Credit and Capital Markets, Volume 51, Issue 2, pp. 259–292
Scientific Papers

Cash-flow Sensitivities of Interdependent Corporate Decisions – The Role of Financial Constraints and Hedging Needs

Christina E. Bannier and Carolin Schürg*

Abstract

We examine the cash-flow sensitivities of firms' simultaneous choice of investment, liquidity, dividends and net debt respectively equity financing in a large sample of US corporates between 1971 and 2016. We differentiate firms according to their (external) financial constraints and their (internal) needs to hedge against future shortfalls in operating income. Our estimation approach shows that financially constrained firms in our sample save more future funding capacity but invest and pay out less out of free cash flows than unconstrained firms. In the financial crisis 2007–2009, all firms invested less out of cash flow and raised their debt repayments, cash holdings and dividend payments. Constrained firms, however, show particularly strong increases in their cash savings but much smaller debt reductions compared to unconstrained firms – both in the crisis and post-crisis period. Internal hedging needs have different effects than external constraints: They weaken the build-up of future debt capacity out of cash flows for all firms, and raise the investment cash-flow sensitivity only for unconstrained firms.

Cash-Flow Sensitivitäten verflochtener Unternehmensentscheidungen – Der Einfluss finanzieller Restriktionen und der Notwendigkeit zur Absicherung

Zusammenfassung

Dieser Artikel untersucht die Cash-Flow Sensitivitäten simultaner Unternehmensentscheidungen zu Investitionen, Liquidität, Dividendenausschüttungen sowie zur Fremd- und Eigenkapitalfinanzierung anhand eines Datensatzes US-amerikanischer Unterneh-

* Prof. Dr. Christina E. Bannier, Justus-Liebig-University, Chair of Banking & Finance, Licher Str. 62, 35394 Giessen, Germany, E-Mail: Christina.Bannier@wirtschaft.uni-giessen.de.

Dipl.-Volksw. Carolin Schürg, Justus-Liebig-University, Chair of Banking & Finance, Licher Str. 62, 35394 Giessen, Germany, E-Mail: Carolin.Schuerg@wirtschaft.uni-giessen.de.

The authors would like to thank the editor and an anonymous referee for helpful comments and advice.

men zwischen 1971 und 2016. Unterschieden werden Unternehmen bezüglich ihrer (externen) Finanzierungsrestriktionen und ihrer (internen) Notwendigkeit sich gegen zukünftige Gewinneinbrüche abzusichern. Unsere Ergebnisse zeigen, dass finanziell restringierte Unternehmen ihren Cash-Flow stärker dazu nutzen, Kapazität für zukünftige Finanzierung vorzuhalten, aber weniger investieren und an Anteilseigner ausschütten als finanziell nicht-restringierte Unternehmen. Während der Finanzkrise 2007–2009 tätigten alle Unternehmen weniger Investitionen aus ihrem Cash-Flow, welcher dafür verstärkt für Fremdkapitalrückzahlungen, Kassehaltung und Dividendenausschüttungen genutzt wurde. Vor allem finanziell restringierte Unternehmen sparten vermehrt und zahlten weniger Fremdkapital zurück als finanziell nicht-restringierte Unternehmen – sowohl während der Krise als auch danach. Im Vergleich zu externen Finanzierungsrestriktionen zeigt die interne Notwendigkeit sich abzusichern andere Auswirkungen: Sie schwächt den Aufbau zukünftiger Fremdkapitalkapazität aus dem Cash-Flow für alle Unternehmen und erhöht die Investment-Cash-Flow Sensitivität lediglich für finanziell nicht-restringierte Unternehmen.

Keywords: Cash-flow sensitivity, investment, debt issuance, cash holdings, dividend payments

JEL Classification: G31, G32

I. Introduction

In the presence of financing frictions, sustaining financial flexibility becomes one of the most important objectives of Chief Financial Officers (*Graham/Harvey* 2001). Financing frictions prevent firms from investing in valuable projects in some states of the world by making investments dependent on sufficiently deep cash pools. Choosing policies that preserve the flexibility to respond to periods of unexpected financial shortages may therefore create value by ensuring efficient investments. In recent years, a large body of research has evolved around this topic (*Denis* 2011). While the earlier literature considered mainly the link between financing frictions and investment, more recent studies focus on the relation between financing frictions and cash holdings, i. e. the cash stock that a firm has available. Comparatively few insights have so far been gained on the comprehensive choice of investment, corporate liquidity, payout and financing policy (*Gatchev* et al. 2010; *Dasgupta* et al. 2011; *Chang* et al. 2014).

Our paper contributes to this issue and studies simultaneous decisions on investment, change in cash holdings, dividend policy, and net debt and equity issuance for a large sample of US corporates between 1971 and 2016. To account for the simultaneity of corporate decisions we follow *Chang* et al. (2014) and ensure that the cash-flow identity holds in our sample. This allows us to study precisely how one dollar of free cash flows is used on the five different corporate decisions. We extend the results of the earlier literature in two ways. First, collecting a broad set of U.S. corporates that spans several industries and time periods allows us to also account for the effect of the financial crisis 2007/08 and

examine in which way cash-flow sensitivities have changed due to this extreme event. Second, we consider not only companies' financial constraints but also their needs to hedge against future shortfalls in operating income, i. e. a potential lack of internal funds for arising investment opportunities. In doing so, we essentially consider two dimensions of inflexibility that may impact firms' corporate decisions; one being imposed from external capital markets, the other rooted in internal cash flow mechanisms.

While the distinction with regard to financial constraints has been shown to be relevant mainly for the cash-flow sensitivities of investments and cash holdings (*Fazzari* et al. 1988; *Almeida* et al. 2004), the distinction according to hedging needs has rather been related to financing and liquidity decisions (*Acharya* et al. 2007). Clearly, both external and internal frictions will become relevant once the simultaneity of corporate investment, liquidity, payout policy and debt as well as equity financing is acknowledged. This comprehensive consideration of inflexibility sets our work apart from *Gatchev* et al. (2010) who also account for the contemporaneous nature of corporate decisions but study only external financial frictions. In order to do justice to the extensive literature on the identification of financial constraints, we employ four different ways of differentiating between financially constrained and unconstrained firms. These comprise both univariate measures such as firm size or the existence of a bond rating and multivariate indices such as the WW and SA index (*Fazzari* et al. 1988; *Faulkender*/*Petersen* 2006; *Whited*/*Wu* 2006; *Hadlock*/*Pierce* 2010). With regard to hedging needs, we follow *Acharya* et al. (2007) and use two different proxies that are based on industry-level R&D expenses, respectively sales growth.

We derive three main results. We find that, first, all firms in our sample raise their investments and dividend payments with increasing free cash flows, but unconstrained firms do so to a stronger degree than constrained firms. Cash-flow sensitivities of liquidity and net debt and equity issuance, in contrast, are larger for financially constrained firms. They hence raise their cash holdings and reduce their external financing more strongly along with their cash flows than unconstrained firms. This may be taken as a sign that constrained firms try to save more future funding capacity if their free cash flows allow them to do so. In combination, this seems to enable them to uphold their investment and dividend levels even with varying free cash flows, so that they show generally weaker cash-flow sensitivities of their investment and dividend decisions than unconstrained firms.

Second, we observe that the financial crisis starting in 2007 has had long-lasting effects on corporate decision making for both financially constrained and unconstrained firms: They show weaker cash-flow sensitivities of investments and net debt financing and stronger sensitivities of cash holdings and dividend payments in and after the crisis than before. Both constrained and uncon-

strained firms hence have invested and reduced their debt levels less strongly and increased their cash levels and dividend payments more strongly out of each dollar of additional cash flow since the start of the financial crisis. As regards funding, both types of firms thus seem to prefer the build-up of more immediately accessible cash stocks over future debt capacity in crisis times. Nevertheless, it is instructive to see that unconstrained firms still invest much more than constrained firms while the latter save much more cash and reduce their debt levels more strongly in the years following the onset of the crisis.

Finally, accounting for firms' hedging needs additionally, we find that a strong wedge between current investment proceeds and new investment opportunities (i. e. high hedging needs) leads to weaker reductions in debt levels along with cash flows for both financially constrained and unconstrained firms. Firms with high expected shortfalls in future operating revenues hence use a smaller fraction of an additional dollar in free cash flow to repay outstanding debt (and hence save future debt capacity) than firms with low hedging needs. In addition to that, financially unconstrained firms show a slightly stronger cash-flow sensitivity of investments if they have high hedging needs. Internal frictions to financial flexibility hence do seem to play a role for the question whether investment decisions are dependent on the availability of free cash flows or not, but only for unconstrained firms.

So is full financial flexibility really a necessary condition for unlocking the value hidden in investment opportunities? According to our results, it is unconstrained (rather than constrained) firms with high hedging needs that show the strongest dependence of investments on their cash flows. Financially constrained firms, in contrast, display a much weaker cash-flow sensitivity of their investments that is, moreover, independent of their hedging needs. Firms suffering from external constraints hence seem to be able to overcome this latter inflexibility by saving more of their free cash flow in the form of both cash and future debt capacity. Financially constrained firms can hence tap both financing pools, if needed, to uphold their investment levels in case of shortfalls in operating revenues. Financially unconstrained firms, on the other hand, invest and pay out dividends to a larger extent in good times and contract this spending in bad times. Furthermore, they need to adapt their investment levels particularly strongly to their cash-flow levels if their hedging needs are high.

In sum, our results point towards a quite complex corporate decision frame. Accounting explicitly for the endogeneity between investment, liquidity, dividend and financing choices, we find that not only the wedge between inside and outside financing costs (i. e. financing constraints) plays an important role but so does the wedge between current investment proceeds and new investment opportunities (i. e. hedging needs). Even more importantly, we observe that these frictions do not parallel each other's impact on corporate decisions. Rath-

er, the existence of external financial constraints seems to have led to the employment of strategies that help to bear the consequences of the internal constraints more effectively. Unconstrained firms that do not follow this "save for a rainy day"-strategy to the same degree are then forced to adjust investments to their cash inflows. As high hedging needs imply that these cash inflows will not occur at the same time that investment opportunities arise, financially unconstrained firms with high hedging needs show more volatile investment behavior in correspondence with varying cash flows, while financially constrained firms are more stable in their investments.

Clearly, the need to hedge against future shortfalls in operating income is ingrained in the industry and production technology that a firm uses. If, for instance, production cycles are particularly long or product demand extremely volatile, hedging needs will most likely be high. At the same time, however, hedging needs will also be severe for entrepreneurial firms that actively search for disruptive new technologies without a strong foothold in the respective outlet market and the corresponding sales proceeds. These factors can hardly be influenced from the outside so that high hedging needs may persist over long periods of a firm's life cycle. Fortunately, our study shows that financially constrained firms follow very careful liquidity and financing policies that allow them to deal successfully with these internal frictions.

The paper is organized as follows: Section II. gives a brief overview of the related literature. Section III. describes the main features of our dataset and of our empirical methodology. Section IV. presents the main results, where we consider external frictions in Subsection IV.1. Subsection IV.2. examines the effect of the recent financial crisis on firms' contemporaneous decisions making while Subsection IV.3. introduces internal frictions additionally. Section V. discusses robustness tests. Section VI. concludes.

II. Related Literature

Whereas the traditional valuation approach following *Modigliani/Miller* (1958) ascribes no value to capital structure choices and sees cash stocks (i. e. accumulated past cash flows) simply as the mirror image of "negative debt", a large body of research has since investigated the economic role of financing and liquidity decisions. *Fazzari* et al. (1988) are among the first to argue that when outside financing is more expensive than inside financing, investment decisions of constrained firms are highly sensitive to changes in cash flow.[1] In contrast,

[1] They subdivide firms according to a priori measures of financing constraints and employ a reduced-form investment Q model, which controls for firms' investment opportunities. Their result then follows from comparing the investment cash-flow sensitivities of the different subsamples (*Hoshi* et al. 1991).

Kaplan/*Zingales* (1997) report that investment cash-flow sensitivities are non-monotonic in the degree of financing constraints. In essence, they show that the least constrained firms exhibit the highest sensitivities and conclude that high cash-flow sensitivities of investment cannot unequivocally be interpreted as signs of financial constraints, in line with *Cleary* (1999).[2] Extending this work, *Cleary* et al. (2007) find that investment is a U-shaped curve of cash flows once external financing costs are endogenized. The accompanying discussion on the (non-)monotonicity of investment-cash flow sensitivities directly bears on the way financial constraints are measured, with different measurements leading to different results. In order to account for the insights from this debate, we employ four different and widely established methods to approximate financial constraints. Our observation of higher investment-cash flow sensitivities for financially unconstrained firms is actually robust to the way external constraints are measured. However, our findings are derived in a multi-equation setting where investments are just one of several cash-flow intensive corporate choices that are considered jointly, which is different to the earlier models on this topic.

From an agency perspective, a high cash-flow sensitivity of investment may also reflect managers' tendency to overinvest when they have access to internal funds (*Jensen* 1986), independent of the existence of financial constraints. *Pawlina*/*Renneboog* (2005) test the relation between investment and cash flow on a sample of listed UK firms between 1992 and 1998 and indeed find evidence of overinvestment. *Hovakimian*/*Hovakimian* (2009) examine the development of investment cash-flow sensitivities along the cash flow cycle. Using a large sample of US firms between 1985 and 2003, they find that investment cash-flow sensitivity is associated with underinvestment when cash flows are low and with overinvestment when cash flows are high. *Almeida*/*Campello* (2007) use a sample of US manufacturing firms between 1985 and 2000 and find that asset tangibility positively and significantly affects the investment-cash flow sensitivity of financially constrained firms but not of unconstrained firms.[3] While our work does not attempt to answer the question whether a high investment-cash flow sensitivity is beneficial or harmful to firm value, we try to capture the gist of this discussion by controlling for asset tangibility in our regressions.

---

[2] In addition, there is also a literature showing that cash flow sensitivities of investment can exist even irrespective of financial frictions (*Gomes* 2001; *Alti* 2003). *Kadpakkam* et al. (1998) moreover report higher cash-flow sensitivities for large firms that they ascribe to the greater flexibility of large firms in timing their investments and to agency considerations.

[3] They argue that constrained firms can reach a higher borrowing capacity if they invest in assets with a higher degree of tangibility, as these allow an easier use as collateral for new debt issuances.

Almeida et al. (2004) study the cash-flow sensitivity of cash stocks rather than investment in a sample of US manufacturing firms over the period 1971 to 2000. They observe that only financially constrained firms show a positive cash-flow sensitivity of cash and explain that these firms feel a particular need to save cash out of cash flow in order to consistently uphold their ability to invest in valuable projects. *Bates* et al. (2009) study industrial firms in the US between 1980 and 2006 and show a general inclination of firms to increase cash holdings with increasing volatility of their cash flows. *Denis*/*Sibilkov* (2010) use a broad sample of US firms between 1985 and 2006 and find that cash holdings are positively associated with capital expenditures for financially constrained firms and that for these firms the association between investment and firm value is significantly stronger than for unconstrained firms.[4] Our results generally support these earlier findings as financially constrained firms in our sample also show consistently higher cash-flow sensitivities of cash holdings than unconstrained firms, particularly since the financial crisis starting in 2007.

Acharya et al. (2007) focus more closely on the impact of financing frictions on the tradeoff between debt and cash holdings. They argue that "both higher cash stocks and lower debt levels today increase a constrained firm's future funding capacity and, thus, its ability to undertake new investment opportunities". However, in low cash-flow states, the effect of cash on investment will be higher, whereas in high cash-flow states, the effect of reducing debt will be higher. Cash and debt are, hence, no longer substitutes when financing is not frictionless. Testing their theoretical predictions on a sample of US manufacturing firms between 1971 and 2001, the authors find that unconstrained firms use their free cash flows to reduce their level of debt rather than save it as cash. Constrained firms, in contrast, vary their cash-debt tradeoff in correspondence with their hedging needs. If they have high hedging needs, they show a strong propensity to save cash out of cash flows. If their hedging needs are low, in contrast, they use excess cash flows to reduce their amount of outstanding debt. Our results, that are based on a broader set of companies that stretches over a longer time period, show that for both constrained and unconstrained firms lower hedging needs lead to a higher propensity to reduce debt levels. The inclination to save cash out of cash flows, in contrast, is independent of hedging needs, both for constrained and unconstrained firms in our sample.

Among the first to consider interdependent corporate decisions in a dynamic multi-equation model, *Gatchev* et al. (2010) find that investment decisions are

[4] *Lee*/*Park* (2016), in contrast, consider agency concerns relating to corporate cash holdings and examine whether good corporate governance can substitute for the disciplining role of financial constraints. They find that indeed, corporate governance is more effective in determining cash levels of financially unconstrained firms than of constrained firms.

independent of cash flow for constrained as well as unconstrained firms, employing a measure of bankruptcy probability to assign firms to the financially constrained or the unconstrained sub-sample. They also report that firms decrease their outstanding debt and increase their cash holdings with rising cash flows, but they do not find any difference with respect to financial constraints. Similar to our analysis, their data also stretches over a broad set of US companies but covers a slightly different time period: 1950 to 2007. *Dasgupta* et al. (2011) also study interrelated corporate decisions that are explicitly based on the cash-flow identity. They consider only manufacturing firms during the period 1971 to 2006 and find that firms invest less and reduce their leverage more strongly the tighter their financial constraints are. As a consequence, they argue that short-term cash flow shocks may have a stronger impact on corporate debt markets than on capital goods markets if financing constraints tighten. In a similar framework, *Chang* et al. (2014) differentiate between transitory and permanent cash flows. They show that financially constrained firms direct less transitory cash flows to investment but save more future funding capacity by building up cash stocks. While our results support these findings, we complement the earlier work by considering the effect of the financial crisis in more detail and by examining internal constraints via firms' hedging needs in addition. Similarly to *Dasgupta* et al. (2011) and *Chang* et al. (2014) and in contrast to *Gatchev* et al. (2010), we do not impose the cash-flow identity as a condition on our system of equations but rather define our variables such that it is automatically satisfied. This allows us to make clear statements on the use of an additional dollar of cash flows on each of the corporate decisions during different time periods, respectively for different combinations of external and internal financial constraints.

With regard to an analysis of crisis effects, *Chang* et al. (2016) report that excess cash holdings are more valuable to unconstrained than to constrained firms during crisis times. They argue that financially constrained firms had to deal with liquidity squeezes even before the financial crisis and therefore were better prepared to endure the extreme liquidity shortages within the crisis. *Lee/Park* (2016) explain that due to reduced credit supply, corporate cash holdings became more valuable particularly for less-constrained firms in terms of sustaining their financial flexibility. They therefore conclude that governance mechanisms became less important in mitigating agency problems associated with excess cash holdings for less-constrained firms since the crisis added enough discipline for managers of these firms not to waste valuable cash reserves. While we also find that firms' cash stocks are more dependent on cash flows during crisis times, our reliance on the cash-flow identity allows us to be even more precise in a comparison of constrained and unconstrained firms. From this comparison, we see that constrained firms save more cash out of each dollar of cash flow than unconstrained firms and that this effect is maintained even after the crisis.

Only few theoretical analyses have examined firms' interconnected choice of cash, investment and risk management in light of financial constraints. Starting with the static model by *Froot* et al. (1993), subsequent contributions have focused on dynamic risk management. *Mello* et al. (1995) and *Morellec*/*Smith* (2007) consider corporate investment and optimal hedging. *Bolton* et al. (2011) additionally model financial constraints and the firms' cash accumulation process. They show that constrained firms' investment decisions are strongly affected by the ratio between marginal Q and the marginal costs of financing, so that the relation between investment and Q changes along with the source of financing that the firms choose. *DeMarzo* et al. (2012) consider a similar model but introduce an explicit dynamic contracting problem with moral hazard into the neoclassical Q framework. Against the backdrop of this literature, we control for investment opportunities via Q in our empirical analyses and make sure that our results are robust by the use of further methods to reduce endogeneity concerns.

III. Empirical Methodology, Sample Selection, and Variable Construction

1. Methodology

Following *Dasgupta* et al. (2011) and *Chang* et al. (2014), our empirical analysis is based on the cash-flow identity, which states that the sources of funds have to equal their uses. Funds can be used for investments (Invest), paying dividends (Div), and increasing cash holdings (ΔCashHold). Sources of funds consist of internally generated cash flows (CashFlow) and increases in outstanding debt (*Δ*Debt) or equity (*Δ*Equity). Solving the cash-flow identity for cash flow hence yields the following equation:

$$(1) \qquad Invest_t + \Delta CashHold_t + Div_t - \Delta Debt_t - \Delta Equity_t = CashFlow_t\,,$$

where –*Δ*Debt and –*Δ*Equity represent reductions in outstanding debt or repurchases of outstanding stock respectively. Rather than enforcing the cash-flow identity as a constraint in our empirical analysis, we define the variables in the following system of equations and collect corresponding flow-of-funds data such that it holds automatically.

Our baseline empirical model regresses the five uses of funds as displayed in Equation 1 on our main variables of interest, CashFlow and its interaction term CashFlow *x* Constrained, and on further control variables:[5]

[5] We will use augmented versions of this system of equations in Subsections IV.2. and IV.3. These versions are described explicitly in Appendix C.

$$Invest_{i,t} = \alpha_0 + \alpha_1 CashFlow_{i,t} + \alpha_2 CashFlow_{i,t} \times Constrained + \alpha_3 Constrained + \alpha_4 Q_{i,t} + \alpha_5 CONTROLS_{i,t-1} + \sum_i firm_i + \sum_t year_t + \varepsilon_{1,i,t} \quad (2)$$

$$\Delta CashHold_{i,t} = \beta_0 + \beta_1 CashFlow_{i,t} + \beta_2 CashFlow_{i,t} \times Constrained + \beta_3 Constrained + \beta_4 Q_{i,t} + \beta_5 CONTROLS_{i,t-1} + \sum_i firm_i + \sum_t year_t + \varepsilon_{2,i,t} \quad (3)$$

$$Div_{i,t} = \gamma_0 + \gamma_1 CashFlow_{i,t} + \gamma_2 CashFlow_{i,t} \times Constrained + \gamma_3 Constrained + \gamma_4 Q_{i,t} + \gamma_5 CONTROLS_{i,t-1} + \sum_i firm_i + \sum_t year_t + \varepsilon_{3,i,t} \quad (4)$$

$$\Delta Debt_{i,t} = \delta_0 + \delta_1 CashFlow_{i,t} + \delta_2 CashFlow_{i,t} \times Constrained + \delta_3 Constrained + \delta_4 Q_{i,t} + \delta_5 CONTROLS_{i,t-1} + \sum_i firm_i + \sum_t year_t + \varepsilon_{4,i,t} \quad (5)$$

$$\Delta Equity_{i,t} = \epsilon_0 + \epsilon_1 CashFlow_{i,t} + \epsilon_2 CashFlow_{i,t} \times Constrained + \epsilon_3 Constrained + \epsilon_4 Q_{i,t} + \epsilon_5 CONTROLS_{i,t-1} + \sum_i firm_i + \sum_t year_t + \varepsilon_{5,i,t} \quad (6)$$

In these regression equations, Q is used as a proxy for investment opportunities. CONTROLS is a set of firm-specific variables that may affect the uses of cash flow. These variables will be discussed in detail later. The variables firm and year absorb firm- and time-specific effects, respectively.

The focus of our analysis is on the coefficients of the variables CashFlow and CashFlow × Constrained. The variable CashFlow captures the cash-flow sensitivity of the respective corporate decision for financially unconstrained firms. By virtue of the cash-flow identity, the sum of its five coefficients ($\alpha_1 + \beta_1 + \ldots + \epsilon_1$) must add to unity, while the coefficients of the interaction term, the variable Constrained and all other control variables have to add up to zero. The coefficients of the CashFlow variable hence effectively tell us how much of an additional dollar of generated cash flow is used for either of the five decision variables (investment, liquidity, dividends, changes in debt and equity levels) by an unconstrained firm. The interaction term CashFlow × Constrained captures the additional effect of a dollar increase in cash flow for financially constrained firms as compared to unconstrained firms.

We estimate this SUR (seemingly unrelated regressions) model with equation-by-equation OLS. Since the explanatory variables are the same in all regressions, OLS and GLS are identical (*Greene* 2017). Furthermore, since we ensure that the flow-of-funds variables are consistently defined and the cash flow identity holds well in our data, we do not have to explicitly impose constraints on our estimation. Further details will be provided in the following.

2. Data and Variable Construction

Our sample comprises all corporates with financial data available from the annual COMPUSTAT North-America database over the period 1971 to 2016. Following Frank and *Goyal* (2003), *Dasgupta* et al. (2011), and *Chang* et al. (2014) we use flow-of-funds data to construct the variables used in the cash-flow identity.[6] We exclude banks, insurance companies and other financial firms (SIC 6000–6999) as their investments and accounting data differ from those of industrial and commercial firms. We also exclude utilities (SIC 4900–4999) and not-for-profit and government organizations (SIC > 8000) since these firms' investment and financing choices are subject to regulation. We convert all dollar series to 2000 dollars using the CPI.

Our data selection criteria and variable construction approach closely follows that of *Almeida* et al. (2004) as well as *Acharya* et al. (2007). We retain only those observations for which asset growth is less than 100 %. This procedure ensures that we solely consider firms that are not too strongly impaired by extreme corporate events leading to large jumps in their business fundamentals. Additionally we drop firm-year observations for which a company's market value of assets is less than $1 million as well as observations for which annual sales are less than $1 million. This procedure aims at excluding financially distressed firms from the sample, since they typically exhibit non-standard financing and investment policies. Finally, we require that firms appear in the sample for at least six consecutive years in order to compute a robust empirical proxy for their hedging needs, to be explained in more detail below. In line with *Chang* et al. (2014), we require the cash-flow identity to hold in our sample. We therefore drop observations for which the absolute difference between the uses of funds and cash flow (cf. Equation 1) exceeds 1 % of the beginning-of-period total assets. This leads to 159,573 firm-year observations for 17,757 firms in our unbalanced panel.[7]

We define the variable Invest as the ratio of total investments[8] to the book value of total assets, ΔCashHold as the changes in the holdings of cash and cash equivalents divided by total assets, Div as total cash dividends paid, ΔDebt as

[6] Flow-of-funds data are extensively available from the annual Compustat database starting in 1971 which makes this the starting point of our investigation period.

[7] Univariate statistics as well as regression results which will be discussed throughout this paper refer to considerably smaller sample sizes as these require our main variables to be non-missing. Furthermore, the different constraint measures leave us with varying sample sizes.

[8] Total investments comprise capital expenditures, acquisitions paid in cash, and other investments. This allows us to do justice to the cash flow identity in its entirety. In a robustness check, we also split total investments into capital expenditures and other investments to study potential differences in their cash-flow sensitivities.

the ratio of net long-term and short-term debt issuance to total assets, and ΔEquity as the sale and purchase of common as well as preferred stock divided by total assets. It should be noted that in constructing the variables from the cash-flow identity, we consider the format code valid at the respective point in time when calculating the variables using flow-of-funds data.[9] Details on the definitions of all variables are provided in Appendix A.

Following *Bushmann* et al. (2011), we calculate the variable CashFlow as operating cash flows minus the change in working capital.[10] Constrained is a dummy variable that takes the value 1 if a firm is classified as being financially constrained according to one of four classification criteria which are described below. Our regressions also contain a host of control variables that have become standard in the literature (cf. *Acharya* et al. 2007 or *Chang* et al. 2014): According to *Dasgupta* et al. (2011) we define the proxy for investment opportunities, (Finance) *Q*, as the sum of total assets and market value of common equity less the book value of common equity divided by total assets. *Size* is the natural logarithm of total assets. We also include sales growth (Salesgrowth) as a measure of firms' growth prospects. The variable Tangibility is measured as the ratio of property, plant and equipment to total assets and proxies for firms' asset tangibility. Finally, we also include the leverage ratio (Leverage) defined as total debt divided by total assets.

3. *Approximating Financial Constraints and Hedging Needs*

The earlier literature has employed several methods for identifying the level of financial constraints. To account for this, we use four different approaches to classify firms as being either financially constrained or unconstrained: In the first approach, we partition the sample according to size (total assets), assigning to the group of constrained (unconstrained) firms those in the bottom (top) three deciles of the annual size distribution (*Fazzari* et al. 1988). In a second approach, we use the lack of a bond rating as a proxy for financial constraints. Given that firms may choose not to issue debt and therefore do not solicit a credit rating, we require that constrained firms do not have a public credit rating while

[9] For the time period that we consider, there were four different format codes U.S. companies adopted when reporting their flow of funds: Statement of Cash flows (format code = 7) effective as of July 15, 1888; Working Capital Statement (format code = 1), Cash Statement by Source and Use of Funds (format code = 2), or Cash Statement by Activity (format code = 3) before July 15, 1888.

[10] *Bushmann* et al. (2011) show that investment-cash flow sensitivities are driven by the positive correlation between investment and working capital accruals. To alleviate the concern that the investment-cash flow sensitivity is simply driven by the way we construct the cash-flow variable, we exclude the change in working capital.

reporting positive debt at the same time (*Faulkender*/*Petersen* 2006).[11] As two further measures of financial constraints we employ the WW Index introduced by *Whited*/*Wu* (2006) and the SA (Size and Assets) Index introduced by *Hadlock*/*Pierce* (2010). By construction, higher scores of these two indices indicate that a firm is more financially constrained. Therefore, a firm is classified as being financially constrained (unconstrained) if it falls into the top (bottom) three deciles of the respective index on an annual basis.[12] It should be noted that the number of firm-year observations in our analyses varies (between a minimum of 77,391 and a maximum of 120,275) depending on the way financial constraints are approximated.

Table 1 presents some information on the univariate characteristics of our dataset. As can be seen, unconstrained firms invest more, hold higher cash balances and pay higher dividends. They increase their debt levels more strongly but also repurchase equity more strongly. Unconstrained firms show higher cash flows but weaker investment opportunities. They are larger, show a larger sales growth and employ more tangible assets. They also tend to use a higher leverage. Most of these observations are in line with firm characteristics of constrained versus unconstrained samples in the study of *Gatchev* et al. (2010), whose data set also comprises firms from several industries. Interestingly, constrained firms in our sample do not display lower values of Q than unconstrained firms. Though the differences are small, constrained firms rather show higher investment opportunities.

With regard to identifying firms with high or low needs for hedging against future income shortfalls, we follow *Acharya* et al. (2007). The basic problem in classifying the relationship between a firm's operating cash flows and investment opportunities is that the typical proxies for investment possibilities are not exogenous to cash flows. *Acharya* et al. (2007) suggest two approaches to circumvent these difficulties which we apply as well: In the first, we calculate the correlation between a firm's operating cash flow and its industry-level median of R&D expenses, using the firm's three-digit SIC code. This correlation effectively proxies for the correlation between the supply of internal funds and the investment demand facing each firm. We then assign to the group of high hedging needs those firms with empirical correlation below –0.2 and to the group of low hedging needs those with correlation above 0.2. In the second approach, we employ the correlation between a firm's operating cash flow and a proxy of product-market demand to identify hedging needs. Product market demand is cal-

[11] A firm belongs to the group of unconstrained firms once it has its outstanding debt rated, even if it does not solicit a rating for the entire sampling period.

[12] It should be noted that except for the categorization via the existence of a bond rating, all measures of financial constraints allow for migration between the two groups over time.

Table 1

Summary Statistics – Constrained vs. Unconstrained Firms

Financial constraints measured via:	Firm Size			Bond Rating			WW Index			SA Index		
Variables	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
Invest												
Unconstrained	0.100	0.104	0.078	0.097	0.113	0.073	0.097	0.099	0.077	0.095	0.100	0.074
Constrained	0.058	0.108	0.036	0.080	0.109	0.054	0.062	0.113	0.037	0.064	0.111	0.040
Difference	0.042***			0.017***			0.035***			0.031 ***		
Δ*CashHold*												
Unconstrained	0.006	0.046	0	0.006	0.055	0	0.005	0.045	0	0.006	0.047	0
Constrained	0.005	0.084	0	0.004	0.065	0	0.005	0.083	0	0.005	0.084	0
Difference	0.001***			0.002***			0.000			0.001 **		
Div												
Unconstrained	0.019	0.021	0.014	0.016	0.021	0.009	0.022	0.023	0.017	0.019	0.021	0.014
Constrained	0.007	0.020	0	0.009	0.019	0	0.003	0.013	0	0.007	0.020	0
Difference	0.012***			0.007***			0.019***			0.012 ***		
Δ*Debt*												
Unconstrained	0.019	0.083	0	0.018	0.094	0	0.016	0.076	0	0.017	0.080	0
Constrained	0.003	0.096	0	0.012	0.097	−0.002	0.008	0.102	0	0.005	0.097	0
Difference	0.016***			0.006***			0.008***			0.012 ***		
Δ*Equity*												
Unconstrained	−0.001	0.050	0	0.003	0.064	0	−0.003	0.048	0	−0.003	0.048	0
Constrained	0.027	0.103	0	0.016	0.083	0	0.030	0.107	0	0.028	0.105	0
Difference	−0.028***			−0.013***			−0.033***			−0.031		
CashFlow												
Unconstrained	0.109	0.080	0.103	0.101	0.090	0.097	0.114	0.078	0.107	0.107	0.079	0.102
Constrained	0.045	0.144	0.054	0.069	0.121	0.074	0.037	0.141	0.047	0.047	0.144	0.056
Difference	0.064***			0.032***			0.077***			0.060 ***		

Q												
Unconstrained	1.555	1.356	1.293	1.598	1.556	1.318	1.583	1.406	1.312	1.542	1.330	1.290
Constrained	1.785	2.387	1.230	1.516	1.590	1.151	1.732	2.303	1.207	1.786	2.372	1.228
Difference	−0.230***			0.082***			−0.149***			−0.244 ***		
Size												
Unconstrained	8.038	1.319	7.860	7.307	1.735	1.735	7.991	1.394	7.838	7.934	1.405	7.785
Constrained	3.070	0.995	3.171	4.544	1.698	1.698	3.247	1.125	3.310	3.148	1.047	3.229
Difference	4.968***			2.763***			4.744**			4.786 ***		
Salesgrowth												
Unconstrained	0.054	0.372	0.037	0.056	0.395	0.037	0.066	0.619	0.036	0.045	0.227	0.032
Constrained	0.029	0.481	0.008	0.045	0.427	0.025	0.013	0.280	0.004	0.038	0.484	0.015
Difference	0.025***			0.011***			0.053***			0.007 ***		
Tangibility												
Unconstrained	0.385	0.228	0.346	0.365	0.230	0.322	0.385	0.224	0.347	0.373	0.222	0.332
Constrained	0.255	0.215	0.194	0.313	0.222	0.262	0.259	0.218	0.196	0.261	0.219	0.198
Difference	0.130***			0.052***			0.053***			0.112 ***		
Leverage												
Unconstrained	0.280	0.181	0.259	0.304	0.233	0.272	0.262	0.185	0.246	0.269	0.175	0.251
Constrained	0.246	0.742	0.158	0.269	0.544	0.222	0.269	0.724	0.190	0.249	0.733	0.166
Difference	0.034***			0.035***			−0.007**			0.020 ***		

This table displays summary statistics of the uses of funds as defined in Equation 1, CashFlow, Q and all remaining control variables. Size is the natural logarithm of total assets. All variables except for Size and Salesgrowth are deflated by total assets. Financial constraints are determined via (1.) firm size, (2.) the existence of a bond rating, (3.) the WW index (*Whited/Wu* 2006), and (4.) the SA index (*Hadlock/Pierce* 2010). All data are taken from the annual COMPUSTAT industrial tapes between 1971 and 2016. *, **, and *** indicate statistical significance between groups at the 10-, 5- and 1-percent level, respectively.

culated as the industry's median three-years-ahead sales growth rate based on the three-digit SIC code. Again, we denote as high (low) hedging needs firms with correlation below –0.2 (above 0.2).

IV. Results

This section presents results of the system of equations (Eqs. (2)–(6)). For ease of exposition, we present only the cash-flow sensitivities of investment, liquidity, dividend, debt and equity decisions in the tables below. The full set of results, i. e. including all control factors, is deferred to Appendix B. We start by discussing the cash-flow sensitivities when considering only the distinction between financially constrained and unconstrained firms in Subsection IV.1. Since our period of investigation comprises the financial crisis, Subsection IV.2. displays the comparison of cash-flow sensitivities during the crisis period, Q3 2007–Q1 2010 (*Kahle*/*Stulz* 2013) with the more tranquil periods before and after. Finally, we account additionally for firms' hedging needs in Subsection IV.3.

1. *Financial Constraints*

Table 2 reports the results from the system of equations (2)–(6), estimated as seemingly unrelated regressions using OLS. The table contains the estimated coefficients of the cash-flow variable in the five estimated regression equations on investment, change in cash holdings, dividends, changes in net debt and equity financing, i. e. α_1, β_1, γ_1, δ_1 and ϵ_1. Since the equations also include the interaction term CashFlow x Constrained, these first coefficients capture solely the effect for the baseline category, i. e. the unconstrained firms in our sample. The coefficients of the interaction term (α_2, β_2, γ_2, δ_2 and ϵ_2) reported in the second line in the table represent the additional effect for those firms that are categorized as financially constrained. The cash-flow sensitivities for constrained firms are hence given by the sums of the two corresponding coefficients, i. e. $\alpha_1 + \alpha_2$, $\beta_1 + \beta_2$,…, $\epsilon_1 + \epsilon_2$. Table 2 shows the results where the four different financial constraints criteria are employed in turn.

As can be seen from the investment column in Table 2, both the pure cash-flow variable and the interaction term have a significant effect in all four constraints classifications. The sign of the cash-flow coefficient is positive while the interaction coefficient is negative (but smaller in absolute size), so that the cash-flow sensitivity of financially constrained firms' investments is significantly smaller than that of unconstrained firms. Firms that are financially unconstrained hence invest between 18 and 29 cents (depending on the respective measure of financial constraints) more out of each additional dollar of free cash flow than firms that are constrained.

Table 2

Cash-Flow Sensitivities

	Invest	ΔCashHold	Div	ΔDebt	ΔEquity
1. Firm Size					
CashFlow	0.479***	0.152***	0.041***	–0.188***	–0.108***
CashFlow × Constrained	–0.285***	0.128***	–0.030***	–0.117***	–0.081***
Obs.	77,391	77,391	77,391	77,391	77,391
R-squared	0.147	0.137	0.054	0.116	0.097
2. Bond Rating					
CashFlow	0.424***	0.173***	0.028***	0.224***	–0.110***
CashFlow × Constrained	–0.177***	0.042***	–0.016***	–0.126***	–0.045***
Obs.	120,275	120,275	120,275	120,275	120,275
R-squared	0.134	0.097	0.052	0.115	0.079
3. WW Index					
CashFlow	0.474***	0.158***	0.048***	–0.179***	–0.109***
CashFlow × Constrained	–0.276***	0.101***	–0.043***	–0.140***	–0.089***
Obs.	78,825	78,825	78,825	78,825	78,825
R-squared	0.134	0.123	0.068	0.116	0.096
4. SA Index					
CashFlow	0.461***	0.161***	0.042***	–0.197***	–0.107***
CashFlow × Constrained	–0.267***	0.114***	–0.032***	–0.108***	–0.088***
Obs.	78,777	78,777	78,777	78,777	78,777
R-squared	0.139	0.133	0.056	0.114	0.096

This table reports the cash-flow sensitivities, i.e. the regression coefficients of the variable *CashFlow* (α_1, β_1, γ_1, δ_1, ε_1) and of the interaction term *CashFlow* × *Constrained* (α_2, β_2, γ_2, δ_2, ε_2) from our baseline model (Eqs. (2) to (6) in Section III.1.). *Constrained* is a dummy variable that takes on the value 1 if a firm is considered financially constrained during the respective year. Financial constraints are determined via (1.) firm size, (2.) the existence of a bond rating, (3.) the WW index, and (4.) the SA index. Dependent variables are the uses of funds as defined in Equation (1): Investments (Invest), changes in cash holdings (ΔCashHold), dividends (Div), net debt (ΔDebt) and net equity issuance (ΔEquity), respectively. All regressions include controls as well as firm- and year-fixed effects. All data are taken from the annual COMPUSTAT industrial tapes between 1971 and 2016. *, ** and *** indicate statistical significance at the 10-, 5- and 1-percent level, respectively.

With regard to cash savings, in contrast, we observe that constrained firms show an even stronger sensitivity to cash flows than unconstrained firms. This follows from the fact that both the coefficient of the cash-flow variable and of the interaction term are significantly positive. Constrained firms hence raise their cash stocks by 4 to 13 cents more with each dollar of cash flow than unconstrained firms do.

The opposite is the case for dividend decisions: While both unconstrained and constrained firms in our sample increase their dividend payments along with their cash flows, unconstrained firms do so to a much stronger degree than constrained firms, i.e. they pay between 2 to 4 cents more. This can be seen from the fact that the coefficient of the cash-flow variable is significantly positive, while the coefficient of the interaction term is significantly negative but of

smaller size. Financial constraints hence reduce the cash-flow sensitivity of dividend payments.

Regarding financial decisions we see that financially constrained firms show a stronger cash-flow sensitivity than unconstrained firms: Both reduce their net debt and equity levels with increasing cash flows, but the effect is much stronger for constrained firms, following from the highly significant and negative coefficient of the interaction term CashFlow × Constrained that strengthens the negative effect of the variable CashFlow. Depending on the way the constraints are approximated, constrained firms use almost double the amount of an additional dollar of cash flow to reduce their debt and equity levels. In essence, constrained firms hence employ a large fraction of their cash flows to save future financing capacity by reducing their levels of external financing currently outstanding.

To summarize, we can see from Table 2 that unconstrained firms spend almost half of each additional dollar of cash flows on investments, use 20 % to reduce their net debt levels and only slightly less (about 15 %) to raise their cash stocks. Only about a tenth goes into stock repurchases and an even smaller fraction into paying a dividend. Constrained firms, in contrast, employ about 30 % of each additional dollar of cash flows to repay debt, use about 25 % to increase their cash stocks and invest another 20 %. Only very small amounts go into stock repurchases and dividend payments.

2. Crisis Effects

The acute financial crisis 2007/08 has allegedly led to severe and lasting changes in firms' operations and strategies (*Kahle*/*Stulz* 2013). Reconsidering our analysis for the time period starting immediately after the onset of the financial crisis, Q3 2007, until the end of the reverberations in the real economy in Q1 2010 is therefore particularly interesting. It should be noted that our dataset covers many additional crises, for instance the savings and loans crisis at the beginning of the 1980s or the dot-com bubble in 2000. Since these crises were less severe with respect to the real economy and rather more limited to financial markets, however, we do not expect their comprehensive effects on firms' joint investment, financing and liquidity decisions to be very strong. We therefore only consider the recent financial crisis and its aftermath – admittedly one of the strongest crises since the worldwide depression in 1929 – in this section.

In order to be able to examine potential crisis effects in more detail, we introduce two dummy variables into our regressions. The first captures the pre-crisis time period, i. e. before the onset of the crisis in Q3 2007. The second captures the post-crisis time period, i. e. after the real turmoil subsided in Q1 2010. To simplify interpretations, we use the crisis period Q3 2007 to Q1 2010 as the

baseline category in our regressions. The interaction terms hence relate unconstrained or constrained firms to either the pre- or post-crisis period, respectively. For a full description of the regression model including these three-way interactions see Appendix C. Our approach is methodologically similar to that of *Chang* et al. (2016) who investigate the effect of excess cash holdings on firm value during the financial crisis.

Panel A in Table 3 displays the cash-flow sensitivities results where the unconstrained firms (during the crisis) serve as baseline category. In Panel B, constrained firms (during the crisis) are the baseline category. As can be seen from Panel A, unconstrained firms show a weaker cash-flow sensitivity of investments and of debt reductions in the crisis as compared to the pre-crisis period. This follows from the fact that the interaction term CashFlow × Pre-crisis shows a significant coefficient with the same sign as the simple cashflow variable. As such, the respective cash-flow sensitivities have been stronger before than during the crisis. Unconstrained firms hence reduced their investments by 7 to 8 cents and debt repayments by 11 to 15 cents out of free cash flows during the acute crisis period as compared to the time period before the onset of the financial crisis.

In contrast to that, the cash-flow sensitivities of cash holdings and of dividend payments are stronger in the crisis than before, due to the opposite sign of the interaction term CashFlow × Pre-crisis as compared to the simple cash-flow variable. As a consequence, unconstrained firms have started to save more cash stocks and to pay out more in dividends out of each dollar of cash flows during the crisis than before. Interestingly, all theses effects remain to hold even after the acute crisis years (CashFlow × Post-crisis) and unconstrained firms have paid out even more in dividends out of cash flows in the post crisis years.

Examining the crisis effects on constrained firms becomes easier from Panel B where constrained firms during the crisis period serve as baseline category. It should be noted that the regressions underlying Panel B are structured symmetrically to those of Panel A with the only difference being the choice of baseline category. To keep the reporting as short as possible, however, the results from the interactions with the unconstrained dummy have been left out of the table.[13] As such, we can see that also the constrained firms show a weaker cash-flow sensitivity of investments and debt reductions during the crisis as compared to the pre-crisis period, but a stronger cash-flow sensitivity of cash holdings and dividend payments. Again, these effects remain to hold in the post-crisis period with even stronger dividend payments out of each dollar of cash flows.

[13] Essentially, all the results can be derived from Panel A, but using unconstrained firms as baseline category allows for more immediate interpretations.

Table 3

Cash-flow Sensitivities – Pre-crisis, Crisis, and Post-crisis

	Invest	ΔCashHold	Div	ΔDebt	ΔEquity
Panel A – Baseline: Unconstrained firms during the crisis					
1. Firm Size					
CashFlow	0.405***	0.206***	0.078***	−0.082***	−0.173***
CashFlow × Pre-crisis	0.086***	−0.065***	−0.047***	−0.128***	0.079***
CashFlow × Post-crisis	0.016	0.01	0.025***	0.025	−0.011
CashFlow × Constrained	−0.233***	0.159***	−0.060***	−0.188***	0.015
CashFlow × Constrained × Pre-crisis	−0.058*	−0.040	0.035***	0.081**	−0.112***
CashFlow × Constrained × Post-crisis	−0.023	−0.036	−0.013	−0.008	−0.025
Obs.	77,391	77,391	77,391	77,391	77,391
R-squared	0.148	0.140	0.067	0.117	0.098
2. Bond Rating					
CashFlow	0.405***	0.235***	0.056***	−0.100***	−0.121***
CashFlow × Pre-crisis	0.023	−0.072***	−0.034***	−0.147***	0.018
CashFlow × Post-crisis	−0.005	−0.022	0.016**	−0.005	−0.043*
CashFlow × Constrained	−0.181***	0.073***	−0.028***	−0.197***	−0.009
CashFlow × Constrained × Pre-crisis	0.005	−0.035	0.016**	0.085**	−0.043
CashFlow × Constrained × Post-crisis	−0.003	−0.003	−0.019**	−0.001	0.008
Obs.	120,275	120,275	120,275	120,275	120,275
R-squared	0.134	0.099	0.06	0.117	0.079
3. WW Index					
CashFlow	0.410***	0.223***	0.088***	−0.008***	−0.116***
CashFlow × Pre-crisis	0.076**	−0.078**	−0.051***	−0.114***	0.016
CashFlow × Post-crisis	0.026	−0.007	0.020**	0.035	−0.051*
CashFlow × Constrained	−0.231***	0.139***	−0.079***	−0.186***	−0.049
CashFlow × Constrained × Pre-crisis	−0.047	−0.048*	0.044***	0.057*	−0.051
CashFlow × Constrained × Post-crisis	−0.047	−0.018	−0.009	−0.033	0.012
Obs.	77,825	77,825	77,825	77,825	77,825
R-squared	0.134	0.128	0.081	0.118	0.097
4. SA Index					
CashFlow	0.401***	0.221***	0.079***	−0.081***	−0.168***
CashFlow × Pre-crisis	0.071**	−0.071***	−0.048***	−0.139***	0.074***
CashFlow × Post-crisis	0.017	−0.009	0.026***	0.004	0.001
CashFlow × Constrained	−0.249***	0.154***	−0.061***	−0.188***	0.000
CashFlow × Constrained × Pre-crisis	−0.019	−0.051*	0.035***	0.091***	−0.103***
CashFlow × Constrained × Post-crisis	−0.010	−0.021	−0.014	0.011	−0.031
Obs.	78,777	78,777	78,777	78,777	78,777
R-squared	0.140	0.138	0.07	0.115	0.098
Panel B – Baseline: Constrained firms during the crisis					
1. Firm Size					
CashFlow	0.172***	0.365***	0.019***	−0.271***	−0.158***
CashFlow × Pre-crisis	0.028*	−0.104***	−0.012***	−0.047**	−0.033
CashFlow × Post-crisis	−0.007	−0.025	0.012***	0.017	−0.036
Obs.	77,391	77,391	77,391	77,391	77,391
R-squared	0.148	0.140	0.067	0.117	0.098

	Invest	ΔCashHold	Div	ΔDebt	ΔEquity
2. Bond Rating					
CashFlow	0.224***	0.308***	0.028***	–0.298***	–0.130***
CashFlow × Pre-crisis	0.028*	–0.108***	–0.018***	–0.061***	–0.025
CashFlow × Post-crisis	–0.008	–0.025	–0.002	–0.006	–0.035
Obs.	120,275	120,275	120,275	120,275	120,275
R-squared	0.134	0.099	0.06	0.117	0.079
3. WW Index					
CashFlow	0.179***	0.363***	0.009***	–0.275***	–0.165***
CashFlow × Pre-crisis	0.028	–0.126***	–0.006**	–0.058**	–0.035
CashFlow × Post-crisis	–0.022	–0.025	0.011***	0.002	–0.039
Obs.	77,825	77,825	77,825	77,825	77,825
R-squared	0.134	0.128	0.081	0.118	0.097
4. SA Index					
CashFlow	0.152***	0.375***	0.018***	–0.269***	–0.168***
CashFlow × Pre-crisis	0.052***	–0.122***	–0.012***	–0.048**	–0.029
CashFlow × Post-crisis	0.008	–0.03	0.012***	0.016	–0.031
Obs.	78,777	78,777	78,777	78,777	78,777
R-squared	0.140	0.138	0.07	0.115	0.098

This table reports the cash-flow sensitivities of unconstrained as well as constrained firms during the acute financial crisis (Q3 2007 to Q1 2010) versus the pre-crisis (before Q3 2007) and post-crisis period (after Q1 2010). The augmented system of equations is displayed in Appendix C (model A Eq. (7)). In Panel A (B) financially unconstrained (constrained) firms during the crisis period serve as the baseline category. Financial constraints are determined via (1.) the firm size, (2.) the existence of a bond rating, (3.) the WW index, and (4.) the SA index. The dependent variables are the uses of funds displayed in Equation (1): Investments (Invest), changes in cash holdings (ΔCashHold), dividends (Div), net debt (ΔDebt) and net equity issuance (ΔEquity), respectively. All regressions include controls as well as firm and year-fixed effects. All data are taken from the annual COMPUSTAT industrial tapes between 1971 and 2016. *, ** and *** indicate statistical significance at the 10-, 5- and 1-percent level, respectively.

Considering the fractions out of an additional dollar spent on each of the five corporate decisions during the crisis period, we find again strong differences between constrained and unconstrained firms: During the acute crisis period, unconstrained firms invested about 40 % of each dollar in cash flows, they used about 22 % to increase their cash stocks and about 15 % to repurchase stock. Less than 10 % were spent on dividends or debt reductions. The crisis has obviously induced unconstrained firms to raise their liquidity more strongly out of cash flows and to reduce their outstanding equity capital. In the same time period, constrained firms spent about 35 % of each dollar in cash flows to increase their cash stocks, almost 30 % were used to repay debt and a bit less than 20 % to invest. About 15 % went to stock repurchases and only a tiny fraction were used for dividends. For constrained firms, we hence also see that liquidity concerns have become more important during the crisis but there is a much stronger focus on saving future debt capacity as compared to unconstrained firms.

3. *Financial Constraints and Hedging Needs*

In this subsection, we account for hedging needs in addition to financial constraints in examining the cashflow sensitivities of corporate decision making. The system of equations that underlies the results in Table 4 is now an augmented version, where the cash-flow variable is interacted with a two-dimensional dummy variable that combines high, respectively low, financial constraints with high, respectively low, hedging needs. For a full representation of the augmented system of equations, see Appendix C. Hedging needs are approximated with two different approaches as delineated in Section III.3. In the following, we present the results following from the correlation between firms' operating cash flows and their industry-level median of R&D expenses as proxy. Employing the correlation between cash flows and the industry's median sales growth rate instead delivers similar results which are available upon request.[14] It should be noted that the number of observations in the estimations of Table 4 is now smaller than before as only those firm-quarter observations are retained for which hedging needs are sufficiently high or low, i. e. firms with "intermediate" hedging needs drop out of the analyses.

Panel A in Table 4 uses unconstrained firms with low hedging needs as baseline category. The coefficients of the pure CashFlow variable hence capture the effects for this baseline category, so that the effects of the three interaction terms (CashFlow × Constrained/High, CashFlow × Unconstrained/Low, CashFlow × Unconstrained/High) need to be interpreted in relation to firms with neither external nor internal frictions. I.e. the coefficients of these interaction terms capture the additional effects which have to be added to the baseline coefficient. In Panel B, in contrast, constrained firms with low hedging needs serve as baseline category to ease interpretations for this group of firms.

As can be seen from Panel A, unconstrained firms show a slightly higher cash-flow sensitivity of investments and a slightly weaker propensity to reduce their outstanding financing when their hedging needs are high as compared to when there are only low internal frictions between cash inflows and investment opportunities. These results follow from the significant coefficient of the interaction term CashFlow *x* Constrained/High that takes the same sign as the coefficient of the simple cash-flow variable in three out of the four different ways of approximating financial constraints in the investment equation, and that takes the opposite sign in three, respectively two, ways of approximating financial constraints in the debt, respectively equity financing equations. Panel B shows a similar effect also for constrained firms. Here, however, the weakening effect on

[14] However, these results are weaker in their statistical power as the firms' sales growth rate already enters as one of the control factors in our analyses.

Table 4

Cash-flow Sensitivities and Hedging Needs

	Invest	ΔCashHold	Div	ΔDebt	ΔEquity
Panel A – Baseline: Unconstrained firms with low hedging needs					
1. Firm Size					
CashFlow	0.418***	0.145***	0.043***	–0.205***	–0.163***
CashFlow × Unconstrained/High	0.089**	0.014	0.000	0.052	0.055**
CashFlow × Constrained/Low	–0.249***	0.146***	–0.032***	–0.114***	–0.026
CashFlow × Constrained/High	–0.220***	0.147***	–0.031***	–0.055**	–0.062***
Obs.	28,872	28,872	28,872	28,872	28,872
R-squared	0.150	0.149	0.057	0.130	0.114
2. Bond Rating					
CashFlow	0.388***	0.156***	0.030***	–0.242***	–0.145***
CashFlow × Unconstrained/High	0.062*	0.042**	–0.007	0.059*	0.041*
CashFlow × Constrained/Low	–0.186***	0.071***	–0.018***	–0.134***	–0.018
CashFlow × Constrained/High	–0.153***	0.082***	–0.018***	–0.063**	–0.051**
Obs.	42,962	42,962	42,962	42,962	42,962
R-squared	0.145	0.108	0.054	0.138	0.095
3. WW Index					
CashFlow	0.424***	0.138***	0.05***	–0.205***	–0.154***
CashFlow × Unconstrained/High	0.061	0.025	–0.003	0.055*	0.026
CashFlow × Constrained/Low	–0.239***	0.130***	–0.046***	–0.121***	–0.038
CashFlow × Constrained/High	–0.226***	0.137***	–0.045***	–0.067**	–0.082***
Obs.	30,215	30,215	30,215	30,215	30,215
R-squared	0.140	0.132	0.071	0.134	0.111
4. SA Index					
CashFlow	0.404***	0.147***	0.041***	–0.229***	–0.147***
CashFlow × Unconstrained/High	0.083**	0.005	0.005	0.057*	0.032
CashFlow × Constrained/Low	–0.231***	0.146***	–0.032***	–0.089***	–0.041*
CashFlow × Constrained/High	–0.203***	0.144***	–0.031***	–0.022	–0.085***
Obs.	30,350	30,350	30,350	30,350	30,350
R-squared	0.146	0.146	0.056	0.128	0.112
Panel B – Baseline: Constrained firms with low hedging needs					
1. Firm Size					
CashFlow	0.168***	0.292***	0.010***	–0.319***	–0.189***
CashFlow × Constrained/High	0.029	0.001	0.001	0.059***	–0.036
CashFlow × Unconstrained/Low	0.249***	–0.146***	0.032***	0.114***	0.026
CashFlow × Unconstrained/High	0.338***	–0.132***	0.032***	0.166***	0.081***
Obs.	29,872	29,872	29,872	29,872	29,872
R-squared	0.150	0.149	0.057	0.130	0.114
2. Bond Rating					
CashFlow	0.202***	0.228***	0.012***	–0.376***	–0.163***
CashFlow × Constrained/High	0.034*	0.011	0.000	0.071***	–0.032
CashFlow × Unconstrained/Low	0.186***	–0.071***	0.018***	0.134***	0.018
CashFlow × Unconstrained/High	0.248***	–0.030	0.011**	0.193***	0.059**
Obs.	42,962	42,962	42,962	42,962	42,962
R-squared	0.145	0.108	0.054	0.138	0.095

(Continue next page)

(Table 4: Continued)

	Invest	ΔCashHold	Div	ΔDebt	ΔEquity
3. WW Index					
CashFlow	0.185***	0.269***	0.004***	–0.326***	–0.192***
CashFlow × Constrained/High	0.013	0.007	0.001	0.054**	–0.044*
CashFlow × Unconstrained/Low	0.239***	–0.130***	0.046***	0.121***	0.038
CashFlow × Unconstrained/High	0.300***	–0.106***	0.043***	0.176***	0.063**
Obs.	30,215	30,215	30,215	30,215	30,215
R-squared	0.140	0.132	0.071	0.134	0.111
4. SA Index					
CashFlow	0.173***	0.293***	0.008***	–0.318***	–0.188***
CashFlow × Constrained/High	0.028	–0.001	0.002	0.067***	–0.044*
CashFlow × Unconstrained/Low	0.231***	–0.146***	0.032***	0.089***	0.041*
CashFlow × Unconstrained/High	0.315***	–0.140***	0.037***	0.145***	0.073***
Obs.	30,350	30,350	30,350	30,350	30,350
R-squared	0.146	0.146	0.056	0.128	0.112

This table reports the cash-flow sensitivities of unconstrained as well as constrained firms in combination with hedging needs. The augmented system of equations is displayed in Appendix C (model B Eq. (8)). *Unconstrained/Low*, *Unconstrained/High*, *Constrained/Low* and *Constrained/High* are dummy variables that take on the value of 1 if a firm-year observation belongs to the respective group. In Panel A (B) financially unconstrained (constrained) firms with low hedging needs serve as the baseline category. In Panel A (B) financially unconstrained (constrained) firms during the crisis period serve as the baseline category. Financial constraints are determined via (1.) the firm size, (2.) the existence of a bond rating, (3.) the WW index, and (4.) the SA index. Hedging needs are based on the correlation between a firm's cash flow and industry-level R&D expenses. The dependent variables are the uses of funds displayed in Equation (1): Investments (Invest), changes in cash holdings (ΔCashHold), dividends (Div), net debt (ΔDebt) and net equity issuance (ΔEquity), respectively. All regressions include controls as well as firm and year-fixed effects. All data are taken from the annual COMPUSTAT industrial tapes between 1971 and 2016. *, ** and *** indicate statistical significance at the 10-, 5- and 1-percent level, respectively.

the cash-flow sensitivity of debt reductions is even more strongly significant, while the impact on the cash-flow sensitivity of investment is much weaker.

Irrespective of the existence of external financial constraints, firms obviously reduce their debt levels less strongly if they are affected by high hedging needs. This may be interpreted as the existence of internal constraints making it more difficult for firms to save future debt capacity out of their cash flows. Stated differently, firms where internal cash flows and investment opportunities coincide more strongly (low hedging needs) can reduce their debt levels and improve their future funding capacity to a much higher degree. The fact that the same effect is observed for financially constrained and unconstrained firms may be taken as an indication that the two types of constraints do not work in parallel: Even financially unconstrained firms cannot avoid the repercussion of high hedging needs on their future debt financing capacity. However, the fact that they retain a higher future debt capacity in case of low hedging needs allows them to invest even more strongly if cash flows are high, which explains their higher investment-cash flow sensitivity.

Overall, we hence find that the additional consideration of internal frictions (hedging needs) seems to play a role in its own right: Firms with high hedging needs display weaker cash-flow sensitivities of net debt changes and, to a smaller degree, also of net equity changes. Combined with our earlier results, this implies that internal frictions rather tend to offset the impact of external frictions with regard to financing decisions. As a consequence, it is not firms with both types of frictions that show the strongest cash-flow sensitivity of investments. Rather, it is financially unconstrained firms with high hedging needs that appear to vary their investments to the strongest degree with their cash flows. Whether or not this is harmful with respect to firm value maximization is, unfortunately, outside the scope of our analytical framework.

V. Robustness

1. Hedging Needs

In our main analyses, we follow *Acharya* et al. (2007) and use a correlation cutoff of ± 0.2 to determine whether a firm faces high or low hedging needs for both ways identifying hedging needs. To test the robustness of our results against the backdrop of this rather arbitrary choice, we rerun the regressions in Section IV.3. with cutoffs of ± 0.1 as well as ± 0.3. Untabulated results show that changing the correlation cutoff leaves the initial results basically unchanged.[15] Our results hence appear robust with regard to the precise way of measuring hedging needs.

2. Measurement Error in Q

Erickson/Whited (2000, 2006) point out that errors in the measurement of firms' investment opportunities (Q) might lead to biases in the coefficients of other variables, including the coefficient of the cash-flow variable which is the main focus of our work. To attenuate concerns related to measurement-induced biases, *Chang* et al. (2014) decompose the cash flow variable into a trend and a cycle component based on the procedure developed by *Beveridge/Nelson* (1981), as they argue that the cyclical component of cash flow contains only little information about future growth opportunities. Even after decomposing the cash-flow variable, they find statistically as well as economically significant cash-flow sensitivities, which suggests that cash flow has explanatory power for corporate decisions beyond its correlation with mismeasured investment opportunities.

[15] Results are available from the authors upon request.

This is an established way to address endogeneity issues related to the measurement of investment opportunities and we follow a similar procedure that will be described in more detail in Subsection V.3. However, we also choose another way to deal with the problem of endogeneity which, to the best of our knowledge, has not been used so far in this setting: Since exogenous instruments for the empirical proxy of investment opportunities, Q, are hard to find,[16] we employ *Lewbel's* (2012) method to achieve identification with internally constructed instruments. This approach exploits variation on higher moment conditions of the error distribution from the first-stage regression in a two-stage least squares approach to achieve identification. Instruments are constructed from variables within the given set of covariates via regressors that are not correlated with the product of the heteroscedastic errors in the first-stage regression. Using this set of instruments, one can then estimate an instrumental variables regression with two-stage least-squares procedures, just as with conventional instruments.

The applicability of the *Lewbel* (2012) approach clearly rests on the condition that there is heteroscedasticity in the errors of the first-stage regression, which we can confirm for our dataset.[17] Untabulated results of applying *Lewbel*'s (2012) method show that accounting for endogeneity of Q does barely change any of our results concerning cash-flow sensitivities.[18]

3. Investments

A company's total investments comprise different types, such as capital expenditures, acquisitions and other investments. In order to test whether specific types of these investments show different cash-flow sensitivities, we also split total investments into its sub-items and rerun our analyses using this more disaggregated investment variable. As such, we account for the more cyclical characteristic of some investment types, such as acquisitions, and more trend-oriented types, such as capital expenditures.

Similarly to the analysis by *Chang* et al. (2014), this disaggregation of investment does not change our general results. However, we do find that the crisis effects are primarily driven by net capital expenditures whereas other investments remained basically unaffected by the crisis. This holds for both financially constrained and unconstrained firms.

---

[16] *Erickson/Whited* (2012) show that using lagged mismeasured regressors as instruments can still lead to biased results if the measurement error is serially correlated.

[17] Modified Wald test statistics confirm that the hypothesis of homoscedastic errors in the first-stage regression can be rejected in each case.

[18] This holds for the results presented in all sub-sections of Section IV. Results are available upon request.

VI. Conclusion

Accounting explicitly for the simultaneity of investment, liquidity, investment and financing decisions via consideration of the cash-flow identity allows to portray a nuanced picture of corporate policies. Corresponding with the earlier literature and reconciling the individual findings on (mainly) isolated corporate decisions, we find that not only external financial constraints trigger different strategies for preserving financial flexibility but so does the internal need to hedge against future income shortfalls.

Generally, we observe stronger cash-flow sensitivities of investment and dividend payments but weaker propensities to save future funding capacity out of free cash flows for financially unconstrained as compared to constrained firms. While the crisis period 2007–2010 reduces the investment-cash flow sensitivity for all firms, it raises the propensity to save cash out of cash flows particularly for firms with a larger wedge between the costs of outside and inside capital (i. e. higher financial constraints).

The additional consideration of internal frictions due to a mismatch between cash flows from operations and investment needs can be shown to have important effects in its own right. More precisely, we mostly observe the largest cash-flow sensitivity of investment decisions for firms with low financial constraints but high hedging needs. Financially constrained firms, in contrast, show no differential investment behavior with varying hedging needs. Both constrained and unconstrained firms, however, reduce their debt levels more strongly if they are less affected by mismatched internal cash flows.

What does this imply for firms' investment decisions that tend to be most under public scrutiny? If the policy objective is to raise investments in times of high cash flows, it would be most advisable to reduce barriers to external financing for firms whose industries or outlet markets imply high hedging needs. If a more stable investment behavior over the cash-flow cycle is targeted, in contrast, external financial constraints appear to be less of a problem. This is because constrained firms seem to prefer a cautious approach of saving future funding capacity whenever their cash flows allow them to do so, which enables them to keep their investments relatively stable. Even internal hedging needs are not critical in this case, as they do not seem to affect the investment-cash flow sensitivity of constrained firms. A reduction in financial constraints therefore appears to be less necessary than might have been expected from earlier work. The complexity of our results, however, underpins the importance of paying close attention to both external and internal financing frictions when designing appropriate policy tools for shaping firms' investment behavior.

References

Acharya, V./*Almeida*, H./*Campello*, M. (2007): Is cash negative debt? A hedging perspective on corporate financial policies, Journal of Financial Intermediation, 16, pp. 515–554.

Almeida, H./*Campello*, M. (2007): Financial Constraints, Asset Tangibility, and Corporate Investment, Review of Financial Studies, 20(5), pp. 1429–1460.

Almeida, H./*Campello*, M./*Weisbach*, M. (2004): The cash flow sensitivity of cash, Journal of Finance, 59, pp. 1777–1804.

Alti, A. (2003): How sensitive is investment to cash flow when financing is frictionless, Journal of Finance, 58, pp. 707–722.

Bates, T. W./*Kahle*, K. M./*Stulz*, R. M. (2009): Why Do U.S. Firms Hold So Much More Cash than They Used To?, Journal of Finance, 64(5), pp. 1985–2021.

Beveridge, S./*Nelson*, C. (1981): A New Approach to Decomposition of Economic Time Series into Permament and Transitory Components with Particular Attention to Measurement of the Business Cycle, Journal of Monetary Economics, 7, pp. 151–174.

Bolton, P./*Chen*, H./*Wang*, N. (2011): A Unified Theory of Tobin's q, Corporate Investment, Financing, and Risk Management, Journal of Finance, 66(5), pp. 1545–1578.

Bushmann, R. M./*Smith*, A. J./*Zhang*, X. F. (2011): Investment Cash Flow Sensitivities Really Reflect Related Investment Decisions, SSRN Working Paper.

Chang, X./*Dasgupta*, S./*Wong*, G./*Yao*, J. (2014): Cash-Fow Sensitivities and the Allocation of Internal Cash Flow, The Review of Financial Studies, 27(12), pp. 3628–3657.

Chang, Y./*Benson*, K./*Faff*, R. (2016): Are Excess Cash Holdings more Valuable to Firms in Times of Crisis? Financial Constraints and Governance Matters, Pacific Basin Finance Journal.

Cleary, S. (1999): The Relationship between Firm Investment and Financial Status, Journal of Finance, 54(2), pp. 673–692.

Cleary, S./*Povel*, P./*Raith*, M. (2007): The U-Shaped Investment Curve: Theory and Evidence, Journal of Financial and Quantitative Analysis, 42, pp. 1–39.

Dasgupta, S./*Noe*, T. H./*Wang*, Z. (2011): Where Did All the Dollars Go? The Effect of Cash Flows on Capital and Asset Structure, Journal of Financial and Quantitative Analysis, 46(5), pp. 1259–1294.

Demarzo, P./*Fishman*, M./*He*, Z./*Wang*, N. (2012): Dynamic Agency and The q Theory of Investment, Journal of Finance, 67(6), pp. 2295–2341.

Denis, D. J. (2011): Financial flexibility and corporate liquidity, Journal of Corporate Finance, 17, pp. 667–674.

Denis, D. J./*Sibilkov*, V. (2010): Financial Constraints, Investment and the Value of Cash Holdings, Review of Financial Studies, 23(1), pp. 247–269.

Erickson, T./*Whited*, T. (2000): Measurement error and the relationship between investment and q, Journal of Political Economy, 108, pp. 1027–1057.

– (2006): On the accuracy of different measures of q, Financial Management, 35, pp. 5–33.

– (2012): Treating Measurement Error in Tobin's q, Review of Financial Studies, 25(4), pp. 1286–1329.

Faulkender, M./*Petersen*, M. A. (2006): Does the Source of Capital Affect Capital Structure?, Review of Financial Studies, 19(1), pp. 45–79.

Fazzari, S./*Hubbard*, R./*Petersen*, M. A. (1988): Financing Constraints and Corporate Investment, Brooking Papers on Economic Activity, 1, pp. 141–206.

Frank, M./*Goyal*, V. (2003): Testing the pecking order theory of capital structure, Journal of Financial Economics, 67, pp. 217–248.

Froot, K. A./*Scharfstein*, D. S./*Stein*, J. C. (1993): Risk management, coordinating corporate investment, and financing policies, Journal of Finance, 48, pp. 1629–1658.

Gatchev, V./*Pulvino*, T./*Tarhan*, V. (2010): The interdependent and intertemporal nature of financial decisions: An application to cash flow sensitivities, Journal of Finance, 65, pp. 725–763.

Gomes, J. (2001): Financing investment, American Economic Review, 91(5), pp. 1263–1295.

Graham, J./*Harvey*, C. (2001): The theory and practice of corporate finance: evidence from the field, Journal of Financial Economics, 60, pp. 187–243.

Greene, W. H. (2017): Econometric Analysis. Prentice-Hall, eighth edn.

Hadlock, C. J./*Pierce*, J. R. (2010): New Evidence on Measuring Financial Constraints: Moving Beyond the KZ Index, Review of Financial Studies, 23(5), pp. 1909–1940.

Hoshi, T./*Kashyap*, A./*Scharfstein*, D. S. (1991): Corporate Structure Liquidity and Investment: Evidence from Japanese Panel Data, Quarterly Journal of Economics, 106, pp. 33–60.

Hovakimian, A./*Hovakimian*, G. (2009): Cash Flow Sensitivity of Investment, European Financial Management, 15(1), pp. 47–65.

Jensen, M. (1986): Agency costs of free cash flow, corporate finance, and takeovers, American Economic Review, 76, pp. 323–29.

Kadpakkam, P.-R./*Kumar*, P./*Riddick*, L. (1998): The impact of cash flows and firm size on investment: The international evidence, Journal of Banking and Finance, 22, pp. 293–320.

Kahle, K./*Stulz*, R. M. (2013): Access to capital, investment, and the financial crisis, Journal of Financial Economics, 110, pp. 280–299.

Kaplan, S./*Zingales*, L. (1997): Do Financing Constraints Explain Why Investment is Correlated with Cash Flow?, Quarterly Journal of Economics, 112, pp. 169–215.

Lee, C./*Park*, H. (2016): Financial Constraints, Board Governance Standards, and Corporate Cash Holdings, Review of Financial Economics, 28, pp. 21–34.

Lewbel, A. (2012): Using Heteroscedasticity to Identify and Estimate Mismeasured and Endogenous Regressor Models, Journal of Business & Economic Statistics, 30(1), pp. 67–80.

Mello, A. S./*Parsons*, J. E./*Triantis*, A. J. (1995): An integrated model of multinational flexibility and financial hedging, Journal of International Economics, 39, pp. 27–51.

Modigliani, F./*Miller*, M. (1958): The Cost of Capital, Corporation Finance and the Theory of Investment, American Economic Review, 53, pp. 261–97.

Morellec, E./*Smith*, C. W. (2007): Agency conflicts and risk management, Review of Finance, 11, pp. 1–23.

Pawlina, G./*Renneboog*, L. (2005): Is Investment-Cash Flow Sensitivity Caused by Agency Costs of Asymmetric Information? Evidence from the UK, European Financial Management, 11(4), pp. 483–513.

Whited, T./*Wu*, G. (2006): Financial Constraints Risk, Review of Financial Studies, 19(2), pp. 531–559.

Appendix A
Variable Definitions

Variable		Definition
Cash-flow Identity (flow-of-funds data)		
Invest	scf = 1,2,3	capital expenditure (*capx*) + increase in investment (*ivch*) + acquisition (*aqc*) + other uses of funds (*fuseo*) – sale of PPE (*sppe*) – sale of investment (*siv*)
	scf = 7	capital expenditure (*capx*) + increase in investment (*ivch*) + acquisition (*aqc*) – sale of PPE (*sppe*) – sale of investment (*siv*) – change in short-term investment (*ivstch*) + other investing activities (*ivaco*)
ΔCashHold	scf = 1,2,3,7	cash and cash equivalents increase/decrease (*chech*)
Div	scf = 1,2,3,7	cash dividends (*dv*)
ΔDebt	scf = 1	long-term debt issuance (*dltis*) – long-term debt reduction (*dltr*) – changes in current debt (*dlcch*)
	scf = 2,3,7	long-term debt issuance (*dltis*) – long-term debt reduction (*dltr*) + changes in current debt (*dlcch*)
ΔEquity	scf = 1,2,3,7	sale of common and preferred stock (*sstk*) – purchase of common and preferred stock (*prstkc*)
ΔWC	scf = 1	change in working capital (*wcapc*)
	scf = 2,3	– change in working capital (*wcapc*)
	scf = 7	– change in account receivable (*recch*) – change in iventory (*invch*) – change in account payable (*apalch*) – accrued income taxes (*txach*) – other changes in assets and liabilities (*aoloch*) – other financing activities (*fiao*)
CashFlow	scf = 1,2,3	income before extra items (*ibc*) + extra items & discontinued operations (*xidoc*) + depreciation & amortization (*dpc*) + deferred taxes (*txdc*) + equity in net loss (*esubc*) + gains in sale of PPE&investment (*sppiv*) + other funds from operation (*fopo*) + other sources of funds (*fsrco*) – ΔWC
	scf = 7	income before extra items (*ibc*) + extra items & discontinued operations (*xidoc*) + depreciation & amortization (*dpc*) + deferred taxes (*txdc*) + equity in net loss (*esubc*) + gains in sale of PPE&investment (*sppiv*) + other funds from operation (*fopo*) + other sources of funds (*fsrco*) – ΔWC

Variable	Definition
Further Regression Variables	
Q	(total assets (*at*) + price close fiscal (*prcc_f*)* common shares outstanding (*csho*) – common equity (*ceq*))/ total assets (*at*)
Size	natural logarithm of total assets (*at*)
Salesgrowth	(sales (*sale*) – lagged sales (*sale*))/ lagged sales (*sale*)
Tangibility	property plant and equipment (*ppent*)/ total assets (*at*)
Leverage	(debt in current liabilities (*dlc*) + long-term debt (*dltt*))/ total assets (*at*)
Financial Constraints	
CF/Assets	(income before extraordinary items (*ib*) + depreciation (*dp*))/ lagged total assets (*at*)
Dividend Payer	Dummy variable indicating whether a firm pays cash dividends (dv) in a respective year
Long-term Debt/Assets	long-term debt (*dltt*)/lagged total assets (*at*)
Ln(Assets)	natural logarithm of total assets (*at*)
Salesgrowth	(sales (*sale*) – lagged sales (*sale*))/ lagged sales (*sale*)
Industry Median Salesgrowth	Yearly median salesgrowth based on the three-digit SIC code
WW Index	– 0.091* CF/Assets – 0.062* Dividend Payer + 0.021* Long-term Debt/Assets – 0.044* Ln(Assets) + 0.102* Industry median Sales-growth – 0.035* Salesgrowth
Firm Age	Number of years elapsed since a firm's stock price is reported in the Compustat database
SA Index	– 0.737* Ln(Assets) + 0.043* Ln(Assets)^2 + 0.04* Firm Age

This table presents the construction of variables used throughout this paper along with the names of the corresponding Compustat data items.

Appendix B

Regression Results SUE Model

Financial Constraints measured via:	Firm Size					Bond Rating				
	Invest	ΔCashHold	Div	ΔDebt	ΔEquity	Invest	ΔCashHold	Div	ΔDebt	ΔEquity
CashFlow	0.479***	0.152***	0.041***	−0.188***	−0.108***	0.424***	0.173***	0.028***	−0.224***	−0.110***
	(0.012)	(0.007)	(0.003)	(0.012)	(0.008)	(0.011)	(0.006)	(0.002)	(0.011)	(0.008)
CashFlow × Constrained	−0.285***	0.128***	−0.030***	−0.117***	−0.081***	−0.177***	0.042***	−0.016***	−0.126***	−0.045***
	(0.014)	(0.010)	(0.003)	(0.015)	(0.011)	(0.013)	(0.008)	(0.002)	(0.014)	(0.010)
Constrained	−0.090***	−0.047***	0.002	−0.091***	−0.043***					
	(0.009)	(0.004)	(0.002)	(0.008)	(0.006)					
Q	0.002***	0.002***	0.001***	0.002**	0.004***	0.004***	0.001*	0.001***	0.003***	0.004***
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)
Size	−0.022***	−0.010***	0.001**	−0.018***	−0.017***	−0.013***	−0.006***	0.000***	−0.007***	−0.014***
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)
Salesgrowth	0.017***	0.001	−0.000	0.014***	0.004***	0.011***	0.001	−0.000	0.008***	0.004***
	(0.002)	(0.001)	(0.000)	(0.002)	(0.002)	(0.003)	(0.001)	(0.000)	(0.002)	(0.001)
Tangibility	-0.005	0.047***	−0.007***	0.003	0.025***	0.000	0.043***	−0.005***	0.011*	0.021***
	(0.007)	(0.003)	(0.001)	(0.006)	(0.004)	(0.006)	(0.003)	(0.001)	(0.006)	(0.004)
Leverage	−0.019*	−0.001	−0.003**	−0.024	0.007	−0.033*	0.002	−0.004**	−0.042*	0.012*
	(0.011)	(0.001)	(0.001)	(0.017)	(0.004)	(0.017)	(0.002)	(0.002)	(0.024)	(0.006)
N	77,391	77,391	77,391	77,391	77,391	120,275	120,275	120,275	120,275	120,275
R-Squared	0.147	0.137	0.054	0.116	0.097	0.134	0.097	0.052	0.115	0.079
Number of Firms	7,760	7,760	7,760	7,760	7,760	9,588	9,588	9,588	9,588	9,588

Financial Constraints measured via:	WW Index					SA Index				
	Invest	ΔCashHold	Div	ΔDebt	ΔEquity	Invest	ΔCashHold	Div	ΔDebt	ΔEquity
CashFlow	0.474***	0.158***	0.048***	−0.179***	−0.109***	0.461***	0.161***	0.042***	−0.197***	−0.107***
	(0.012)	(0.007)	(0.003)	(0.012)	(0.008)	(0.012)	(0.007)	(0.003)	(0.012)	(0.007)
CashFlow × Constrained	−0.276***	0.101***	−0.043***	−0.140***	−0.089***	−0.267***	0.114***	−0.032***	−0.108***	−0.088
	(0.015)	(0.010)	(0.003)	(0.015)	(0.011)	(0.014)	(0.010)	(0.003)	(0.014)	(0.011)
Constrained	−0.014**	−0.020***	−0.010***	−0.025***	−0.020***	−0.060***	−0.038***	0.001	−0.060***	−0.039***
	(0.007)	(0.003)	(0.001)	(0.006)	(0.005)	(0.007)	(0.003)	(0.002)	(0.006)	(0.004)
Q	0.002***	0.002***	0.001***	0.002**	0.004***	0.002***	0.002***	0.001***	0.002***	0.004***
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Size	−0.015***	−0.008***	−0.001***	−0.011***	−0.016***	−0.019***	−0.010***	0.001**	−0.014***	−0.016***
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Salesgrowth	0.013***	0.001	−0.000	0.010***	0.004***	0.016***	0.002*	0.000	0.013***	0.005***
	(0.004)	(0.001)	(0.000)	(0.003)	(0.001)	(0.002)	(0.001)	(0.000)	(0.002)	(0.002)
Tangibility	0.003	0.044***	−0.005***	0.011*	0.024***	−0.002	0.050***	−0.006***	0.010*	0.025***
	(0.006)	(0.003)	(0.001)	(0.006)	(0.005)	(0.007)	(0.004)	(0.001)	(0.006)	(0.005)
Leverage	−0.018*	−0.001	−0.003**	−0.021	0.007	−0.019*	−0.001	−0.003**	−0.024	0.007
	(0.011)	(0.001)	(0.001)	(0.016)	(0.004)	(0.011)	(0.001)	(0.002)	(0.017)	(0.005)
N	77,825	77,825	77,825	77,825	77,825	78,777	78,777	78,777	78,777	78,777
R-squared	0.134	0.123	0.068	0.116	0.096	0.139	0.133	0.056	0.114	0.096
Number of Firms	8,289	8,289	8,289	8,289	8,289	7,797	7,797	7,797	7,797	7,797

This table reports the cash-flow sensitivities, i.e. the regression coefficients of the variable *CashFlow*(α1, β1, γ1, δ1, ε1) and of the interaction term *CashFlow x Constrained*(α2, β2, γ2, δ2, ε2) as well as of all controls from the system of equations(Eqs.(2) to(6) in Section III.1). *Constrained* is a dummy variable that takes on the value 1 if a firm is considered financially constrained during the respective year. Financial constraints are determined via(1.) firm size,(2.) the existence of a bond rating,(3.) the WW index, and(4.) the SA index. Dependent variables are the uses of funds as defined in Equation(1): Investments(Invest), changes in cash holdings(ΔCashHold), dividends(Div), net debt(ΔDebt) and net equity issuance(ΔEquity), respectively. All regressions include controls as well as firm- and year-fixed effects. All data are taken from the annual COMPUSTAT industrial tapes between 1971 and 2016. *, ** and *** indicate statistical significance at the 10-, 5- and 1-percent level, respectively.

Appendix C

A) Augmented system of equations including the crisis period:

$$
\begin{aligned}
Invest_{i,t} &= \alpha_0 + \alpha_1 CashFlow_{i,t} + \alpha_{1\,pre} CashFlow_{i,t} \times Pre\text{-}Crisis \\
&+ \alpha_{1\,post} CashFlow_{i,t} \times Post\text{-}Crisis + \alpha_2 CashFlow_{i,t} \\
&\times Constrained + \alpha_{2\,pre} CashFlow_{i,t} \times Constrained \\
&\times Pre\text{-}Crisis + \alpha_{2\,post} CashFlow_{i,t} \times Constrained \\
&\times Post\text{-}Crisis + \alpha_3 Constrained + \alpha_{3\,pre} Constrained \\
&\times Pre\text{-}Crisis + \alpha_{3\,post} Constrained \times Post\text{-}Crisis \\
&+ \alpha_4 Pre\text{-}Crisis + \alpha_5 Post\text{-}Crisis + \alpha_6 Q_{i,t} + \alpha_7 CONTROLS_{i,t-1} \\
&+ \sum_i firm_i + \sum_t year_t + \varepsilon_{1,i,t}, \\
&\vdots
\end{aligned}
\tag{7}
$$

and equivalently for the remaining four regression equations $\Delta CashHold_{i,t}$, $Div_{i,t}$, $\Delta Debt_{i,t}$ and $\Delta Equity_{i,t}$.

B) Augmented system of equations including hedging needs:

$$
\begin{aligned}
Invest_{i,t} &= \alpha_0 + \alpha_1 CashFlow_{i,t} + \alpha_2 CashFlow_{i,t} \times Unconstrained\,/\,High \\
&+ \alpha_3 CashFlow_{i,t} \times Constrained\,/\,Low + \alpha_3 CashFlow_{i,t} \\
&\times Constrained\,/\,High + \alpha_5 Unconstrained\,/\,High \\
&+ \alpha_6 Constrained\,/\,Low + \alpha_7 Constrained\,/\,High \\
&+ \alpha_8 Q_{i,t} + \alpha_9 CONTROLS_{i,t-1} + \sum_i firm_i \\
&+ \sum_t year_t + \varepsilon_{1,i,t}, \\
&\vdots
\end{aligned}
\tag{8}
$$

and equivalently for the remaining four regression equations $\Delta CashHold_{i,t}$, $Div_{i,t}$, $\Delta Debt_{i,t}$, $\Delta Equity_{i,t}$.