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The impact of negative cash flow and influential observations on investment–cash flow sensitivity estimates ☆

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Abstract

Kaplan and Zingales [Quart. J. Econ. 112 (1997) 169] and Clearly [J. Finance 54 (2) (1999) 673] diverge from the large literature on investment–cash flow sensitivity by showing that investment is most sensitive to cash flow for the least financially constrained firms. We examine if this result can be explained by the fact that when firms are in sufficiently bad shape (incurring cash losses), investment cannot respond to cash flow. We find that while Cleary's results can be explained by such negative cash flow observations, the Kaplan–Zingales results are driven more by a few influential observations in a small sample. We also record a decline in investment–cash flow sensitivity over the 1977–1996 period, particularly for the most constrained firms.

JEL classification: G31; G32
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1. Introduction

The relation between firm financing constraints and investment–cash flow sensitivity has been the topic of an important debate in recent years. The traditional viewpoint, originally put forward by Fazzari et al. (1988) (hereafter FHP) holds that firms that face tighter financing constraints, i.e., a larger cost differential between internal and external funds, have to rely more on internal cash for making investments. Using different proxies for financing constraints, numerous empirical studies have found that the estimated investment–cash flow sensitivity is indeed higher for more constrained firms. [2] However, Kaplan and Zingales (1997) (hereafter KZ) challenge this literature by presenting opposing evidence from the low dividend payout subset of the FHP 1970–1984 sample. They show that within this sample of low dividend payout firms, the least constrained firms have the highest estimated sensitivity. The KZ result finds further support from Cleary (1999), who uses more recent data (1987–1994), examines a large cross-section (1317 firms), and measures financing constraints by a discriminant score estimated from several financial variables.

This paper examines whether the KZ/Cleary (1999) findings are driven by the fact that when a firm is in sufficiently bad shape, investment cannot respond to cash flow. The intuition is that when the cash shortfall is severe, the firm is pushed into financial distress and is able to make only the absolutely essential investments. Any further cutback in investment in response to further declines in cash flow is impossible, so that investment–cash flow sensitivity is very low. By definition, the more constrained firm has more restricted access to external financing and reaches this 'minimal investment' stage more rapidly. Therefore, the less constrained firm is likely to display greater investment–cash flow sensitivity than the more constrained firm, when internal cash flows are particularly low. [3] We argue that negative cash flow is a useful proxy for characterizing firms that are in such financially distressed situations, and present evidence on firm characteristics such as growth rates, debt ratings, debt ratios, and dividend changes, confirming the validity of this proxy.

In KZ, the bias induced by negative cash flows is compounded by the problem of small sample size. KZ take the 49 firms that FHP identify as the most constrained, and further rank them by the degree of financing constraints. Consequently, there is little systematic cross-sectional variation in financing constraints between the different groups, and we find that their results are sensitive to the inclusion of two firms (Coleco and Mohawk Data Sciences) in the constrained group, and two firms (Digi-

[2] Some of the proxies used for financing constraints are: dividend payout ratio (FHP), bond ratings and access to debt markets (Calomiris et al., 1995; Gilchrist and Himmelberg, 1995), membership in corporate groups (Hoshi et al., 1991; Calem and Rizzo, 1995; Shin and Park, 1998), banking relationships (Houston and James, 2001), and age and dispersion of ownership (Schaller, 1993). See Hubbard (1998) for a review of this literature.

[3] Fazzari et al. (2000) make a similar point in their response to KZ. Specifically, they point out that even when firm cash flows are extremely low or negative, gross investment cannot be less than zero. This may introduce a censored regression bias in the estimated investment–cash flow sensitivities if the impact of such negative cash flow observations is not accounted for in the estimation procedure.

tal and Data General) in the less constrained one. Along with the negative cash flow observations, these observations induce the difference in estimated sensitivities for the two groups found by KZ.

Small sample size is not a problem in Cleary (1999): we find that the results in this study are driven largely by the impact of negative cash flow observations. Cleary (1999) includes all non-financial, non-utility, publicly-traded US firms over the 1987–1994 period, without reference to their cash flow positions. This leads to the inclusion of several negative cash flow observations, which lowers the investment–cash flow sensitivity estimates for the groups in which they are included. Since the incidence of these negative cash flow observations is the highest in the high-financing-constraints group, this effect is the strongest, and the estimated sensitivity the lowest for this group. Using a sample and methodology similar to Cleary's, but excluding the negative cash flow observations, we find that investment–cash flow sensitivity estimates are almost identical across all financing constraint groups. Specifically, in line with Cleary's results, the estimated sensitivities for the most and least constrained groups are 0.069 and 0.142, respectively, (the difference being statistically significant) when negative cash flow observations are included; and 0.19 and 0.211, respectively, when they are excluded (the difference being statistically insignificant). This indicates that the Cleary (1999) result is materially affected by the inclusion of negative cash flow observations. [4] We obtain similar results in an alternative specification, where instead of omitting negative cash flow observations, we include an additional interaction term between the negative cash flow dummy variable and the cash flow variable to account for the impact of negative cash flow observations on estimated sensitivities.

The result on the uniformity of investment–cash flow sensitivity across constraint categories found in the Cleary sample when negative cash flow observations are excluded is of additional interest because it is also different from the evidence in FHP and other earlier studies that showed a positive relation between financing constraints and investment–cash flow sensitivity (e.g., estimated sensitivities of 0.461 and 0.230 for the most constrained and least constrained groups, respectively, in FHP). A possible explanation is that there has been a reduction over time in the impact of financing constraints on firm investment. We examine this possibility using data for all manufacturing firms with continuous coverage by Compustat for the period 1977–1996, and find evidence supporting such a conclusion: after excluding negative cash flow observations from the sample, the investment–cash flow sensitivity is significantly higher for more constrained firms than less constrained firms (0.586 versus 0.213) over the 1977–1986 period, but they are similar for the two groups (0.196 versus 0.175) and the difference statistically insignificant over the 1987–1996 period.

The paper thus makes two contributions to the literature. First, it reconciles the findings of KZ and Cleary (1999) with earlier results, and shows that the level of internal wealth as proxied by cash flow is a major determinant of investment, and has a

[4] Note that for a firm with cash losses in some years, we do not exclude observations for all years, but only for those specific years in which cash flow was negative.

major influence on the investment–cash flow relationship. To the extent that financial distress is a form of financing constraint, our results also confirm the central conclusions of KZ/Cleary that the investment outlays of firms with weaker financial positions are less sensitive to internal cash flows by showing that negative cash flow observations (our proxy for weak financial health), which are most prevalent among the most constrained firms, show less sensitivity of investment to cash flow. [5] Second, the paper documents a decline in investment–cash flow sensitivities for US firms, especially for the financially constrained category.

The paper is organized as follows. Section 2 presents a brief review of the literature and develops our hypothesis, employing KZ's theoretical framework. Section 3 revisits the KZ and Cleary (1999) studies and examines the impacts of influential observations and negative cash flow observations. Section 4 examines the change in investment–cash flow sensitivity over time using Compustat data on manufacturing firms over the 1977–1996 period. Section 5 examines the operating and financial characteristics of firms across the different constraint categories, and for the negative cash flow observations. Section 6 concludes.

2. Literature review and hypothesis development

In their seminal paper, FHP observe that capital market imperfections lead to corporate underinvestment when internal cash is not enough to invest at the first-best level. They argue that this connection between cash flow and investment should be strongest for those firms that are most constrained in accessing external capital. Empirically, they find that firms facing tighter financing constraints indeed have higher investment–cash flow sensitivities. In contrast, KZ argue that it is theoretically not necessary for this sensitivity to be strongest for the most constrained firms. [6] Therefore, their empirical finding that the sensitivity is strongest for the least constrained firms should not be seen as an enigma. Rather, they argue that both their theoretical and empirical results refute the traditional view that this sensitivity is a measure of financing constraints.

In the most recent exchange in this ongoing debate, Fazzari et al. (2000) contest KZ's conclusions by arguing that the KZ sample is too small and homogeneous. They also suggest that the low investment–cash flow sensitivity for the most constrained group may be due to instances of financial distress. In response, Kaplan and Zingales (2000) argue that this distinction between financing constraints and financial distress is unimportant. Further, they counter the criticism about insufficient cross-sectional heterogeneity in their sample by citing Cleary's (1999) study, where the sample is large and clearly heterogeneous.

[5] We thank one of the referees for pointing out this additional interpretation of our findings.

[6] KZ adopt the underinvestment model of Froot et al. (1993) which shows that when the production function is concave and the additional cost of external finance is convex, investment is below the first-best level if internal cash is not sufficient.

This paper seeks to break this impasse, by examining the impact of negative cash flow observations on the KZ and Cleary (1999) results. [7] Negative cash flow observations need special scrutiny because they represent instances in which investments are down to their lowest possible levels, and cannot be reduced any further in response to additional cash flow declines. Therefore, for such firms, the estimated investment–cash flow sensitivity is low. To the extent that one views financial distress as an abnormal state and not representative of the capital market imperfections that the investment–cash flow sensitivity literature seeks to study (i.e., how otherwise healthy firms are forced to cut back investments when they experience cash flow shortfalls) then these observations should be excluded from consideration. On the other hand, however, to the extent that financial distress is a form of financing constraint, then the inclusion of these observations is appropriate. [8]

Consider the basic Froot et al. (1993) framework that KZ adopt. The firm invests I in a production technology with (gross) output $F(I)$ that is increasing and concave, i.e., $F_I > 0$ and $F_{II} < 0$. The firm has internally generated cash W. If W is insufficient to invest in all available positive NPV projects, the firm has to raise external financing $E = I - W$. Due to capital market imperfections, external funding E has an additional cost $C(E, k)$ over the cost of internal funds (assumed to be zero), where k measures the degree of financing constraints faced by the firm. C is increasing and convex in E, and increasing in k, i.e., $C_E > 0$, $C_{EE} > 0$, and $C_k > 0$.

FSS and KZ show that when the firm has to rely upon external funds, it underinvests, i.e., the investment level chosen is lower than the first-best level. The f.o.c. for this constrained solution is

$$F_I = 1 + C_E \tag{1}$$

and the investment–cash flow sensitivity is

$$\frac{\mathrm{d}I}{\mathrm{d}W} = \frac{C_{EE}}{C_{EE} - F_{II}}. \tag{2}$$

KZ argue that it is not necessary for $\mathrm{d}I/\mathrm{d}W$ to be higher for firms facing tighter financing constraints. If the degree of financing constraints is measured by the lack of internal cash W, then this condition is equivalent to

$$\frac{\mathrm{d}^2 I}{\mathrm{d}W^2} < 0. \tag{3}$$

But,

$$\frac{\mathrm{d}^2 I}{\mathrm{d}W^2} = \left(\frac{F_{III}}{F_{II}^2} - \frac{C_{EEE}}{C_{EE}^2}\right)\frac{F_{II}^2 C_{EE}^2}{(C_{EE} - F_{II})^3} \tag{4}$$

[7] Since FHP measured financing constraints on the basis of dividend payout ratio, they explicitly concentrated on firms that had at least some income to distribute. Specifically, they included a firm in their sample only if it had positive real sales growth over the sample period (1969–1984). Therefore, their sample is likely to have excluded most negative cash flow observations (see Fazzari et al., 1996, p. 27).

[8] See Fazzari et al. (2000) and Kaplan and Zingales (2000) for details on this ongoing debate.

so that condition (3) is satisfied iff

$$\left(\frac{F_{III}}{F_{II}^2}-\frac{C_{EEE}}{C_{EE}^2}\right)<0, \tag{5}$$

which is not necessarily true. For example, KZ show that when C is a quadratic function of E and $F(I)=I^\rho$, $0<\rho<1$, condition (5), and therefore condition (3) are violated.

However, it is arguable whether the degree of financing constraints is properly measured by the shortfall in internal cash flow W. A low-W firm is probably in greater financial distress, but not necessarily facing tighter financing constraints (see, e.g., Fazzari et al., 2000). This distinction between financial distress and financial constraints is also discussed by Lamont et al. (2001), who use negative real sales growth as a proxy for financial distress. [9] Financing constraints refer to the difficulty of raising external financing, or the cost differential between internal and external funds, and are represented by k in the model. A high value of k, rather than a low value of W, is a more direct sign of financing constraints, even though the two are likely to be correlated. [10] Thus, a more appropriate condition describing the traditional view of the impact of financing constraints on investment–cash flow sensitivity is

$$\frac{\mathrm{d}^2 I}{\mathrm{d}k\,\mathrm{d}W}>0, \tag{6}$$

i.e., investment–cash flow sensitivity ($\mathrm{d}I/\mathrm{d}W$) is greater for firms facing a bigger cost differential (k) between internal and external funds. But again, it is easy to find instances where this condition would be violated. From (2), we obtain

$$\frac{\mathrm{d}^2 I}{\mathrm{d}k\,\mathrm{d}W}=\frac{C_{Ek}(F_{II}C_{EEE}-F_{III}C_{EE})}{(C_{EE}-F_{II})^3}-\frac{C_{EEk}F_{II}}{(C_{EE}-F_{II})^2} \tag{7}$$

and there are no theoretical arguments to guarantee that this expression is positive. [11]

The fact that there are no theoretical restrictions on the signs of $\mathrm{d}^2I/(\mathrm{d}k\,\mathrm{d}W)$ and $\mathrm{d}^2I/\mathrm{d}W^2$ *unconditionally* leads KZ to conclude that the relation between financing constraints and investment–cash flow sensitivity is completely indeterminate. Further analysis of the model, however, suggests that in an empirical context, we can qualify this indeterminacy result to some extent, and develop predictions about

[9] We show in Section 5 that negative cash flow observations are also associated with negative real sales growth, indicating that these two proxies for financial distress are strongly correlated.

[10] This correlation between financial distress and financial constraints is particularly problematic in empirical work. For example, Kaplan and Zingales (2000) argue that financial distress is a form of financing constraints, and Povel and Raith (2001) suggest that low cash flow is a component of financing constraints. (We thank one of the referees for pointing this out to us.).

[11] If $C(E,k)$ is additively separable, i.e., $C(E,k)=f(E)+g(k)$, then $C_{Ek}=C_{EEk}=\mathrm{d}^2I/(\mathrm{d}k\,\mathrm{d}W)=0$. If $C(E,k)$ is multiplicatively separable, i.e., $C(E,k)=f(E)g(k)$, then $C_{Ek}=f_E g_k>0$, $C_{EEk}=f_{EE}g_k>0$, the second term on the RHS of (7) is positive, and the first term is negative if $F_{III}>0$ and/or $C_{EEE}>0 \Rightarrow$ condition (6) may or may not be satisfied.

the relation *conditional* on the cash flow realization. The quantity $\mathrm{d}^2I/(\mathrm{d}k\,\mathrm{d}W)$ measures the derivative of $\mathrm{d}I/\mathrm{d}W$ w.r.t. k given a specific value of W. We find that even when $\mathrm{d}^2I/(\mathrm{d}k\,\mathrm{d}W)$ is negative for some (extremely low) values of W, there are reasons to expect it to be positive in most cases (moderate and large W).

Consider the class of functions that KZ use – a quadratic cost function and a fractional power returns function, i.e., $C(E) = kE^2$ and $F(I) = I^\rho$, $\rho \in (0,1)$. [12] Substituting these functions into Eq. (7), we show that $\mathrm{d}^2I/(\mathrm{d}k\,\mathrm{d}W)$ is positive for $W > -((1-\rho)/2k)$ and negative for $W < -((1-\rho)/2k)$ (exposition available upon request). For example, with $k = 1$ and $\rho = 0.5$, $\mathrm{d}^2I/(\mathrm{d}k\,\mathrm{d}W)$ is positive when W is higher than, and negative when W is lower than, −0.25.

Figs. 1–3 provide a graphical illustration. The intuition is clearer when the problem is viewed in terms of marginal returns and costs, instead of total returns and cost functions $F(I)$ and $C(E,k)$. Accordingly, let $\phi(I) = F_I(I)$ be the marginal returns function and $\psi(E,k) = C_E(E,k)$ be the marginal cost function, with $\phi_I = F_{II} \leqslant 0$, and $\psi_E = C_{EE} \geqslant 0$. Figs. 1 and 2 depict the underinvestment problem. The unconstrained optimal level of investment, I^0, represents the point at which $\phi = 1$. But if internal cash flow W is less than I^0, then this level of investment is not attained. The constrained optimal level of investment is the point at which condition (1) is satisfied, i.e., $\phi = 1 + \psi$. Thus, investment has to be cut back from its first-best level.

Figs. 1 and 2 illustrate how it is possible for $\mathrm{d}^2I/(\mathrm{d}k\,\mathrm{d}W)$ to have different signs over different values of W. For $i = 1,2$, let $\psi(W,k_i)$ be the (additional) marginal cost of external financing for firm-i, with $k_2 > k_1$ and $\psi(W,k_2) > \psi(W,k_1)$, $\forall W$. When the cash flow level changes by ΔW, the change in investment for firm-i is ΔI_i. In Fig. 1, $(\Delta I_1/\Delta W) < (\Delta I_2/\Delta W)$, while in Fig. 2, $(\Delta I_1/\Delta W) > (\Delta I_2/\Delta W)$. In the limit as $\Delta W \to 0$ and $k_2 \to k_1$, $\mathrm{d}^2I/(\mathrm{d}k\,\mathrm{d}W) > 0$ at $W = W_H$ (Fig. 1), while $\mathrm{d}^2I/(\mathrm{d}k\,\mathrm{d}W) < 0$ at $W = W_L$ (Fig. 2). In Fig. 1, the cash flow level W_H is relatively large and both firms have significant flexibility in choosing the level of investments. The marginal impact of cash flow reduction on investment is stronger for the more constrained firm-2 than the less constrained firm-1. In Fig. 2, however, the cash flow level W_L is very low. Firm-2 has already cut investments drastically, and has very little room to reduce investments any further, while firm-1 still has some investments that can be cut if cash flow declines further. Thus, the sign of $\mathrm{d}^2I/(\mathrm{d}k\,\mathrm{d}W)$ is seen to reverse as cash flow falls from moderate to very low levels. Recent work by Povel and Raith (2001) reaches a similar conclusion using a more formal theoretical model.

Note however, that the constrained optimal level of investments is always lower for the more constrained firm, i.e., $I^*(W,k_1) > I^*(W,k_2)$, $\forall W$, $k_1 < k_2$, while the unconstrained optimal level is independent of k. Therefore, the investment–cash flow profile for the more constrained firm always lies below that for the less constrained firm, as shown in Fig. 3. The figure also shows that investment sensitivity $\mathrm{d}I/\mathrm{d}W$ is higher for the more constrained (high-k) firm for normal levels of cash flow, but is

[12] When both the cost and returns functions are quadratic (marginal cost and returns functions are linear), i.e., $C(E) = kE^2$ and $F(I) = l + mI - nI^2$, it can be easily shown that $\mathrm{d}^2I/\mathrm{d}k\mathrm{d}W > 0$, $\forall W$.

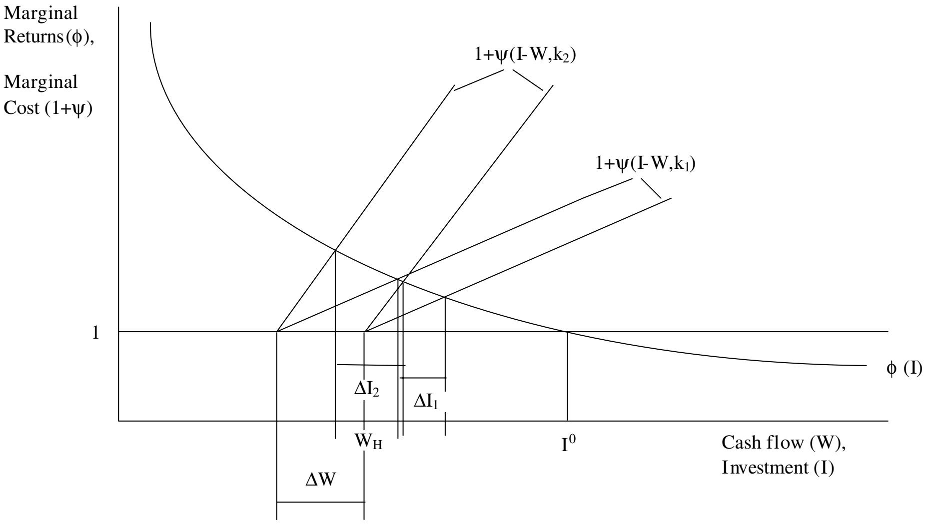

Fig. 1. Higher investment–cash flow sensitivity for the more constrained firm: The flatter marginal cost functions are for the less constrained firm (firm-1) and the steeper marginal cost functions are for the more constrained firm (firm-2). Original cash flow is at a moderate level W_H. When cash flow declines by ΔW, the constrained optimal investment level falls by ΔI_1 for firm-1 and by ΔI_2 for firm-2, where $\Delta I_1 < \Delta I_2$. Thus, investment is more sensitive to cash flow for the more constrained firm.

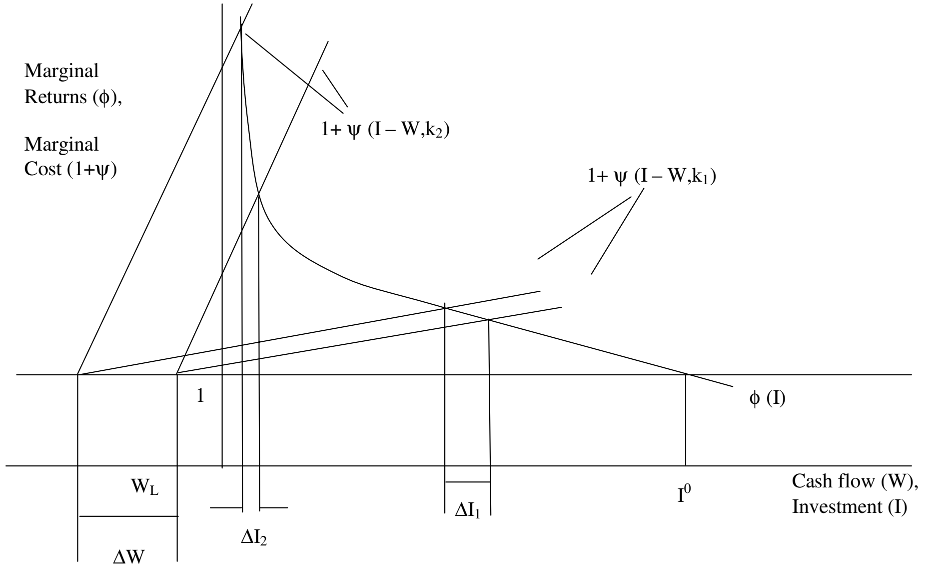

Fig. 2. Higher investment–cash flow sensitivity for the less constrained firm: The flatter marginal cost functions are for the less constrained firm (firm-1) and the steeper marginal cost functions are for the more constrained firm (firm-2). Original cash flow is at a very low level W_L. When cash flow declines by ΔW, the constrained optimal investment level falls by ΔI_1 for firm-1 and by ΔI_2 for firm-2, where $\Delta I_1 > \Delta I_2$. Thus, investment is more sensitive to cash flow for the less constrained firm.

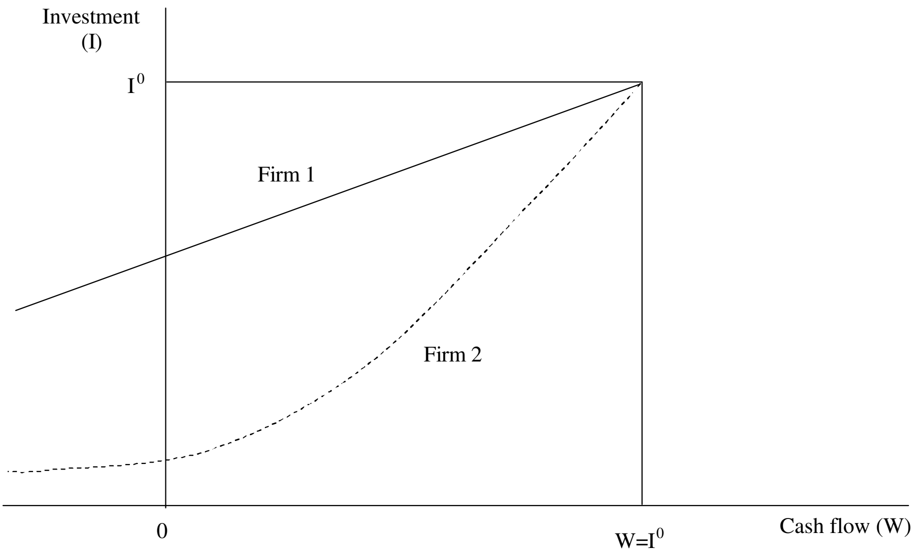

Fig. 3. Investment as a function of cash flow for two firms with different degrees of financing constraints: The solid line shows the investment level for the less constrained firm, and the broken line for the more constrained firm. The unconstrained optimal level of investment (I^0) is the same for both firms and occurs when cash flow W equals I^0. The constrained optimum is always lower than the unconstrained optimum and occurs when W is less than I^0. The constrained optimal level of investment, given a cash flow level W, is always lower for the more constrained firm than the less constrained one.

higher for the low-k firm for very low/negative cash flows, confirming the reversal of the sign of discussed $\mathrm{d}^2 I/(\mathrm{d}k\,\mathrm{d}W)$ earlier.

Empirical studies of investment–cash flow sensitivity typically estimate the straight line approximation of a possibly non-linear cash flow-investment profile, given a certain degree of financing constraints k faced by the firm (controlling for other factors). [13] The usual specification is

$$\frac{I_t}{K_{t-1}} = \alpha + \beta Q_t + \gamma \frac{W_t}{K_{t-1}} + \text{FIRMDUM} + \text{YEARDUM} + \epsilon, \tag{8}$$

where I_t/K_{t-1} is investment during year t, scaled by beginning-of-year capital stock; W_t/K_{t-1} is cash flow during year t, scaled similarly; Q_t is beginning-of-year Tobin's Q, used as a proxy for investment opportunities, and FIRMDUM and YEARDUM are firm and year dummies. [14] The coefficient γ does not measure the slope of the curve for any specific value of internally generated cash W. Rather, it measures the average

[13] In actual empirical work, it is customary to use a group of firms with similar levels of k.

[14] Erickson and Whited (2000) have recently critiqued this specification by arguing that researchers do not have a true measure of marginal Q and resort to using average Q instead, leading to a bias in the estimated coefficients. They propose a measurement error-consistent estimator that uses the information in third and higher order moments of the regression variables to overcome this problem.

slope over the entire observed range of W. Clearly, its value depends upon this range. Consider the investment–cash flow sensitivities of two firms as shown in Fig. 3. The investment–cash flow profile of the more constrained firm (firm-2) is more steeply sloped, i.e., it has higher $\mathrm{d}I/\mathrm{d}W$, when cash flow W is positive. However, investment as a function of cash flow flattens out, and its investment–cash flow sensitivity becomes lower than that of the less constrained firm (firm-1) when cash flow turns negative. If observations from the left tail of the distribution (the low-cash flow or the distressed state observations) are excluded, then $\mathrm{d}^2I/(\mathrm{d}k\,\mathrm{d}W) > 0 \Rightarrow \mathrm{d}\gamma/\mathrm{d}k > 0$, i.e., the more constrained firms have higher investment–cash flow sensitivity. In contrast, when a large number of observations from the left tail are included (as in KZ and Cleary, 1999), the signs of $\mathrm{d}^2I/(\mathrm{d}k\,\mathrm{d}W)$ and $\mathrm{d}\gamma/\mathrm{d}k$ cannot be determined a priori.

The empirical analysis is complicated by the fact that W and k are not independent. The more constrained (high-k) firms are also more likely to have low realizations of W. Therefore, when low-W observations are included in the sample, the estimated coefficient γ is reduced more for the high-k firms. Alternatively, when negative cash flow observations are excluded from the sample, more constrained firms should exhibit greater investment–cash flow sensitivity.

3. The Kaplan and Zingales (1997) and Cleary (1999) evidence revisited

3.1. The Kaplan and Zingales (1997) evidence revisited

In this section, we examine the role of negative cash flow observations on the KZ results. A second concern about the KZ results relates to the small size, and consequently, the possible lack of cross-sectional variation in their sample. Hubbard (1998) argues that since KZ use the subset of firms that were already identified by FHP as being most financially constrained, and then further categorize them on the basis of financing constraints, there may be little cross-sectional heterogeneity between their different constraint groups. In such a situation, even a few influential outliers may materially alter results. Therefore, we examine the impact of (1) negative cash flow observations, and (2) influential observations in a small sample, on the KZ results.

Following KZ, we obtain Compustat data on the low dividends (high financing constraint) subset of the FHP sample over the 1970–1984 period. Firms are categorized as being financially constrained (FC), possibly financially constrained (PFC), and not financially constrained (NFC) according to the qualitative classification reported by KZ (Appendix of their paper, pp. 214–215). [15] The model specification is given by Eq. (8), with Tobin's Q measured as in KZ.

[15] Data are missing for 44 observations, resulting in a total sample of 691 observations. KZ's sample had 719 observations. The difference in the number of observations is due to different versions of Compustat used.

Results are reported in Table 1. For each of the three constraint groups (FC, PFC, and NFC), we report the estimated investment–cash flow sensitivity γ. The first row of estimates reports γ when the group includes all firms assigned to that group. Estimated investment–cash flow sensitivities are 0.344, 0.144, and 0.662 for the FC, PFC, and NFC groups, respectively. These estimates are similar to those reported by KZ (0.34, 0.18, 0.702) and support their conclusion that the least constrained firms display the greatest investment–cash flow sensitivity. The NFC–FC difference in estimated sensitivities is highly significant, both economically and statistically.

However, the subsequent rows in Table 1 report γ excluding one firm in the group at a time, and show that the results hinge critically on the inclusion of two firms (Coleco and Mohawk Data Sciences) in the FC group, and two firms (Digital and Data General) in the NFC group. Investment–cash flow sensitivities are estimated using all (positive and negative cash flow) observations, as well as using positive cash flow observations only. For the full sample, sensitivity estimates for the FC group are tightly clustered in the range $[0.321, 0.365]$ when Coleco (CLO) is included in the sample, but increases to 0.438 when it is excluded, and to 0.484 when both Coleco and Mohawk (MDS) are excluded. For the NFC group, the estimates lie in the range $[0.656, 0.683]$ when Data General (DGN) and Digital (DEC) are included, but it declines to 0.585 when Digital is excluded, 0.573 when Data General is excluded, and to 0.490 when both are excluded from the sample. When these firms are removed from their respective groups, investment–cash flow sensitivities are not significantly different for the most and least constrained firms (the *t*-statistic for the difference is 0.084). [16] When these firms as well as negative cash flow observations are excluded from the sample, the estimated sensitivities are almost identical for the FC and NFC groups (0.621 and 0.618, respectively) and the difference is statistically insignificant (*t*-statistic of −0.033). Results for the 1970–1977 and 1978–1984 sub-samples are similar. [17]

[16] *t*-Statistics are calculated as $(\gamma_1 - \gamma_2)/\sqrt{s_1^2 + s_2^2}$. Weighting the estimated variances by the number of observations, i.e., calculating *t*-statistics as $(\gamma_1 - \gamma_2)/\sqrt{(2/(n_1 + n_2))(n_1 s_1^2 + n_2 s_2^2)}$ yields qualitatively very similar results.

[17] In 1970–1977, for the FC group the estimated sensitivity lies in the range $[0.378, 0.501]$ when negative cash flow observations are included, and is not particularly sensitive to the exclusion of any one firm. For the NFC group, however, the estimate is in the range $[0.686, 0.733]$ when Digital and Data General are included, but reduces to 0.583 when Digital is excluded, 0.578 when Data General is excluded, and 0.443 when both are excluded. When Digital and Data General are excluded, the *t*-statistic for the difference in the estimated sensitivities of the FC and NFC groups is 0.147. When negative cash flow observations are also excluded, the estimated sensitivities are 0.613 for the FC group, 0.504 for the NFC group, and the *t*-statistic for the difference is −0.775. In 1978–1984, the estimated sensitivity for the NFC group lies in the range $[0.481, 0.66]$, when negative cash flow observations are included. For the FC group, it lies in the range $[0.121, 0.173]$ when either Coleco or Mohawk Data Sciences (MDS), or both are included, but increases to 0.435 when both are excluded. When negative cash flow observations as well as these firms are excluded, the investment–cash flow sensitivity estimate for the FC group is 0.688 while that for the NFC group is 0.746, and the difference is statistically insignificant (*t*-statistic of 0.317). Complete results are available from the authors upon request.

Table 1
Financing constraints and investment–cash flow sensitivity: Kaplan and Zingales (1997) sample – impact of individual firm observations

1970–1984								
FC			PFC			NFC		
Excluding firm	Neg. CF included	Neg. CF excluded	Excluding firm	Neg. CF included	Neg. CF excluded	Excluding firm	Neg. CF included	Neg. CF excluded
None	0.344[a]	0.523[a]	None	0.144[a]	0.205[a]	None	0.662[a]	0.750[a]
	(0.042)	(0.054)		(0.051)	(0.070)		(0.041)	(0.045)
AAR	0.343[a]	0.520[a]	COA	0.118[a]	0.224[a]	RGB	0.660[a]	0.740[a]
	(0.043)	(0.054)		(0.054)	(0.074)		(0.041)	(0.044)
ADI	0.337[a]	0.536[a]	COHR	0.124[a]	0.203[a]	DWG	0.662[a]	0.750[a]
	(0.043)	(0.057)		(0.053)	(0.080)		(0.043)	(0.046)
APM	0.337[a]	0.524[a]	CBU	0.238[a]	0.201[a]	**DEC**	0.585[a]	0.665[a]
	(0.042)	(0.054)		(0.071)	(0.075)		(0.042)	(0.046)
AYD	0.348[a]	0.521[a]	NUE	0.126[a]	0.182[a]	FLK	0.663[a]	0.752[a]
	(0.045)	(0.056)		(0.053)	(0.072)		(0.042)	(0.046)
CHB	0.326[a]	0.506[a]	PLT	0.151[a]	0.229[a]	FRX	0.674[a]	0.732[a]
	(0.044)	(0.057)		(0.055)	(0.088)		(0.042)	(0.044)
CLO	0.438[a]	0.621[a]	TER	0.135[a]	0.188[a]	GCA.	0.678[a]	0.758[a]
	(0.049)	(0.063)		(0.055)	(0.075)		(0.043)	(0.047)
5852B	0.328[a]	0.511[a]	VRN	0.163[a]	0.232[a]	HC.	0.683[a]	0.763[a]
	(0.043)	(0.056)		(0.052)	(0.072)		(0.043)	(0.045)
CDA	0.344[a]	0.527[a]	WHT.1	0.135[a]	0.192[a]	HWP	0.665[a]	0.755[a]
	(0.043)	(0.056)		(0.055)	(0.076)		(0.043)	(0.046)
CORD.	0.352[a]	0.533[a]				IBL.	0.668[a]	0.757[a]
	(0.042)	(0.054)					(0.043)	(0.046)
GHX	0.344[a]	0.533[a]				JR	0.664[a]	0.751[a]
	(0.043)	(0.054)					(0.042)	(0.046)
GRB	0.338[a]	0.532[a]				NSM	0.656[a]	0.744[a]
	(0.044)	(0.057)					(0.042)	(0.046)
4580B	0.321[a]	0.494[a]				SFA	0.662[a]	0.750[a]
	(0.043)	(0.056)					(0.043)	(0.046)
IRF	0.349[a]	0.522[a]				SDW	0.666[a]	0.753[a]
	(0.044)	(0.055)					(0.043)	(0.046)
KT	0.348[a]	0.526[a]				TMO	0.665[a]	0.753[a]
	(0.048)	(0.056)					(0.042)	(0.046)
MDS	0.365[a]	0.523[a]				TRCO	0.680[a]	0.776[a]
	(0.044)	(0.055)					(0.042)	(0.045)
RYC	0.343[a]	0.522[a]				WANG	0.656[a]	0.744[a]
	(0.044)	(0.056)					(0.042)	(0.046)
REC	0.351[a]	0.525[a]				WGO	0.681[a]	0.764[a]
	(0.044)	(0.055)					(0.044)	(0.046)
ROCK.	0.346[a]	0.520[a]				CIW	0.662[a]	0.750[a]
	(0.044)	(0.055)					(0.041)	(0.045)
ROG	0.343[a]	0.522[a]				**DGN**	0.573[a]	0.721[a]
	(0.043)	(0.055)					(0.050)	(0.058)
SCI	0.331[a]	0.510[a]						
	(0.041)	(0.053)						
TSN	0.331[a]	0.508[a]						
	(0.041)	(0.053)						
USS	0.326[a]	0.501[a]						
	(0.041)	(0.053)						

Table 1 (*continued*)

1970–1984								
FC			PFC			NFC		
Excluding firm	Neg. CF included	Neg. CF excluded	Excluding firm	Neg. CF included	Neg. CF excluded	Excluding firm	Neg. CF included	Neg. CF excluded
CLO and **MDS**	0.484[a] (0.051)	0.621[a] (0.064)				**DGN** and **DEC**	0.490[a] (0.050)	0.618[a] (0.063)

This table provides estimates for the investment–cash flow sensitivity γ_i, with standard errors in parentheses, for the model

$$\frac{I_t}{K_{t-1}} = \alpha_i + \beta_i Q_t + \gamma_i \frac{W_t}{K_{t-1}} + \text{FIRMDUM}_{it} + \text{YEARDUM}_{it} + \epsilon_{it}, \quad i \in \{\text{FC}, \text{PFC}, \text{NFC}\},$$

for the three financing constraints groups (financially constrained (FC), partially financially constrained (PFC), and not financially constrained (NFC)). Degree of financing constraints is obtained from Kaplan and Zingales (1997, p. 214–215). The top row of estimates reports results using all firms in the constraint group. The subsequent rows report estimates excluding the individual firm(s) indicated. For each constraint group, the left column reports the ticker symbol of the excluded firm, the middle column reports γ_i using both positive and negative cash flow observations, and the right column reports γ_i using positive cash flow observations only. a, b, and c indicate significance at the 1%, 5%, and 10% levels, respectively.

The *t*-statistics mentioned above and described in Footnote 16 may be inappropriate because of the heteroscedasticity inherent in panel data. However, most earlier papers, including FHP and KZ, use similar *t*-tests and we report these *t*-statistics for ready comparison with such earlier findings. Cleary (1999) uses empirical *p*-values to overcome this potential problem. Another way to deal with it is to pool observations from two groups, and use a group dummy variable as well as an interaction variable (cash flow interacted with group dummy). A *t*-test of the interaction term coefficient then yields the statistical significance of the difference in the estimated sensitivities for the two groups. We call this statistic t^*, and report it along with the usual *t*-statistics. All our results are robust to this adjustment for *t*-statistics. The t^*-statistics for the KZ sample are 0.08 when the four firms are excluded, and −0.21 when negative cash flows are excluded as well. [18]

These results indicate the sensitivity of the KZ findings to the influence of two firms in each constraint group – Coleco and Mohawk in the constrained group, and Digital and Data General in the not-constrained one. The difference in the estimated investment–cash flow sensitivities of constrained and unconstrained groups is actually the sensitivity difference of these few firms only. When these firms are removed from the sample, the estimated investment–cash flow sensitivities are not

[18] We thank one of the referees for suggesting this correction.

significantly different for the FC and NFC groups, and are similar to the estimates reported by FHP for their constrained group (i.e., the universe of KZ's sample).

3.2. The Cleary (1999) evidence revisited

We next examine the impact of negative cash flow observations on Cleary's (1999) results. Specifically, following Cleary (1999), we obtain data on all non-financial, non-utility firms traded on US stock exchanges over the period 1987–1994 from Disclosure Worldscope, January 1995. [19] As in Cleary (1999), we perform a discriminant analysis of the decision to increase or decrease dividends. The discriminant score Z_{FC} is used as the measure of (the inverse of) financing constraints. [20] In each year, the top one-third firms with the highest Z_{FC} scores are assigned to the NFC group, the next one-third to the partially financially constrained (PFC) group, and the lowest one-third to the FC group. Combining data for the seven years, we obtain three groups of 2660 firm-years each. These are now used to estimate the investment–cash flow sensitivity model. While it has been customary in the literature to use Tobin's Q to control for growth opportunities (see model specification (8)), Cleary (1999) uses the simpler substitute of equity market-to-book ratio. Accordingly, we estimate model (8) using equity market-to-book (M_{t-1}/B_{t-1}) instead of Tobin's Q for each of the three financing constraints groups.

The results are very similar to those reported in Cleary (1999). To conserve space, we have not reported detailed results. (Detailed results will be provided to interested readers upon request.) The estimated investment–cash flow sensitivities are 0.069, 0.1, and 0.142 for the FC, PFC, and NFC groups, respectively, which closely match those reported by Cleary (1999) (0.064 for FC, 0.09 for PFC, and 0.153 for NFC). The t-statistics for the difference in estimated sensitivities between PFC and FC, NFC and PFC, and NFC and FC are 2.658, 2.97, and 6.26, respectively, supporting the hypothesis that the less constrained firms exhibit greater investment–cash flow sensitivities.

We next examine the extent to which these estimates are affected by the inclusion of negative cash flow observations in the sample. We find a significant change in the results when we exclude the negative cash flow observations from the sample (results are reported in Table 2). Panel A reports results for the regression specification (8), using the discriminant score as the measure of financing constraints, and excluding negative cash flow observations. Estimated investment–cash flow sensitivities are similar for all three financing constraints groups: 0.19, 0.194, and 0.211 for the FC, PFC, and NFC groups, respectively. The t-statistics for the differences in investment–cash flow sensitivities between PFC and FC, NFC and PFC, and NFC and FC groups are 0.246, 1.002, and 1.29, respectively, none of which denotes significance at conventional levels. t^*-statistics as described in Section 3.1 are also all insignificant.

[19] While our recreated sample is qualitatively similar to the original, there is a difference in the number of firms (1140 versus 1317) that is due to a difference in the versions of Disclosure Worldscope used. Also, as the analysis requires several beginning-of-year data items, our first year of analysis is 1988.

[20] See Cleary (1999) for exact descriptions and measurement details of the discriminant variables.

Table 2
Financing constraints and investment–cash flow sensitivity: Cleary (1999) sample – negative cash flow observations excluded

	FC	PFC	NFC	Combined
Panel A: Groupwise regressions (financing constraints measured by Z_{FC})				
Constant	0.134[c] (0.081)	0.149[c] (0.086)	0.671[a] (0.126)	0.128[b] (0.063)
M_{t-1}/B_{t-1}	0.008 (0.005)	0.009[c] (0.005)	0.015[a] (0.004)	0.016[a] (0.002)
W_t/K_{t-1}	0.190[a] (0.011)	0.194[a] (0.012)	0.211[a] (0.012)	0.204[a] (0.006)
$\overline{R}^2$	0.356	0.392	0.478	0.424
No. of obs.	2223	2512	2580	7315
$t(\gamma_{PFC}-\gamma_{FC})$	0.246	$t^*(\gamma_{PFC}-\gamma_{FC})$	−1.11	
$t(\gamma_{NFC}-\gamma_{PFC})$	1.002	$t^*(\gamma_{NFC}-\gamma_{PFC})$	1.52	
$t(\gamma_{NFC}-\gamma_{FC})$	1.290	$t^*(\gamma_{NFC}-\gamma_{FC})$	−0.07	
Panel B: Pooled regression (financing constraints measured by Z_{FC})				
Constant	0.126[b] (0.062)	0.153[b] (0.062)	0.174[a] (0.063)	0.128[b] (0.063)
M_{t-1}/B_{t-1}	0.006[c] (0.004)	0.015[a] (0.004)	0.014[a] (0.003)	0.016[a] (0.002)
W_t/K_{t-1}	0.205[a] (0.008)	0.186[a] (0.009)	0.204[a] (0.008)	0.204[a] (0.006)
$\overline{R}^2$	0.433	0.433	0.433	0.424
No. of obs.	2223	2512	2580	7315
$t(\gamma_{PFC}-\gamma_{FC})$	−1.578	$t^*(\gamma_{PFC}-\gamma_{FC})$	−1.11	
$t(\gamma_{NFC}-\gamma_{PFC})$	1.495	$t^*(\gamma_{NFC}-\gamma_{PFC})$	1.52	
$t(\gamma_{NFC}-\gamma_{FC})$	0.088	$t^*(\gamma_{NFC}-\gamma_{FC})$	−0.07	
Panel C: Pooled regression with cash flow-NEGDUM interaction term (financing constraints measured by Z_{FC})				
Constant	0.130[b] (0.064)	0.147[b] (0.064)	0.169[a] (0.064)	0.128[b] (0.063)
M_{t-1}/B_{t-1}	0.007[b] (0.003)	0.019[a] (0.004)	0.015[a] (0.003)	0.016[a] (0.002)
W_t/K_{t-1}	0.195[a] (0.008)	0.183[a] (0.009)	0.208[a] (0.007)	0.204[a] (0.006)
*NEGDUM** W_t/K_{t-1}	−0.078[a] (0.010)	−0.170[a] (0.020)	−0.291[a] (0.026)	−0.110[a] (0.009)
$\overline{R}^2$	0.414	0.414	0.414	0.397
No. of obs.	2660	2660	2660	7980
$t(\gamma_{PFC}-\gamma_{FC})$	−0.997	$t^*(\gamma_{PFC}-\gamma_{FC})$	−3.23	
$t(\gamma_{NFC}-\gamma_{PFC})$	2.193	$t^*(\gamma_{NFC}-\gamma_{PFC})$	1.08	
$t(\gamma_{NFC}-\gamma_{FC})$	1.223	$t^*(\gamma_{NFC}-\gamma_{FC})$	−1.77	
Panel D: Pooled regression (financing constraints measured by payout ratio)				
Constant	0.088(0.063)	0.132[b] (0.062)	0.117[c] (0.063)	0.128[b] (0.063)
M_t/B_{t-1}	0.015[a] (0.004)	0.017[a] (0.003)	0.010[a] (0.004)	0.016[a] (0.002)
W_t/K_{t-1}	0.199[a] (0.008)	0.192[a] (0.008)	0.228[a] (0.011)	0.204[a] (0.006)
$\overline{R}^2$	0.428	0.428	0.428	0.424
No. of obs.	2217	2521	2577	7315
$t(\gamma_{PFC}-\gamma_{FC})$	−0.619	$t^*(\gamma_{PFC}-\gamma_{FC})$	0.28	
$t(\gamma_{NFC}-\gamma_{PFC})$	2.647	$t^*(\gamma_{NFC}-\gamma_{PFC})$	2.02	
$t(\gamma_{NFC}-\gamma_{FC})$	2.132	$t^*(\gamma_{NFC}-\gamma_{FC})$	1.71	

This table provides estimates for the investment–cash flow sensitivity γ_i and the coefficient β_i of the control variable (equity market-to-book), with standard errors in parentheses, for the models specified below for the three financing constraints groups (financially constrained (FC), partially financially constrained (PFC), and not financially constrained (NFC)). Degree of financing constraints is measured by the discriminant score (Z_{FC}) in Panels A, B, and C, and by payout ratio in Panel D. Panel A reports results for the groupwise regressions

(*continued on next page*)

Table 2 (*continued*)

$$\frac{I_t}{K_{t-1}} = \alpha_i + \beta_i \frac{M_{t-1}}{B_{t-1}} + \gamma_i \frac{W_t}{K_{t-1}} + \text{FIRMDUM}_{it} + \text{YEARDUM}_{it} + \epsilon_{it}, \quad i \in \{\text{FC}, \text{PFC}, \text{NFC}\},$$

while Panels B and D report results for the pooled regression

$$\frac{I_t}{K_{t-1}} = \sum_i \alpha_i \text{FCDUM}_{it} + \sum_i \beta_i \frac{M_{t-1}}{B_{t-1}} \text{FCDUM}_{it} + \sum_i \gamma_i \frac{W_t}{K_{t-1}} \text{FCDUM}_{it} + \text{FIRMDUM} + \text{YEARDUM} + \epsilon_t, \quad i \in \{\text{FC}, \text{PFC}, \text{NFC}\},$$

and Panel C reports results for the pooled regression

$$\frac{I_t}{K_{t-1}} = \sum_i \alpha_i \text{FCDUM}_{it} + \sum_i \beta_i \frac{M_{t-1}}{B_{t-1}} \text{FCDUM}_{it} + \sum_i \gamma_i \frac{W_t}{K_{t-1}} FCDUM_{it} + \sum_i \gamma_i^- \frac{W_t}{K_{t-1}} \text{FCDUM}_{it} * \text{NEGDUM} + \text{FIRMDUM} + \text{YEARDUM} + \epsilon_t, \quad i \in \{\text{FC}, \text{PFC}, \text{NFC}\},$$

where negative cash flow observations are not omitted, but are accounted for by the additional interaction term between W_t/K_{t-1} and the negative cash flow dummy variable NEGDUM. a, b, and c indicate significance at the 1%, 5%, and 10% levels, respectively. Also reported are t-statistics for the differences in the estimated investment–cash flow sensitivities between the groups, and heteroscedasticity-adjusted t^*-statistics as described in Section 3.1 in the text.

Panels B, C, and D present results from several robustness checks. Panel B reports estimates from the alternative specification

$$\frac{I_t}{K_{t-1}} = \sum_i \alpha_i \text{FCDUM}_{it} + \sum_i \beta_i \frac{M_{t-1}}{B_{t-1}} \text{FCDUM}_{it} + \sum_i \gamma_i \frac{W_t}{K_{t-1}} \text{FCDUM}_{it} + \text{FIRMDUM} + \text{YEARDUM} + \epsilon_t, \quad i \in \{\text{FC}, \text{PFC}, \text{NFC}\}, \tag{9}$$

where FCDUM_i, $i \in \{\text{FC}, \text{PFC}, \text{NFC}\}$, are dummy variables for the financing constraint groups. This specification has the twin advantage of greater efficiency and of constraining the firm and year fixed effects to be uniform across the three groups. The investment–cash flow sensitivity estimates are 0.205, 0.186, and 0.204 for the FC, PFC, and NFC groups, respectively, and the t-statistics for the estimate differences are −1.578, 1.495, and 0.088, confirming that the sensitivities are not significantly different across the constraints groups.

Panel C reports results for the specification

$$\frac{I_t}{K_{t-1}} = \sum_i \alpha_i \text{FCDUM}_{it} + \sum_i \beta_i \frac{M_{t-1}}{B_{t-1}} \text{FCDUM}_{it} + \sum_i \gamma_i \frac{W_t}{K_{t-1}} \text{FCDUM}_{it} + \sum_i \gamma_i^- \frac{W_t}{K_{t-1}} \text{FCDUM}_{it} * \text{NEGDUM} + \text{FIRMDUM} + \text{YEARDUM} + \epsilon_t, \quad i \in \{\text{FC}, \text{PFC}, \text{NFC}\}, \tag{10}$$

where instead of omitting negative cash flow observations, we include an additional interaction term between the negative cash flow dummy variable NEGDUM and cash flow to control for the impact of such observations on investment–cash flow sensitivity estimates. This approach overcomes the censored regression bias problem induced by the negative cash flow observations without having to drop these observations (Greene, 2000, pp. 322–325). Once again, estimated sensitivities (0.195, 0.183, 0.208) are very close for the three constraint groups. While the NFC–PFC difference in the estimated sensitivities is statistically significant, the economic significance is small, and the PFC–FC and NFC–FC differences are statistically insignificant as well. Note also that the coefficient on the interaction term is negative and statistically significant, confirming our intuition that distressed firms as proxied by negative cash flow observations have lower investment–cash flow sensitivities than non-distressed firms in each of the financing constraints groups.

One important distinction between the approach of FHP and those of KZ and Cleary (1999) lies in the measurement of financing constraints. While FHP use payout ratio as the measure of (the lack of) financing constraints, KZ and Cleary (1999) measure financing constraints on the basis of several firm-level variables, KZ combine the information in these variables qualitatively, while Cleary (1999) uses the discriminant analysis approach described above. We find however, that forming financing constraints groups based on the easily calculated payout ratio instead of the more data- and computation-intensive discriminant score makes little qualitative difference to the results. Panel D reports results from estimating model (9) using financing constraints groups based on payout ratio. The estimated investment–cash flow sensitivities are 0.199 for FC, 0.192 for PFC, and 0.228 for NFC. The t-statistics for the difference in investment–cash flow sensitivities between the PFC and FC, NFC and PFC, and NFC and FC are −0.619, 2.647, and 2.132, respectively. The alternative t^*-statistics also convey a similar picture. While the estimated investment–cash flow sensitivity for the least constrained group is significantly higher than the other two, the economic significances of the differences are small, and the relationship between financing constraints and investment–cash flow sensitivity is not monotonic, but U-shaped, which is in line with Povel and Raith's (2001) theoretical prediction. Overall, the evidence in Panels A-D suggests that the earlier result of the sensitivity being higher for the less constrained firms is primarily due to the inclusion of negative cash flow observations.

An interesting feature of the data relates to the number of negative cash flow observations in each financing constraints group. When financing constraints are measured by the discriminant score (payout ratio), the number of negative cash flow observations is 437 (443) for the FC group, 148 (139) for the PFC group, and 80 (83) for the NFC group. This highlights the effectiveness of Cleary's (1999) approach in identifying firms with weak financial status. It also provides empirical support to our earlier intuitive argument that the more financially constrained firms are more likely to encounter financial distress and low cash flows. The low investment–cash flow sensitivity of firms with very low internal cash flows reduces the estimated sensitivity of the group in which they are included. Since the incidence of negative cash flow is higher for the more constrained firms, the estimated investment–cash flow sensitivity is lower for more constrained groups when negative cash flow observations are included in the estimation, even when the sensitivity in normal, i.e., non-distressed states is similar across financing constraints groups.

4. Changing patterns of investment–cash flow sensitivity over 1977–1996

The evidence presented in Section 3.2 is interesting for two reasons. First, it shows that Cleary's (1999) result that more constrained firms have lower investment–cash flow sensitivity over the 1988–1994 period is sensitive to the inclusion of negative cash flow observations, and at the same time consistent with his conclusion that the investment outlays of firms with weaker financial positions are less sensitive to internal cash flow. Second, the finding that investment–cash flow sensitivity is similar across financing constraints groups is also different from the FHP finding that over the 1970–1984 period, the most constrained firms displayed the highest investment–cash flow sensitivity. Does this represent a temporal change in the pattern of cross-sectional variation of investment–cash flow sensitivity from the seventies to the nineties? In this section, we examine this question using data for manufacturing firms over the period 1977–1996. [21]

We collect data from annual industrial Compustat for all manufacturing firms (primary four-digit SIC codes in the range 2000–3999). We form two datasets. the first consists of firms having continuous data from 1977 to 1986 (524 firms), and the second from 1987 to 1996 (708 firms). As before, we sort firms in each set by financing constraints (measured by payout ratio), [22] and group them into three categories of equal size – FC, PFC, and NFC. Investment–cash flow sensitivity models (8) and (9) are estimated for each data set, using Tobin's Q as a proxy for growth opportunities. Results are presented in Table 3, Panels A and B. Panel A reports results for specifications (8) and (9) for 1977–1986, and Panel B for 1987–1996, respectively.

For the 1977–1986 sample, the estimated investment–cash flow sensitivities for the groupwise regressions (8) are 0.434, 0.417, and 0.091 for the FC, PFC, and NFC groups respectively, and the t-statistics for the differences in investment–cash flow sensitivities between the PFC and FC, NFC and PFC, and NFC and FC groups are −0.471, −10.879, and −12.567, respectively. Results are similar for the pooled regression. The most constrained group (FC) displays a higher investment–cash flow sensitivity than the least constrained (NFC), under both specifications. For the 1987–1996 sample, the estimated coefficients for the groupwise regressions are 0.045, 0.291, and 0.133 for FC, PFC, and NFC groups, respectively, and the corresponding t-statistics are 15.256, −8.874, and 6.47 for the PFC–FC, NFC–PFC, and

[21] We focus on manufacturing firms in order to keep our sample size manageable, and also because these are the firms that have a clear and unambiguous need for steady investments in physical plant and equipment.

[22] Payout ratio is measured as the sum of cash dividends and stock repurchases divided by the sum of net income and depreciation and amortization.

NFC–FC differences, respectively. Again, we obtain similar results for the pooled regressions. While there is some indication of a hump-shaped pattern in this period, the more noticeable finding clearly is the low estimated sensitivity for the most constrained firms.

As shown in the previous sections, however, these estimates are likely to be affected by the influence of negative cash flow observations. To obtain the non-distressed investment–cash flow sensitivities, we reestimate models (8) and (9) after excluding negative cash flow observations from the sample. Results are presented in Panels C and D of Table 3. Investment–cash flow sensitivity estimates are higher for all categories, which confirms the previous section's finding that negative cash flow observations induce a downward bias in estimated sensitivities. For the 1977–1986 sample, the investment–cash flow sensitivities estimated from the groupwise regressions are 0.586, 0.417, and 0.213 for the FC, PFC, and NFC groups, respectively. The t-statistics for the differences in investment–cash flow sensitivities between the PFC and FC, NFC and PFC, and NFC and FC groups are −4.187, −5.964, and −10.186, respectively. Similar results are also obtained in the pooled regressions. These results show a clear and monotonic pattern of the more constrained firms exhibiting greater investment–cash flow sensitivity, completely in line with the results of FHP.

For the 1987–1996 sample, as in Section 3.2, all evidence of any systematic relation between financing constraints and investment–cash flow sensitivity disappears when negative cash flow observations are excluded. The estimated coefficients from the groupwise and pooled regressions are (0.196, 0.291, 0.175) and (0.194, 0.214, 0.207) for the FC, PFC, and NFC groups, respectively, and the corresponding t-statistics are (4.166, −6.072, −0.946) and (1.229, −0.411, 0.735) for the PFC–FC, NFC–PFC, and NFC–FC differences, respectively. The t^*-statistics calculated as described in Section 3.1 present a similar picture as well. Overall, the evidence suggests that investment–cash flow sensitivity is independent of the degree of financing constraints in the 1987–1996 sample. [23]

Thus, there has been an interesting trend in the evolution of investment–cash flow sensitivities over time from 1977 to 1996. Estimated sensitivities in the 1987–1996 period are lower across all financing constraint groups than in the 1977–1986 period. Moreover, the decline in investment–cash flow sensitivity has been the sharpest for the most constrained group. Consequently, while the most constrained group displayed much higher investment–cash flow sensitivity than the least constrained group in the earlier period, the sensitivities were similar in the later period. [24]

[23] For both the 1977–1986 and 1987–1996 samples, investment–cash flow sensitivity estimates are almost identical to those reported when instead of deleting the negative cash flow observations, we include a negative cash flow dummy interaction term in the specification, as in Eq. (10).

[24] Estimating investment–cash flow sensitivities on a year-by-year basis for the different constraint groups also shows that sensitivities for the constrained and unconstrained groups have converged over the 1977–1996 period (results not reported).

Table 3
Financing constraints and investment–cash flow sensitivity: Compustat data

	Groupwise regressions			Pooled regression		
	FC	PFC	NFC	FC	PFC	NFC
Panel A: 1977–1986 – negative cash flow observations included						
Constant	0.064 (0.077)	0.096 (0.064)	0.039 (0.047)	0.034 (0.038)	0.064 (0.038)[c]	0.103[a] (0.038)
Q_t	0.051[a] (0.015)	0.054[a] (0.011)	0.061[a] (0.009)	0.058[a] (0.009)	0.051[a] (0.008)	0.054[a] (0.008)
W_t/K_{t-1}	0.434[a] (0.024)	0.417[a] (0.027)	0.091[a] (0.013)	0.355[a] (0.015)	0.295[a] (0.020)	0.151[a] (0.013)
$\overline{R}^2$	0.479	0.463	0.363	0.448	0.448	0.448
No. of obs.	1740	1750	1750	1740	1750	1750
$t(\gamma_{\mathrm{PFC}} - \gamma_{\mathrm{FC}})$	−0.471	$t^*(\gamma_{\mathrm{PFC}} - \gamma_{\mathrm{FC}})$	0.17	$t(\gamma_{\mathrm{PFC}} - \gamma_{\mathrm{FC}})$	−2.400	
$t(\gamma_{\mathrm{NFC}} - \gamma_{\mathrm{PFC}})$	−10.879	$t^*(\gamma_{\mathrm{NFC}} - \gamma_{\mathrm{PFC}})$	−6.90	$t(\gamma_{\mathrm{NFC}} - \gamma_{\mathrm{PFC}})$	−6.037	
$t(\gamma_{\mathrm{NFC}} - \gamma_{\mathrm{FC}})$	−12.567	$t^*(\gamma_{\mathrm{NFC}} - \gamma_{\mathrm{FC}})$	−11.73	$t(\gamma_{\mathrm{NFC}} - \gamma_{\mathrm{FC}})$	−10.277	
Panel B: 1987–1996 – negative cash flow observations included						
Constant	0.107 (0.161)	−0.207[a] (0.056)	0.115[a] (0.042)	−0.007 (0.040)	0.028 (0.041)	0.060 (0.040)
Q_t	0.078[a] (0.007)	0.046[a] (0.007)	0.026[a] (0.005)	0.085[a] (0.005)	0.043[a] (0.006)	0.037[a] (0.006)
W_t/K_{t-1}	0.045[a] (0.008)	0.291[a] (0.014)	0.133[a] (0.011)	0.056[a] (0.006)	0.184[a] (0.011)	0.121[a] (0.010)
$\overline{R}^2$	0.377	0.501	0.361	0.387	0.387	0.387
No. of obs.	2360	2360	2360	2360	2360	2360
$t(\gamma_{\mathrm{PFC}} - \gamma_{\mathrm{FC}})$	15.256	$t^*(\gamma_{\mathrm{PFC}} - \gamma_{\mathrm{FC}})$	9.49	$t(\gamma_{\mathrm{PFC}} - \gamma_{\mathrm{FC}})$	10.216	
$t(\gamma_{\mathrm{NFC}} - \gamma_{\mathrm{PFC}})$	−8.874	$t^*(\gamma_{\mathrm{NFC}} - \gamma_{\mathrm{PFC}})$	−5.10	$t(\gamma_{\mathrm{NFC}} - \gamma_{\mathrm{PFC}})$	−4.238	
$t(\gamma_{\mathrm{NFC}} - \gamma_{\mathrm{FC}})$	6.470	$t^*(\gamma_{\mathrm{NFC}} - \gamma_{\mathrm{FC}})$	1.68	$t(\gamma_{\mathrm{NFC}} - \gamma_{\mathrm{FC}})$	5.574	
Panel C: 1977–1986 – negative cash flow observations excluded						
Constant	0.051 (0.075)	0.096 (0.064)	0.051 (0.045)	0.030 (0.038)	0.065[c] (0.038)	0.103[a] (0.038)
Q_t	0.028[c] (0.015)	0.054[a] (0.011)	0.038[a] (0.010)	0.035[a] (0.009)	0.045[a] (0.008)	0.037[a] (0.009)
W_t/K_{t-1}	0.586[a] (0.030)	0.417[a] (0.027)	0.213[a] (0.021)	0.467[a] (0.018)	0.362[a] (0.021)	0.280[a] (0.020)
$\overline{R}^2$	0.501	0.463	0.394	0.465	0.465	0.465
No. of obs.	1674	1750	1608	1674	1750	1608
$t(\gamma_{\mathrm{PFC}} - \gamma_{\mathrm{FC}})$	−4.187	$t^*(\gamma_{\mathrm{PFC}} - \gamma_{\mathrm{FC}})$	−1.69	$t(\gamma_{\mathrm{PFC}} - \gamma_{\mathrm{FC}})$	−3.796	
$t(\gamma_{\mathrm{NFC}} - \gamma_{\mathrm{PFC}})$	−5.964	$t^*(\gamma_{\mathrm{NFC}} - \gamma_{\mathrm{PFC}})$	−3.93	$t(\gamma_{\mathrm{NFC}} - \gamma_{\mathrm{PFC}})$	−2.828	
$t(\gamma_{\mathrm{NFC}} - \gamma_{\mathrm{FC}})$	−10.186	$t^*(\gamma_{\mathrm{NFC}} - \gamma_{\mathrm{PFC}})$	−8.53	$t(\gamma_{\mathrm{NFC}} - \gamma_{\mathrm{PFC}})$	−6.950	

Panel D: 1987–1996 – negative cash flow observations excluded						
Constant	0.054 (0.157)	−0.207[a] (0.056)	0.109[a] (0.041)	−0.036 (0.039)	−0.001 (0.040)	0.031 (0.039)
Q_t	0.058[a] (0.008)	0.046[a] (0.007)	0.016[a] (0.005)	0.064[a] (0.006)	0.041[a] (0.006)	0.021[a] (0.006)
W_t/K_{t-1}	0.196[a] (0.018)	0.291[a] (0.014)	0.175[a] (0.013)	0.194[a] (0.012)	0.214[a] (0.011)	0.207[a] (0.013)
$\overline{R}^2$	0.414	0.501	0.385	0.424	0.424	0.424
No. of Obs.	2159	2360	2125	2159	2360	2125
$t(\gamma_{\text{PFC}} - \gamma_{\text{FC}})$	4.166	$t^*(\gamma_{\text{PFC}} - \gamma_{\text{FC}})$	2.34	$t(\gamma_{\text{PFC}} - \gamma_{\text{FC}})$	1.229	
$t(\gamma_{\text{NFC}} - \gamma_{\text{PFC}})$	−6.072	$t^*(\gamma_{\text{NFC}} - \gamma_{\text{PFC}})$	−2.21	$t(\gamma_{\text{NFC}} - \gamma_{\text{PFC}})$	−0.411	
$t(\gamma_{\text{NFC}} - \gamma_{\text{FC}})$	−0.946	$t^*(\gamma_{\text{NFC}} - \gamma_{\text{PFC}})$	−0.41	$t(\gamma_{\text{NFC}} - \gamma_{\text{FC}})$	0.735	

This table provides estimates for the investment–cash flow sensitivity γ_i and the coefficient β_i of the control variable Q, with standard errors in parentheses, for the models specified below for the three financing constraints groups (financially constrained (FC), partially financially constrained (PFC), and not financially constrained (NFC)), with and without including negative cash flow observations in the sample. Degree of financing constraints is measured by Payout Ratio. Panels A and B report results for the sample including negative cash flow observations, and Panels C and D for the sample excluding negative cash flow observations. Panels A and C report results for 1977–1986 data, and Panels B and D for 1987–1996 data. The set of estimates on the left are from the groupwise regressions

$$\frac{I_t}{K_{t-1}} = \alpha_i + \beta_i Q_t + \gamma_i \frac{W_t}{K_{t-1}} + \text{FIRMDUM}_{it} + \text{YEARDUM}_{it} + \epsilon_{it}, \quad i \in \{\text{FC}, \text{PFC}, \text{NFC}\},$$

and the estimates on the right are from the pooled regression

$$\frac{I_t}{K_{t-1}} = \sum_i \alpha_i \text{FCDUM}_{it} + \sum_i \beta_i Q_t \text{FCDUM}_{it} + \sum_i \gamma_i \frac{W_t}{K_{t-1}} \text{FCDUM}_{it} + \text{FIRDUM} + \text{YEARDUM} + \epsilon_{it}, \quad i \in \{\text{FC}, \text{PFC}, \text{NFC}\}.$$

a, b, and c indicate significance at the 1%, 5%, and 10% levels, respectively. Also reported are t-statistics for the differences in the estimated investment–cash flow sensitivities between the groups, and heteroscedasticity-adjusted t^*-statistics as described in Section 3.1 in the text.

5. Characteristics of financing constraints categories

The evidence thus far highlights the impact of negative cash flow observations on investment–cash flow sensitivity estimates. We have argued that these observations are likely proxying for firms in distress whose investment cannot respond to cash flow. In this section we examine if negative cash flow observations are indeed associated with financial distress, by analyzing the operating and financial characteristics of these observations. We also present evidence on the characteristics of the firms in each constraint group.

Table 4 reports summary statistics for several variables describing firms in each of the three financing constraints groups (FC, PFC, NFC) and for the negative cash flow observations, for the 1977–1996 sample of manufacturing firms described in Section 4. Panel A reports estimates for 1977–1986, and Panel B for 1987–1996. In both sub-periods, and for all measures of size (sales, total assets, and fixed assets) FC firms are smaller than NFC and PFC firms. FC firms are also younger than PFC and NFC firms in both sub-periods, [25] and record higher real sales growth, both in the year of observation, and averaged over ten years. This is in line with intuition and earlier findings (FHP, Cleary, 1999) that older and larger firms find it easier to raise external financing than younger, smaller, high-growth firms. The relative smallness and higher growth rates of FC firms are particularly pronounced in the later sub-period, indicating that the proportion of small, high-growth firms in the FC category has increased over time.

FC firms are also less profitable (as measured by net income margin), and have higher debt-to-asset ratios. They have lower debt service coverage ratios, and lower credit ratings – median rating of BBB in 1977–1986 and BB in 1987–1996, compared to A for NFC firms in both sub-periods. All of these indicate lower financial flexibility for FC firms, compared to PFC and NFC ones. However, the evidence on liquidity measures is mixed. While there is some evidence that current ratio, cash balance, [26] and financial slack [27] are lower for FC firms over 1977–1986, indicating lower flexibility for these firms during this period, there is no clear pattern in the 1987–1996 sub-period. This finding is in line with KZ, who show that liquidity reserves are not necessarily low for many firms included in FHP's financially constrained category.

Turning to the negative cash flow observations, we find that these observations are associated with small size, low profitability, negative real sales growth, [28] high leverage, low debt service coverage, and poor credit ratings (median rating of B+ in both sub-periods). There is also a pattern of ratings downgrades in the year of the cash loss – ratings fell by an average of almost four grades in the 1977–1986

[25] Age is calculated as the number of years since listing, as reported in CRSP.

[26] Normalized by total assets less cash, as in Opler et al. (1999). Normalizing by total assets, as in Lie (2000), yields similar results.

[27] Measured as in Cleary (1999).

[28] Negative real sales growth has recently been used as a proxy for identifying and excluding instances of financial distress by Lamont et al. (2001).

Table 4
Financing constraints categories and negative cash flow observations: Summary statistics

	FC				PFC				NFC				Negative cash flow			
	# Obs.	Mean	S.D.	Median	# Obs.	Mean	S.D.	Median	# Obs.	Mean	S.D.	Median	# Obs.	Mean	S.D.	Median
Panel A: 1977–1986																
Sales ($ mil.)	1523	2290[a]	6837	412	1587	3408[a]	8161	846	1424	2304[a]	4978	659	196	1199[a]	2036	324
Total assets ($ mil.)	1523	1594[a]	4595	244	1587	2473[a]	5787	548	1424	1721[a]	3747	458	196	1157[a]	1720	385
Fixed assets ($ mil.)	1674	736[a]	2492	95	1750	1241[a]	3254	202	1608	913[a]	2972	155	208	468[a]	813	97
Age (years)	1389	19.10[a]	14.26	14	1449	26.05[a]	17.65	19	1286	26.68[a]	17.97	20	157	29.46[a]	18.4	21
Growth rate (%)	1523	14.72[a]	19.68	12.60	1587	10.50[a]	14.64	10.19	1424	7.10[a]	21.55	7.85	196	−7.91[a]	36.68	−10.45
Avg. growth rate (%)	1523	8.48[a]	6.79	8.45	1587	7.40[a]	5.27	7.28	1424	6.55[a]	5.42	6.69	196	0.54	6.91	0.16
Net income margin (%)	1523	3.74[a]	6.62	3.97	1587	5.38[a]	3.52	5.11	1424	6.49[a]	5.65	5.72	196	−6.22	76.89	−1.33
Debt–assets ratio (%)	1523	21.82[a]	14.11	20.40	1587	16.79[a]	10.04	16.86	1417	14.09[a]	10.40	13.67	195	28.48[a]	18.75	25.97
Debt rating	103	11.44[a]	4.64	11	168	8.01[a]	3.60	8	127	8.56[a]	3.68	8	38	15.92[a]	4.92	16
Rating change	38	0.76[a]	1.67	0	75	0.12	0.82	0	54	0.61[b]	1.71	0	12	3.75[b]	5.40	2.50
Current ratio	1519	2.18[a]	0.86	2.02	1587	2.33[a]	0.84	2.22	1424	2.54[a]	1.08	2.31	196	2.22[a]	1.09	2.01
Debt service coverage	1507	9.56[a]	47.26	4.47	1551	18.71[a]	77.67	6.21	1324	24.05[a]	92.07	7.35	191	−9.85	152.58	0.30
Slack	1521	0.65	0.69	0.49	1586	0.73	0.66	0.58	1420	0.86	0.70	0.70	196	0.56	0.53	0.47
Cash balance	1523	0.10[a]	0.14	0.06	1587	0.10[a]	0.12	0.06	1424	0.14[a]	0.17	0.08	196	0.07[a]	0.11	0.04
Dividend change ($)	1521	−0.001	0.34	0	1586	0.01	0.38	0.06	1424	0.01	0.47	0.05	196	−0.192[a]	0.358	0
Δ cash balance (%)	1523	2.14[a]	9.31	0.66	1587	0.84[a]	6.77	0.24	1424	0.47	11.60	0.14	196	−0.13	7.39	−0.07
Δ slack (%)	1521	12.86[a]	46.72	6.58	1586	6.31[a]	23.38	3.68	1419	1.67[b]	29.83	1.10	196	−7.57[b]	41.36	−9.07
Net new debt (%)	1523	2.18[a]	11.83	0	1587	1.67[a]	7.73	0	1424	1.93[a]	9.46	0	196	0.08	18.95	−0.91

Table 4 (*continued*)

	FC				PFC				NFC				Negative cash flow			
	# Obs.	Mean	S.D.	Median	# Obs.	Mean	S.D.	Median	# Obs.	Mean	S.D.	Median	# Obs.	Mean	S.D.	Median
Net new equity (%)	1523	1.61[a]	4.99	0.06	1587	0.85[a]	3.82	0.04	1424	−1.41[a]	6.90	0	196	2.00[a]	6.27	0
Panel B: 1987–1996																
Sales ($ mil.)	2038	1974[a]	7734	285	2215	3854[a]	10212	787	1947	3799[a]	8435	948	400	1202[a]	4591	245
Total assets ($ mil.)	2038	1848[a]	9008	208	2215	3754[a]	12869	563	1947	4264[a]	14085	733	400	1338[a]	5595	224
Fixed assets ($ mil.)	2159	543[a]	1893	59	2360	1511[a]	4511	196	2125	1632[a]	5174	243	436	475[a]	1809	60
Age (years)	1945	19.73[a]	14.39	18	2154	28.76[a]	17.67	24	1890	30.47[a]	18.38	24	372	22.17[a]	16.43	20
Growth rate (%)	2037	16.51	41.32	11.29	2215	9.81[a]	16.92	7.97	1947	5.58[a]	14.79	5.63	398	−0.02	18.40	−3.90
Avg. growth rate (%)	2038	8.99[a]	8.76	7.89	2215	6.14[a]	5.55	5.88	1947	5.56[a]	5.41	5.51	400	5.13[a]	10.64	2.90
Net income margin (%)	2037	1.89[a]	14.07	3.24	2215	4.49[a]	5.15	4.41	1947	6.24[a]	6.59	5.63	400	−16.15[a]	105.80	−0.58
Debt–assets ratio (%)	2038	25.69[a]	19.03	23.44	2214	19.64[a]	12.76	18.98	1946	16.32[a]	13.10	14.89	399	24.64[a]	20.51	22
Debt rating	579	12.78[a]	4.22	14	948	9.35[a]	3.11	9	950	8.08[a]	3.56	8	138	15.89	5.17	16
Rating change	527	−0.18[a]	1.30	0	921	−0.02	0.84	0	909	0.09[a]	0.79	0	136	0.96[a]	2.73	0
Current ratio	2005	2.40[a]	1.38	2.12	2140	2.24[a]	1.15	1.98	1872	2.35[a]	1.29	2.02	392	2.61[a]	2.21	2.11
Debt service coverage	1993	9.75[a]	50.38	2.86	2181	22.06[a]	129.43	4.91	1848	21.56[a]	71.80	6.68	381	−0.32	35.57	0.79
Slack	2036	0.78[a]	1.06	0.57	2215	0.63[a]	0.84	0.47	1947	0.81[a]	1.02	0.57	399	0.66[a]	1.31	0.59
Cash balance	2038	0.14[a]	0.23	0.054	2215	0.09[a]	0.14	0.05	1947	0.13[a]	0.20	0.06	400	0.17[a]	0.36	0.06
Dividend change ($)	2032	−0.01[c]	0.26	0	2211	−0.01	0.46	0.01	1939	0.034	0.99	0.02	399	−0.059[a]	0.26	0
Δ cash balance (%)	2038	2.53[a]	14.46	0.27	2215	0.82[a]	7.75	0.17	1947	−0.77[a]	9.67	−0.12	400	−1.14	27.49	−0.36

Δ slack (%)	2036	16.23[a]	62.59	5.71	2215	5.21[a]	34.53	2.54	1947	−1.29	60.93	−0.41	398	−9.99[b]	93.15	−10.37
Net new debt (%)	2038	0.97[a]	13.58	−0.42	2215	1.61[a]	12.11	−0.14	1947	1.83[a]	9.69	0	400	0.68	12.05	−0.17
Net new equity (%)	2038	1.97[a]	6.71	0.11	2215	0.56[a]	3.93	0	1947	−3.1[a]	6.67	−1.56	400	2.33[a]	11.53	0

This table provides summary statistics describing the three financing constraint categories (FC, PFC, NFC) and negative cash flow observations. Real growth rate refers to annual sales growth in the year of observation, adjusted for annual change in Consumer Price Index. Average real sales growth is annual real sales growth averaged over 10 years. Net income margin is net profit divided by sales. Debt–assets ratio is total long term debt divided by total assets. Debt rating translates Standard & Poor's alphabetical rating scale to a numerical scale, as reported by Compustat. AAA corresponds to 2, AA+ to 4, AA to 5, and so on until D, which corresponds to 27. Debt service coverage equals cash flow before interest divided by debt obligations due in the year. Slack equals the sum of cash, marketable securities, 0.7 times accounts receivable, and 0.5 times inventories, less accounts payable, normalized by fixed assets, as in Cleary (1999). Cash balance is cash and marketable securities, normalized by total assets less cash and marketable securities, as in Opler et al. (1999). Δ cash balance and Δ slack refer to annual changes in cash balance and slack, respectively. Net new debt is new debt issued less outstanding debt retired, normalized by total assets. Net new equity is new equity issued less outstanding equity bought back, normalized by total assets. a, b, c indicate statistical difference from zero at the 1%, 5%, and 10% significance levels respectively. Panel A reports estimates from the 1977–1986 sub-period, and Panel B for the 1987–1996 sub-period.

sub-sample, [29] and by almost one in the 1987–1996 sub-sample. Firms also cut dividends in these years – mean change in dividends per share was −19.2 cents in 1977–1986 and −5.9 cents in 1987–1996. Overall, the evidence indicates that cash losses are indeed associated with financial distress.

In terms of the time pattern of negative cash flow observations, we find that as expected, across all financing constraint groups, such observations are most frequent during the recessionary periods of 1982–1983 and 1990–1992. Recessionary periods are as defined by the US Department of Commerce, *Business Cycle Indicators*, Series 910. For our reconstruction of the Cleary (1999) sample as well, cash loss observations are the most frequent during the 1990–1992 period.

The last four rows in each panel of Table 4 describe sources/uses of cash other than operating cash flow. For FC firms, cash balances increase by an average of 2.14% and 2.53% over 1977–1986 and 1987–1996, respectively, while the corresponding numbers for NFC firms are 0.47% and −0.77%. Similarly, financial slack increases by 12.86% (1977–1986) and 16.23% (1987–1996) for FC firms, and by 1.67% and −1.29% for NFC firms. For the negative cash flow observations, consistent with our earlier findings, cash balances decline by an estimated 0.13% and 1.14% over 1977–1986 and 1987–1996, respectively, while slack declines by an estimated 7.57% and 9.99%, suggesting again an association with financial distress. The evidence thus indicates that FC firms aggressively build up liquidity reserves when operating cash flow is positive, in anticipation of having to draw them down if and when cash flow turns negative. This supports Fazzari et al. (2000) 'liquidity buffer' explanation for KZ's finding that many FC firms have moderate to large cash balances and financial slack. This is also in line with Opler et al. (1999) finding that large declines in excess cash are typically associated with large negative operating cash flows. Further, with respect to issuing new securities, the evidence suggests that FC firms and negative cash flow firms have to rely more on equity, while NFC firms rely more on debt. [30]

One important distinction between the two sub-periods relates to the average age of firms having negative cash flows. Mean age associated with such observations is 29.46 years, which is comparable to the larger and older firms in the earlier sub-sample, while it is 22.17 years, which is similar to the younger firms in the later sub-sample. Similarly, while the median age for all three constraints categories increased by 4 years from 1977–1986 to 1987–1996, it declined by 1 year for the negative cash flow observations. Further, the observation-year and ten-year-average real sales growth rates increased from −1453% to −5.28% and from −5.26% to 2.84%, respectively. The evidence thus suggests that the importance of young growing firms within the universe of negative cash flow observations has increased over time.

This inference finds further support from an age- and industry-wise breakdown of firms. Table 5 presents the fraction of observations in different age and primary

[29] This estimate should be treated with caution, as it is based on only 12 observations.

[30] In fact, the estimated mean net new equity for NFC firms is negative in both sub-periods, indicating that many of these firms were buying back outstanding equity.

Table 5
Financing constraints categories and negative cash flow observations: Age and industry characteristics

Age (years)	1977–1986				1987–1996			
	FC	PFC	NFC	Negative cash flow	FC	PFC	NFC	Negative cash flow
Panel A: Age distribution								
0–10	0.2855	0.1923	0.2008	0.1226	0.2881	0.1081	0.0947	0.2634
10–20	0.4319	0.3333	0.3191	0.3484	0.3122	0.2543	0.2429	0.2581
20–30	0.1291	0.1362	0.1175	0.1484	0.2625	0.3271	0.3175	0.3118
30–40	0.0303	0.0788	0.0872	0.0452	0.0599	0.1002	0.0974	0.0538
40–50	0.0505	0.0816	0.0848	0.0710	0.0118	0.0450	0.0582	0.0108
50–60	0.0728	0.1777	0.1907	0.2645	0.0246	0.0492	0.0524	0.0242
60–	–	–	–	–	0.0409	0.1160	0.1370	0.0780
Panel B: Industry distribution								
Primary SIC category	FC	PFC	NFC	Negative cash flow	FC	PFC	NFC	Negative cash flow
Food	0.0877	0.0903	0.1063	0.0194	0.0877	0.0903	0.1063	0.0194
Chemicals	0.0752	0.1337	0.1878	0.0874	0.0694	0.1059	0.1722	0.1016
Petroleum refining	0.0621	0.0669	0.0404	0.0680	0.0222	0.0530	0.0381	0.0370
Rubber and plastics	0.0245	0.0257	0.0199	0.0583	0.0342	0.0394	0.0273	0.0115
Stone, clay, glass	0.0304	0.0234	0.0168	0.0049	0.0356	0.0216	0.0118	0.0393
Primary metals	0.0674	0.0406	0.0466	0.1990	0.0606	0.0597	0.0386	0.0831
Fabrication metals	0.0650	0.0714	0.0690	0.0728	0.0467	0.0653	0.0569	0.0554
Computer equipment	0.1402	0.1263	0.1294	0.1748	0.1526	0.1242	0.1129	0.2009
Electrical equipment	0.0907	0.0686	0.0790	0.0825	0.1961	0.0860	0.0767	0.1617
Transport equipment	0.0835	0.0880	0.0678	0.1019	0.0569	0.0852	0.0598	0.0670
Measuring instruments	0.0794	0.0434	0.0373	0.0049	0.0883	0.0682	0.0715	0.0600
Others	0.1939	0.2217	0.1996	0.1262	0.1665	0.2339	0.2372	0.1247

This table presents the age and industry compositions of firms in each of the three financing constraints categories (FC, PFC, NFC) and the negative cash flow observations. Results for the 1977–1986 sub-period are reported on the left, and those for the 1987–1996 sub-period on the right. Panel A reports the proportion of firms in each ten-year age category, where age is measured as the number of years since listing, as reported by CRSP. Panel B reports the proportion of firms in each of the major two-digit primary SIC code categories for manufacturing firms. The last category ('Others') consists of SIC codes that accounted for less than 4% of firms in both sub-periods, and includes tobacco, textile mill, apparel, lumber, furniture, paper, printing, leather, and miscellaneous manufacturing.

2-digit SIC code categories for each constraint group, and for the negative cash flow observations. Panel A shows that while over 1977–1986, only 12.26% of the negative cash flow observations were associated with 0–10 years old firms, the fraction increased to 26.34% over 1987–1996. Conversely, the fraction of cash loss observations in the oldest firms category fell from 26.44% over 1977–1986 to 7.78% over 1987–1996. Within the industry categories too, the sharpest declines in the proportion of negative cash flow observations from 1977–1986 to 1987–1996 were in the mature industries – primary metals (19.90–8.31%) and transportation equipment (10.19–6.70%), while the increases were in the high-tech, growth industries of electrical equipment (8.25–16.17%) and computers (17.48–20.09%).

The increased importance of small, growing firms in the FC and negative cash flow categories reflects the growth in their overall numbers, as recorded by Fama and French (2001). The improved ability of these firms to access public financing indicates greater informational efficiency of financial markets, and suggests a possible explanation for the previous section's finding that investment–cash flow sensitivities have declined over time. As information gathering and processing abilities of capital markets have improved, information asymmetries between firm insiders and outsiders have narrowed, resulting in improved access to external funds and reduced sensitivity of investments to internal cash flow. The reduction in information asymmetry has been the most beneficial to those firms for which such problems were the most severe before, i.e., the most constrained group, resulting in this group experiencing the sharpest decline in investment–cash flow sensitivity. Moreover, as the supply of funds into primary markets has experienced rapid growth over the last two decades, largely through mutual funds, pension funds, and hedge funds, fund managers have been forced to look beyond the large, stable, well-capitalized firms that dominated their portfolios in the past. Consequently, smaller, riskier, high-growth firms have enjoyed improved access to external capital, thereby reducing their reliance on internal funds for making investments.

6. Conclusions

Recent years have witnessed an important debate on financing constraints and investment–cash flow sensitivity. Fazzari et al. (1988) argued that in the presence of capital market imperfections, firms facing a larger cost differential between internal and external funds should be more severely affected by underinvestment problems when experiencing negative shocks to internal cash. More constrained firms should therefore exhibit higher investment–cash flow sensitivity. Their paper and several subsequent papers have presented empirical evidence to support this hypothesis. However, Kaplan and Zingales (1997) and Cleary (1999) have provided evidence showing the opposite – the least constrained firms exhibit higher investment–cash flow sensitivity. Our analysis provides an explanation for this puzzle by showing that the KZ/Cleary results are largely due to firms in distress as proxied by negative cash flow observations. In addition, our tests suggest that KZ's results are also affected by a few influential observations in a small sample. When such observations are excluded from their sample, the estimated sensitivities for financially constrained firms are much higher, and overall results much closer to those in earlier papers. Hence, our results pinpoint the importance of internal wealth on the investment–cash flow relationship, and at the same time also confirm the KZ/Cleary conclusions that the investment outlays of firms with weaker financial positions are less sensitive to internal cash flows. [31]

In addition, we find an interesting trend in investment–cash flow sensitivities over time. Compared to 1977–1986, estimated sensitivities are lower in 1987–1996 for all constraint categories. The decline is particularly striking for the most constrained group of firms. Examination of the operating and financial characteristics of firms in the different constraints categories and for the negative cash flow observations confirms the incidence of financial distress for the negative cash flow observations. The evidence also reveals an increase in the proportion of small, high-growth firms in the financially constrained and negative cash flow groups. Two possible explanations for this development lie in improved informational efficiency of capital markets, and the increased supply of funds to capital markets resulting in easier access to external capital, especially for small, high-growth firms. Further investigation of this issue is an important direction for future research.

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[31] We thank one of the referees for pointing this out.

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