004	0.023	0.000	-0.000
	[0.189]	[0.593]	[0.650]	[0.108]	[0.600]	[0.435]	[0.782]	[0.248]	[0.789]	[0.986]
IK_{t-1}									0.129***	0.113***
									[0.000]	[0.000]
Const	0.085***	0.090***	0.096***	0.103***	0.092***	0.099***	0.069***	0.064***		
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]		
Obs	516	516	573	573	393	393	358	358	4063	4063
R-2	0.13	0.14	0.1	0.11	0.1	0.11	0.15	0.16		
Wald(joint)									29.25***	28.00***
Wald(time)									55.84***	36.93***
Sargan test									$73.37_{(65)}$	$89.61_{(81)}$
m1									-10.22***	-9.995***
m2									0.5203	0.3034
λ									0.871	0.887

This table presents cross-sectional and GMM regressions predicting capital expenditures decisions. The estimation period for CSA is 1991-2002 with a total of 4 cross-section averages. The dependent variable is IK, measured in 1994, 1997, 2000 and 2002, while the regressors are averaged over the three years preceding the year of the dependent variable. In all CSA industry dummies are included. The estimation period for GMM is 1993-2002, depending on the availability of "cash holding status" dummies. In GMM estimations CFK, "cash holding status" dummies and the interaction terms are dated at [t-1], while Q at time [t]. GMM is the model in the first differences with levels dated [t-2, t-3] of all regressors as instruments. In GMM model time dummies are included. Asymptotic standard errors robust to heteroskedasticity are used in all the estimations. P-values are reported in parentheses. IK is defined as the ratio of investment to capital stock; CFK is equal to the ratio of cash flow to capital stock; Q represents the ratio of market value of assets to capital stock; PLC is a dummy equal to 1 if a company is identified as persistently low cash firm and 0 otherwise; PHC is a dummy equal to 1 if a company is identified as persistently high cash firm and 0 otherwise; INTER is the interaction term between PLC and CFK; INTER_OV is the interaction term between PHL and CFK.

Wald test 1 is a Wald test of joint significance of the estimated coefficients which is asymptotically distributed as chi-square under the null of no relationship; Wald test 2 is a Wald test of the joint significance of the time dummies; Sargan test is a test of overidentifying restrictions, distributed as chi-square under the null of instrument validity; m1 and m2 are test statistics for first and second order autocorrelations in residuals, respectively, distributed as standard normal N(0,1) under the null of no serial correlation; λ is the adjustment factor calculated from the estimated coefficient of the lagged dependent variable. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 10. CSA results for investment model with overlapping sub-panels.

Panel A. PLC firms

	cs94	cs94	cs95	cs95	cs96	cs96	cs97	cs97	cs98	cs98
CFK	-0.006	0.041	0.04	0.071	-0.055	-0.043	-0.029	-0.017	-0.027	-0.02
	[0.887]	[0.421]	[0.266]	[0.112]	[0.237]	[0.392]	[0.458]	[0.711]	[0.362]	[0.519]
Q	0.014***	0.013***	0.003	0.003	0.013***	0.013***	0.012***	0.012***	0.011***	0.011***
	[0.000]	[0.000]	[0.420]	[0.339]	[0.006]	[0.006]	[0.000]	[0.000]	[0.000]	[0.000]
INTER		-0.075*		-0.068*		-0.023		-0.026		-0.049
		[0.097]		[0.057]		[0.553]		[0.459]		[0.255]
PLC	-0.032***	-0.01	-0.007	0.018	-0.036***	-0.028	-0.022*	-0.012	-0.011	0.01
	[0.001]	[0.552]	[0.580]	[0.293]	[0.004]	[0.115]	[0.053]	[0.463]	[0.491]	[0.664]
Const	0.099***	0.086***	0.114***	0.103***	0.123***	0.119***	0.104***	0.099***	0.113***	0.109***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Obs	516	516	546	546	559	559	574	574	550	550
R-2	0.14	0.15	0.09	0.1	0.11	0.11	0.1	0.1	0.12	0.12

	cs99	cs99	cs00	cs00	cs01	cs01	cs02	cs02
CFK	-0.002	0.004	-0.01	0.001	0.022	0.022	0.02	0.019
	[0.928]	[0.867]	[0.637]	[0.970]	[0.377]	[0.381]	[0.418]	[0.409]
Q	0.006**	0.006**	0.006**	0.006**	0.004***	0.004***	0.005***	0.005***
	[0.018]	[0.012]	[0.010]	[0.014]	[0.004]	[0.003]	[0.002]	[0.001]
INTER		-0.044**		-0.047**		-0.173***		-0.061**
		[0.049]		[0.014]		[0.002]		[0.044]
PLC	0.005	0.027	-0.065**	0.014	-0.068***	0.018	-0.031	0.055
	[0.813]	[0.273]	[0.019]	[0.629]	[0.001]	[0.513]	[0.365]	[0.394]
Const	0.104***	0.100***	0.095***	0.091***	0.071***	0.071***	0.070***	0.070***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Obs	465	465	393	393	366	366	357	357
R-2	0.1	0.1	0.1	0.11	0.13	0.13	0.14	0.14

Table 10. CSA results for investment model with overlapping sub-panels. (continued)

Panel B. PHC firms

	cs94	cs94	cs95	cs95	cs96	cs96	cs97	cs97	cs98	cs98
CFK	-0.009	-0.025	0.044	0.03	-0.039	-0.053	-0.025	-0.049	-0.031	-0.051*
	[0.841]	[0.518]	[0.207]	[0.381]	[0.348]	[0.229]	[0.521]	[0.231]	[0.293]	[0.098]
Q	0.014***	0.013***	0.002	0.002	0.012***	0.013***	0.012***	0.012***	0.011***	0.011***
	[0.000]	[0.000]	[0.518]	[0.542]	[0.003]	[0.002]	[0.001]	[0.001]	[0.000]	[0.000]
INTER_OV		0.099*		0.086**		0.057		0.100*		0.074*
		[0.081]		[0.027]		[0.206]		[0.052]		[0.066]
PHC	0.014	-0.012	-0.006	-0.035**	0.005	-0.015	0.005	-0.034	0.031***	0
	[0.189]	[0.593]	[0.556]	[0.029]	[0.656]	[0.432]	[0.650]	[0.108]	[0.009]	[0.986]
Const	0.085***	0.090***	0.118***	0.123***	0.110***	0.113***	0.096***	0.103***	0.100***	0.107***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Obs	541	541	570	570	584	584	600	600	552	552
R-2	0.13	0.14	0.09	0.1	0.11	0.11	0.12	0.12	0.13	0.14

	cs99	cs99	cs00	cs00	cs01	cs01	cs02	cs02
CFK	-0.016	-0.019	-0.012	-0.023	0.041**	0.035**	0.021	0.028
	[0.480]	[0.422]	[0.587]	[0.293]	[0.032]	[0.048]	[0.406]	[0.351]
Q	0.007***	0.007***	0.006***	0.006**	0.003	0.003	0.005***	0.005***
	[0.007]	[0.007]	[0.009]	[0.013]	[0.118]	[0.124]	[0.002]	[0.002]
INTER_OV		0.011		0.041*		0.018		-0.025
		[0.646]		[0.066]		[0.599]		[0.485]
PHC	0.034***	0.029*	0.007	-0.014	-0.008	-0.016	0.004	0.023
	[0.007]	[0.083]	[0.600]	[0.435]	[0.522]	[0.312]	[0.782]	[0.248]
Const	0.092***	0.093***	0.092***	0.099***	0.079***	0.082***	0.069***	0.064***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Obs	468	468	393	393	367	367	358	358
R-2	0.11	0.11	0.1	0.11	0.11	0.11	0.14	0.14

This table presents cross-sectional regressions on overlapping panels predicting capital expenditures decisions. The estimation period for CSA is 1991-2002 with a total of 9 cross-section averages. The dependent variable is IK, measured in each year from 1994 to 2002, while the regressors are averaged over the three years preceding the

year of the dependent variable. In all CSA industry dummies are included. Asymptotic standard errors robust to heteroskedasticity are used in all the estimations. P-values are reported in parentheses. IK is defined as the ratio of investment to capital stock; CFK is equal to the ratio of cash flow to capital stock; Q represents the ratio of market value of assets to capital stock; PLC is a dummy equal to 1 if a company is identified as persistently low cash firm and 0 otherwise; PHC is a dummy equal to 1 if a company is identified as persistently high cash firm and 0 otherwise; INTER is the interaction term between PLC and CFK; INTER_OV is the interaction term between PHL and CFK. * significant at 10%; ** significant at 5%; *** significant at 1%.

Appendix 1
Panel data specification and structure of panel

The underlining assumption of a partial adjustment model for cash holding policy is that firms have a cash target ($CASH^*_{it}$) which is a function of K firm-specific characteristics (anticipated changes), ($\sum_{k=1}^{k} \beta_k X_{kit}$) and a disturbance term (unanticipated shocks), (u_{it}) (Maddala, 2001).

$$\mathrm{CASH}^*_{it} = \sum_{k=1}^{k} \beta_k X_{kit} + u_{it} \qquad \text{(A1)}$$

Firms try to adjust their current cash holding level to be closer to their target. This produces a partial adjustment process as follows:

$$\mathrm{CASH}_{it} - \mathrm{CASH}_{it-1} = \lambda\left(\mathrm{CASH}^*_{it} - \mathrm{CASH}_{it-1}\right) \qquad \text{(A2)}$$

where CASH_{it} is the current cash holding, $\left(\mathrm{CASH}^*_{it} - \mathrm{CASH}_{it-1}\right)$ is the target change and λ is the adjustment factor or, in other words, what can effectively be adjusted.

If we substitute the function (A1) in the partial adjustment equation (A2) and include η_i and η_t, we obtain our model (1)

$$\mathrm{CASH}_{it} = \delta \mathrm{CASH}_{it-1} + \sum_{k=1}^{k} \gamma_k X_{kit} + \eta_i + \eta_t + \nu_{it} \qquad \text{(A3)}$$

where now $\delta = (1 - \lambda)$, $\gamma_k = \lambda\beta_k$ and $v_{it} = \lambda u_{it}$. From the estimated coefficient of the lagged dependent variable, thus, we derive the estimated adjustment factor λ for our sample. λ can take any value between 0 and 1. If λ=1 there is an immediate adjustment ($\mathrm{CASH}_{it} = \mathrm{CASH}^*_{it}$) which, in turn, means that both the costs of adjustments are very low and the costs of being off-target are pretty high. On the other hand, if λ =0, implying $\mathrm{CASH}_{it} = \mathrm{CASH}_{it-1}$, the costs of adjustments are so high that firms cannot change their actual cash holding level. This may also imply that the costs of being away from the target are negligible.

Table A1. Structure of panel.

consecutive obs for each firm	**5**	**6**	**7**	**8**	**9**	**10**	**11**
number of firms	7	45	79	98	71	53	299

Appendix 2
Robustness checks for PLC and PHC firms

Table A.1. Deviation from the cash target over the entire period of those firms defined as PLC in each single sub-panel.

	Sub-panel 1	+ 1 yr	+ 2 yrs	+ 3 yrs	+ 4 yrs	+ 5 yrs	+ 6 yrs	+7 yrs	+8 yrs
Deviation	-0.0764	-0.0244	-0.0697	-0.0357	0.0147	0.0428	0.0739	0.1138	0.1083
Obs	159	155	157	151	150	137	115	95	86
	- 3 yrs	**- 2 yrs**	**- 1 yr**	**Sub-panel 2**	**+ 1 yr**	**+ 2 yrs**	**+ 3 yrs**	**+ 4 yrs**	**+ 5 yrs**
Deviation	-0.0861	-0.0400	-0.0450	-0.0576	-0.0041	0.0328	0.0669	0.1079	0.0987
Obs	156	169	177	203	189	180	147	132	117
	- 6 yrs	**- 5 yrs**	**- 4 yrs**	**- 3 yrs**	**- 2 yrs**	**- 1 yr**	**Sub-panel 3**	**+ 1 yr**	**+ 2 yrs**
Deviation	-0.0868	-0.0262	-0.0312	-0.0056	-0.0779	-0.0551	-0.0260	0.0716	0.0439
Obs	31	34	34	36	38	41	42	19	15

This table illustrates the deviations of PLC firms from their target in each year, from 1991 to 2001, before and after having been identified as PLC. Deviation is the difference between the actual level of cash and the target cash. Negative deviations represent undershooting firms, while positive deviations indicate overshooting firms. Deviations close to zero indicate that firms are close to their target cash. Figures of deviation in the sub-panels (1, 2, and 3) are averaged over the years of each sub-panel. Sub-panel 1 includes 1991 to 1993 information; sub-panel 2 includes 1994 to 1996 information; sub-panel 3 includes 1997 to 1999 information. The observations in the sub-panels represent the number of firms that has been identified as PLC in each sub-panel. Deviations of these firms are reported in the (preceding) subsequent years of each sub-panel. We present the results only for the first three sub-panels, because for the fourth one (2000-2001) we do not have information on deviations for the following years.

Table A.2. Spending patterns over the entire estimation period for those firms defined as PLC in each single sub-panel.

	- 2 yrs	- 1 yr	Sub-panel 1	+ 1 yr	+ 2 yrs	+ 3 yrs	+ 4 yrs	+ 5 yrs	+ 6 yrs	+7 yrs	+8 yrs	+9 yrs
IK	0.2895	0.2252	0.1193	0.1071	0.1257	0.1244	0.1237	0.1301	0.1108	0.1164	0.0942	0.0937
R&D	0.0009	0.0008	0.0048	0.0141	0.0056	0.0045	0.0074	0.0079	0.0073	0.0010	0.0024	0.0015
DIV	0.0290	0.0272	0.0247	0.0238	0.0236	0.0255	0.0265	0.0253	0.0236	0.0220	0.0203	0.0231

	- 5 yrs	- 4 yrs	- 3 yrs	- 2 yrs	- 1 yr	Sub-panel 2	+ 1 yr	+ 2 yrs	+ 3 yrs	+ 4 yrs	+ 5 yrs	+ 6 yrs
IK	0.2652	0.2012	0.1371	0.0915	0.1240	0.1362	0.1166	0.1308	0.1266	0.1021	0.1007	0.0858
R&D	0.0011	0.0008	0.0018	0.0042	0.0078	0.0068	0.0022	0.0008	0.0007	0.0008	0.0013	0.0015
DIV	0.0299	0.0274	0.0269	0.0267	0.0274	0.0281	0.0295	0.0272	0.0257	0.0239	0.0215	0.0233

	- 8 yrs	- 7 yrs	- 6 yrs	- 5 yrs	- 4 yrs	- 3 yrs	- 2 yrs	- 1 yr	Sub-panel 3	+ 1 yr	+ 2 yrs	+ 3 yrs
IK	0.2666	0.1966	0.1513	0.1099	0.1445	0.1665	0.1947	0.1857	0.1532	0.1066	0.1176	0.1117
R&D	0.0069	0.0038	0.0006	0.0008	0.0041	0.0032	0.0016	0.0027	0.0065	0.0073	0.0211	0.0112
DIV	0.0288	0.0298	0.0305	0.0305	0.0315	0.0337	0.0344	0.0365	0.0391	0.0391	0.0431	0.0393

	- 11 yrs	- 10 yrs	- 9 yrs	- 8 yrs	- 7 yrs	- 6 yrs	- 5 yrs	- 4 yrs	- 3 yrs	- 2 yrs	- 1 yr	Sub-panel 4	+ 1 yr
IK	0.1493	0.2517	0.0968	0.2963	0.1481	0.2667	0.0800	0.2098	0.4666	0.1704	0.1085	0.1602	0.1628
R&D	0	0	0.0004	0	0	0	0	0	0	0	0	0	0
DIV	0	0.0486	0.0518	0.0699	0.0520	0.0597	0.0585	0.0299	0.1194	0.1093	0.0597	0.0448	0.0340

This table illustrates the investment patterns of PLC firms in each year, from 1989 to 2002, before and after having been identified as PLC. IK is defined as the ratio of investment to capital stock; R&D is equal to the ratio of total intangible assets to total assets; DIV is the ratio of total payment dividend to total assets. Figures of IK, R&D and DIV in the sub-panels (1, 2, 3 and 4) are averaged over the years of each sub-panel. Sub-panel 1 includes 1991 to 1993 information; sub-panel 2 includes 1994 to 1996 information; sub-panel 3 includes 1997 to 1999 information; sub-panel 4 includes 2000 and 2001 information.

Table A.3. CSA and GMM results for investment model for PHC firms, augmented by managerial ownership.

IK	cs94	cs94	cs97	cs97	cs00	cs00	cs02	cs02	GMM	GMM
CFK	-0.038	-0.035	-0.052	-0.052	-0.023	-0.023	0.027	0.023	0.0006	-0.014
	[0.319]	[0.322]	[0.197]	[0.122]	[0.299]	[0.313]	[0.381]	[0.445]	[0.987]	[0.739]
Q	0.014***	0.014***	0.012***	0.013***	0.006**	0.006**	0.005***	0.005***	0.011***	0.010***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.014]	[0.018]	[0.002]	[0.003]	[0.010]	[0.004]
INTER_OV	0.091	0.044	0.105**	0.091*	0.037*	0.035	-0.021	0.02	0.036*	0.030
	[0.117]	[0.383]	[0.042]	[0.100]	[0.087]	[0.195]	[0.567]	[0.612]	[0.095]	[0.224]
PHC	-0.012	-0.017	-0.036*	-0.03	-0.011	-0.025	0.012	-0.012	-0.001	-0.000
	[0.564]	[0.347]	[0.088]	[0.152]	[0.526]	[0.133]	[0.517]	[0.482]	[0.845]	0.929]
MAN	0.001***	0	0.001*	0.001*	0	0	0.001	0.001*	0.003***	0.003***
	[0.005]	[0.218]	[0.090]	[0.059]	[0.286]	[0.340]	[0.222]	[0.085]	[0.008]	[0.009]
INTER_OV*MAN		0.004**		0		0		-0.002**		0.000
		[0.037]		[0.998]		[0.684]		[0.041]		[0.920]
IK_{t-1}									0.094***	0.102***
									[0.002]	[0.000]
Const	0.082***	0.086***	0.099***	0.099***	0.095***	0.095***	0.063***	0.062***		
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]		
Obs	516	516	573	573	393	393	358	358	3648	3648
R-2	0.16	0.17	0.11	0.11	0.11	0.11	0.16	0.16		
Wald(joint)									30.74***	32.44***
Wald(time)									34.66***	39.40***
Sargan test									86.85 (85)	97.63 (99)
m1									-9.432***	-9.56***
m2									0.144	0.260
λ									0.906	0.898

This table presents cross-sectional and GMM regressions predicting capital expenditures decisions. The estimation period for CSA is 1991-2002 with a total of 4 cross-section averages. The dependent variable is IK, measured in 1994, 1997, 2000 and 2002, while the regressors are averaged over the three years preceding the year of the dependent variable. In all CSA industry dummies are included. The estimation period for GMM is 1993-2002, depending on the availability of "cash holding status" dummies. In GMM estimations CFK, "cash holding status" dummies and the interaction terms are dated at [t-1], while Q at time [t]. GMM is the model in the first differences with levels dated [t-2, t-3] of all regressors as instruments. In GMM model time dummies are included. Asymptotic standard errors robust to heteroskedasticity are used in all the estimations. P-values are reported in parentheses. IK is defined as the ratio of investment to capital stock; CFK is equal to the ratio

of cash flow to capital stock; Q represents the ratio of market value of assets to capital stock; PHC is a dummy equal to 1 if a company is identified as persistently high cash firm and 0 otherwise; INTER_OV is the interaction term between PHL and CFK; MAN represents the percentage of shares held by executive directors; INTER_OV*MAN is the interaction term between INTER_OV and MAN.
Wald test 1 is a Wald test of joint significance of the estimated coefficients which is asymptotically distributed as chi-square under the null of no relationship; Wald test 2 is a Wald test of the joint significance of the time dummies; Sargan test is a test of overidentifying restrictions, distributed as chi-square under the null of instrument validity; m1 and m2 are test statistics for first and second order autocorrelations in residuals, respectively, distributed as standard normal N(0,1) under the null of no serial correlation. λ is the adjustment factor calculated from the estimated coefficient of the lagged dependent variable. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A.4. Distributions by sector for both PHC and PLC firms.

Sectors	High Growth	Services	Manufacturing
% of PHC firms	31.34	27.87	40.79
% of PLC firms	23.77	22.95	53.28

This table shows the distribution of PLC and PHC firms by sectors. PLC is a dummy equal to 1 if a company is identified as persistently low cash firm and 0 otherwise; PHC is a dummy equal to 1 if a company is identified as persistently high cash firm and 0 otherwise. We group the two-digit sectors provided by Datastream in three main categories. In particular, "High Growth" includes chemicals, healthcare and pharmaceuticals, computer, electrical & electronic equipment, engineering, mining, metallurgy and oil-gas exploration; "Services" includes retailers, wholesalers, distributors, telecommunications and media and other services; "Manufacturing" includes automotive, aviation, transportation, beverages, tobacco, building and construction, diversified industry, food producer, farming and fishing, leisure, hotels, restaurants and pubs, paper, forestry, packaging, printing and publishing, photography, textile, leather, clothing and furniture.

Table A.5. Spending patterns over the entire period available for those firms defined as PHC in each single sub-panel.

	- 2 yrs	- 1 yr	Sub-panel 1	+ 1 yr	+ 2 yrs	+ 3 yrs	+ 4 yrs	+ 5 yrs	+ 6 yrs	+7 yrs	+8 yrs	+9 yrs
IK	0.2861	0.2138	0.1204	0.1353	0.1393	0.1361	0.1343	0.1498	0.1322	0.1265	0.1051	0.0996
R&D	0.0015	0.0024	0.0020	0.0014	0.0011	0.0028	0.0030	0.0016	0.0019	0.0025	0.0026	0.0028
DIV	0.0292	0.0288	0.0294	0.0308	0.0317	0.0331	0.0343	0.0344	0.0345	0.0327	0.0278	0.0288

	- 5 yrs	- 4 yrs	- 3 yrs	- 2 yrs	- 1 yr	Sub-panel 2	+ 1 yr	+ 2 yrs	+ 3 yrs	+ 4 yrs	+ 5 yrs	+ 6 yrs
IK	0.2746	0.2249	0.1439	0.1138	0.1063	0.1301	0.1330	0.1443	0.1276	0.1394	0.1189	0.1038
R&D	0.0015	0.0069	0.0025	0.0035	0.0031	0.0044	0.0078	0.0092	0.0091	0.0074	0.0073	0.0054
DIV	0.0292	0.0287	0.0288	0.0269	0.0275	0.0307	0.0339	0.0343	0.0337	0.0315	0.0251	0.0270

	- 8 yrs	- 7 yrs	- 6 yrs	- 5 yrs	- 4 yrs	- 3 yrs	- 2 yrs	- 1 yr	Sub-panel 3	+ 1 yr	+ 2 yrs	+ 3 yrs
IK	0.2648	0.2041	0.1356	0.1010	0.1160	0.1412	0.1351	0.1352	0.1284	0.1193	0.1065	0.1025
R&D	0.0004	0.0031	0.0004	0.0036	0.0066	0.0052	0.0040	0.0033	0.0057	0.0032	0.0046	0.0046
DIV	0.0306	0.0287	0.0279	0.0271	0.0273	0.0291	0.0295	0.0319	0.0333	0.0295	0.0274	0.0303

	- 11 yrs	- 10 yrs	- 9 yrs	- 8 yrs	- 7 yrs	- 6 yrs	- 5 yrs	- 4 yrs	- 3 yrs	- 2 yrs	- 1 yr	Sub-panel 4	+ 1 yr
IK	0.2952	0.2162	0.1293	0.1023	0.1272	0.1329	0.1370	0.1551	0.1463	0.1755	0.1482	0.1171	0.0914
R&D	0.0021	0.0006	0.0008	0.0015	0.0013	0.0127	0.0055	0.0051	0.0080	0.0015	0.0033	0.0037	0.0034
DIV	0.0289	0.0271	0.0271	0.0267	0.0277	0.0290	0.0304	0.0322	0.0333	0.0319	0.0309	0.0254	0.0269

This table illustrates the investment patterns of PHC firms in each year, from 1989 to 2002, before and after having been identified as PHC. IK is defined as the ratio of investment to capital stock; R&D is equal to the ratio of total intangible assets to total assets; DIV is the ratio of total payment dividend to total assets. Figures of IK, R&D and DIV in the sub-panels (1, 2, 3 and 4) are averaged over the years of each sub-panel. Sub-panel 1 includes 1991 to 1993 information; sub-panel 2 includes 1994 to 1996 information; sub-panel 3 includes 1997 to 1999 information; sub-panel 4 includes 2000 and 2001 information.