Investment and cashflow: New evidence

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Abstract

We provide new estimates of investment-cashflow sensitivities for a large cross section of U.S. firms from 1971–2009. Our tests extend the literature in several key ways and provide strong evidence that cashflow explains investment beyond its correlation with Tobin's Q. Controlling for a firm's market-to-book (M/B) ratio—our proxy for Q—a dollar of current- and prior-year cashflow is associated with $0.53 of additional investment for firms that are the least likely to be constrained and $0.67 for firms that are the most likely to be constrained. Investment-cashflow sensitivities for the two groups drop to a conservatively estimated but still significant 0.32 and 0.63, respectively, after correcting for measurement error in M/B. Our results suggest that financing constraints and, perhaps, free cashflow problems are important for investment decisions.

1. Introduction

The interaction between investment and financing decisions is arguably the central issue in corporate finance. It is now well-established that a firm's financing choices may affect its investment decisions because taxes, issuance costs, agency conflicts, and information problems associated with debt and equity will affect the firm's cost of capital, drive a wedge between the cost of internal and external funds, and alter managers' incentives to take different types of projects.

An issue that has received particular attention is the sensitivity of investment to internally generated cashflow. Theoretically, a firm might invest more when cashflow is high for three reasons: (i) internal funds may be less costly than external funds (so-called 'financing constraints'); (ii) managers may tend to overspend internally available funds (the 'free cashflow hypothesis'); and (iii) cashflow may simply be correlated with investment opportunities ('Q theory').

Empirically, investment and cashflow do appear to be significantly related, though both the strength of the relationship and its cause are the subject of much debate. For example, Fazzari, Hubbard, and Petersen (1988) and Kaplan and Zingales (1997) estimate investment-cashflow sensitivities of 0.20–0.70 for a sample of 422 manufacturing firms from 1970–1984, significant even among firms that do not appear to be financially constrained. Cleary (1999) and Baker, Stein, and Wurgler (2003) report substantially lower values of 0.05–0.15, the former for a sample of 1,317 surviving firms from 1988–1994 and the latter for a large unbalanced panel from 1980–1999. Rauh (2006) estimates an investment-cashflow sensitivity of 0.11 from 1990–1998 but also finds that firms cut investment by $0.60–0.70 in response to a dollar of mandatory pension contributions. More recently, Hennessy, Levy, and Whited (2007), Almeida, Campbello, and Galvao Jr. (2010), and Erickson and Whited (2012) report investment-cashflow sensitivities of just 0.01–0.09 after correcting for measurement error in Q, down from OLS estimates of 0.07–0.15; Chen and Chen (2012) find that investment-cashflow sensitivities have declined steadily through time and have 'completely disappeared in recent years' (p. 394), with estimates consistently below 0.03 after 1997. In short, while there remains disagreement about why investment and cashflow are related, much of the recent literature suggests that cashflow has, at most, a relatively small impact on investment.

This paper provides new evidence on the link between investment and cashflow. Our tests offer a number of methodological refinements that substantially improve estimates of investment-cashflow sensitivities and, as it turns out, dramatically strengthen the apparent impact of cashflow on investment. Specifically, our tests extend the literature in five keys ways:

(1) We introduce a new measure of cashflow that is significantly better than the standard measure used in the literature (income before extraordinary items plus depreciation). We show that the standard measure has become noisier over time—with cross-sectional variability that spikes significantly in the last two recessions—because it reflects a variety of noncash accruals that have become more important in recent years, such as deferred taxes and asset write-downs. We show that correcting for these noncash items, using data widely available on Compustat, substantially raises estimates of investment-cashflow sensitivities, especially during the second half of our sample (1971–2009).

(2) We employ several new IV estimators to correct for measurement error in Q, proxied in our regressions by the market-to-book ratio of assets (M/B). Our IVs address limitations of existing estimators. For example, most IV estimators in the literature are based on lagged M/B, which, as Erickson and Whited (2000, 2012) note, requires serial correlation in measurement error to be small or short-lived. We use a variety of alternative instruments, including lagged returns, lagged cashflow, and current squared cashflow, to get around this concern. An alternative approach in the literature, the Erickson-Whited (EW) higher-moment estimator, also addresses the serial-correlation issue. However, it 'can be applied only to samples that are arguably i.i.d.' (EW 2012)—an assumption that is unlikely to describe either time series or cross sectional data—and can give very imprecise estimates when applied to particular years of the sample, requiring tests to give disproportionately large or small weight to different years when aggregating the results (via EW's minimum-distance approach). We show that one of our IV estimators requires fewer assumptions than the EW estimator—it is valid under EW's assumptions but does not require the data to be i.i.d.—and delivers precise estimates even when all years of the sample are weighted equally. Of course, our instruments may not be perfect, but we argue that our results are likely to be conservative if the identifying assumptions are violated. Our tests provide a powerful and straightforward alternative to existing methods in the literature.

(3) We study the impact of both current and lagged cashflow on investment. The literature largely focuses on the contemporaneous relation between investment and cashflow, but that relation can miss a substantial part of the total effect if investment decisions are implemented slowly or if investment reacts to changes in expected cashflows (expected and lagged cashflow appear to be highly correlated). Indeed, we find that investment is more strongly related to lagged than to current cashflow and that adding lagged cashflow to the regressions significantly raises estimates of investment-cashflow sensitivities.

(4) We study all of the ways firms spend cashflow, not just their capital expenditures. Firms can use cashflow in seven basic ways: to increase cash holdings, to invest in working capital, to buy property, plant, and equipment (PP&E) and other fixed assets, to acquire other firms, to pay down debt, to repurchase shares, or to pay dividends. We simultaneously track all seven uses in order to provide a complete picture of what firms do with cashflow. Prior studies have looked at specific components in isolation, but, to our knowledge, ours is the first to provide a full accounting of the use of cashflow.[1]

(5) We offer a new way to sort firms into financially constrained and unconstrained groups using forecasts of a firm's free cashflow (predicted at the start of the year). Our goal here is more to identify firms that are unconstrained—in our case, firms with lots of excess cashflow—than to identify firms that are unambiguously constrained (something that seems harder to do). In the three years leading up to the sort, the unconstrained group has high and increasing sales, profits, cashflow, dividends, returns, and cash holdings, but low and decreasing debt and investment. Cashflow exceeds capital expenditures by an average of 11.5% of asset value and exceeds total investment—including spending on working capital, acquisitions, etc.—by 2.1% of asset value. By the year of the sort, the firms' cash holdings and net working capital together exceed their total liabilities, and the firms could pay down almost all debt with a single year of operating cashflow. This group allows us to explore the sensitivity of investment to cashflow for firms that, by all appearances, seem to be financially unconstrained.

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[1] A recent paper by Gatchev, Pulvino, and Tarhan (2010) takes a step in this direction but, because of how they measure investment, financing, and cashflow, their tests appear to track only a portion what firms do with cashflow. For example, the slopes in their 'unconstrained' regressions suggest that their variables capture roughly 60–80% of a firm's cash expenditures (see their Table V, columns (1) and (3)).

Our results suggest that investment and cashflow are strongly linked after controlling for a firm's investment opportunities. For the full sample of firms, basic OLS investment regressions—i.e., with no correction for measurement error in Q—show that an additional dollar of cashflow is associated with an extra $0.14 of working capital, $0.26 of capital expenditures, and $0.35 of total long-term investment, with the remainder split fairly evenly between additions to cash holdings ($0.15), reductions in debt ($0.13), share repurchases ($0.13), and dividends ($0.06). (The effects, all highly significant, sum to slightly less than one because of so-called 'dirty surplus' accounting.) The prior year's cashflow is even more strongly related to investment and, together, an additional dollar of cashflow in the current and prior years is associated with an extra $0.60 of total investment. These cashflow effects are much stronger than found in the recent literature, due in part to the data refinements discussed earlier.

Interestingly, lagged cashflow is significant even controlling for a firm's beginning-of-year cash holdings and debt, suggesting that it picks up more than a direct financial-constraint effect (i.e., the impact of lagged cashflow does not work through its effects on a firm's cash and debt positions). One interpretation is that high prior-year cashflow raises managers' expectation of current cashflow, and it is this expected, rather than total, cashflow that drives investment. In fact, when we break the current year's cashflow into expected and unexpected components, we find that a dollar of expected cashflow leads to an additional $0.68 of fixed investment ($0.50 of which is capital expenditures) compared to an estimate of just $0.12 for unexpected cashflow. Further, unexpected cashflow is largely used to reduce debt (–$0.47) while higher expected cashflow actually leads to more borrowing (+$0.09). The latter finding suggests some complementarity between internal funds and debt, consistent with the multiplier effects discussed by Almeida and Campello (2007) and Hennessy, Levy, and Whited (2007).

Splitting the sample into constrained and unconstrained firms reveals significant differences between the two groups. Consistent with prior studies, capital expenditures for both groups react strongly to cashflow: capital expenditures increase by $0.28 for unconstrained firms and $0.41 for constrained firms when current cashflow increases by a dollar. However, total investment expenditures of constrained firms, including spending on working capital and all types of fixed assets, go up $0.72 for each extra dollar of cashflow, more than double our estimate of \$0.30 for unconstrained firms. The flip-side of this result is that constrained firms pay out just \$0.11 of each additional dollar of cashflow compared to \$0.50 for unconstrained firms (both groups add about \$0.15 to their cash holdings). These disparities are largely driven by the groups' differential response to unexpected cashflow.

A sizable fraction of the link between investment and cashflow can be attributed to measurement error in Q. To be clear, we strongly reject for the full sample and the constrained and unconstrained subsamples the joint hypothesis that (i) investment is linear in Q and (ii) cashflows are important only because M/B measures Q with error. But we also find that error-corrected investment-cashflow sensitivities are significantly smaller than our raw estimates, especially for unconstrained firms. Focusing on total fixed investment, the slope on current-year cashflow drops from 0.29 to -0.05 for unconstrained firms and from 0.53 to 0.45 for constrained firms after we correct for measurement error in M/B. The slope on prior-year cashflow drops from 0.53 to 0.37 for unconstrained firms and from 0.47 to 0.45 for constrained firms. Thus, investment opportunities seem to explain why unconstrained firms' investment reacts to current-year cashflow but only partially explain why it reacts to prior-year cashflow. The key open question is whether the remaining cashflow effect among 'unconstrained' firms reflects lingering constraints or violations of the standard Q model, for example, caused by managerial free cashflow problems. At a minimum, the significantly higher investment-cashflow sensitivity among firms that are the most likely to be constrained strongly suggests that financing constraints play an important role.

The remainder of the paper is organized as follows: Section 2 reviews Q theory; Section 3 describes the data and variable construction; Section 4 reports OLS investment regressions; Section 5 explores the impact of measurement error in Q; Section 6 concludes.

2. Q theory

We begin with a quick review of Q theory to provide a foundation for our tests. The value of a firm is given by the present value of its expected payouts, equal to profits $\Pi(K_t,s_t)$—a function of the beginning-of-period capital stock, K_t, and a state variable s_t—minus new investment, I_t, and any adjustment costs associated with investment, $C(I_t,K_t,\lambda_t)$. Adjustment costs depend on the existing scale of the firm and an exogenous stochastic parameter, λ_t. Expressed in recursive form, the value of the firm is

$$V_t = \Pi(K_t,s_t) - I_t - C(I_t,K_t,\lambda_t) + \beta\, E_t[V_{t+1}]. \tag{1}$$

For simplicity, we assume the discount factor, β, is constant and the state variables s_t and λ_t are Markov processes (payouts can be negative, interpreted as raising funds). Capital depreciates through time at a rate δ and evolves according to $K_{t+1} = (1 - \delta)\, K_t + I_t$. If we write the value function as $V_t = V(K_t,s_t,\lambda_t)$, the first-order condition for value maximization is

$$1 + C_I(I_t,K_t,\lambda_t) = \beta\, E_t[V_K(K_{t+1},s_{t+1},\lambda_{t+1})], \tag{2}$$

where C_I and V_K denote partial derivatives. The left-hand side is the marginal cost of investment and the right-hand side is marginal Q, the present value of an additional dollar of capital. To make this equation concrete for empirical tests, adjustment costs are typically assumed to be quadratic in I_t/K_t, e.g.,

$$C = .5\, \alpha\, (I_t/K_t - \lambda_t)^2\, K_t, \tag{3}$$

implying that $C_I = \alpha\, (I_t/K_t - \lambda_t)$. Substituting into (2), and denoting the right-hand side simply as Q_t, the optimal investment rate becomes linear in Q:

$$I_t/K_t = -(1/\alpha) + (1/\alpha)\, Q_t + \lambda_t. \tag{4}$$

The most common empirical proxy for Q is some form of M/B ratio for assets or capital. In truth, M/B is likely to be a better measure of average than marginal Q, but Hayashi (1982) shows the two are identical if the firm has constant returns to scale and is a price taker in both input and output markets (with those assumptions, the profit and value functions become linear in K_t).

If λ_t represents unobservable random noise—i.e., if it is uncorrelated with Q_t and other observable variables like profits—eq. (4) can be interpreted as a regression equation, with two main implications: (i) investment depends solely on Q_t, and (ii) the slope on Q_t should be determined by the adjustment-cost parameter α. These implications represent the traditional starting point for thinking about investment in a world without financial frictions. The first point, in particular, says that investment should be unrelated to cashflow (or any other measure of net worth or liquidity) after controlling for Q.

Adding cashflow to an investment regression can be thought of as a basic test of (4) against an unspecified alternative. More concretely, cashflow is likely to be important if the firm faces financing constraints, short-hand in this paper for saying that internal funds are less costly than external funds. The simplest way to incorporate such constraints into the model is to assume that negative payouts are costly. Suppose, for example, that financing costs are quadratic in the spread between investment and profits (this does not exactly equal the amount of capital raised, since it ignores adjustment costs and financing costs themselves, but should capture the first-order effects pretty well):

$$FC_t = .5\, b\, (I_t/K_t - \Pi_t/K_t)^2\, K_t \quad \text{if} \quad I_t > \Pi_t, \tag{5}$$

for some parameter $b \geq 0$. If we include this cost in eq. (1), and keep all other assumptions the same, the first-order condition for value maximization becomes

$$1 + \alpha\, (I_t/K_t - \lambda_t) + b\, (I_t/K_t - \Pi_t/K_t) = Q_t \tag{6}$$

for $I_t > \Pi_t$ and remains unchanged (eq. 4) if $I_t \leq \Pi_t$. Rearranging (6) yields:

$$I_t/K_t = \frac{-1}{\alpha + b} + \frac{1}{\alpha + b} Q_t + \frac{b}{\alpha + b} \Pi_t/K_t + \frac{\alpha}{\alpha + b} \lambda_t\,. \tag{7}$$

Thus, with external financing costs, the coefficient on Q_t drops and profit directly enters the investment equation, becoming incrementally important after controlling for Q_t.

Our regressions can be interpreted as horse race between (4) and (7) or, equivalently, as a test of whether the financing cost parameter, b, is greater than zero. The key empirical challenge comes from the fact that, when Q is measured with error, profits (or cashflow) may appear to be important even if (4) holds, assuming that profits themselves are correlated with Q.

3. Data

Our tests use all nonfinancial firms on Compustat, merged with CRSP to get annual stock returns. Firms in a given year must have data for both stock returns and 'net' assets, the latter defined as a firm's total assets minus its current operating liabilities. In addition, to ensure that small stocks do not drive the results, we drop firms smaller than the NYSE 10th percentile of net assets mesured at the beginning of the year (to avoid any look-ahead bias).[2]

3.1. Variable definitions

The tests require data on a firm's cashflow, investments, stock returns, and financing choices. We start with the following accounting identities:

Net assets = cash + net working capital (NWC) + PP&E + other fixed assets, (8)

Net assets = debt + equity. (9)

Here, NWC is defined as non-cash current assets minus current operating liabilities; debt is the sum of short-term debt, long-term debt, and other long-term liabilities; and equity includes both common and preferred stock. The market value of net assets is found by substituting the market value of common stock in place of the book value in eq. (9). Our proxy for Q is the market-to-book ratio of net assets.

Cashflow is typically measured as income before extraordinary items ('profits') plus depreciation, a definition that suffers from at least four limitations. First, and most obviously, it misses any cashflow implications of extraordinary items, events such as lawsuits or natural disasters that are 'unusual in nature and infrequent in occurrence' (Kieso, Weygandt, and Warfield, 2011). Second, it wrongly reflects accruals such as deferred taxes and asset write-downs that reduce profits but are not cash expenses (write-downs are typically classified as special, not extraordinary, items). Third, profits include gains and losses from the sale of PP&E, which are more appropriately classified as (negative) investments than as operating cashflows. Fourth, depreciation reported in the income statement is incomplete because it does not reflect depreciation that has been allocated to specific goods and included in the firm's cost of goods sold.

To overcome these problems, our cashflow variable, CF, is based on data from the Statement of Cash Flows (SCF). Like the traditional measure, we start with income before extraordinary items plus depreciation (taken

[2] The 10th percentile is $327 million in 2009. Firms above this cutoff represent roughly half the firms on Compustat but more than 98% of total asset value. We have repeated our tests using firms bigger than the NYSE 1st percentile and found results similar to those reported here. (The 1st percentile is $93 million in 2009; firms above this cutoff represent 71% of firms and 99.6% of total asset value.) In addition, earlier versions of this paper dropped the bottom 20% of firms ranked by PP&E-to-net assets, in order to eliminate firms for whom capital expenditures are not important. Again, results for that sample are very similar to those reported below. Details are available upon request.

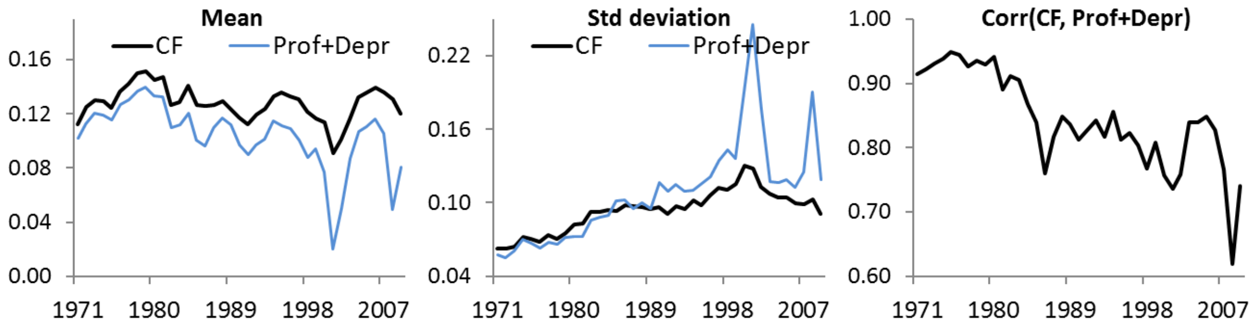

Fig. 1. Cashflow, 1971–2009. The figure plots the annual cross-sectional mean, standard deviation, and correlation of cashflow (CF) and income before extraordinary items plus depreciation (Prof+Depr). The variables are scaled by average net assets during the year and winsorized at their 1st and 99th percentiles. Data come from Compustat. The sample consists of all nonfinancial firms that are larger than the NYSE 10th percentile (measured by net assets at the beginning of the year) and that have data for net assets and stock returns.

from the SCF, not the income statement), but then correct for the effects of extraordinary items, deferred taxes, the unremitted portion of losses (or earnings) in unconsolidated subsidiaries, losses from the sale of PP&E, and other funds from operations identified in the SCF.[3] Our procedure mimics the definition of operating cashflow in the SCF except that it excludes a firm's spending on working capital, which we view as a component of investment, not of cashflow.

Fig. 1 shows how CF evolves through time compared with income before extraordinary items plus depreciation (scaled by a firm's average net assets during the year). The two variables are highly cross-sectionally correlated during the first part of the sample, with similar means and standard deviations, but start to diverge significantly in the mid-1980s. While both measures become more volatile over time, the relative volatility of Prof+Depr increases rapidly in the 1990 and spikes dramatically in 2000–2002 and 2008. The patterns suggest that Prof+Depr becomes a noisier measure of cashflow during the second half of the sample, largely due to an increase in non-cash special items. As we discuss further below, this fact helps to explain why recent studies tend to estimate low investment-cashflow sensitivities (see the Introduction).

We consider three measures of investment in our empirical tests. Following the literature, our first measure,

[3] The last item adjusts for asset write-downs and other non-cash expenses. Using Compustat variable names, CF is defined as IBC (income before extraordinary items) + XIDOC (extraordinary items and discontinued operations) + DPC (depreciation and amortization) + TXDC (deferred taxes) + ESUBC (equity in net loss of unconsolidated subsidiaries) + SPPIV (losses from the sale of PP&E) + FOPO (funds from operations–other). All of these items come from the SCF and can differ from the counterparts in the income statement.

Capx1, is simply (net) capital expenditures. This variable misses a firm's spending on other long-term assets, such as purchased intangibles (e.g., patents bought from other firms) or cash used for acquisitions. Our second measure, Capx2, therefore includes these other 'investing activities' from the SCF. Finally, our broadest measure of long-term investment, Capx3, is based on the change in a firm's fixed assets during the year (from the balance sheet). Since our goal is to measure actual expenditures, we adjust the change in fixed assets to reflect any non-cash charges that affect the accounts, such as depreciation and asset write-downs, and we add gains or losses from the sale of PP&E (which are not reflected in the change in fixed assets). An important point is that Capx3 reflects all acquisitions, whereas the item 'acquisitions' on Compustat (from the SCF) only picks up cash expenditures. Therefore, stock-for-stock transactions would be included in our broadest measure of investment but not in the first two measures. In essence, Capx3 views any asset acquired by the firm as an investment, regardless of how the transaction is structured.

One of our goals is to provide a complete picture of what firms do with cashflow. In addition to buying fixed assets, the balance-sheet identities (8) and (9) show that a firm can use cashflow to increase cash holdings, to invest in NWC, to pay down debt, or, within the equity account, to repurchase shares and pay dividends. The first three are measured as changes in cash holdings (dCash), working capital (dNWC), and debt (dDebt) during the year (debt, here, includes long-term deferred taxes, so we adjust dDebt to reflect accruals related to deferred taxes). Dividends (Div) include cash dividends paid to common and preferred shareholders. Equity issuance (Issues) is measured as the change in total equity minus the change in retained earnings, capturing sales of both common and preferred stock.

By virtue of basic accounting identities, the following relation holds approximately in the data:

$$CF \approx dCash + dNWC + Capx3 - dDebt - Issues + Div. \quad (10)$$

This relation is approximate only because so-called 'dirty surplus' accounting means that some items affect equity directly without flowing through the income statement or SCF (i.e., the change in retained earnings for the year does not exactly equal net income minus dividends). An implication of (10) is that the slopes when the right-hand side variables are regressed on CF should, appropriately signed, sum roughly to one, a condition that holds closely in our tests.

We scale all level variables—cash, NWC, fixed assets, debt, and equity—by contemporaneous net assets and all flow and change variables, except stock returns, by a firm's average net assets for the year. The latter helps to neutralize any mechanical cashflow effects that could arise if investment becomes immediately profitable during the year. Finally, we winsorize all (scaled) variables at their 1st and 99th percentiles to reduce the impact of outliers.

Table 1 reports descriptive statistics for our sample of roughly 1,800 firms per year from 1971–2009 (the starting date is determined by the availability of cashflow data on Compustat). The average firm has income before extraordinary items equal to 4.6% of net assets, depreciation of 6.1%, and other operating cashflow of 2.0%, implying that total cashflow equals 12.8% of net assets. CF is somewhat less variable than profits and, unlike profits, is slightly positively skewed (comparing means vs. medians). Capital expenditures average 8.9% of net assets, growing to 11.6% of net assets when we include other 'investing activities' from the SCF and to 14.1% of net assets based on our broadest measure of long-term investment. Adding in working capital, firms invest 15.2% of net assets in an average year, 2.4% more than cashflow. Firms also use cashflow to increase cash holdings (1.0% of net assets) and to make dividend payments (1.9% of net assets), implying that the average firm has to raise more than 5% of net assets annually from new debt (3.7%) and equity (2.6%) issuance. The means and standard deviations of the variables provide only weak evidence that debt is a more important source of new funds than equity, consistent with Frank and Goyal (2003) and Fama and French (2005). In levels, debt equals 35.7% of net assets and total nonoperating liabilities equal 46.6% of net assets, with equity making up the remainder.

3.2. Unconstrained firms

Ideally, we would like to isolate firms that are financially unconstrained in order to study how investment reacts to cashflow in the absence of financing costs. These firms might be identified in two possible ways: The first would be to find firms that have sufficient internal funds to cover profitable investment opportunities; the second would be to identify firms that, even if they must raise external funds, can do so cheaply (i.e., for whom the parameter b in our earlier analysis is small). The classification scheme we pursue is based more on the first idea than the second, though we suspect the two approaches overlap if the first dollars raised by a firm

Table 1
Descriptive statistics, 1971–2009
This table reports the time-series average of the annual cross-sectional mean, median, standard deviation (Std), 1st percentile (Min), 99th percentile (Max), and sample size (N) for the variables listed. All flow variables other than stock returns are scaled by average net assets during the year, while all level variables are scaled by ending net assets (net assets equal total assets minus non-debt current liabilities). Variables are winsorized annually at their 1st and 99th percentiles. Accounting data come from Compustat and returns come from CRSP. The sample consists of all nonfinancial firms that are larger than the 10th percentile of NYSE firms (measured by net assets at the beginning of the year) and that have data for net assets and stock returns.

Variable	Description	Mean	Median	Std	Min	Max	N
OpProf	Operating income	0.119	0.113	0.111	-0.231	0.457	1,816
Prof	Income before extraordinary items	0.046	0.055	0.105	-0.417	0.291	1,815
NI	Net income	0.044	0.055	0.112	-0.454	0.303	1,815
Depr	Depreciation	0.061	0.053	0.036	0.007	0.218	1,776
OthCF	Other operating cashflows[1]	0.020	0.009	0.054	-0.112	0.310	1,776
CF	Prof + Depr + OthCF	0.128	0.123	0.094	-0.172	0.410	1,776
Cash	Cash holdings	0.119	0.062	0.144	0.001	0.693	1,809
NWC	Non-cash net working capital[2]	0.196	0.169	0.209	-0.246	0.752	1,791
Plant	Property, plant, and equipment	0.476	0.431	0.262	0.033	1.003	1,814
FA	Fixed assets[3]	0.686	0.704	0.236	0.143	1.081	1,799
Debt1	Short-term + long-term debt	0.357	0.344	0.232	0.000	1.162	1,817
Debt2	Total nonoperating liabilities	0.466	0.462	0.253	0.011	1.342	1,811
Toteq	Shareholders equity	0.534	0.538	0.253	-0.342	0.989	1,811
dNA	Change in net assets	0.081	0.068	0.203	-0.582	0.780	1,817
dCash	Change in cash holdings	0.010	0.003	0.082	-0.256	0.338	1,806
dDebt2	Change in Debt2	0.037	0.015	0.148	-0.408	0.612	1,812
dToteq	Change in Toteq	0.042	0.040	0.140	-0.497	0.511	1,812
Inteq	Internal equity[4]	0.024	0.036	0.108	-0.478	0.262	1,811
Issues	Share issuance[5]	0.026	0.004	0.087	-0.174	0.455	1,799
Capx1	Capital expenditures (net)[6]	0.089	0.070	0.076	-0.027	0.410	1,801
Capx2	Capx1 + other investments[7]	0.116	0.091	0.121	-0.176	0.605	1,801
Capx3	Total investment in fixed assets[8]	0.141	0.109	0.158	-0.284	0.788	1,757
Capx4	Total investment[9]	0.152	0.127	0.188	-0.399	0.847	1,772
FCF1	CF – Capx1	0.039	0.046	0.102	-0.336	0.311	1,764
FCF4	CF – Capx4	-0.024	0.000	0.184	-0.727	0.483	1,772
Sales	Revenues	1.581	1.331	1.256	0.126	7.383	1,816
M/B	Market-to-book asset ratio	1.617	1.282	1.011	0.637	6.558	1,800
Div	Dividends	0.019	0.013	0.022	0.000	0.125	1,812
dDiv	Change in dividends	0.001	0.001	0.009	-0.046	0.043	1,809
Return	Annual stock return	0.134	0.079	0.442	-0.690	1.869	1,817

[1] OthCF = Operating cashflows other than income, depreciation, and working capital from the Statement of Cash Flows
[2] NWC = current assets – cash – non-debt current liabilities
[3] FA = total assets – current assets
[4] Inteq = NI – DIV
[5] Issues = dToteq – change in retained earnings
[6] Capx1 = capital expenditures – sale of PP&E
[7] Capx2 = Capx1 + other investing activities from the Statement of Cash Flows
[8] Capx3 = dFA + depr – other non-cash adjustments to FA from the Statement of Cash Flows
[9] Capx4 = Capx3 + dNWC

are nearly costless, e.g., because the firm has some pledgeable assets.

To the extent our classification scheme works, we side-step the concerns of Kaplan and Zingales (1997), who argue that investment-cashflow sensitivities do not have to be lower for moderately constrained vs. highly constrained firms. (Their point can be seen in eq. 7 of our investment model, which implies that cashflow has the same impact on investment for any positive amount of external financing.) For our purposes, the more important prediction is that cashflow should not matter at all for unconstrained firms. Indeed, our paper does not try to rank firms based on how constrained they are, nor do we interpret investment-cashflow sensitivities as a measure of financing constraints. We simply try to identify a sample of 'unconstrained' firms for which financing costs should not be important.

To be specific, we sort firms at the beginning of each year based on their expected free cashflow for the year, defined for this purpose as cashflow in excess of capital expenditure (FCF1 in Table 1). We sort based on expected, rather than realized, free cashflow in part to avoid sorting on realized investment—the dependent variable in our tests—but also because expected cashflow might be more important than realized cashflow if investment decisions are planned in advance (a view supported by our empirical results). We sort based on expected cashflow in excess of capital expenditures, rather than cashflow in excess of total investment (FCF4), because it is more predictable and seems, in some sense, more fundamental.

Expected free cashflow is predicted using a cross-sectional regression of FCF1 on firm characteristics from the prior year. Since we are not interested in individual slopes—multicollinearity is not relevant—and have a large cross section of firms, we are biased toward including too many, rather than too few, variables. Thus, the forecasting regression uses most of the main variables in our data, including lagged cashflow, stock returns, investment (Capx1, Capx3, dNWC), dividends, debt, M/B, sales, PP&E, and the level of and change in cash holdings. Without going into the details, most of the variables are significant and the average R^2 from the annual regressions is 45.6%. We rank firms each year based on the fitted value from these regressions, classifying the top 1/3 firms as 'unconstrained' and the bottom 1/3 as 'constrained' (it might be more accurate to say that the top 1/3 are the least likely to be constrained and the bottom third are the most likely). Firms can move between groups each year.

Table 2 reports descriptive statistics for the two groups, focusing on how they evolve in the years before and after the sort (the sort takes place at the end of year 0 based on expected FCF1 in year +1). Leading up to the sort, unconstrained firms have high and increasing sales, profits, cashflow, dividends, cash holdings, and stock returns. They have relatively little debt and invest significantly less, based on any of our measures, than constrained firms in all three years prior to the sort. By year 0, unconstrained firms have short-term assets (cash plus NWC) equal to 41.5% of net assets, compared with debt of 24.0% and total liabilities of 32.8% (the short-term component of debt, not reported in the table, is 4.5% of net assets). Cashflow for unconstrained firms exceeds capital expenditures by 10.1%, 11.1%, and 13.2% of net assets in the three years leading up to the sort and exceeds total investment, including spending on working capital and acquisitions, by an average of 2.1% of net assets. These patterns suggest that our sort does a good job of identifying firms that are likely to be unconstrained—not just firms that have temporarily high cashflows, but firms with persistently high profitability, strong liquidity, and seemingly significant unused debt capacity.

4. Basic investment regressions

We start with basic OLS regressions to provide the most direct view of how investment relates to cashflow and a baseline for our subsequent error-corrected estimates.

4.1. Methodology

Our tests focus on the average slopes and R^2s from 39 annual cross-sectional regressions, 1971–2009. Following Fama and Macbeth (1973), standard errors are based on the time-series variability of the estimates, incorporating a Newey-West correction with three lags to account for possible autocorrelation in the slopes. This approach has the advantage that (i) it corrects very simply for both time-series and cross-sectional dependence in the data and (ii) a firm can be included in the tests as long as it has a single valid observation, thus mitigating survival bias.

It is important to point out that we do not de-mean the variables relative to the firm's average or otherwise

Table 2
Descriptive statistics: Constrained vs. unconstrained firms, 1971–2009
This table compares the characteristics of constrained and unconstrained firms in event time. The groups are defined at the end of year 0 based on expected cashflows in excess of capital expenditures (FCF1) in year +1 (predicted in a cross-sectional regression of $FCF1_{+1}$ on firm characteristics in year 0); unconstrained firms represent the top 1/3 of firms ranked on this measure, while constrained firms represent the bottom 1/3. Flow variables are scaled by average net assets during the year and level variables are scaled by ending net assets. The table reports the time-series average of the annual cross-sectional mean of each variable. Accounting data come from Compustat and returns come from CRSP. The sample consists of all nonfinancial firms that are larger than the NYSE 10th percentile of net assets at the beginning of year +1 and that have data for net assets and stock returns. The variables are defined in Table 1.

	Constrained					Unconstrained				
Year	-2	-1	0	+1	+2	-2	-1	0	+1	+2
OpProf	0.090	0.080	0.058	0.055	0.062	0.199	0.203	0.212	0.198	0.185
Prof	0.031	0.023	0.000	-0.008	-0.003	0.105	0.109	0.119	0.108	0.097
NI	0.031	0.022	-0.002	-0.011	-0.004	0.105	0.109	0.119	0.108	0.096
Depr	0.062	0.062	0.062	0.065	0.066	0.062	0.062	0.061	0.060	0.060
OthCF	0.016	0.016	0.016	0.025	0.025	0.016	0.017	0.021	0.018	0.018
CF	0.109	0.100	0.078	0.082	0.089	0.184	0.189	0.202	0.187	0.177
Cash	0.123	0.120	0.112	0.109	0.112	0.154	0.157	0.161	0.158	0.152
NWC	0.135	0.129	0.125	0.119	0.116	0.266	0.260	0.254	0.249	0.249
Plant	0.587	0.588	0.596	0.601	0.602	0.370	0.363	0.354	0.352	0.355
FA	0.742	0.750	0.762	0.771	0.773	0.578	0.582	0.584	0.592	0.599
Debt1	0.401	0.410	0.436	0.444	0.442	0.259	0.255	0.240	0.246	0.253
Debt2	0.504	0.514	0.545	0.565	0.570	0.341	0.339	0.328	0.336	0.347
Toteq	0.496	0.486	0.455	0.435	0.430	0.659	0.661	0.672	0.664	0.653
dNA	0.162	0.165	0.154	0.054	0.041	0.128	0.123	0.114	0.120	0.105
dDebt2	0.025	0.022	0.013	-0.001	0.004	0.024	0.027	0.028	0.019	0.014
dCash	0.068	0.078	0.098	0.041	0.026	0.032	0.028	0.014	0.041	0.043
dToteq	0.084	0.078	0.050	0.010	0.013	0.091	0.091	0.095	0.076	0.061
Inteq	0.016	0.009	-0.015	-0.023	-0.017	0.073	0.077	0.087	0.076	0.065
Issues	0.068	0.068	0.065	0.036	0.033	0.029	0.027	0.022	0.015	0.011
Capx1	0.127	0.131	0.136	0.110	0.100	0.084	0.078	0.070	0.078	0.079
Capx2	0.156	0.160	0.163	0.122	0.109	0.120	0.117	0.111	0.121	0.119
Capx3	0.190	0.197	0.203	0.146	0.129	0.151	0.147	0.141	0.153	0.149
Capx4	0.207	0.214	0.216	0.144	0.127	0.178	0.172	0.164	0.178	0.170
FCF1	-0.018	-0.032	-0.060	-0.029	-0.012	0.101	0.111	0.132	0.109	0.098
FCF4	-0.098	-0.113	-0.137	-0.063	-0.039	0.007	0.018	0.039	0.010	0.007
Sales	1.314	1.269	1.202	1.197	1.238	2.083	2.077	2.081	2.037	2.003
M/B	1.615	1.565	1.402	1.358	1.372	2.277	2.302	2.291	2.177	2.092
Div	0.014	0.013	0.012	0.011	0.012	0.029	0.030	0.030	0.030	0.030
dDiv	0.001	0.001	0.000	0.001	0.001	0.003	0.003	0.003	0.002	0.003
Return	0.177	0.149	0.056	0.094	0.128	0.207	0.232	0.234	0.158	0.144

control for firm fixed effects (a common, but not universal, procedure in the literature). We are reluctant to do so both to avoid imposing survivorship requirements—it is only meaningful to adjust for firm fixed effects if a firm has multiple observations—and because adding fixed effects to the regressions can induce significant bias in the slopes. The latter problem arises because, in a fixed-effects regression, slopes are estimated from time-series variation within firms; such estimates, with only a few observations per firm, suffer from the biases discussed by Stambaugh (1999) and others. Despite these concerns, we have repeated all of our tests using de-meaned (within firm) variables, restricting the sample to firms with at least five years of data, and found very similar cashflow effects to those reported (differences are noted in the text).

4.2. Results

Table 3 shows regressions for the full sample. The dependent variables include our three long-term investment measures—capital expenditures (Capx1), all investing activities from the SCF (Capx2), and all purchases of fixed assets (Capx3)—plus the other ways firms use cashflow, including changes in cash holdings (dCash), investments in working capital (dNWC), changes in debt (dDebt2), net share issuance (Issues), and dividends (Div). Together, these provide a complete picture of how firms spend cashflow. If the identity in eq. (10) held exactly in the data, the slopes on CF for dCash, dNWC, Capx3, –dDebt2, –Issues, and Div would sum exactly to one (in practice, they sum to over 0.95 for the various models). Note that positive values of dDebt2 and Issues represent sources, not uses, of cash.

Model 1 is the most basic investment model, with CF_t and M/B_{t-1} as the only regressors (our use of lagged M/B follows the convention in the literature; it is more strongly related to investment than the end-of-period value). In these regressions, cashflow is strongly linked to both short-term and long-term investment: a dollar of cash-flow is associated with an additional \$0.14 of working capital (t=9.71), \$0.26 of capital expenditure (t=9.06), and \$0.35 of total long-term investment (t=9.11). Thus, a dollar of cashflow leads to nearly \$0.50 of additional spending. The remainder is split fairly evenly between additions to cash holdings (\$0.15), reductions in debt (\$0.13), lower share issuance (\$0.13), and higher dividends (\$0.06), effects that are all highly statistically significant. Like our earlier descriptive statistics, the slopes for dDebt2 and Issues provide little evidence that debt is the more important source of external funds.

For additional perspective, an increase in CF from one standard deviation below to one standard deviation above its mean predicts a jump in total investment from 10.7% to 19.8% of net assets (when M/B equals its mean). Cashflow and M/B together explain about 13% of the variation in capital expenditures and 11% of the variation in total long-term investment. CF and M/B explain slightly more of the variation in dividends but substantially less of the variation in working capital, cash, debt, and share issuance.

Model 2 adds current and lagged stock returns to the regressions. Returns in the prior two years are strongly related to investment but cashflow effects in this specification are similar to those in Model 1. (The slopes on current-year returns also become significantly positive if CF is dropped from the regressions.) The predictive power of lagged returns is intuitive, but it is also important because it provides a strong clue that M/B measures Q with error—if not, M/B should directly absorb the explanatory power of past returns (prior returns could also be related to financing constraints, but that relation seems likely to be weaker than their correlation with investment opportunities).

Model 3 adds lagged cashflow to the regressions, along with beginning-of-year cash holdings and debt. Our main interest is in testing whether investment reacts with a delay to cashflow. We include cash and debt in the regressions, in part, because they are interesting in their own right and, in part, to test whether lagged cashflow is important only through its impact on the firm's financial position.

Lagged cashflow turns out to be strongly related to investment. Controlling for CF_t and the other variables, an extra dollar of prior-year cashflow is associated with \$0.24 of capital expenditures (t=5.29) and \$0.38 of total fixed investment (t=11.73). In addition, the slope on current cashflow drops significantly with lagged cashflow in the regression, from 0.26 to 0.15 for capital expenditures and from 0.35 to 0.12 for total fixed investment (the t-statistics drop to 8.15 and 2.92, respectively). Cash holdings and debt are not reliably significant across the various investment measures and have only a modest impact on the regressions (the slopes on other variables are similar if we drop Cash and Debt2).[4]

[4] We have also explored specifications with lagged investment as an additional control variable. Cashflow effects in these regressions remain significant but are somewhat smaller than those in Table 3. For example, if we include lagged capital expenditures in Model 3, the slope on CF_t drops to 0.11 (t=8.26) for capital expenditures and to 0.08 (t=2.17) for total fixed investment; the slope on CF_{t-1} drops to 0.04 (t=3.13) for capital expenditures and to 0.21 (t=9.25) for total fixed investment. We omit lagged investment from our main tests because it is endogenously chosen and, thus, inappropriate to use as a control variable. In particular, since higher cashflow leads to higher current investment, part of the impact of CF_{t-1} shows up in lagged investment. Taking that component out, by including lagged investment in the regressions, therefore understates the full impact of CF_{t-1} on current investment.

Table 3
Investment and cashflow, 1971–2009

This table reports average slopes, R^2s, and sample sizes (N) from annual cross-sectional regressions (intercepts are included in all regressions). t-statistics, reported below the slope estimates, are based on the time-series variability of the estimates, incorporating a Newey-West correction with three lags to account for possible autocorrelation in the estimates. Flow variables other than stock returns are scaled by average net assets during the year, while level variables are scaled by ending net assets. The variables are winsorized annually at their 1st and 99th percentiles. Accounting data come from Compustat and returns come from CRSP. The sample consists of all nonfinancial firms larger than the NYSE 10th percentile (measured by net assets at the beginning of the year) and with data for all variables within each panel. Models 3 and 4 are estimated from 1972–2009.

	Dependent variable							
	dCash	dNWC	Capx1	Capx2	Capx3	dDebt2	Issues	Div
Model 1 (N = 1,683)								
CF_t	0.15	0.14	0.26	0.33	0.35	-0.13	-0.13	0.06
	9.24	9.71	9.06	16.22	9.11	-7.01	-3.58	6.69
M/B_{t-1}	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.00
	2.81	2.99	2.33	4.20	5.91	6.49	7.16	3.43
R^2	0.051	0.045	0.129	0.122	0.109	0.019	0.052	0.144
Model 2 (N = 1,605)								
CF_t	0.09	0.12	0.26	0.31	0.33	-0.17	-0.19	0.07
	6.41	10.45	10.66	16.25	9.48	-7.55	-4.96	6.99
M/B_{t-1}	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.00
	6.15	1.32	0.76	2.58	4.14	4.66	8.36	4.50
$Return_t$	0.03	0.00	-0.01	0.00	0.00	0.01	0.03	0.00
	9.03	-0.09	-4.57	-0.29	0.36	0.94	6.41	-0.60
$Return_{t-1}$	0.00	0.02	0.02	0.03	0.04	0.04	0.02	0.00
	0.07	11.40	9.43	8.34	8.39	7.91	5.27	-3.04
$Return_{t-2}$	-0.01	0.02	0.02	0.03	0.04	0.04	0.01	0.00
	-5.08	7.62	9.60	13.18	11.97	12.25	3.37	-2.16
R^2	0.082	0.070	0.162	0.156	0.138	0.051	0.095	0.179
Model 3 (N = 1,614)								
CF_t	0.11	0.11	0.15	0.14	0.12	-0.47	-0.15	0.04
	5.46	4.15	8.15	6.21	2.92	-15.56	-4.14	8.05
CF_{t-1}	-0.07	-0.01	0.24	0.32	0.38	0.38	-0.03	0.02
	-4.52	-0.56	5.29	7.44	11.73	11.48	-2.53	4.53
M/B_{t-1}	0.01	0.00	0.00	0.00	0.00	0.01	0.02	0.00
	9.73	0.67	0.59	1.26	1.86	5.06	8.05	4.78
$Cash_{t-1}$	-0.11	0.01	-0.04	0.00	0.03	-0.08	0.00	-0.01
	-13.03	0.86	-3.47	0.24	1.91	-7.12	0.07	-4.56
$Debt2_{t-1}$	-0.02	-0.03	0.05	0.03	0.03	-0.06	0.02	-0.02
	-10.21	-3.80	2.72	1.67	1.76	-4.61	3.67	-2.77
$Return_t$	0.03	0.00	-0.01	0.01	0.01	0.02	0.03	0.00
	8.04	0.07	-2.85	1.93	2.07	3.10	6.17	0.66
$Return_{t-1}$	0.00	0.03	0.01	0.03	0.04	0.04	0.02	0.00
	-0.36	11.75	6.18	6.64	6.80	8.35	4.87	-3.46
$Return_{t-2}$	0.00	0.02	0.01	0.02	0.03	0.03	0.01	0.00
	-4.20	9.30	7.19	7.69	7.77	9.69	3.39	-3.16
R^2	0.121	0.085	0.210	0.195	0.169	0.093	0.107	0.226

Table 3, cont.

	Dependent variable							
	dCash	dNWC	Capx1	Capx2	Capx3	dDebt2	Issues	Div
Model 4 (N = 1,614)								
$U[CF_t]$	0.11	0.11	0.15	0.14	0.12	-0.47	-0.15	0.04
	5.46	4.15	8.15	6.21	2.92	-15.56	-4.14	8.05
$E[CF_t]$	0.01	0.09	0.50	0.61	0.68	0.09	-0.20	0.06
	0.61	4.05	6.31	9.30	10.04	3.07	-4.17	7.60
M/B_{t-1}	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.00
	10.34	0.84	-2.65	-2.33	-2.22	0.79	7.90	4.35
$Cash_{t-1}$	-0.11	0.00	-0.04	0.01	0.04	-0.07	0.00	-0.01
	-12.19	0.24	-2.57	0.50	1.89	-5.26	-0.24	-4.66
$Debt2_{t-1}$	-0.03	-0.03	0.05	0.04	0.04	-0.05	0.02	-0.02
	-10.30	-3.91	2.84	1.92	2.07	-3.76	3.48	-2.72
$Return_t$	0.03	0.00	-0.01	0.01	0.01	0.02	0.03	0.00
	8.04	0.07	-2.85	1.93	2.07	3.10	6.17	0.66
$Return_{t-1}$	0.00	0.03	0.01	0.02	0.03	0.03	0.02	0.00
	0.65	11.38	2.81	4.47	4.87	6.41	5.00	-4.07
$Return_{t-2}$	-0.01	0.02	0.01	0.03	0.03	0.04	0.01	0.00
	-4.50	8.39	8.41	9.37	8.79	10.65	3.35	-2.89
R^2	0.121	0.085	0.210	0.195	0.169	0.093	0.107	0.226

dCash = change in cash holdings
dNWC = change in non-cash net working capital
Capx1 = net capital expenditures
Capx2 = all investing activities from the Statement of Cash Flows (SCF)
Capx3 = change in fixed effects + depr – other non-cash adjustments to fixed assets from the SCF
dDebt2 = change in total nonoperating liabilities
Issues = change in shareholders equity – change in retained earnings
Div = cash dividends (common + preferred)
CF = income before extraordinary items + depreciation + other operating cashflow
M/B = market-to-book ratio of net assets
Return = annual stock return, contemporaneous and lagged 1 and 2 years

Investment might be sensitive to prior-year cashflow because investment decisions are made or executed slowly, thus reacting with a delay either to changes in financing constraints or to the information about investment opportunities conveyed by cashflow. At first glance, the financing-constraints story seems hard to reconcile with the fact that CF_{t-1} is significant after controlling for cash holdings, debt, and current cashflow, all of which are more direct measures of a firm's financial condition in year t. A more subtle argument is that CF_{t-1} affects *expected* cashflow and financing constraints in year t, and it might be anticipated cashflow and constraints that actually drive investment.

Unfortunately, it does not appear to be possible to distinguish empirically between a direct role for lagged cashflow and an indirect role through expectations: cashflow is highly persistent, so lagged and expected cashflow seem to be very highly correlated. For example, we estimate an average R^2 of 58% when CF_t is regressed on its lag, rising only slightly to 61% when the other variables (lagged returns, M/B, cash, and debt) are added to the regression.

At a minimum, however, we can modify Model 3 to facilitate a more direct interpretation of the results in terms of expected and unexpected cashflows: we regress CF_t on the lagged variables in Model 3 and use the residuals and fitted values from this first-stage regression in place of CF_t and CF_{t-1} in the model. The revised model is equivalent to Model 3—with exactly the same R^2—but the new variables reinterpret the roles of CF_t and CF_{t-1} as unexpected and expected cashflows, respectively. In addition, the slopes on lagged M/B, returns, cash holdings, and debt now show how those variables correlate with investment after controlling for their association with expected cashflow.

The results are reported as Model 4. Unexpected cashflow, $U[CF_t]$, is only weakly related to investment, with a slope of 0.15 for capital expenditures (t=8.15) and 0.12 for total fixed investment (t=2.92). Instead, it is used mostly to reduce a firm's reliance on external financing: $0.47 of each dollar goes to pay down debt (t=15.56) and $0.15 goes to share repurchases (t=4.14). A smaller amount is retained as cash ($0.11), spent on working capital ($0.11), or paid out as dividends ($0.04).

In contrast, expected cashflow, $E[CF_t]$, raises investment almost one-for-one: a dollar of expected cashflow is associated with an extra $0.09 of working capital (t=4.15), $0.50 of capital expenditure (t=6.31) and $0.68 of spending on all fixed assets (t=10.04), for a total investment-cashflow sensitivity of nearly 0.80. Moreover, expected cashflow and debt seem to be complements—a dollar of expected cashflow is associated with $0.09 of new debt—in contrast to the strong substitution effect found for unexpected cashflow. This result is consistent with Q theory, to the extent that expected cashflow captures variation in Q missed by M/B, but is also consistent with expected cashflow having both a direct effect on financing frictions and an indirect effect through the relaxation of borrowing constraints.

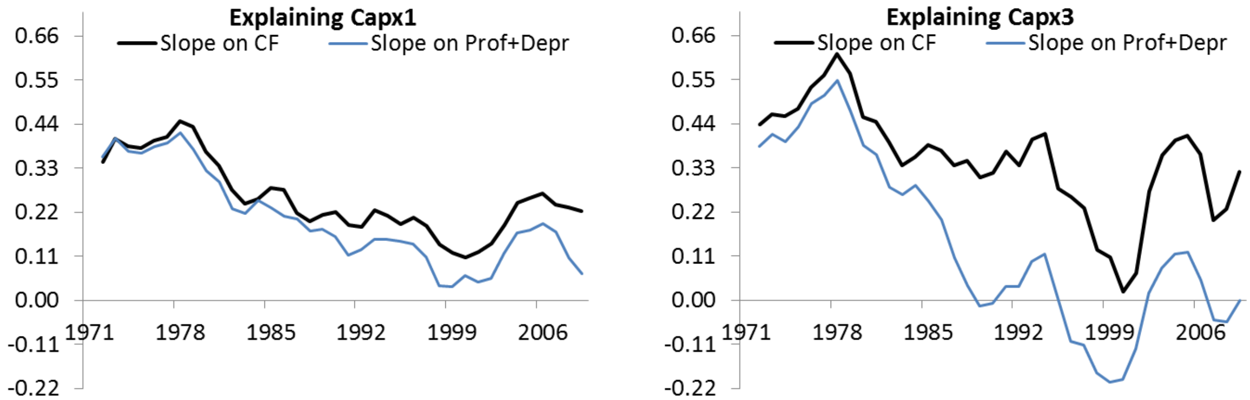

Fig. 2. Investment-cashflow sensitivity, 1971–2009. The figure plots the two-year rolling average of the slopes on cashflow (CF) and income before extraordinary items plus depreciation (Prof+Depr) when capital expenditures (Capx1) and total fixed investment (Capx3) are regressed on each of the variables and M/B_{t-1}. The variables are scaled by average net assets during the year and winsorized at their 1st and 99th percentiles. Data come from Compustat. The sample consists of all nonfinancial firms that are larger than the NYSE 10th percentile (measured by net assets at the beginning of the year) and that have data for net assets and stock returns.

It is also interesting that M/B is now negatively related to investment (t-statistics of -2.22 to -2.65), though the slopes are insignificant if we drop past returns from the regression (slightly negative for capital expenditures and slightly positive for total fixed investment). Thus, the portion of M/B that is orthogonal to expected cashflow has little correlation with investment. The Q-theory interpretation is that $E[CF_t]$ must provide a better measure of Q that does M/B. The result is harder to reconcile with the mispricing view of Baker, Stein, and Wurgler (2003), who argue that M/B is positively associated with investment in part because constrained firms prefer to cut back on investment when their stock is undervalued (low M/B) rather than sell low-priced equity in the market. Our priors would be that the portion of M/B that is orthogonal to expected cashflow should be a better proxy for mispricing than raw M/B, but the opposite would have to be true to reconcile our results with their model.

Fig. 2 illustrates how investment-cashflow sensitivities change through time and compares the results to the slope on income before extraordinary items plus depreciation (Prof+Depr, the conventional proxy for cashflow used in the literature). Investment-cashflow sensitivities decline steadily for most of the sample but start to increase in 2000 and, using CF, end the sample only about one-third lower than in the early 1970s. If we split the sample in half (in 1990), the average slope on CF for capital expenditures drops from 0.32 in the first half to 0.19 in the second half; the slope on CF for total fixed investment drops from 0.43 to 0.27 (all four estimates have t-statistics greater than six). The slope on Prof+Depr is almost always smaller and declines more substantially through time, from 0.30 to 0.11 for capital expenditures and from 0.31 to -0.02 for total fixed investment (the last is insignificant). The results are consistent with the fact that Prof+Depr diverges significantly from cashflow after 1985 (see Fig. 1).

The downward trend in the slope on Prof+Depr mimics the findings of Chen and Chen (2012), who conclude that investment-cashflow sensitivities largely disappear in recent years. Our results suggest that a substantial part of the apparent decline can be attributed to the fact that Prof+Depr has become an increasingly poor measure of cashflow through time, especially during the last two recessions (2001 and 2008; see Fig. 1).

4.3. Constrained vs. unconstrained firms

Table 4 divides the sample into constrained and unconstrained firms. The results show that cashflow effects are strong in both groups but, consistent with a role for financing costs, tend to be significantly higher among constrained firms (i.e., those expected to need external financing).

Controlling just for M/B, constrained firms spend an extra $0.19 on working capital, $0.41 on capital expenditures, and $0.53 on all fixed assets for each additional dollar of cashflow, compared with cashflow effects of $0.02, $0.28, and $0.29, respectively, for unconstrained firms. The slopes are significantly higher for constrained firms in all three cases, with t-statistics testing equality ranging from 4.50 to 6.12 (not shown in the table). The total investment-cashflow sensitivity of constrained firms, 0.72, is more than double that of unconstrained firms, 0.30, and much greater than a narrow focus on capital expenditure would indicate. Unconstrained firms are much more inclined than constrained firms to reduce debt (0.30 vs. 0.01), and somewhat more inclined to raise dividends (0.07 vs. 0.02) and reduce share issuance (0.14 vs. 0.07), in response to higher cashflow. The groups increase their cash holdings by about the same amount for each additional dollar of cashflow ($0.13 for unconstrained firms; $0.16 for constrained firms).

Investment by constrained firms is also much more sensitive to M/B, consistent with the findings of Baker, Stein, and Wurgler (2003). Constrained firms have a M/B slope that is more than ten times larger for capital expenditures (0.040 vs. 0.003) and five times larger for total fixed investment (0.061 vs. 0.011) compared with unconstrained firms, differences that are statistically significant (t-statistics of 5.00 and 8.33, respectively). Q theory would tend to predict the opposite pattern, if M/B is a good proxy for Q, since unconstrained firms should react more aggressively to changes in investment opportunities (see our model in Section 2). Baker et al. attribute this result to the impact of mispricing on investment, which should be stronger for constrained firms that rely on new equity to finance growth.

The results are similar if returns are included in the regression (Model 2): the slopes on CF and M/B drop slightly in the investment regressions relative to Model 1 but the comparison across groups does not change. And past returns, like M/B, are more strongly related to investment for constrained than unconstrained firms (the table reports the sum of the slopes on past returns to save space).

Model 3 includes lagged cashflow, cash holdings, and debt in the regressions. Lagged cashflow is highly significant and, unlike current cashflow, has about the same impact on investment for the two groups of firms: controlling for the other variables, an additional dollar of prior-year cashflow is associated with \$0.42 of capital expenditures and \$0.47 of total fixed investment for constrained firms (t-statistics of 15.56 and 13.58), compared with estimates of \$0.27 and \$0.53, respectively, for unconstrained firms (t-statistics of 12.52 and 11.56). The difference between the groups is significant for capital expenditures (t=8.09) but not for total fixed investment (t=–1.03).

Model 4 reinterprets the role of lagged cashflow via its impact on expected cashflow. As we did for the full sample, we replace CF_{t-1} and CF_t with expected and unexpected cashflow, respectively (estimated in separate first-stage regressions for constrained and unconstrained firms). Fixed investment increases almost one-for-one with expected cashflow for both constrained (\$0.91) and unconstrained (\$0.84) firms, the majority of which represents increases in capital expenditures. Unexpected cashflow has a smaller impact on investment but helps to drive the different investment-cashflow sensitivities of the two groups: constrained firms invest an extra \$0.19 in working capital (t=8.71) and \$0.20 in fixed assets (t=7.76) for each dollar of unexpected

Table 4

Cashflow and investment for constrained vs. unconstrained firms, 1972–2009

This table reports average slopes, R^2s, and sample sizes (N) from annual cross-sectional regressions for constrained and unconstrained firms (intercepts are included in all regressions). t-statistics, reported below the slope estimates, are based on the time-series variability of the estimates, incorporating a Newey-West correction with three lags to account for possible autocorrelation in the estimates. The groups are determined at the beginning of the year based on expected free cashflow for the year. Variables are winsorized annually at the 1st and 99th percentiles. Accounting data come from Compustat and returns come from CRSP. The sample consists of all nonfinancial firms larger than the NYSE 10th percentile, measured by net assets at the beginning of the year.

	dCash		dNWC		Capx1		Capx2		Capx3		dDebt2		Issues		Div	
	Cons.	Unc.	Cons.	Unc.	Cons.	Unc.	Cons.	Unc.	Cons.	Unc.	Cons.	Unc.	Cons.	Unc.	Cons.	Unc.
Model 1 (N = 548 for constrained, N = 549 for unconstrained)																
CF_t	0.16	0.13	0.19	0.02	0.41	0.28	0.51	0.26	0.53	0.29	-0.01	-0.30	-0.07	-0.14	0.02	0.07
	5.55	7.88	8.34	0.93	10.66	9.91	15.75	7.07	12.33	5.81	-0.43	-11.82	-2.72	-3.24	4.52	6.45
M/B_{t-1}	0.00	0.01	0.01	0.01	0.04	0.00	0.05	0.01	0.06	0.01	0.04	0.02	0.03	0.01	0.00	0.00
	0.59	2.94	4.81	2.69	5.21	1.95	6.99	4.98	11.43	5.17	7.40	8.05	12.35	5.82	-1.85	3.16
R^2	0.051	0.052	0.071	0.021	0.271	0.188	0.242	0.084	0.191	0.082	0.038	0.031	0.090	0.050	0.043	0.127
Model 2 (N = 522 for constrained, N = 532 for unconstrained)																
CF_t	0.12	0.07	0.17	0.00	0.39	0.29	0.47	0.24	0.48	0.27	-0.08	-0.33	-0.12	-0.21	0.02	0.08
	4.63	3.23	9.92	-0.02	11.00	10.07	15.70	6.13	13.02	4.96	-2.55	-10.88	-4.48	-4.51	3.92	6.48
M/B_{t-1}	0.01	0.01	0.00	0.00	0.03	0.00	0.04	0.01	0.04	0.01	0.02	0.02	0.03	0.01	0.00	0.01
	2.49	5.47	2.50	1.73	4.45	0.32	5.37	2.93	7.50	3.13	3.98	6.63	12.51	7.35	-2.79	4.38
$Return_t$	0.03	0.04	0.00	0.00	-0.01	-0.01	0.00	0.01	0.00	0.01	0.01	0.02	0.03	0.04	0.00	0.00
	8.75	6.98	0.49	-0.16	-2.50	-5.60	-0.52	1.58	0.32	1.38	1.01	2.00	7.93	5.31	0.74	-1.95
$Return_{t-2,t-1}$	-0.01	0.00	0.03	0.05	0.05	0.02	0.07	0.04	0.09	0.05	0.10	0.04	0.02	0.04	0.01	-0.02
	-4.21	0.92	5.64	14.02	20.14	5.07	11.55	7.71	10.65	7.40	12.09	5.75	3.55	5.15	3.05	-8.64
R^2	0.088	0.090	0.092	0.050	0.310	0.212	0.284	0.109	0.223	0.106	0.083	0.052	0.129	0.106	0.095	0.194
Model 3 (N = 522 for constrained, N = 532 for unconstrained)																
CF_t	0.11	0.12	0.19	-0.02	0.12	0.15	0.20	0.04	0.20	0.00	-0.39	-0.57	-0.10	-0.24	0.01	0.07
	5.68	3.43	8.71	-0.59	6.55	7.67	10.34	0.87	7.76	-0.05	-9.84	-16.56	-3.87	-4.41	4.08	8.70
CF_{t-1}	-0.08	-0.08	-0.02	0.00	0.42	0.27	0.45	0.40	0.47	0.53	0.42	0.41	-0.03	0.07	0.00	0.00
	-8.04	-3.72	-0.71	0.03	15.56	12.52	13.57	13.03	13.58	11.16	9.67	20.30	-2.15	3.25	-0.28	-0.45
M/B_{t-1}	0.02	0.01	0.00	0.00	0.03	0.00	0.03	0.00	0.04	0.00	0.02	0.01	0.03	0.01	0.00	0.01
	4.99	9.75	0.14	1.94	6.07	-1.21	6.08	0.37	7.82	0.06	5.76	6.24	11.48	6.55	-2.30	5.40
$Cash_{t-1}$	-0.18	-0.05	0.03	-0.02	0.01	-0.05	0.08	-0.02	0.09	0.00	-0.06	-0.08	-0.02	0.01	-0.03	-0.01
	-12.54	-4.32	2.42	-3.34	1.74	-14.19	5.36	-2.00	5.95	0.36	-3.17	-6.16	-1.54	1.39	-3.44	-4.09
$Debt2_{t-1}$	-0.02	-0.02	-0.01	-0.04	0.01	0.00	0.00	0.00	-0.01	0.02	-0.06	-0.08	0.00	0.02	-0.01	-0.02
	-5.68	-5.19	-1.52	-5.83	1.05	0.48	0.33	-0.09	-1.28	1.39	-4.69	-7.37	-0.02	2.66	-2.55	-2.32
$Return_t$	0.03	0.04	0.00	0.00	0.00	0.00	0.01	0.02	0.01	0.02	0.02	0.03	0.03	0.04	0.00	0.00
	7.42	6.67	-0.09	0.35	1.19	-2.12	1.81	3.44	2.19	2.82	3.31	3.41	7.94	5.31	1.34	-1.48
$Return_{t-2,t-1}$	-0.01	0.01	0.03	0.05	0.03	0.01	0.05	0.04	0.07	0.05	0.08	0.04	0.02	0.04	0.01	-0.02
	-3.24	1.05	6.35	14.88	10.85	3.33	7.98	5.37	7.78	5.10	11.34	5.34	3.63	4.86	3.57	-8.20
R^2	0.175	0.116	0.113	0.070	0.386	0.278	0.337	0.154	0.266	0.151	0.135	0.102	0.142	0.121	0.147	0.252

Table 4, cont.

	dCash		dNWC		Capx1		Capx2		Capx3		dDebt2		Issues		Div	
	Cons.	Unc.	Cons.	Unc.	Cons.	Unc.	Cons.	Unc.	Cons.	Unc.	Cons.	Unc.	Cons.	Unc.	Cons.	Unc.
Model 4 (N = 522 for constrained, N = 532 for unconstrained)																
$U[CF_t]$	0.11	0.12	0.19	-0.02	0.12	0.15	0.20	0.04	0.20	0.00	-0.39	-0.57	-0.10	-0.24	0.01	0.07
	5.68	3.43	8.71	-0.59	6.55	7.67	10.34	0.87	7.76	-0.05	-9.84	-16.56	-3.87	-4.41	4.08	8.70
$E[CF_t]$	-0.02	-0.02	0.17	-0.01	0.75	0.61	0.87	0.68	0.91	0.84	0.23	0.11	-0.15	-0.14	0.01	0.06
	-1.17	-1.61	5.38	-0.19	13.75	12.08	19.04	11.82	18.75	17.29	4.95	4.40	-3.91	-3.38	1.40	3.74
M/B_{t-1}	0.02	0.01	0.00	0.00	0.02	-0.01	0.02	-0.01	0.03	-0.01	0.01	0.00	0.03	0.01	0.00	0.01
	5.65	11.45	0.26	1.53	5.67	-6.36	5.66	-5.05	6.85	-4.91	3.95	-0.69	11.65	4.97	-2.19	4.95
$Cash_{t-1}$	-0.18	-0.05	0.03	-0.02	0.02	-0.04	0.08	-0.01	0.10	0.02	-0.06	-0.07	-0.02	0.01	-0.03	-0.01
	-11.79	-4.38	1.74	-3.02	1.53	-9.99	4.22	-0.93	4.68	2.12	-2.70	-5.45	-1.71	1.44	-3.47	-4.21
$Debt2_{t-1}$	-0.02	-0.03	-0.01	-0.04	0.02	0.01	0.01	0.01	0.00	0.03	-0.05	-0.07	0.00	0.02	-0.01	-0.02
	-6.51	-6.22	-1.48	-5.95	2.38	1.23	1.53	0.56	-0.29	1.83	-3.93	-7.17	0.06	2.66	-2.57	-2.35
$Return_t$	0.03	0.04	0.00	0.00	0.00	0.00	0.01	0.02	0.01	0.02	0.02	0.03	0.03	0.04	0.00	0.00
	7.42	6.67	-0.09	0.35	1.19	-2.12	1.81	3.44	2.19	2.82	3.31	3.41	7.94	5.31	1.34	-1.48
$Return_{t-2,t-1}$	-0.01	0.01	0.03	0.05	0.02	0.01	0.04	0.04	0.06	0.04	0.08	0.03	0.02	0.03	0.01	-0.02
	-2.74	1.13	6.34	16.18	6.45	2.41	6.07	4.57	6.17	4.27	9.62	4.45	3.82	4.92	3.58	-8.61
R^2	0.175	0.116	0.113	0.070	0.386	0.278	0.337	0.154	0.266	0.151	0.135	0.102	0.142	0.121	0.147	0.252

dCash = change in cash holdings
dNWC = change in non-cash net working capital
Capx1 = net capital expenditures
Capx2 = all investing activities from the Statement of Cash Flows (SCF)
Capx3 = change in fixed effects + depr – other non-cash adjustments to fixed assets from the SCF
dDebt2 = change in total nonoperating liabilities
Issues = change in shareholders equity – change in retained earnings
Div = cash dividends (common + preferred)
CF = income before extraordinary items + depreciation + other operating cashflow
M/B = market-to-book ratio for net assets
Return = annual stock return, contemporaneous and lagged 1 and 2 years

cashflow, compared with insignificant effects of -$0.02 and $0.00, respectively, for unconstrained firms (capital expenditures react about the same for the two groups, with a slope 0.12 for constrained firms (t=6.55) and 0.15 for unconstrained firms (t=7.67)).

The slopes on cash holdings are also fairly large for constrained firms (a combined slope of 0.13 for short-term and long-term investment) and close to zero for unconstrained firms (a combined slope of 0.00). The differential effect is consistent with financing constraints, but the slopes on lagged debt do not exhibit a corresponding pattern.

Perhaps the most surprising result from Model 4 is that, after controlling for expected cashflow, investment is negatively related to M/B for unconstrained firms (an effect that remains even when past returns are dropped from the regressions). That finding is hard to reconcile either with Q theory—measurement error might explain an insignificant slope, but not a negative one—or with Baker et al.'s (2003) mispricing story. One intriguing possibility is that free cashflow problems might be so severe among unconstrained firms that higher investment actually reduces firm value.

4.4. Summary

Overall, Tables 3 and 4 provide strong evidence that cashflow is significantly related to investment after controlling for M/B and stock returns. The effects are economically large, implying that spending increases by $0.51 for unconstrained firms and $0.84 for constrained firms when current- and prior-year cashflows increase by one dollar (Model 3 in the tables). Prior-year cashflow has a stronger impact on investment than current-year cashflow but both are significant for constrained firms.

5. Measurement error in Q

In principle, investment opportunities could explain many of the cashflow effects above if M/B is a noisy proxy for Q. Measurement error in M/B might also contaminate the comparison between constrained and unconstrained firms. In this section, we test whether measurement error does explain the results and provide error-corrected estimates of the slopes.

5.1. Methodology

Our goal here is to estimate an empirical version of eq. (7), i.e.,

$$INV = c_0 + c_1 Q + c_2 CF + \varepsilon, \quad (11)$$

recognizing that M/B is an imperfect proxy for Q:

$$M/B = g_0 + g_1 Q + \eta. \quad (12)$$

The approach we take is a version of the standard instrumental-variables (IV) methodology in the literature, the main innovation being our choice of instruments. Prior studies typically use lagged M/B, lagged changes in M/B, or a combination of the two as instruments. However, as noted by Erickson and Whited (2000, 2012) and Almeida, Campello, and Galvao (2010), that approach requires strong assumptions about serially correlation in measurement error (i.e., M/B_{t-k} can only be used as an instrument if $cov(\eta_t, \eta_{t-k}) = 0$). As an alternative, our tests use lagged *returns* as an instrument for Q, based on the logic that measurement error in M/B is more likely to come from book value in the denominator than from market value in the numerator. Even if market prices measure true value with error, it still seems reasonable to assume that stock prices are driven primarily by fundamental value (see, e.g., Cohen, Polk, and Vuolteenaho, 2009).

To be specific, we start with a first-stage regression of M/B on cashflow and lagged returns. The fitted value from this regression then replaces Q in the investment regression (11), yielding a consistent estimate of c_2 under the assumption that returns and cashflow are correlated with Q but not with η. Formally, let x be any vector of variables that is orthogonal to η. The slope when M/B is regressed on x is proportional to the slope when Q is regressed on x, i.e., in the regressions $Q = \gamma_0 + \gamma_1' x + \mu$ and $M/B = \delta_0 + \delta_1' x + \omega$, the slopes satisfy $\delta_1 = g_1 \gamma_1$, where g_1 comes from (12). In addition,

$$INV = c_0 + c_1^*(\delta_1' x) + c_2 CF + \varepsilon^*, \quad (13)$$

where $c_1^* = c_1/g_1$ and $\varepsilon^* = \varepsilon + c_1\mu$. As long as CF is included in x, ε^* is uncorrelated with both regressors and eq. (13) provides a consistent estimate of c_2. The idea is simply that the fitted value from the first-stage regression, $\delta_1' x$, captures how CF relates to Q, so the slope on CF in the second-stage regression (13) reflects just the portion of CF that is unrelated to investment opportunities.

We recognize that our IV estimator may not be perfect. The biggest concern, in our view, is that error in the book value of net assets could induce a positive correlation between (scaled) CF and η. If so, our tests would provide a downward-biased estimate of the slope on cashflow (c_2).[5] Fortunately, the possibility of a downward bias does not pose a big problem for our main conclusions because we find that cashflow effects remain significant anyway. In a sense, our results may well be conservative in that they might attribute too much of the cashflow effects to investment opportunities and too little to financing frictions (while OLS regressions likely do the opposite).

Using past returns as instruments for Q could also be problematic for at least two reasons. First, Erickson and Whited (2012) suggest that returns might be correlated with measurement error in M/B—though, again, we use lagged returns, rather than lagged M/B, specifically because returns do not depend on the book value of assets and seem less likely to be correlated with η. Second, returns might enter the investment regression directly, not just through their correlation with current Q. For example, lagged returns might be correlated with lagged Q and, if investment takes time, both current and lagged Q might explain investment (eq. 11 implicitly ruled this out by including only current Q as an explanatory variable).

The Appendix reports several robustness checks to address these concerns: (i) We drop returns from the first-stage regressions and instead use either lagged cashflow or current squared cashflow as instruments for Q (the second of these is discussed further below). (ii) We continue to use returns but add M/B_{t-2} to the investment regressions to address the possibility that lagged Q might enter the regression (we instrument for both M/B_{t-1} and M/B_{t-2}). (iii) We drop recent returns from the set of instruments, the logic being that more distant returns are less likely to correlate with measurement error in M/B. The upshot is that the results reported in the text seem to provide, in anything, conservative estimates of cashflow effects.

An alternative to IV regressions would be to use the higher-order moment estimators of Erickson and Whited (2000, 2012). Given the popularity of that approach, it may be useful note that two of our IV-based estimators in the Appendix are valid under the assumptions used to derive the Erickson-Whited estimator, the key

[5] Suppose that CF is positively correlated with η, contrary to the assumptions of our IV estimator. We can write $\eta = \lambda'x + \eta^* = \lambda_{CF}CF + \eta^*$, where $\lambda_{CF} > 0$ and η^* is orthogonal to x. In the regression of M/B on x, the slope becomes $\gamma_2 = g_1\gamma_1 + \lambda$ and, from eq. (11), $INV = c_0 + c_1^*(\gamma_2'x) + (c_2 - c_1^*\lambda_{CF})\, CF + \varepsilon^*$. Thus, if $\lambda_{CF} > 0$, the error-corrected slope on CF will be biased downward, assuming that Q is positively correlated with investment ($c_1^* > 0$).

difference being that identification is obtained differently. As a quick review, Erickson and Whited start with same basic model that we consider:

$$INV = c_0 + c_1 Q + c_2 CF + \varepsilon, \tag{14}$$

$$M/B = g_0 + g_1 Q + \eta, \tag{15}$$

but, rather than instrument for Q, they derive a GMM-based higher-moment estimator under the assumption that η and ε are statistically independent of each other and of CF and Q.[6] Identification in their context requires that the appropriate higher moments are not zero. Given the same independence assumption, squared CF is a valid instrument for Q, where identification now requires that CF^2 correlates with Q. Further, if independence holds not just contemporaneously but also on a lead-lag basis (that is, η is uncorrelated with both current and prior CF), lagged CF is also a valid instrument for Q. Thus, our IV-based estimates in the Appendix provide an alternative way to exploit the statistical assumptions required of Erickson and Whited's estimator without requiring some of their additional assumptions. Again, we use returns as an instrument in the main text because it provides the most conservative estimates.

5.2. Results

Table 5 reports the first-stage regressions of M/B on cashflow and returns. CF_t by itself explains 23% of the variation in M/B for the full sample of firms, with a slope of 5.18 (t=10.24). The relation is much stronger for unconstrained than constrained firms: a dollar of cashflow raises the value of unconstrained firms by $8.58 and the value of constrained firms by just $1.01. The small coefficient for constrained firms poses a challenge for Q theory, as we will see formally in a moment, since cashflow for that group is, at once, strongly related to investment but weakly related to Q.

The remaining columns in Table 5 add lagged cashflow and returns to the regression. Current- and prior-year CF are strongly related to M/B, with individual slopes that roughly split the slope on cashflow in Model 1 of

[6] The simplest version of the estimator exploits information in third moments and can be implemented in three steps. The first step is to get the residuals, ε_{INV} and $\varepsilon_{M/B}$, when INV and M/B are regressed on CF and a constant. The second step is to estimate the moments $E[\varepsilon_{INV}^2 \varepsilon_{M/B}]$ and $E[\varepsilon_{INV} \varepsilon_{M/B}^2]$, the ratio of which, under the independence assumption above, provides a consistent estimator of c_1 (for identification, the moment used in the denominator, $E[\varepsilon_{INV} \varepsilon_{M/B}^2]$, cannot be zero). Third, given c_1, the slope on CF is obtained using basic regression identities that relate the slopes in the multiple regression (14) to the slopes in the simple regressions estimated in step 1.

Table 5
Explaining Q, 1971–2009
This table reports average slopes, R^2s, and sample sizes (N) from annual cross-sectional regressions of firms' M/B ratios at the end of year t-1 on cashflow (CF) and returns at various leads and lags. t-statistics, reported below the slope estimates, are based on the time-series variability of the estimates, incorporating a Newey-West correction with three lags to account for possible autocorrelation in the estimates. The full sample ('All') includes all nonfinancial firms larger than the NYSE 10th percentile of net assets. The constrained ('Cons.') and unconstrained subsamples ('Unc.') are determined at the beginning of the year based on the firm's predicted cashflows in excess of capital expenditures (unconstrained firms represent the top 1/3 of firms ranked on this measure, while constrained firms represent the bottom 1/3). Variables are winsorized annually at their 1st and 99th percentiles.

	Model 1			Model 2			Model 3			Model 4		
	All	Cons.	Unc.	All	Cons.	Unc.	All	Cons.	Unc.	All	Cons.	Unc.
CF_t	5.18	1.01	8.58	2.33	0.84	4.39	2.09	0.60	3.84	2.31	0.81	3.91
	10.24	2.20	10.04	8.66	5.54	10.35	8.89	6.59	9.53	9.41	7.55	9.46
CF_{t-1}				3.75	0.18	6.72	3.26	-0.43	6.12	2.74	-0.99	5.15
				9.41	0.24	6.63	10.34	-0.77	7.59	13.40	-1.99	8.71
$Return_{t-1}$							0.46	0.51	0.55	0.48	0.49	0.58
							4.56	6.68	3.76	4.77	6.75	4.12
$Return_{t-2}$							0.32	0.37	0.36	0.34	0.37	0.39
							3.99	6.15	2.98	4.27	7.39	3.10
$Return_{t-3}$										0.31	0.26	0.43
										4.18	7.28	3.70
$Return_{t-4}$										0.28	0.21	0.40
										4.49	5.35	4.39
R^2	0.231	0.063	0.298	0.281	0.103	0.377	0.361	0.259	0.447	0.407	0.313	0.495
N	1,723	552	552	1,721	552	552	1,647	525	535	1,493	456	495

the table (the relation for lagged cashflow is weak among constrained firms). Returns up to four years in the past also have significant explanatory power, with slopes that decay from 0.50–0.60 at lag 1 to 0.21–0.40 at lag 4 (the t-statistics range from 3.10 to 7.39).

For our purposes, a key finding is that past returns raise the regression R^2 substantially, implying that they explain significant variation in M/B that is orthogonal to cashflow. Thus, the fitted value from these regressions—our instrument for Q—has sufficiently low correlation with cashflows to permit precise estimates of the second-state investment equation. The trade-off we face by adding more return lags is that we explain a greater fraction of the variation in M/B but reduce the number of firms with data. For our subsequent tests, we include all four return lags in the first-stage regression in the belief that the gain in R^2 more than compensates for the modest drop in sample size.[7]

[7] We find similar results if we instead use three or five returns lags in the first-stage regression. Cashflow effects in the

Table 6 reports error-corrected estimates of the investment equation for the full sample of firms. Model 1, with CF_t and instrumented M/B_{t-1} in the regression, is the direct analog of Model 1 in Table 3. After correcting for measurement error, an extra dollar of cashflow is associated with $0.08 of capital expenditure (t=3.46) and $0.00 of total fixed investment (t=-0.16), compared with estimates of $0.26 and $0.35 in Table 3. Summing working capital and fixed assets, the total investment-cashflow sensitivity drops from 0.49 in Table 3 to just 0.04 here. Thus, a significant portion of the cashflow effects estimated earlier can be attributed to a correlation between cashflow and Q.[8] After controlling for Q, cashflow is used mostly to reduce debt ($0.49), with the remainder split fairly evenly between additions to cash holdings ($0.18), lower share issuance ($0.19), and increases in dividends ($0.08), effects that are all highly significant.

Model 2 adds lagged cashflow to the regression. The slopes on lagged cashflow drop substantially relative to our earlier estimates but, unlike those on current cashflow, they remain significant for all three long term investment measures. Controlling for Q and current cashflow, an extra dollar of prior-year cashflow is associated with $0.10 of capital expenditures (t=3.82) and $0.14 of total fixed investment (t=4.19), down from estimates of $0.24 and $0.38, respectively, in Table 3. These results suggest that much of the combined effect of current and lagged cashflow relates to investment opportunities, but cashflow also seems to have a direct impact on investment, consistent with a role for financing frictions.

For completeness, Model 3 adds cash holdings and debt to the regression, as we did in Table 3 (they are also included in the first-stage regression to control for their correlation with Q). The variables are significantly related to investment but have signs that are opposite to naive expectations, positive for debt and negative for cash holdings. (Those effects are presumably driven by the endogenous choice of cash and debt levels, decisions that are beyond the scope of our paper.) For our purposes, the more important result is that adding $Cash_{t-1}$ and $Debt2_{t-1}$ to the regression has only a small impact on the cashflow effects, slightly raising the

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investment regressions tend to be slightly stronger when more lags are included, consistent with the fact that the first-stage regressions then pick up more variation in M/B that is orthogonal to cashflow.

[8] This is one instance where adjusting for firm fixed effects makes a difference (see our discussion in Section 4.1). In particular, the error-corrected slope on CF_t remains significant for all investment measures if we use de-meaned (within firm) data in the tests. Comparing OLS and IV estimates, the slope drops from 0.22 to 0.14 for working capital (the t-stat drops from 11.17 to 5.19), from 0.20 to 0.08 for capital expenditures (the t-stat drops from 8.83 to 4.32), and from 0.33 to 0.09 for total fixed investment (the t-stat drops from 11.55 to 2.74).

Table 6
Investment and cashflow: Correcting for measurement error in Q, 1972–2009
This table reports average slopes, R^2s, and sample sizes (N) from annual cross-sectional regressions. M/B* is the fitted value when M/B is regressed on current and lagged cashflow (CF_t and CF_{t-1}), four lags of stock returns, and, for Model 3, lagged cash holdings ($Cash_{t-1}$) and debt ($Debt2_{t-1}$). t-statistics, reported below the slope estimates, are based on the time-series variability of the estimates, incorporating a Newey-West correction with three lags to account for possible autocorrelation in the estimates. Flow variables are scaled by average net assets during the year, while level variables are scaled by ending net assets. Variables are winsorized annually at their 1st and 99th percentiles. Accounting data come from Compustat and returns come from CRSP. The sample consists of all nonfinancial firms larger than the 10th percentile of NYSE firms, as measured by net asssets at the beginning of the year, and with data available for all variables within each panel.

	Dependent variable							
	dCash	dNWC	Capx1	Capx2	Capx3	dDebt2	Issues	Div
Model 1 (N = 1,465)								
CF_t	0.18	0.04	0.08	0.04	0.00	-0.49	-0.19	0.08
	10.37	2.47	3.46	0.77	-0.06	-10.82	-3.56	8.59
M/B_{t-1}*	-0.01	0.03	0.05	0.08	0.09	0.10	0.02	0.00
	-1.76	4.32	5.51	8.04	9.59	7.05	5.26	0.49
R^2	0.048	0.057	0.174	0.170	0.147	0.058	0.052	0.169
Model 2 (N = 1,465)								
CF_t	0.19	0.06	0.06	0.03	-0.02	-0.53	-0.15	0.07
	11.39	2.05	2.83	0.54	-0.36	-14.05	-2.92	8.33
CF_{t-1}	-0.11	-0.04	0.10	0.13	0.14	0.27	-0.16	0.07
	-5.46	-0.80	3.82	3.59	4.19	5.76	-5.31	6.75
M/B_{t-1}*	0.01	0.03	0.03	0.06	0.07	0.06	0.04	-0.01
	2.12	3.44	4.80	5.89	6.61	4.48	5.39	-2.05
R^2	0.054	0.065	0.181	0.175	0.151	0.069	0.064	0.191
Model 3 (N = 1,465)								
CF_t	0.19	0.04	0.07	0.01	-0.03	-0.57	-0.15	0.06
	10.37	1.28	2.09	0.18	-0.40	-15.30	-2.86	9.10
CF_{t-1}	-0.11	-0.08	0.16	0.15	0.16	0.21	-0.14	0.05
	-7.59	-1.64	2.87	2.05	2.35	3.35	-3.82	7.78
$Cash_{t-1}$	-0.09	-0.05	-0.11	-0.13	-0.14	-0.20	-0.06	0.00
	-11.82	-4.32	-6.95	-3.63	-3.72	-7.95	-3.21	0.72
$Debt2_{t-1}$	-0.02	-0.02	0.04	0.03	0.03	-0.05	0.02	-0.02
	-8.64	-3.94	2.38	1.27	1.37	-3.82	3.12	-2.46
M/B_{t-1}*	0.01	0.04	0.03	0.06	0.08	0.08	0.04	-0.01
	2.62	4.22	5.93	5.31	5.92	5.15	5.34	-2.04
R^2	0.085	0.076	0.215	0.198	0.169	0.085	0.074	0.237

dCash = change in cash holdings
dNWC = change in non-cash net working capital
Capx1 = net capital expenditures
Capx2 = all investing activities from the Statement of Cash Flows (SCF)
Capx3 = change in fixed effects + depr – other non-cash adjustments to fixed assets from the SCF
dDebt2 = change in total nonoperating liabilities
Issues = change in shareholders equity – change in retained earnings
Div = cash dividends (common + preferred)
CF = income before extraordinary items + depreciation + other operating cashflow
M/B = market-to-book ratio for net assets

slopes overall. For example, the slope on CF_{t-1} increases to 0.16 for both capital expenditures and total fixed investment (t-statistics of 2.87 and 2.35, respectively).

Table 7 repeats the analysis for constrained and unconstrained firms. Measurement error in M/B does not fully explain the cashflow effects for either group, but the corrections have a uniformly larger impact on the slopes for unconstrained firms, increasing the wedge between the two groups and, hence, the apparent impact of financing constraints.

Model 1, with just CF and M/B_{t-1}* in the regression, shows that constrained firms invest an extra \$0.35 in capital expenditures (t=13.23) and \$0.45 in all fixed assets (t=15.25) for each additional dollar of current cashflow, down only slightly from the estimates in Table 4. In comparison, unconstrained firms invest an extra \$0.14 in capital expenditures (t=5.08) and -\$0.05 in all fixed assets (t=-0.46), substantially lower than the estimates of \$0.28 and \$0.29 in Table 4. The spread between the total investment-cashflow sensitivities of the two groups increases from 0.41 in Table 4 to 0.72 in Table 7, combining spending on working capital and all fixed assets,. The corresponding result is that, controlling for Q, unconstrained firms are much more inclined than constrained firms to reduce debt (0.54 vs. 0.15) and equity (0.23 vs. 0.07) when cashflow increases, and are much more likely to increase dividends (0.12 vs. 0.02).

In Models 2 and 3 (the latter with cash holdings and debt included), current and lagged cashflows are both more strongly related to investment for constrained than for unconstrained firms. Focusing on Model 3, the combined slope on CF_t and CF_{t-1} for constrained firms is 0.53 for capital expenditures (t=14.94) and 0.63 for total fixed investment (t=33.72), compared with estimates of 0.37 (t=7.77) and 0.32 (t=2.95), respectively, for unconstrained firms. Lagged cashflow has a stronger impact than current cashflow on investment for both groups, mirroring our earlier finding.

The bottom line is that measurement error in Q seems to explain very little of the investment cashflow sensitivity of constrained firms and only a portion—a significant fraction to be sure—of the investment-cashflow sensitivity of unconstrained firms. The key open question is whether the remaining cashflow effect

Table 7

Cashflow and investment for constrained vs. unconstrained firms: Correcting for measurement error in Q, 1972–2009

This table reports average slopes, R^2s, and sample sizes (N) from annual cross-sectional regressions for constrained and unconstrained firms. M/B* is the fitted value when M/B is regressed on current and lagged cashflow (CF_t and CF_{t-1}), five lags of stock returns, and, for Model 3, lagged cash holdings ($Cash_{t-1}$) and debt ($Debt2_{t-1}$). t-statistics, reported below the slope estimates, are based on the time-series variability of the estimates, incorporating a Newey-West correction with three lags to account for possible autocorrelation in the estimates. Flow variables are scaled by average net assets during the year, while level variables are scaled by ending net assets. Variables are winsorized annually at their 1st and 99th percentiles. Accounting data come from Compustat and returns come from CRSP. The sample consists of all nonfinancial firms larger than the 10th percentile of NYSE firms, as measured by net asssets at the beginning of the year, and with data available for all variables within each panel. The variables are defined in Table 1.

	dCash		dNWC		Capx1		Capx2		Capx3		dDebt2		Issues		Div	
	Cons.	Unc.	Cons.	Unc.	Cons.	Unc.	Cons.	Unc.	Cons.	Unc.	Cons.	Unc.	Cons.	Unc.	Cons.	Unc.
Model 1 (N = 454 for constrained, N = 493 for unconstrained)																
CF_t	0.16	0.15	0.16	-0.06	0.35	0.14	0.43	0.01	0.45	-0.05	-0.15	-0.54	-0.07	-0.23	0.02	0.12
	7.40	5.13	7.35	-1.69	13.23	5.08	14.42	0.10	15.25	-0.46	-2.56	-10.44	-3.23	-3.82	2.84	10.22
M/B_{t-1}*	-0.01	0.00	0.04	0.02	0.09	0.02	0.12	0.04	0.15	0.05	0.15	0.05	0.04	0.02	0.00	0.00
	-1.84	-0.06	4.71	2.70	4.01	5.52	5.32	6.58	6.21	6.90	4.49	6.65	6.53	6.17	0.84	-0.60
R^2	0.050	0.056	0.086	0.032	0.308	0.222	0.281	0.114	0.220	0.113	0.075	0.052	0.097	0.057	0.063	0.189
Model 2 (N = 454 for constrained, N = 493 for unconstrained)																
CF_t	0.20	0.14	0.16	-0.06	0.12	0.14	0.18	0.02	0.19	-0.04	-0.42	-0.51	-0.05	-0.24	0.01	0.13
	7.65	3.66	6.35	-1.72	6.75	6.81	20.58	0.28	9.54	-0.47	-9.28	-9.07	-2.04	-3.29	2.74	7.12
CF_{t-1}	-0.07	-0.19	0.00	-0.11	0.43	0.22	0.47	0.25	0.48	0.33	0.49	0.29	-0.06	-0.10	0.01	0.07
	-4.15	-9.51	0.08	-1.85	18.58	8.68	19.17	4.64	17.67	7.70	17.18	5.85	-2.97	-2.91	1.85	4.87
M/B_{t-1}*	-0.01	0.02	0.04	0.02	0.07	0.00	0.10	0.02	0.13	0.02	0.13	0.02	0.04	0.03	0.00	-0.01
	-1.59	4.92	4.19	3.10	7.18	1.01	9.94	2.07	11.23	2.38	6.65	2.24	6.31	4.76	0.61	-2.28
R^2	0.059	0.067	0.093	0.043	0.389	0.248	0.331	0.130	0.251	0.127	0.113	0.064	0.105	0.065	0.070	0.208
Model 3 (N = 454 for constrained, N = 493 for unconstrained)																
CF_t	0.18	0.17	0.16	-0.08	0.11	0.13	0.17	0.00	0.18	-0.04	-0.44	-0.54	-0.05	-0.22	0.01	0.12
	7.95	5.56	6.22	-2.63	5.33	5.79	18.88	0.03	8.34	-0.50	-10.46	-10.10	-2.13	-3.50	2.50	7.86
CF_{t-1}	-0.13	-0.17	-0.01	-0.10	0.42	0.24	0.45	0.27	0.45	0.37	0.39	0.30	-0.07	-0.07	0.00	0.06
	-5.78	-8.29	-0.28	-1.79	19.89	8.56	29.30	4.93	21.82	8.83	11.08	7.00	-3.09	-2.04	-0.84	4.33
$Cash_{t-1}$	-0.15	-0.04	0.01	-0.05	-0.03	-0.06	0.01	-0.05	0.00	-0.03	-0.15	-0.10	-0.03	0.00	-0.04	0.00
	-10.47	-3.84	0.95	-5.52	-1.55	-15.65	0.31	-3.09	0.04	-1.83	-4.56	-5.37	-2.76	-0.20	-4.08	0.61
$Debt2_{t-1}$	-0.02	-0.02	-0.01	-0.03	0.00	0.01	-0.01	0.00	-0.03	0.03	-0.08	-0.06	0.00	0.02	-0.01	-0.02
	-3.85	-2.80	-1.90	-3.59	0.50	0.73	-0.64	0.22	-1.91	1.81	-5.05	-5.76	0.08	2.71	-2.71	-2.19
M/B_{t-1}*	0.00	0.01	0.04	0.03	0.07	0.00	0.10	0.02	0.12	0.02	0.13	0.03	0.05	0.03	0.01	-0.01
	0.21	5.01	3.87	3.55	9.63	2.25	12.01	2.44	12.97	2.53	6.78	2.78	5.87	4.69	1.54	-2.72
R^2	0.137	0.084	0.106	0.057	0.398	0.267	0.345	0.144	0.267	0.140	0.130	0.088	0.115	0.078	0.124	0.267

for unconstrained firms reflects lingering financing constraints for a subset of those firms or a violation of Q theory, for example, because managers tend to overinvest internal funds.

6. Conclusions

Our results suggest that investment and cashflow are strongly linked after controlling for a firm's investment opportunities, especially for firms that are the most likely to require external funds. The stronger effect for constrained firms suggests that financing frictions have a significant impact on investment decisions, but some of our results also suggest that free cashflow problems play a role. To be more specific, our paper reports six key findings:

(1) Investment and cashflow are strongly linked after controlling for a firm's M/B ratio. In our full sample, a dollar of current-year cashflow is associated with an extra $0.14 of working capital and $0.35 of total fixed investment (i.e., total spending on PP&E, intangibles, and acquisitions). A dollar of cashflow in both the current and prior years is associated with an extra $0.10 of working capital and $0.50 of total fixed investment (controlling for M/B, past returns, cash holdings, and debt). These cashflow effects are statistically significant and economically large.

(2) Investment is more strongly related to a firm's expected cashflow than to its total cashflow. Controlling for M/B, past returns, cash holdings, and debt, an additional dollar of expected cashflow (predicted using information known prior to the year) leads to an extra $0.68 of total fixed investment, compared to just $0.12 for a dollar of unexpected cashflow. Moreover, expected cashflow drives out the significance of M/B for the average firm and, unlike total cashflow, is positively related to new debt issuance (i.e., debt and expected cashflow are complements not substitutes).

(3) Firms that are the most likely to be financially constrained—as reflected in persistently negative free cashflow and low profits, working capital, dividends, and equity—are the most sensitive to cashflow. When current-year cashflow increases by a dollar, constrained firms spend an additional $0.19 on working capital and $0.53 on fixed investment, compared to estimates of $0.02 and $0.29, respectively, for unconstrained

firms (the slopes are statistically different). The higher investment-cashflow sensitivity of constrained firms is largely driven by their reaction to unexpected cashflow.

(4) Investment and M/B are only weakly related for unconstrained firms and actually become negatively related after controlling for a firm's expected cashflow. The latter finding is difficult to reconcile either with Q theory—even if M/B is a noisy proxy for Q—or with the mispricing view of Baker, Stein, and Wurgler (2003). It suggests that free cashflow problems might be severe in unconstrained firms, inducing a negative correlation between investment and firm value.

(5) For unconstrained firms, a large portion of the link between investment and cashflow can be attributed to investment opportunities, i.e., a connection between cashflow and Q that is imperfectly captured by M/B. After controlling for measurement error in M/B, a dollar of cashflow in the current and prior years is associated with an additional $0.32 of fixed investment for unconstrained firms, down from a basic estimate of $0.53. The remaining cashflow effect for this group suggests either that a subset of the firms are misclassified as 'unconstrained' or, consistent with the negative investment-M/B relation found for these firms, that free cashflow problems are important.

(6) For constrained firms, very little of the investment-cashflow sensitivity seems to be explained by noise in our proxy for Q. After correcting for measurement error, a dollar of cashflow in the current and prior years is associated with an additional $0.63 of fixed investment for constrained firms, down only slightly from our basic estimate of $0.67. The error-corrected spread in investment-cashflow sensitivities between constrained and unconstrained firms, equal to 0.31 (0.63 vs. 0.32), suggests that financing frictions have a significant impact on investment.

Collectively, our results do not fit neatly into any single model of investment. Investment opportunities are clearly important, but traditional Q theory—in which Q alone drives investment—is strongly rejected by the data. The costs of external financing seem to play a role, but even firms that appear to have substantial financial slack invest more when cashflow increases (after controlling for investment opportunities). And, ironically, firms that perform the best and seem the most conservative in their investment decisions—i.e., firms that have high profits but generally low investment rates—are the ones that show the clearest evidence of free cashflow problems. In total, we believe the results provide significant new evidence on the role of cashflow in investment decisions.

Appendix

Section 5 presents IV-based estimates of the investment regression using past stock returns as an instrument for Q. This appendix reports a few robustness checks using alternative instruments.

In principle, using past returns as an instrument could go awry in two ways. First, Erickson and Whited (2012) suggest that returns might be correlated with measurement error in M/B—though, again, one of the reasons we use past returns, rather than past M/B, is specifically because they seem less likely to be correlated with measurement error in M/B_t. Second, returns might enter the investment regression directly, not just through their correlation with Q. For example, lagged returns should be correlated with lagged Q and, if investment takes time, both current and lagged Q might explain investment.

Table A1 addresses both concerns with four robustness tests. The first two tests (Models 1 and 2 in the table) drop returns completely from the first-stage regressions and instead use lagged cashflow (Model 1) or current squared cashflow (Model 2) as instruments, i.e., the first-stage regression to get M/B_{t-1}* includes CF_t, CF_{t-1}, … CF_{t-4} in Model 1 and CF_t, CF_t^2, and CF_{t-1} in Model 2. (As discussed in Section 5, CF_t^2 is a valid instrument under the assumptions of EW's (2000, 2012) higher-moment estimator but does not require the data to be IID.) The third test (Model 3) uses the same instruments as Table 6 (CF_t, CF_{t-1}, and four lags of stock returns) but adds M/B_{t-2} to the regression to address the possibility that lagged Q might enter the regression (we instrument for both M/B_{t-1} and M/B_{t-2}). The fourth robustness test (Model 4) drops the most recent three years of returns from the set of instruments, the logic being that more distant returns are the least likely to correlate with measurement error in M/B (the first-stage regression includes CF_t, CF_{t-1}, and lags 4 and 5 of returns). All four tests confirm that cashflow remains significant after controlling for measurement error in M/B. Investment-cashflow sensitivities in Model 3 are very similar to those reported in Section 5, while investment-cashflow sensitivities in Models 1, 2, and 4 are substantially higher.

The conclusions from Table A1 carry over to the constrained and unconstrained subsamples (not tabulated): cashflow effects in our four robustness checks are large, significant, and often greater than those reported in Section 5 (and never significantly lower). Details are available on request.

Table A1
Robustness checks: IV regressions, 1972–2009
This table reports average slopes, R^2s, and sample sizes from annual cross-sectional regressions. M/B* is the fitted value when M/B is regressed on various lags of cashflow and stock returns (instruments for Q): Model 1 uses CF_t, CF_{t-1}, …, CF_{t-4} as instruments; Model 2 uses CF_t, CF_t^2, and CF_{t-1} as instruments; Model 3 uses CF_t, CF_{t-1}, and four lags of stock returns as instruments (for both M/B_{t-1} and M/B_{t-2}); and Model 4 uses CF_t, CF_{t-1}, $Return_{t-4}$, and $Return_{t-5}$ as instruments. t-statistics, reported below the slope estimates, are based on the time-series variability of the estimates, incorporating a Newey-West correction with three lags to account for possible autocorrelation in the estimates. The sample consists of all nonfinancial firms larger than the 10th percentile of NYSE firms, as measured by net assets at the beginning of the year, and with data available for all variables within each panel. Accounting data come from Compustat and returns come from CRSP. Variables are defined in Table 1.

	Dependent variable							
	dCash	dNWC	Capx1	Capx2	Capx3	dDebt2	Issues	Div
Model 1 (N = 1,528)								
CF_t	0.21	0.20	0.09	0.09	0.08	-0.44	-0.05	0.02
	9.49	5.94	5.54	1.78	1.53	-9.06	-1.19	3.00
CF_{t-1}	-0.08	0.14	0.14	0.25	0.31	0.38	-0.02	0.00
	-3.89	3.25	5.70	12.41	11.32	8.47	-0.54	0.05
M/B_{t-1}*	0.00	-0.03	0.02	0.03	0.03	0.03	0.00	0.01
	0.26	-3.93	3.22	3.87	3.81	2.49	-0.12	3.62
R^2	0.053	0.055	0.164	0.154	0.130	0.052	0.052	0.151
Model 2 (N = 1,685)								
CF_t	0.20	0.24	0.09	0.15	0.12	-0.33	-0.08	0.05
	9.61	10.53	7.43	10.60	4.07	-14.68	-2.69	6.51
CF_{t-1}	-0.12	0.26	0.14	0.29	0.34	0.60	-0.08	0.04
	-3.71	3.08	4.96	10.04	9.84	10.39	-4.78	3.89
M/B_{t-1}*	0.01	-0.06	0.02	0.01	0.02	-0.03	0.02	0.00
	2.42	-4.33	3.89	1.63	3.58	-4.26	6.63	-0.08
R^2	0.061	0.085	0.160	0.146	0.130	0.060	0.059	0.148
Model 3 (N = 1,464)								
CF_t	0.19	0.04	0.05	0.01	-0.05	-0.56	-0.17	0.07
	10.70	1.37	2.10	0.11	-0.75	-14.55	-3.13	8.36
CF_{t-1}	-0.10	-0.02	0.09	0.12	0.12	0.28	-0.16	0.07
	-5.13	-0.36	2.36	2.43	2.26	4.73	-4.25	6.83
M/B_{t-1}*	0.00	0.04	0.03	0.06	0.09	0.08	0.05	-0.01
	1.29	4.80	5.99	8.61	8.95	4.93	7.03	-2.40
M/B_{t-2}*	0.00	-0.01	0.00	-0.01	-0.01	-0.01	-0.01	0.00
	-0.25	-4.97	-0.09	-1.04	-0.75	-2.14	-2.17	0.09
R^2	0.057	0.072	0.189	0.180	0.156	0.075	0.071	0.204
Model 4 (N = 1,396)								
CF_t	0.17	0.10	0.09	0.10	0.06	-0.47	-0.13	0.07
	7.87	3.02	2.21	1.87	0.67	-10.17	-1.99	5.92
CF_{t-1}	-0.14	0.03	0.15	0.23	0.27	0.39	-0.13	0.07
	-8.33	0.71	4.07	4.64	4.74	6.86	-2.57	5.76
M/B_{t-1}*	0.01	0.01	0.01	0.02	0.03	0.02	0.03	-0.01
	3.17	1.07	1.07	1.29	1.34	1.55	1.98	-1.63
R^2	0.053	0.053	0.172	0.158	0.136	0.056	0.050	0.182

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