A Wall of Cash: The Investment-Cash Flow Sensitivity When Capital Becomes Abundant

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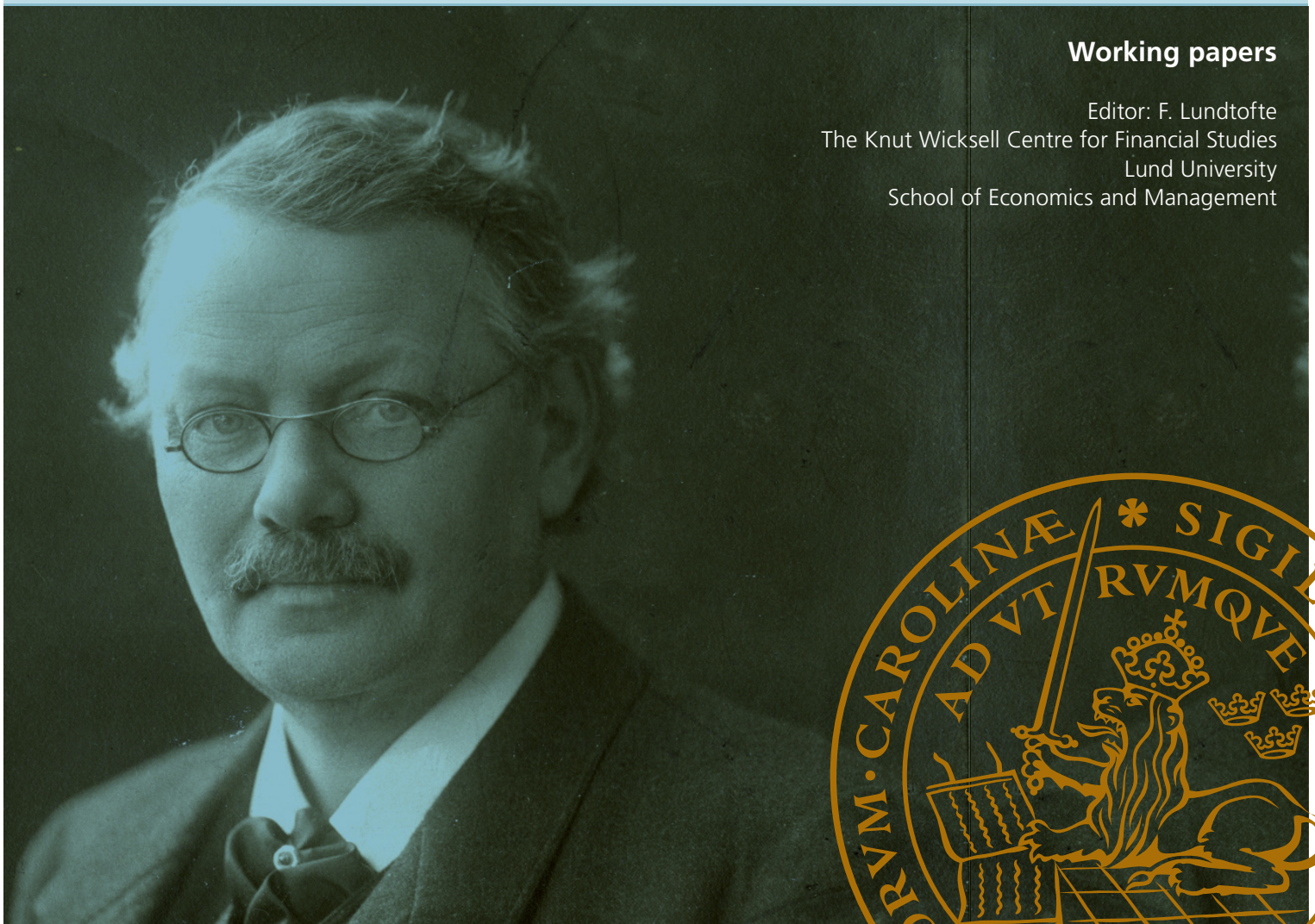

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A Wall of Cash: The Investment-Cash Flow Sensitivity When Capital Becomes Abundant

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Abstract

In the mid 2000s the oil and gas industry was hit by what might be best described as a 'wall of cash' as oil prices successively reached new record levels and access to external financing improved greatly. In this article we investigate what this sudden abundance of liquidity implied for the investment-cash flow relationship, the interpretation of which continues to generate controversy in the financing constraints-literature. For small and financially constrained firms the investment-cash flow sensitivity decreases in the abundance period (2005-2008), suggesting that these firms became less financially constrained in this period. For large and financially unconstrained firms, however, the investment-cash flow sensitivity increases over time, suggesting that this relationship is driven by agency problems related to free cash flow. Our analysis illustrates the importance of a research design that addresses both these competing explanations of the investment-cash flow relationship.

Key words: Corporate investment, financing constraints, agency costs, investment-cash flow sensitivity

JEL code: G30, G32

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1. Introduction

Beginning with Fazzari, Hubbard, and Pedersen (1988) a large empirical literature has documented a positive and significant relationship between cash flow and investment, holding investment opportunities constant. What is more, this research has generally shown that the sensitivity to cash flow tends to be higher for firms a priori classified as more financially constrained, which has typically been interpreted as evidence of contracting problems in the financial markets caused by information asymmetries (Myers and Majluf, 1984) and agency problems (Jensen and Meckling, 1976). This view, however, has been challenged by several researchers who have raised methodological issues or presented conflicting results (e.g. Kaplan and Zingales, 1997; Cleary, 1999; Chen and Chen, 2012). The interpretation of the findings in the literature continues to generate controversy.

A particularly vexing methodological issue is that the financing constraints (FC)-explanation of the investment-cash flow relationship is empirically very difficult to separate from another possible interpretation of it, namely the free cash flow (FCF)-explanation. According to the FCF-explanation, the investment-cash flow relationship reflects overspending by managers with incentives to maximize assets under control (as outlined in Jensen, 1986). The agency model of managerial behavior has found empirical support in a number of empirical studies of corporate investment (e.g. Blanchard et al., 1994; Peyer and Shivdasani, 2001; D'Mello and Miranda, 2010). Consistent with this, Kadapakkam et al. (1998) find that large firms in six different countries have larger investment-cash flow sensitivities than their smaller counterparts, and posit that agency problems related to overinvestment is the likely explanation. Using US data, Richardson (2006) finds that free cash flow is systematically related to overinvestment. On the whole, however, few papers have explored the implications

of the agency model of managerial behavior for the investment-cash flow relationship.[1] This paper is intended as a first step in closing this gap in the literature.

Our empirical strategy for distinguishing between the competing explanations centers around the following intuition: the FCF explanation would be supported if, following a large and persistent cash windfall, firms that a priori are classified as financially unconstrained exhibit an *increase* in the investment-cash flow sensitivity. Why would the fraction of cash flow spent on investment increase for unconstrained firms following a windfall? We posit that this could come about if higher liquidity and creditworthiness due to higher current (and expected) cash flows mean that management assign a lower probability of future financial distress, and therefore feel confident to divert a larger fraction of current cash flow to investment projects. That is, as the prospect of financial distress gets more distant, the disciplining effect this has on capital discipline wears off.[2] Similarly, the FC explanation would be supported if firms classified as financially constrained exhibit a *lower* sensitivity following the windfall because the increased net worth implied by the windfall increases the firm's debt capacity and lowers its cost of external financing. In summary, given the exogenous shock, the FC and FCF-explanations imply different signs on the change in the investment-cash flow sensitivity for these two categories of firms.

We argue that the oil and gas industry in the 2000s offers a useful quasi-natural experiment in which to study the effects on the investment-cash flow relationship of an exogenous and persistent shock to corporate cash flows. Following a research tradition found in, for example, Lamont (1997), Tufano (1996) and Jin and Jorion (2004) we benefit from the relative

[1] Pawlina and Renneboog (2005) investigate the role of proxies for agency costs, but their focus is different from ours. These authors analyze if it is agency or information asymmetry problems that lie behind the contracting problems in the financial markets that give rise to the cost wedge between internal and external funds.
[2] This argument is an application of the 'discipline hypothesis' developed by Luo (2011), who finds empirical support for the idea that financially constrained firms have better spending discipline than unconstrained firms.

transparency and homogeneity of a US commodity industry. Crucially for our research strategy, in the mid 2000s the oil and gas industry was hit by what might be best described as a 'wall of cash'. The oil price successively reached new record levels, peaking at a quarterly average of $122 in the second quarter of 2008, compared to a previous high of $36 in 2000. The windfalls were persistent as well: the average oil price between 2005 and 2008 were $72, compared to $28 in the years 2000-2003. As a consequence, free cash flows in the oil and gas industry rose sharply. Comparing these periods, aggregated funds from operations increased by 227%, and the industry's aggregated cash balance by over 300%. External funding became abundantly available: the average growth rate in interest-bearing debt was 76% per year in the latter period, and aggregate share issues increased tenfold.

The oil and gas industry also compares favorably in terms of identification. The large firms in this industry, who were by most measures financially unconstrained already, accounted for the bulk of the increase in cash flows in the mid 2000s. The small firms, however, did not experience nearly the same windfall due to having less producing assets. Since the investment opportunities for many of these firms increased at a quicker rate than their operating cash flows, these firms continued to be dependent on external funding in the abundance period. This makes for a useful test of the FC-explanation of the investment-cash flow relationship: these firms experienced increased funding needs, which would tend to make them more financially constrained, but also a sharply decreasing cost wedge between internal and external funding, which works in the opposite direction.[3] Further supporting the use of size as splitting criterion, Hadlock and Pierce (2010) find that, out of 16 investigated variables, size and age are particularly useful predictors of financing constraints.

[3] The forward curve for oil (at long maturities) showed a similar increase as the spot price around 2004. In fact, the difference between long-dated forward contracts and the spot price remained remarkably constant throughout the sample period. This means that the exogenous shock was not expected to be transient, and that the collaterable value of oil and gas assets rose accordingly. As we will show in Section 2 of this paper, the borrowing activity of small oil and gas firms increased significantly post-2004.

Using a balanced sample of 78 oil and gas firms, rendering 603 firm year observations, we find evidence consistent with the view that the investment-cash flow sensitivity is caused primarily by overinvestment for the large and financially unconstrained firms, but that it is mainly driven by financing constraints for small firms. Following the standard methodology in the literature, we carry out regressions on investment with Tobins Q and financial variables (cash flow, cash, and leverage) as independent variables. As expected, cash flow and Tobins Q are positive and significant at the 1%-level in the large majority of regressions. To explore the impact of the exogenous shock we interact cash flow with a deterministic time trend variable (or alternatively a regime-shift dummy that takes the value 1 in the years 2005-2008 and zero prior to 2005).[4] For the full sample, the interaction term is negative and significant at the 1%-level, which would suggest that financing constraints for the industry as a whole decreased over the sample period. However, this result hides importance differences in the way firms classified as constrained or unconstrained were impacted by the exogenous shock.

For financially constrained firms the sensitivity of investment to cash flow decreases over time as evidenced by a negative interaction term (significant at the 1%-level) between cash flow and the time trend variable. This supports the FC-explanation, and suggests that the financial constraints of these firms became less binding in the sample period. Again, this occurs in spite of the fact that the aggregate funding need of this category of firms actually increased in the same period, which suggests that the beneficial impact from the decreased cost wedge between internal and external capital is the dominating influence on the investment-cash flow relationship. For financially unconstrained firms the interaction term between cash flow and time is positive (significant at the 1%-level). The sign of the

[4] The time trend variable takes the value 0 in 2000, 1 in 2001, and so on. It replaces the fixed period effect in the panel regressions because it more parsimoniously lets us investigate, through interaction terms, how a particular relationship has changed over time.

interaction term supports the FCF-explanation, which is to say that the overinvestment problem appears to have grown worse as liquidity became increasingly abundant.

We carry out several robustness checks and obtain similar results. In particular, the results are robust to the exclusion of negative cash-flow observations. Allayannis and Mozumdar (2004) illustrate that investment-cash flow sensitivities can be suppressed when negative cash flow observations are at hand. The logic behind this argument is that when cash flow is negative, investment is already at its minimum level and cannot be reduced further. Since negative cash flow occurs more frequently in smaller firms it could potentially affect our results. Whereas the interaction terms of interest to us are still statistically significant, the exclusion of negative cash-flow observations does impact our baseline regressions in important ways. The base regressions indicate considerably higher investment-cash flow sensitivities for large firms, but filtering out the firm-years with negative cash flow observations eliminates or even reverses this difference. This supports the conclusions in Allayannis and Mozumdar (2004) that negative cash flows are important to consider in empirical studies of the investment-cash flow relationship.

The finding of Kadapakkam et al. (1998) that large firms consistently tend to have higher investment-cash flow sensitivities is certainly consistent with the FCF-explanation. Since we are able to study the same set of firms during a period characterized by increasingly abundant liquidity, however, we believe our findings represent the clearest evidence to date of overinvestment-problems being the cause of the investment-cash flow relationship. If it is generally true that the overinvestment problem increases as the disciplining effect of the risk of future financial constraints decreases, then researchers using broad samples are to an extent bound to compare apples and oranges in that firms identified as financially unconstrained are

also those in which overinvestment problems are likely to be the most significant. In this regard, investment-cash flow sensitivities are not likely to be clean measures of financial constraints. Improved identification is, we believe, a compelling argument for studies of single industries and/or exogenous shocks as a complement to using large and broad samples.

This paper proceeds as follows. Section 2 introduces the sample and provides descriptive statistics. Section 3 outlines the econometric models used for testing of the investment-cash flow relationship. Section 4 contains the results from the empirical analysis. Section 5 concludes the paper.

2. Sample and descriptive statistics

The sample in this study consists of US firms in the oil and gas industry (SIC codes 1311 and 2911) between 2000 and 2008.[5] Data is obtained from Datastream. To be included in the sample firms had to be listed on a US stock exchange and have total assets exceeding $1m in all years. Firms with negative equity were excluded since these firms tend to produce extreme values for many financial ratios. To further reduce the impact of outliers we follow Carpenter and Guariglia (2008) and exclude firm-years in which the investment-to-asset-ratio exceeds one. The final sample consists of 78 firms. It is important to note that this is a balanced panel with very few missing firm-years. Balancing the sample may introduce a sample bias in that firms with certain characteristics are more likely to enter or exit the sample. However, we expect any such bias to be small. Exit due to bankruptcy, for example, was very infrequent during the sample period due to the favorable market conditions. Balancing the panel brings an important benefit, however, in that it reinforces the sample's character of a quasi-natural

[5] SIC code 1311 represents oil and gas exploration, whereas code 2911 covers companies in petroleum refining. Both these segments experienced massive cash windfalls due to the rise in the oil price. Firms in 2911 typically have substantial oil assets. For example, Exxon Mobil, Chevron, and ConocoPhilips are in the 2911 segment.

experiment. We are thus able to study the same set of firms throughout both the abundance and pre-abundance periods and thereby use each firm as its own control.

We use size as our splitting criterion for classifying a firm as constrained or unconstrained. Previous research has shown that size and age are particularly informative proxies for financing constraints (Hadlock and Pierce, 2010). Larger firms tend to have a higher fraction of collaterable assets, less idiosyncratic risk, and can also be assumed to have lower information asymmetries due to being older and having a larger analyst following (see e.g. Kadapakkam, 1998, for a discussion). We define large firms as those for which the average of total assets in the 2000-2003 period exceeds the median value of this average. Small firms are correspondingly those below the median.[6] Size may indeed be a particularly relevant segmenting variable in the oil and gas industry, because it is highly stratified. The large firms make up the vast majority of the industry's total assets (around 99% in this sample). Descriptive statistics are reported in Table 1.[7]

[INSERT TABLE 1 ABOUT HERE]

It can be observed in Table 1 that small firms have larger cash positions. This could be attributed to the pre-cautionary motive, i.e. that these firms are more prone to keep a buffer of cash to smooth out future variations in cash flows. We also note that they rely more on equity financing than do large firms, whereas share buybacks are only used in the latter group. Table

[6] We choose this definition to focus the analysis on constrained vs. unconstrained firms rather than firm years. In the robustness section we allow firms to transit between classes. This choice in inconsequential since the degree of transit is modest. Reclassification occurs in only 28 firm-years, so there is very little distinction between constrained firms and constrained firm-years.

[7] TA is total assets (Datastream variable WC02999); CX is additions to fixed assets (WC04601); CF is net operating cash flow (WC04860); CA is cash and cash equivalents (WC02001); DBT is total interest-bearing debt (WC03255); DIV is cash dividends paid (WC04551); BRW is gross new long-term borrowing (WC04401); SB is share buybacks (ECSLDP048); and SI is share issues (WC04251). Q is Tobins Q, measured as (Total assets less book value of equity plus market value of equity)/Total assets.

2, which compares the periods 2000-2003 and 2005-2008 for both large and small firms, confirms that both groups saw increases in investment rates, but that the cash flow windfall occurred largely in large firms, who consequently also experienced an increase in their cash position, a decrease in leverage, and an increase in share-buybacks.[8] The difference between these two categories of firms in terms of their financial status and access to external financing is further illustrated by Fig. 1, which shows financial indicators between 2000 and 2008 for large and small firms, respectively.

[INSERT TABLE 2 ABOUT HERE]

[INSERT FIGURE 1 ABOUT HERE]

It is clear from Fig. 1 that large firms saw large increases in cash flows around the middle of the decade. During 2004 the cash aggregate position for these firms began trending sharply upwards, and by 2005 had established itself on a level more than four times as large as in 2000-2003. In 2006 acquisition activity takes off, which is accompanied by significant amounts of external borrowing.[9] For small firms the pattern is very different. Here the immediate response to higher oil prices is a huge increase in investment spending, without any corresponding increase in cash flow generation. Consequently there is a surge in external borrowing. Cash balances stay relatively flat throughout the period except for an increase in 2008.

[8] The preference of oil and gas companies for returning capital to equity investors through share-buybacks is evident in Table 2: the increase in share buybacks is significant at the 1%-level, whereas dividends hardly register an increase at all.

[9] Graphs that show the aggregated raw numbers are sensitive to the influence of the largest firms and need to be interpreted accordingly. When we delete the three largest firms from the sample (ExxonMobil, Chevron, and ConocoPhilips) the jump in the acquisition variable in 2006 is much less pronounced. In Graph 2, without these three firms the net financing cash flow for large firms decreases in absolute terms (though still negative at $8bn for the years 2005-2008, meaning that cash was returned to investors). Acquisitions are measured by the Datastream variable Net Assets from Acquisitions (WC04355).

The different implications for large and small firms of the abundance period are reinforced by Fig. 2, which shows aggregated net operating, net investing, and net financing cash flows for large and small firms respectively. Large firms are consistently returning capital to investors in successively higher amounts throughout the abundance period (as indicated by the negative net financing cash flow).[10] Small firms, on the other hand, are, taken as a group, relying on external financing for their growth. In the whole abundance period, net investing cash flows consistently exceed net operating cash flows.

[INSERT FIGURE 2 ABOUT HERE]

To summarize this section, we have that in the abundance-period small firms were essentially transformed into high growth-firms that relied heavily on capital markets to fuel this growth. Large firms, on the other hand, enjoyed a huge cash windfall and accumulation of cash reserves.

3. Empirical specification

Our point of departure in the multivariate analysis is the standard model for estimating investment-cash flow sensitivities developed in Fazzari et al. (1988):

$$CX_{i,t}/TA_{i,t-1} = \beta_0 + \beta_1 Q_{i,t-1} + \beta_2 CF_{i,t}/TA_{i,t-1} + d_t + \alpha_i + \nu_{i,t} \quad (1)$$

where CX is the firm's investment in fixed assets, TA, total assets, CF, cash flow, d_t is a time dummy, α_i captures firm fixed effects, and $\nu_{i,t}$ is an error term. The subscript *t* indexes time, and *i* indexes firms. This specification (Model 1) is based on the Q-model for investment with

[10] Again, some caution is warranted due to the influence of large firms. See footnote 10.

the addition of cash flow as an explanatory variable. Under the hypothesis that financing is frictionless, as postulated in Modigliani and Miller (1958), the cash flow variable should be insignificant in explaining investment.

To fully gauge the impact of the impact of financial factors, however, we consider an extended version of Model 1 where cash and leverage are added as explanatory variables. Previous research has documented the relevance of cash reserves for explaining investment in fixed assets (Kadapakkam et al., 1998; Harford, 1999). Given the sharp rise in oil prices around 2004, much internal cash flow was accumulated in the form of cash balances. These cash reserves provide an alternative source of internal funding for investment in subsequent periods, which need to be controlled for in order to estimate the marginal impact of current cash flows on investment. Following Brown and Petersen (2009) we also include leverage in the model. Traditional finance theory holds that financial contracting becomes more difficult the more debt the firm already has in its balance sheet (Myers, 1977). The resulting empirical specification is.

$$CX_{i,t}/TA_{i,t-1} = \beta_0 + \beta_1 Q_{i,t-1} + \beta_2 CF_{i,t}/TA_{i,t-1} + \beta_3 CA_{i,t-1}/TA_{i,t-1} + \beta_4 DBT_{i,t-1}/TA_{i,t-1} + d_t + \alpha_i + \nu_{i,t} \quad (2)$$

where CA is cash and DBT is the firm's debt. The variables CF, CA, and DBT together represent the firm's financial status in a more comprehensive way compared to only including the cash flow-variable. We next turn to a model specification that explicitly considers the possibility that the relationship between cash flow and investment may not be the same throughout the sample period:

$$CX_{i,t}/TA_{i,t-1} = \beta_0 + \beta_1 Q_{i,t-1} + \beta_2 CF_{i,t}/TA_{i,t-1} + \beta_3 CA_{i,t-1}/TA_{i,t-1} + \beta_4 DBT_{i,t-1}/TA_{i,t-1} + \beta_5 TIME + \beta_6 (TIME_1 * CF_{i,t}/TA_{i,t-1}) + \alpha_i + \nu_{i,t} \quad (3)$$

In Model 3 the period fixed effects have been replaced by a deterministic time-variable denoted TIME that takes on values 0-9. The year 2000 is represented by zero, 2001 by one, and so on. This model also contains an interaction term between TIME and cash flow. The interaction terms serves to measure if the relationship between cash flow and investment has changed throughout the sample period as both internal and external funding became successively more available. Interaction models are common in the financing constraints literature (e.g. Ascioglu et al., 2008; Ağca and Mozumdar, 2008). We also consider an interaction with a structural break dummy in the following specification:

$$CX_{i,t}/TA_{i,t-1} = \beta_0 + \beta_1 Q_{i,t-1} + \beta_2 CF_{i,t}/TA_{i,t-1} + \beta_3 CA_{i,t-1}/TA_{i,t-1} + \beta_4 DBT_{i,t-1}/TA_{i,t-1} + \beta_5 POST + \beta_6 (POST_1 * CF_{i,t}/TA_{i,t-1}) + \alpha_i + \nu_{i,t} \quad (4)$$

In Model 4 we replace the deterministic time variable with a structural brake dummy labeled POST. This variable takes the value one in the years 2005 to 2008 and zero otherwise. POST is intended to capture the state of abundance that oil and gas companies found themselves in during the latter half of the decade. Compared to Model 3, which postulates successively less binding financing constraints throughout the 2000s, we now allow for the possibility that financing constraints experienced a shift in the period of continued abundance but that they were essentially the same in each of the years in any of the two periods (in the robustness section we return to the issue of how the results are driven by the choice of 2005 as the first year in the abundance period).

4. Regression results

4.1 Baseline regressions

In our first set of regressions we estimate the baseline Q-model of investment complemented with financial variables (Model 2 in section 3). This specification measures straightforward investment-cash flow sensitivities for all, large, and small firms respectively. Panel A in Table 3 reports the results. We also present the results from a regression where unobserved firm heterogeneity is eliminated by first differencing (these are reported in the FE-column whereas the firm fixed effects estimates are found in the FD-column). The comparison of the sensitivity between large and small firms is initially surprising (0.1 vs. 0.175 for fixed effects and 0.145 vs. 0.252 for first difference). This suggests the investment is considerably more sensitive to cash flows in large and financially unconstrained firms. However, as pointed out by Allayannis and Mozumdar (2004), investment-cash flow sensitivities can be suppressed when negative cash flow observations are at hand. We would expect negative cash flows to be particularly common among small firms, which could distort the comparison. Indeed, when we re-estimate Model 2 excluding firm-years in which cash flow is negative, the difference between small and large firms disappear (when first differencing is used the relationship even reverses). These results are shown in Panel B in Table 3.

Table 3 also shows that the coefficient on Tobins Q, as expected, is positive and statistically significant in all subsamples. We also note that the sign on DBT is negative and generally significant. This suggests that leverage has indeed constrained investment.[11] Cash has the expected positive sign for small firms, but is negative for large firms.

[11] It should be noted that investment and leverage are endogenous variables and therefore such an interpretation need to be made with caution. It could be that fast-growing firms *choose* to have low leverage and that this causes the association. The same endogeneity-concerns are at hand with the cash variable. As these questions are outside the focus of this paper we do not pursue the endogeneity issue for these variables.

[INSERT TABLE 3 ABOUT HERE]

4.2 Interaction regressions

In our next set of regressions we seek to formally test whether investment-cash flow sensitivities are affected by the improving financial conditions throughout the decade, in particular the sharp rise in the availability of internal and external financing after 2004. Table 4 reports the results from specifications in which we interact the cash flow variable with a deterministic time trend and a post-2004 structural dummy, respectively (Models 3 and 4 in section 3).

As can be observed in Table 4, the impact of improving financing conditions is markedly different in the two subgroups. For small firms both the TIME and POST variables are statistically significant and negative. These findings are consistent with the interpretation that these firms were financially constrained in the pre-2005 sample and experienced a relaxing of these constraints in the post-period. For large firms, however, the interaction term has a positive sign. The TIME variable is significant at the 1%-level, whereas the POST variable is marginally insignificant (p-value = 0.123). Despite the large increases in cash balances and external financing opportunities for this category of firms, an increasing fraction of current cash flows has thus been devoted to capital expenditure. As these firms were by most conventional measures financially unconstrained already to begin with, a plausible interpretation is that this result reflects agency problems and the associated overinvestment.

[INSERT TABLE 4 ABOUT HERE]

To gain further insight into whether the agency perspective is appropriate for explaining the results in the sample of large firms, we estimate a model of firm value similar to the one used by Allayannis and Weston (2001), in which Tobins Q is the dependent variable. In this model *contemporaneous* investment is now an independent variable.[12] We interact investment with TIME, using the log of total assets, debt-to-assets, and profitability as control variables. The results indicate that, while overall higher levels of investment are associated with a higher Tobins Q, the interaction term is negative (p-value = 0.06). This indicates that the stock market viewed incremental investment increasingly negative, which supports an interpretation of agency problems being a concern in this particular sample. For the sample of small firms, the corresponding interaction term is statistically insignificant.

4.3 Robustness checks

We have already seen in section 4.2 that our conclusions with regard to changes over time in the relationship between investment and cash flow are robust to the exclusion of negative cash flow observations. In this section we continue to investigate the robustness of our main results. None of these regressions are tabulated, but are available from the authors upon request.

In our first robustness check we include contemporaneous Tobins Q as an independent variable. This is to control for the possibility that beginning-of-year Q inadequately controls for investment opportunities, and that the cash flow-variable is, to some degree, merely reflecting improved investment opportunities. Though the reverse causality in this specification is obvious, it is useful to us in that it should reduce the signaling-content of the coefficient on the cash flow variable. Contemporaneous Tobins Q is generally insignificant, however, and the interaction terms continue to be significant at the 1%-level.

[12] These results are not tabulated but available from the authors upon request.

It is difficult to draw a sharp line between what we have labeled the 'abundance period' (largely post-2004) and the 'pre-abundance' period. We check whether results are sensitive to including 2004 in the structural dummy POST. For the sample of small firms there is a small decrease in the significance of the interaction term between this variable and cash flow (p-value = 0.11). For large firms the statistical significance goes the other way and is now significant at the 1%-level (the coefficient increases from 0.203 to 0.236).

To allow for a more meaningful analysis of what happened to a certain subsample of firms over time we have restricted the analysis so far to firms, as opposed to firm-years. It is common in the investment-cash flow literature, however, to allow firms to transit between the financially constrained and unconstrained subsamples as their financial status changes over time. Although the degree of transit is fairly low (only 28 firm-years in total are re-classified), we investigate what happens when transit is allowed. It turns out that for large firms the interaction terms between TIME and POST with cash flow see a slight increase in the statistical significance. For small firms the corresponding interaction terms continue to be significant at the levels indicated in Table 3.

As a final robustness check, we also include lagged investment as an independent variable in the model. Some researchers prefer to include this term to account for adjustment costs (e.g. Carpenter and Guariglia, 2008). For large firms, the interaction term between cash flow and TIME is significant at the 1%-level, and the interaction term with POST at the 5%-level. For small firms, however, the corresponding interaction terms are no longer significant at conventional levels (p-values about 0.20).

5. Conclusions

In this paper we have used the dramatically altered availability of capital, both internal and external, in the oil and gas industry during the 2000s to disentangle two different explanations of the well-documented relationship between investment and cash flow, namely that it is a consequence of a) a cost wedge between internal and external financing due to capital market imperfections (the financing constraints-explanation) and b) excessive investment due to managements' utility function being positively related to the size of assets under control (the free cash flow-explanation).

Our results show that for the sample of small, financially constrained firms the investment-cash flow sensitivity decreases over time. This decrease is consistent with a view that the financial constraints of these firms were relaxed as their creditworthiness improved. Importantly, lacking a large base of operating assets, many of these firms were dependent on external financing to finance their growth. The large, financially unconstrained firms, however, experienced a major cash windfall. For this category of firms the investment-cash flow sensitivity instead went up. This is consistent with the free cash flow-explanation.

We believe our study presents the clearest evidence to date of the overinvestment problem being the likely cause of the investment-cash flow sensitivity. In this regard this sensitivity is unlikely to be a clean measure of financing constraints, and researchers using large and broad samples are liable to be comparing apples and oranges in that those firms identified as financially unconstrained are also those most likely to suffer from overinvestment problems. By offering improved identification, studies involving a single industry and/or an exogenous shock should, in our view, constitute a valuable complement to the use of broad samples.

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Tables and Figures

Table 1

Descriptive statistics

		All firms (1)	Large firms (2)	Small firms (3)
$CX_{i,t}/TA_{i,t-1}$	Mean	0.233	0.228	0.238
	Standard deviation	0.190	0.152	0.222
$CF_{i,t}/TA_{i,t-1}$	Mean	0.233	0.225	0.242
	Standard deviation	0.159	0.090	0.212
$Q_{i,t-1}$	Mean	1.786	1.564	2.008
	Standard deviation	1.355	0.470	1.833
$CA_{i,t-1}/TA_{i,t-1}$	Mean	0.125	0.048	0.203
	Standard deviation	0.182	0.069	0.222
$DBT_{i,t-1}/TA_{i,t-1}$	Mean	0.208	0.262	0.154
	Standard deviation	0.161	0.143	0.159
$LOG(TA_{i,t-1})$	Mean	12.675	15.004	10.345
	Standard deviation	2.880	1.814	1.561
$DIV_{i,t-1}/TA_{i,t-1}$	Mean	0.014	0.009	0.019
	Standard deviation	0.065	0.011	0.091
$BRW_{i,t-1}/TA_{i,t-1}$	Mean	0.210	0.231	0.189
	Standard deviation	0.425	0.291	0.526
$SB_{i,t-1}/TA_{i,t-1}$	Mean	0.003	0.006	0.000
	Standard deviation	0.014	0.019	0.000
$SI_{i,t-1}/TA_{i,t-1}$	Mean	0.058	0.027	0.089
	Standard deviation	0.234	0.064	0.322

The sample is constructed from oil and gas firms (SIC codes 1311 and 2911) in the years 2000-2008. Firms with total assets missing or below $1mn in any of the years and firms with negative equity are excluded. We also require that firms are listed on a stock exchange in all years. Observations with an investment-to-total-assets ratio exceeding one are excluded. The table reports the mean and standard deviations for all firms, and subsets including only large and small firms. Large firms are those with an average value of total assets above the industry median in 2000-2003, and small firms correspondingly those below the median. CX is investment in fixed assets, CF is net operating cash flow, Q is Tobins Q, CA is cash and cash equivalents, DBT is total interest-bearing liabilities, TA is total assets, DIV is dividends, BRW is gross new external borrowing, SB is share buybacks, and SI are share issues.

Table 2

Change in financial variables between 2000-2003 and 2005-2008

	Large firms			Small firms		
	2000-2003	2005-2008	Change	2000-2003	2005-2008	Change
$CX_{i,t}/TA_{i,t-1}$	0.204	0.250	0.046 ***	0.146	0.205	0.059 **
$CF_{i,t}/TA_{i,t-1}$	0.208	0.232	0.023 **	0.240	0.246	0.005
$Q_{i,t-1}$	1.419	1.699	0.280 ***	1.648	2.324	0.676 ***
$CA_{i,t-1}/TA_{i,t-1}$	0.037	0.057	0.019 ***	0.210	0.198	-0.010
$DBT_{i,t-1}/TA_{i,t-1}$	0.323	0.214	-0.100	0.160	0.143	-0.010
$LOG(TA_{i,t-1})$	14.580	15.531	0.950 ***	9.875	10.903	1.027 ***
$DIV_{i,t-1}/TA_{i,t-1}$	0.009	0.008	-0.000	0.022	0.019	-0.000
$BRW_{i,t-1}/TA_{i,t-1}$	0.204	0.250	0.046 *	0.146	0.205	0.059
$SB_{i,t-1}/TA_{i,t-1}$	0.001	0.010	0.009 ***	0.000	0.000	0.000
$SI_{i,t-1}/TA_{i,t-1}$	0.027	0.021	-0.000	0.053	0.089	0.036 *

This table reports the change in the variables used between the periods 2000-2003 and 2005-2008. The latter period was characterized by sharply increasing oil prices. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level. CX is investment in fixed assets, CF is net operating cash flow, Q is Tobins Q, CA is cash and cash equivalents, DBT is total interest-bearing liabilities, TA is total assets, DIV is dividends, BRW is gross new external borrowing, SB is share buybacks, and SI are share issues.

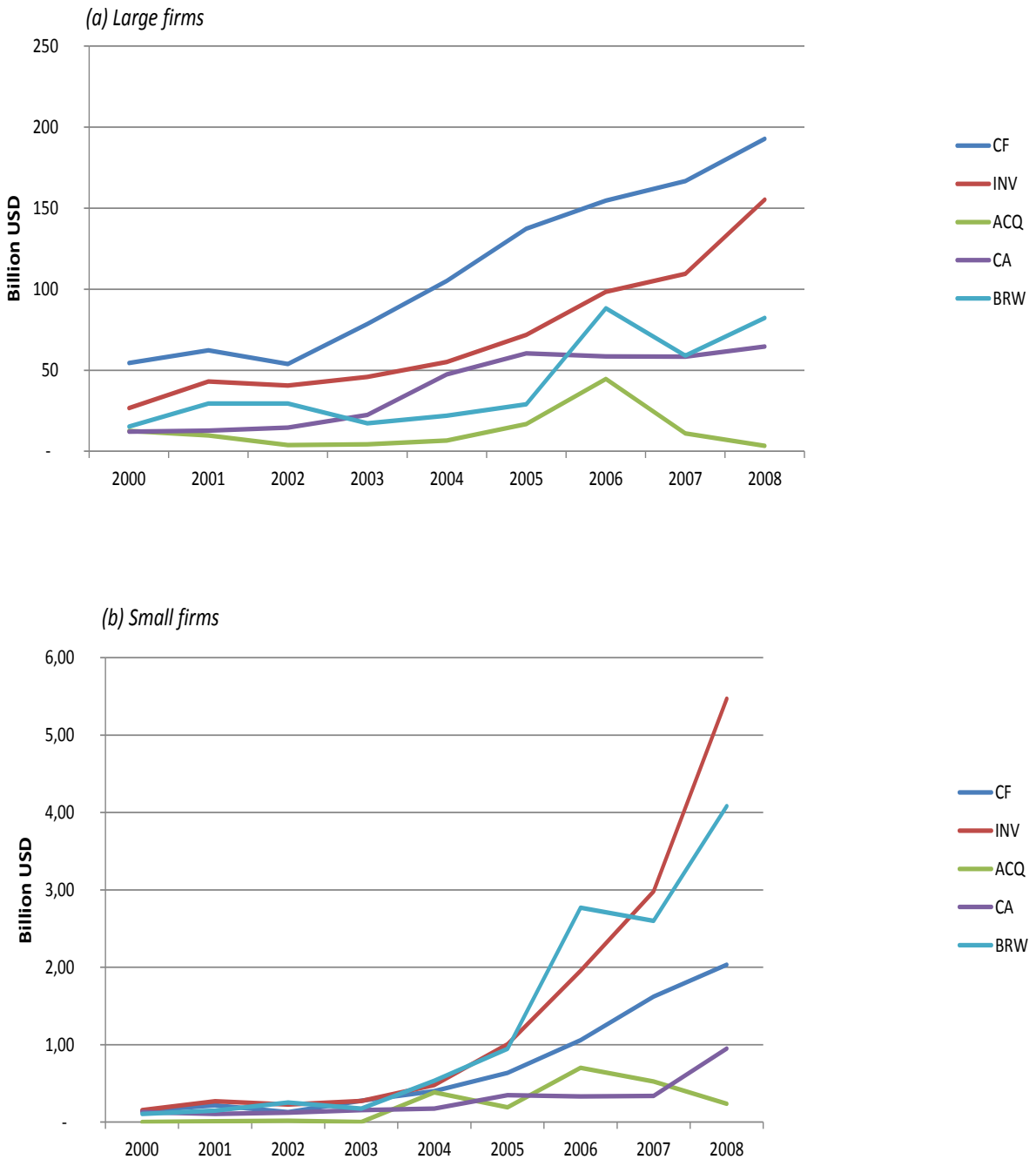

Fig. 1. Various financial indicators for companies in the oil and gas industry between 2000 and 2008. CF is net operating cash flow, CX is capital expenditure on fixed assets, ACQ is acquisition spending, CA is cash and cash equivalents, and BRW is gross new borrowing. Figure (a) shows the sums the non-scaled observations for all firms in the sample that have total assets above the sample median ("large firms"). Figure (b) shows the sums the non-scaled observations for all firms in the sample that have total assets above the sample median ("small" firms).

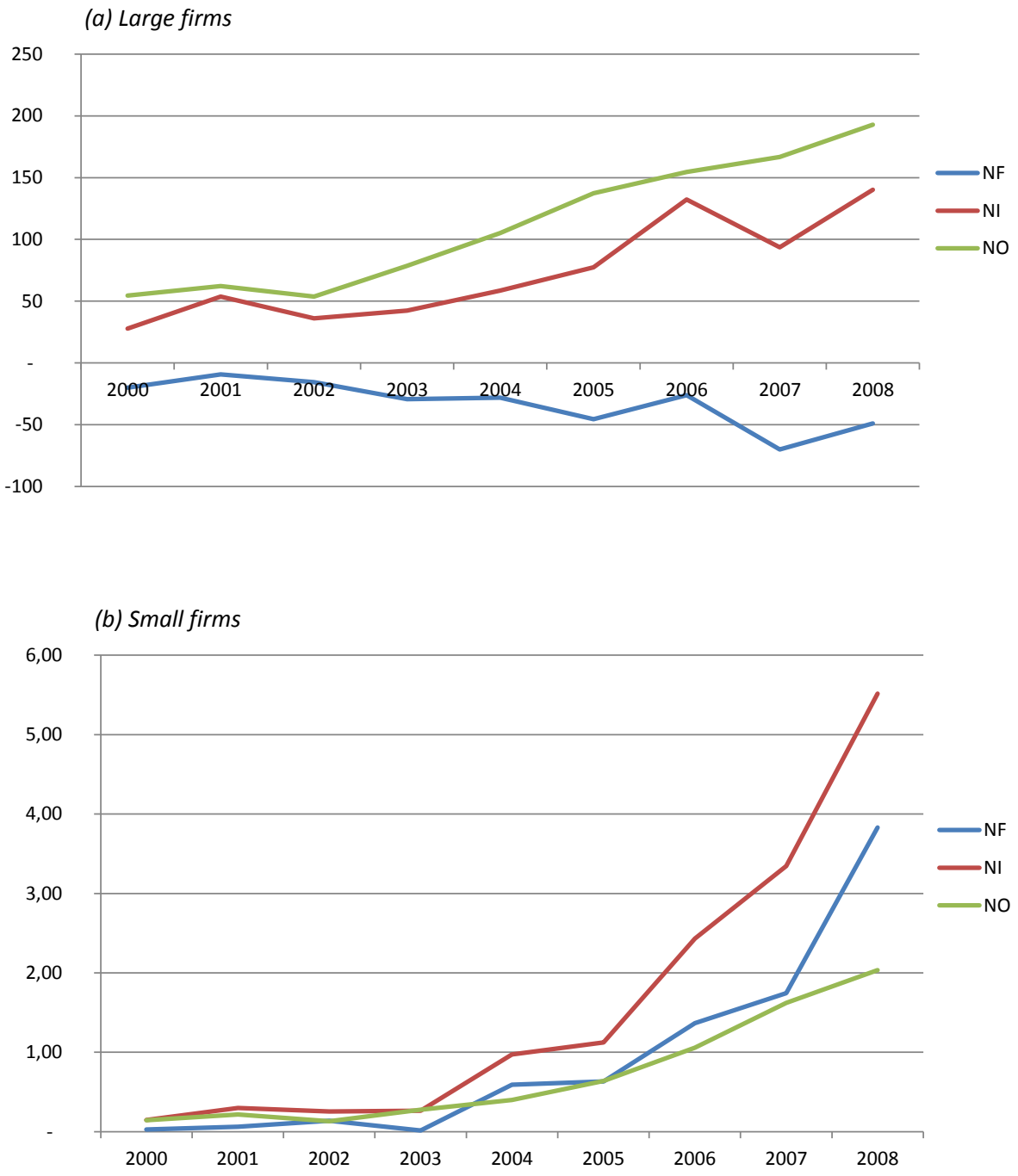

Fig. 2. Net operating (NO), Net investing (NI) and Net financing (NF) cash flows for firms in the US oil and gas industry between 2000-2008. Figure (a) shows the sums the non-scaled observations for all firms in the sample that have total assets above the sample median ("large firms").Figure (b) shows the sums the non-scaled observations for all firms in the sample that have total assets above the sample median ("small" firms).

Table 3

OLS estimates of the investment-cash flow sensitivity.

	All firms				Large firms				Small firms			
	First difference		Fixed effects		First difference		Fixed effects		First difference		Fixed effects	
Dependent variable ($CX_{i,t}/TA_{i,t-1}$)												
Panel A: Including negative cash flows												
$CF_{i,t}/TA_{i,t-1}$	0.154***	(0.000)	0.111***	(0.000)	0.252***	(0.004)	0.175**	(0.044)	0.145**	(0.011)	0.100***	(0.000)
$Q_{i,t-1}$	0.045***	(0.000)	0.055***	(0.000)	0.051**	(0.026)	0.107***	(0.000)	0.041***	(0.000)	0.047***	(0.000)
$CA_{i,t-1}/TA_{i,t-1}$	0.084	(0.251)	-0.000	(0.974)	-0.080	(0.538)	-0.45***	(0.000)	0.113	(0.236)	0.082	(0.380)
$DBT_{i,t-1}/TA_{i,t-1}$	-0.480***	(0.000)	-0.110	(0.213)	-0.420***	(0.000)	-0.120	(0.148)	-0.550***	(0.000)	-0.090	(0.551)
Firms	78		78		39		39		39		39	
Observations	509		603		264		306		245		297	
Adj. R^2	0.241		0.592		0.245		0.628		0.237		0.580	
Panel B: Excluding negative cash flows												
$CF_{i,t}/TA_{i,t-1}$	0.034***	(0.002)	0.055***	(0.000)	0.064**	(0.031)	0.121***	(0.000)	0.027*	(0.083)	0.042*	(0.083)
$Q_{i,t-1}$	0.231***	(0.000)	0.197***	(0.000)	0.253***	(0.001)	0.133	(0.158)	0.233***	(0.000)	0.222***	(0.000)
$CA_{i,t-1}/TA_{i,t-1}$	0.157	(0.123)	0.033	(0.645)	-0.150	(0.165)	-0.50***	(0.000)	0.247*	(0.081)	0.135*	(0.081)
$DBT_{i,t-1}/TA_{i,t-1}$	-0.520***	(0.000)	-0.120	(0.296)	-0.440***	(0.000)	-0.100	(0.273)	-0.600***	(0.000)	-0.110***	(0.000)
Firms	76		77		39		39		37		38	
Observations	473		570		267		308		206		262	
Adj. R^2	0.238		0.583		0.271		0.619		0.231		0.571	

Notes: The table shows OLS estimates of the model: $CX_{i,t}/TA_{i,t(-1)} = \beta_{0+}\beta_1 Q_{i,t-1} + \beta_2 CF_{i,t}/TA_{i,t-1} + \beta_3 CA_{i,t-1}/TA_{i,t-1} + \beta_4 DBT_{i,t-1}/TA_{i,t-1} + d_t + \alpha_i + \nu_{i,t}$. Large firms are those with an average value of total assets above the industry median in 2000-2003, and small firms correspondingly those below the median. Time effects are included in all regressions. Firm effects are removed by firm dummies. Heteroscedasticity-robust errors are reported in parenthesis. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level

Table 4

OLS estimates of the investment-cash flow sensitivity, interacted with time and structural dummies

	All firms				Large firms				Small firms			
	Time dummy		Post-dummy (2005-2008)		Time dummy		Post-dummy (2005-2008)		Time dummy		Post-dummy (2005-2008)	
Dependent variable ($CX_{i,t}/TA_{i,t-1}$)												
Panel A: Including negative cash flows												
$CF_{i,t}/TA_{i,t-1}$	0.244***	(0.000)	0.166***	(0.000)	0.109	(0.266)	0.118	(0.196)	0.236***	(0.000)	0.154***	(0.000)
Time	0.009**	(0.018)			-0.000	(0.564)			0.011***	(0.000)		
Time * $CF_{i,t}/TA_{i,t-1}$	-0.030***	(0.000)			0.020	(0.219)			-0.030***	(0.002)		
Post			0.046**	(0.030)			-0.020	(0.388)			0.061***	(0.000)
Post * $CF_{i,t}/TA_{i,t-1}$			-0.120*	(0.090)			0.163	(0.130)			-0.180**	(0.020)
$Q_{i,t-1}$	0.060***	(0.000)	0.057***	(0.000)	0.118***	(0.000)	0.116***	(0.000)	0.053***	(0.000)	0.050***	(0.000)
$CA_{i,t-1}/TA_{i,t-1}$	-0.030	(0.718)	-0.020	(0.783)	-0.47***	(0.000)	-0.46***	(0.000)	0.039	(0.692)	0.042	(0.688)
$DBT_{i,t-1}/TA_{i,t-1}$	-0.120	(0.152)	-0.110	(0.184)	-0.130	(0.125)	-0.130	(0.122)	-0.130	(0.365)	-0.120	(0.410)
Firms	78		78		39		39		39		39	
Observations	603		603		306		306		297		297	
Adj. R^2	0.594		0.593		0.628		0.630				0.591	

Table 4, continued

OLS estimates of the investment-cash flow sensitivity, interacted with time and structural dummies

	All firms				Large firms				Small firms			
	Time dummy		Post-dummy (2005-2008)		Time dummy		Post-dummy (2005-2008)		Time dummy		Post-dummy (2005-2008)	
Dependent variable ($CX_{i,t}/TA_{i,t-1}$)												
Panel B: Excluding negative cash flows												
$CF_{i,t}/TA_{i,t-1}$	0.278***	(0.000)	0.226***	(0.000)	-0.020	(0.808)	0.078	(0.405)	0.308***	(0.000)	0.238***	(0.000)
Time	0.007	(0.138)			-0.000	(0.285)			0.009***	(0.005)		
Time * $CF_{i,t}/TA_{i,t-1}$	-0.020*	(0.069)			0.047***	(0.003)			-0.030**	(0.043)		
Post			0.037*	(0.096)			-0.030	(0.385)			0.051***	(0.004)
Post * $CF_{i,t}/TA_{i,t-1}$			-0.090	(0.165)			0.203	(0.123)			-0.130*	(0.084)
$Q_{i,t-1}$	0.060***	(0.000)	0.058***	(0.000)	0.132***	(0.000)	0.130***	(0.000)	0.049***	(0.003)	0.046***	(0.006)
$CA_{i,t-1}/TA_{i,t-1}$	0.016	(0.836)	0.020	(0.794)	-0.550***	(0.000)	-0.550***	(0.000)	0.108	(0.219)	0.117	(0.181)
$DBT_{i,t-1}/TA_{i,t-1}$	-0.130	(0.258)	-0.120	(0.281)	-0.110	(0.220)	-0.110	(0.202)	-0.150	(0.427)	-0.140	(0.461)
Firms	77		77		39		39		38		38	
Observations	570		570		308		308		262		262	
Adj. R^2	0.583		0.584		0.624		0.623		0.577		0.577	

Notes: The table shows OLS estimates of the model: $CX_{i,t}/TA_{i,t(-1)} = \beta_{0+}\beta_1 Q_{i,t-1} + \beta_2 CF_{i,t}/TA_{i,t-1} + \beta_3 CA_{i,t-1}/TA_{i,t-1} + \beta_4 DBT_{i,t-1}/TA_{i,t-1} + \beta_5 TIME + \beta_6(TIME_1 * CF_{i,t}/TA_{i,t-1}) + \alpha_i + \nu_{i,t}$ and $CX_{i,t}/TA_{i,t(-1)} = \beta_{0+}\beta_1 Q_{i,t-1} + \beta_2 CF_{i,t}/TA_{i,t-1} + \beta_3 CA_{i,t-1}/TA_{i,t-1} + \beta_4 DBT_{i,t-1}/TA_{i,t-1} + \beta_5 TIME + \beta_6(TIME_1 * CF_{i,t}/TA_{i,t-1}) + \alpha_i + \nu_{i,t}$. TIME is a deterministic time-variable that takes the value zero in 2000 and increases by on for each year. POST is a dummy that takes the value one in the years 2005-2008, and zero otherwise. Firm effects are removed by firm dummies. Heteroscedasticity-robust errors are reported in parenthesis. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

A Wall of Cash: The Investment-Cash Flow Sensitivity When Capital Becomes Abundant

HÅKAN JANKENSGÅRD | NICLAS ANDRÉN

In the mid 2000s the oil and gas industry was hit by what might be best described as a 'wall of cash' as oil prices successively reached new record levels and access to external financing improved greatly. In this article we investigate what this sudden abundance of liquidity implied for the investment-cash flow relationship, the interpretation of which continues to generate controversy in the financing constraints-literature. For small and financially constrained firms the investment-cash flow sensitivity decreases in the abundance period (2005-2008), suggesting that these firms became less financially constrained in this period. For large and financially unconstrained firms, however, the investment-cash flow sensitivity increases over time, suggesting that this relationship is driven by agency problems related to free cash flow. Our analysis illustrates the importance of a research design that addresses both these competing explanations of the investment-cash flow relationship.

Key words: Corporate investment, financing constraints, agency costs, investment-cash flow sensitivity

JEL code: G30, G32

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