Revisiting Investment–Cash Flow Sensitivity

Naveen D. Daniel[a]
Lalitha Naveen[b]
Jingbo Yu[c]

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Abstract

Much of the literature on investment-cash flow sensitivity examines only manufacturing firms, uses capital expenditure as a measure of investment, and uses operating cash flow as a measure of internal funds. Over the last several decades, due to outsourcing, the importance of manufacturing firms in the U.S. economy and the importance of capital expenditure as the primary type of investment have declined. The introduction of the Nasdaq exchange allowed smaller, less-profitable, and more human-capital intensive firms to become public, lowering the importance of operating cash flow as the primary source of internal funds. To take into account these trends, we introduce three innovations to the prior literature. (i) We include non-manufacturing firms. (ii) We broaden the definition of investment to include R&D and SG&A (which are both investments in human capital required at the innovation and marketing stages of the product life cycle), cash investment in subsidiaries and joint ventures, and the cash used to finance acquisitions. (iii) We broaden the definition of internal funds to include cash holding available at the beginning of the year. Empirically, non-manufacturing firms are more capital intensive than non-manufacturing firms, and hence excluding these firms could understate the true investment-cash flow sensitivity. Capital expenditure understates true investment, and hence excluding other forms of investment could also understate the true investment-cash flow sensitivity. Finally, operating cash flow understates true internal funds, and excluding cash holdings could overstate the true investment-cash flow sensitivity. The net effect of our proposed changes on the sensitivity is, therefore, an empirical issue. Overall, we document that investment is highly sensitive to cash flow—it is 570% higher than what we estimate using the definitions in prior literature—and this higher sensitivity is primarily caused by broadening the definition of investment. Further, though the sensitivity declines over time, the decline is modest and, importantly, the sensitivity is still economically and statistically significant in recent years. Overall, our contribution is to document the importance of using more comprehensive measure of investment and available cash that incorporate the macro trends in the economy. Our study has implications for tests of the agency theory and quiet life hypothesis relating to investment.

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[a] *LeBow College of Business, Drexel University, Philadelphia, PA, 19104, USA; nav@drexel.edu*
[b] *Fox School of Business, Temple University, Philadelphia, PA, 19122, USA; lnaveen@temple.edu*
[c] *Fox School of Business, Temple University, Philadelphia, PA, 19122, USA; tuc70544@temple.edu*

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Revisiting Investment–Cash Flow Sensitivity

A large body of literature, starting with Fazzari, Hubbard, and Petersen (1988), documents that firms' investment is sensitive to the availability of their internal funds (termed "investment-cash flow sensitivity"). Recent studies (such as Chen and Chen, 2012) document that this sensitivity has declined over time and virtually disappeared in recent years.[1] Much of this literature examines only manufacturing firms, uses capital expenditure as a measure of investment, and uses operating cash flow as a measure of firms' internal funds. Over the last several decades, however, the importance of manufacturing firms in the U.S. economy has steadily declined (Panel A of Figure 1). Moreover, for manufacturing as well as non-manufacturing firms, since the early 80's, both capital expenditure and operating cash flow have declined (Panels B and C of Figure 1). These trends are partly due to changing characteristics of listed firms (such as outsourcing) and partly due to changing composition of listed firms (due to the introduction of the Nasdaq exchange in 1981, which spurred a huge growth of firms that rely on human capital rather than physical capital).

To take into account the above trends, we introduce three innovations to the investment-cash flow sensitivity literature. (i) We consider a more inclusive sample that includes non-manufacturing firms (but excludes finance and utility firms). (ii) We broaden the definition of investment to include any form of long-term investment that firms undertake to capitalize on growth opportunities. A long-term investment is one where the benefits accrue over multiple years. R&D expenditures, for example, have benefits in the long-term; indeed the finance and

[1] Brown and Peterson (2009) and Allayannis and Mazumdar (2004) also document a declining trend in investment-cash flow sensitivity.

accounting literature assumes that managers that are more myopic invest less in R&D. Similarly, SG&A includes expenses incurred on marketing and advertising (that focus on brand building), information technology, exploration for extractive industries, as well as employee training, all of which are investments that pay off over multiple future periods.[2] In addition, firms invest in joint ventures and acquisitions. Thus our measure of investment in long-term assets—we term this *Total Investment*—includes capital expenditure, R&D, SG&A, cash investment in joint ventures/subsidiaries, and the cash used to acquire other firms. (iii) We broaden the definition of internal funds to include any form of funds that is not subject to information asymmetry and that is readily available to the firm to undertake investment. Specifically, we include cash holding at the beginning of the year. We call this measure "*Total Funds.*" The inclusion of cash is based on theory as well as anecdotal evidence. For instance, in a June 2016 survey of CFOs conducted by Duke, 17% state that they "save cash as dry powder for future investment opportunities." Conditional on deploying cash reserves in the next 12 months, 54% of CEOs say that they will use it for "capital spending or investment," 30% say they will use it for "acquisitions," 18% for "marketing and advertising" and 14% for "research and development." In Section I, we provide a more detailed justification for broadening the sample and the definitions of investment and cash flows.

The goal of this paper is to examine the impact of these three innovations on the average investment-cash flow sensitivity as well as the time trend in investment-cash flow sensitivity. This

[2] Corrado, Hulten, and Sichel (2005) argue that we should treat such expenditures as firms' capital investments as they are intended to increase future rather than current consumption. They state (pg. 13) that "there is no basis…for treating investments in intangible capital differently from investments in plant and equipment, or tangible capital." Also see Lev and Radhakrishnan (2005) and Eisfeldt and Papanikolaou (2013) for a discussion of why SG&A is a good proxy for investment in organizational capital.

is important because recent literature has cast doubt on whether investments are sensitive to internal funds and whether this sensitivity has declined and disappeared in recent years.

Our hypotheses with respect to the three innovations are as follows. With respect to our first change—broadening the sample to include non-manufacturing firms—it is not clear ex-ante whether non-manufacturing firms will have a higher or lower investment cash flow sensitivity relative to manufacturing firms. However, empirically, non-manufacturing firms have higher ratios of capital expenditure to assets than manufacturing firms. Thus, we expect higher sensitivity of investment to cash flows for non-manufacturing firms relative to manufacturing firms. With regard to the second change—broadening the definition of investment—we expect a higher investment-cash flow sensitivity relative to prior literature. This is because capital expenditure understates the firm's true investment and broadening the definition of investment will—holding internal funds constant—lead to an increase in the investment-cash flow sensitivity. Finally, with regard to the third change—broadening the definition of internal funds—we expect a lower investment-cash flow sensitivity relative to prior literature. This is because operating cash flow understates the firm's true internal funds, and broadening the definition of internal funds (holding investment constant) will lead to a decrease in investment-cash flow sensitivity relative to prior literature. The net impact of all three innovations on the investment-cash flow sensitivity—both on the average and the trend—is an empirical issue.

We present two pieces of evidence that validates the importance of our innovations. First, we find that these innovations provide significantly more explanatory power for investment. Specifically, we find that when we estimate the investment-cash flow sensitivity using our definitions, the R^2 for the regression is 63% compared to the R^2 of 39% using definitions based on

prior literature. Second, broadening the definition of investment results in an almost 200% increase in the sensitivity of investment to growth opportunities.

With respect to our key results on investment-cash flow sensitivity, we find a different picture of the overall average sensitivity and its time trend than presented by the current literature. In terms of the overall average, we find that sensitivity of investment to cash flow is 570% higher than that obtained based on definitions in prior literature. Non-manufacturing firms have 60% higher investment-cash flow sensitivity relative to their manufacturing counterparts. This implies that not including non-manufacturing firms understates the true investment-cash flow sensitivity. Consistent with our expectation, broadening the definition of investment results in an increase (about 700%) in sensitivity, while broadening the definition of internal funds results in a decrease (about 40%) in sensitivity.

In terms of the time trend in investment-cash flow sensitivity, we find a decline in sensitivity using our measures of investment and internal funds, though the decline is more modest relative to that documented using the definitions in prior literature. Importantly, there is no disappearance in sensitivity in recent years as documented by prior literature: the sensitivity still remains economically and statistically significant in recent periods.

Our results are robust to several alternative definitions of investment and internal funds. We consider the following variations of the investments measure: (i) include the deal value of M&A in investments (rather than just the cash portion), and (ii) include the post-tax values (instead of pre-tax values) of R&D and SG&A in investments, and (iii) we exclude SG&A from investments. We consider the following variations of the internal funds measure: (i) we include the value of equity-based compensation given to employees in our measure of internal funds, (ii)

we include the equity portion of the M&A in stock-financed deals as part of internal funds. The idea is that information asymmetry problems are less of an issue in equity consideration offered to employees and to shareholders of target companies. We provide more background for these tests in Section VI.A.

Overall, our contribution is to document that it is important to (i) consider a more comprehensive measure of investment than simply capital expenditure given macro trends such as greater outsourcing and greater investment in specialized human capital and (ii) consider a more comprehensive proxy for agency problem than simply free cash flow. Our findings have implications for other streams of literature that use capital expenditure as a measure of investment (for example, in studies of whether firms overinvest or not, as in Coles, Daniel, and Naveen, 2014). Our findings also have implications for the literature that uses free cash flow as a measure of agency problem, where free cash flow is typically defined as *Operating CF* minus *Capex*. Our analysis suggests that we should rethink the definition of free cash flow since *Operating CF* and *Capex* underestimate the true cash available and the true investment. In the next section, we explain the logic underlying our three proposed innovations to the investment cash flow literature. We also provide several examples that illustrate our point.

I. Theoretical and Anecdotal Evidence Supporting Our Innovations

We propose three changes to the current investment-cash flow sensitivity literature: (i) expand the sample to include non-manufacturing firms, (ii) broaden the definition of investment, and (iii) broaden the definition of cash flow. We develop our reasoning below.

A. Expand to Include Non-Manufacturing Firms

With a few exceptions, most papers in this literature examine only manufacturing firms.[3] In keeping with the literature, we define manufacturing firms as those with a two-digit SIC code between 20 and 39 (both inclusive). We drop financials (two-digit SIC codes between 60 and 69) and utilities (two-digit SIC code 49). All other firms are non-manufacturing.

There are at least two reasons to consider non-manufacturing firms. First, there is growing importance of non-manufacturing firms in the economy, and these firms now comprise a significant part of the economy. At the start of our sample period (1967), non-manufacturing firms account for 28% of the total sample. By 2013, the corresponding number is 49%.[4] On average, during our sample period, 42% of the firms are in the non-manufacturing sector. Second, the definition of manufacturing firms excludes firms in capital-intensive industries. We provide examples of several such industries along with the SIC code and one prominent firm in the industry that readers could relate to.

Industry	2-digit SIC	Example
Metal Mining	10	Freeport-McMoRan
Coal Mining	12	Cliffs Natural Resources
Oil and Gas Extraction	13	Halliburton
Residential Construction	15	Toll Brothers
Non-residential Construction	16	Fluor
Rail Transportation	40	CSX
Couriers	42	UPS
Shipping	44	Dryships
Air Transportation	45	Delta Airlines
Pipelines	46	Valero Energy Partners
Communications	48	AT&T
Hardware	52	Home Depot
General Merchandise	54	Walmart

[3] Examples of paper that consider only manufacturing firms include Fazzari et al. (1988), Almeida, Campello, and Weisbach (2004), Allayannis and Mozumdar (2004), and Brown, Hubbard, and Petersen (2009).

[4] In terms of assets and market cap, the numbers are similar: non-manufacturing firms account for 30% and 34% of the sample in terms of assets and market cap in 1967, while by the 2013 the corresponding numbers are 51% and 49%.

Auto Dealers	55	Carmax
Apparel Stores	56	Nordstrom
Home Furnishings	67	Williams Sonoma
Restaurants	58	Chipotle Mexican Group
Hotels	70	Marriot
Equipment Rentals	73	United Rental
Car Rentals	75	Hertz
Cinema Theaters	78	AMC Entertainment
Amusement Parks	79	Six Flags

In fact, during our sample period, 17 out of the top 18 industries in terms of the ratio of *Capex* to lagged assets are in the non-manufacturing sector. The sole exception is petroleum refining (SIC 29). The average value of *Capex* to lagged assets for manufacturing firms is lower than that for non-manufacturing firms (6.6% versus 9.5%). Thus, any study on aggregate investment patterns would be incomplete if we ignore the subsample of non-manufacturing firms.

B. Broaden the Definition of Investment

We view investment as any expenditure made by the firm that is long term in nature; that is, it reaps benefits over multiple years. Corrado and Hulten (2010) conclude that a company's expenditures on product design, marketing and customer support, and human capital and organizational development are to be considered as capital investments. Such expenses show up in both R&D and SG&A. We, therefore, propose that the definition of total investment (*Total Investment*) should include, in addition to *Capex*, R&D expenditure ('*R&D*') and selling and general administrative expenditure ('*SG&A*'). Below, we provide support for our arguments using prior literature as well as excerpts from corporate statements.

There are three different ways we motivate the inclusion of R&D and SG&A as part of the firm's investment. The first way is to view human capital as a factor of production. Lev and

Radhakrishnan (2005) and Eisfeldt and Papanikolaou (2013) argue that investment in human capital has become an increasingly important factor of production. For some firms, investment in human capital is the only factor of production. For example, ARM Holdings during its analyst day in 2015 states: "Now, obviously, in ARM here, we don't run factories. Our investment is in people." *Capex* captures investment in physical capital, but investments in human capital are likely to show up in the form of *R&D* and *SG&A* rather than *Capex*.[5]

A second way to motivate the inclusion of R&D and SG&A in investments is to consider a firm's investments across the entire product life cycle. Firms invest in *R&D* to develop the product, then in *Capex* to produce it, and finally in *SG&A* to market it. As such, all three have to be considered as part of the firm's long-term investment.

A third way to think about inclusion of *R&D* and *SG&A* is to view it as inclusion of investments made through the income statement and not just through the balance sheet. For example, Aerovironment in its earnings call, states "investments to develop and pursue new growth opportunities are primarily on the income statement in the form of R&D and SG&A rather than on the balance sheet." While the current literature considers *Capex*—a balance sheet investment —it ignores income statement investments such as *R&D* and *SG&A*.

Consistent with our reasoning above, starting in 2013, the U.S. Bureau of Economic Analysis, recognizes R&D as an investment, rather than as an operating expense. Firms too, clearly consider *R&D* as an investment. For example, the CEO of LinkedIn, in the April 2015

[5] Microsoft Corp., which spends up to 13% of its revenue on *R&D* and 20% of its revenue on SG&A notes in its 2014 annual report that "research and development expenses include payroll, employee benefits, stock-based compensation expense, and other headcount-related expenses associated with product development,..." and "sales and marketing expenses include payroll, employee benefits, stock-based compensation expense, and other headcount-related expenses associated with sales and marketing personnel..." LinkedIn, in its 2014 annual report, notes that "consistent with our investment philosophy for 2015, we expect general and administrative expenses to increase..."

earnings call, states, "To take full advantage of these market opportunities…we are accelerating R&D head count hired to work on our monetized products." Similarly, Yandex (the Russian equivalent of Google), in its Apr 2015 earnings call, notes "(p)ersonnel costs still remain our largest cost item. Talented personnel is essential for the company to maintain its leadership position in the market…." Such costs of highly-skilled personnel are likely to show up under *R&D*. Consistent with the argument that investment in *R&D* is vital for these firms, the *R&D*/Sales ratio for LinkedIn is 24% while that for Yandex is 17% (as of 2014). In comparison, this ratio is 0% for over almost two-thirds of publicly listed firms. Equity analysts also consider a broader definition of investment. For example, an analyst for Westport Innovations comments: "Investment, as defined by R&D expense and CapEx, has grown at a 43% CAGR since 2009."[6] SG&A includes many expenses that, similar to R&D, generate income not just in the current period, but also in future periods. Lev and Radhakrishnan (2005) state that SG&A "includes most of the expenditures that generate organization capital, such as IT outlays, employee training costs, brand enhancement activities, payment to systems and strategy consultants, and the cost of setting up and maintaining Internet-based supply and distribution channels. Clearly, these expenses are long-term investments made by the firm with payoffs occurring over multiple future years.[7]

[6] Some prior studies have considered the sensitivity of R&D to cash flow (Brown and Petersen, 2009; Fazzari, Brown, and Petersen, 2009; Chen and Chen, 2012). These studies, however, do not consider other investments that firms make (such as SG&A and investment in subsidiaries and joint ventures) and other sources of internal funds (such as cash holding at the beginning of the year). Further, the first study includes only high-tech firms, while the second considers only manufacturing firms.

[7] Lev and Radhakrishnan provide the example of PepsiCo, which had SGA expenses of $7.9, $8.1, and $8.5 billion in 2000, 2001, and 2002, respectively. These included advertising expenses, sales incentives, expenditures to support global and domestic affiliates, and expenditures on logistics of distribution systems. SG&A also includes period expenses that are not "investments" as defined here. Unfortunately, we cannot separate out period expenses from those that are more long-term in nature. As a robustness, we exclude SG&A from the investment measure considered and are results are qualitatively similar.

Supporting the idea that firms view *SG&A* as an important investment, the CFO of Twitter, mentioned at the firm's 2014 annual meeting that the firm had "invested a significant amount of capital…$1.2 billion…across our SG&A expenses to ensure that we are investing in the business to capture long-term opportunity." To put this investment in perspective, the firm's revenue for 2014 was $1.4 billion; in other words, *SG&A* constituted 86% of the sales. These firms have great products but cannot grow without substantial investment in *SG&A* in order to enter new verticals and new geographies.[8]

In addition to *R&D*, *Capex*, and *SG&A*, we consider two investments that flow through the balance sheet just like *Capex*: (i) *SubJV*, which is the cash investment in subsidiaries and joint ventures and (ii) *M&A*, which is the cash used to finance mergers and acquisitions. These are indirect investments that do not show up as *Capex*/*R&D*/*SG&A* but nevertheless help firms capitalize on their growth opportunities.

The choice between direct investment (*R&D*, *Capex*, and *SG&A*) and indirect investment (*SubJV* and *M&A*) may depend on the regulatory environment. For firms that want to expand and grow in countries that restrict foreign ownership, the only way to grow may be through subsidiaries and joint ventures (*SubJV*). For example, in a 2015 conference WhiteWave Foods comments: "In line with our vision of expanding globally, we formed a 51%-49% joint venture ….with Mengniu Dairy, the largest dairy company in China."

Firms use M&A to buy hard assets, technology, or even add personnel quickly (termed

[8] Similarly, Fleetmatics Group, on its analyst day in May 2015 comments: "…we're not afraid to invest in sales and marketing…we are building a sales force for our WORK business, we continue to expand our North American SMB and our enterprise businesses, and we have some new geographies that we continue to grow." Gogo, on its analyst day in Jun 2015, comments on how its SG&A investment is supporting its growth: "we went from North America to global. This required additional infrastructure…"

"Acquihires" in Wall Street). For example, ARM Holdings during its analyst day in Aug 2014 commented: "our Physical IP business came from, in fact, the largest acquisition that we've done."

We focus on the cash used to finance acquisitions because the equity used to finance acquisitions is subject to information asymmetry problems. Thus, for our base case, we only consider the cash component of M&A.[9] We consider the total deal value of M&A as part of the investment in our robustness checks.

Overall, indirect investment can significantly impact growth. Harmon International Industries during its investor day presentation in Aug 2015 noted: "About $450 million of our revenue growth came from organic growth and acquisitions contribute about $350 million."[10]

B.1. Why is it Important to Add Up the Individual Components of Investment?

The proportion of the three types of internal investment (*R&D*, *Capex*, and *SG&A*) varies depending on the product life cycle. For example, an executive for 8x8 Inc. speaking at an industry conference states: "as a company, we've not spent a lot on advertising…we're now finally starting to put some focused effort on marketing, starting to put some focused effort on sales. But we didn't want to do it until we make sure that the technology is rock-solid…Now is the time to turn on the gas."[11] Thus, while a firm is in innovation mode, its *R&D* is likely to dominate its investment in *Capex* and *SG&A*. Therefore, while *Capex* understates true investment for such a firm, adding up

[9] Cvent in its earnings call in the 1st calendar quarter of 2016 states that they had: "cash equivalents and short-term investment of $145.5 million, a decrease from $158.6 million at the end of the third quarter of 2015, reflecting the impact of approximately $11.5 million in cash paid to acquire Alliance Tech."

[10] WhiteWave Foods notes: "In 2014 total net sales increased over 35%, which included a robust 12% organic top-line growth."

[11] Similarly, the CEO of startup Tegile Systems notes: "I would say 75% of the spend now is focused on the selling and marketing."

all the investments gives true picture of actual investments.

The proportion of each of these investments could also vary by industry, and even within the same industry, could vary by firm. For example, within the semiconductor chip industry, there are three types of firms: (i) firms like ARM Holdings that are fabless chip stocks, and focus on only the design of the chips and not the fabrication; (ii) firms like Taiwan Semi that are foundries, and focus on only the fabrication but not the design; and (iii) firms like Intel that are integrated chip manufacturers, and engage in both design and fabrication. The capital investments of these firms are vastly different even though they belong to the same industry (Capex/Assets equals 1.1%, 19.3%, and 11.0% for 2014), as is their R&D/Assets (12.2%, 3.8%, and 12.6%) and SG&A/Assets (12.2%, 1.7%, and 8.9%). If we add up the investments, they are comparable in magnitude (25.5%, 24.8%, and 32.4%). This example reinforces the importance of summing up the investments rather than looking at the individual components.

The choice between growth through investments in R&D/Capex/SG&A versus growth through acquisitions may also depend on the type of firm, industry, and macroeconomic conditions. Some firms explicitly include M&A in their internal models while other firms do not. For example, Tesco Corp in its 2014 annual report states: "we proposed a total of $650 million in strategic capital investments during the five-year period through 2019. This included a budget of $250 million in capital expenditures to fuel organic growth, $250 million in acquisitions and the remainder in enhancing total shareholder return." On the other hand, United Natural Foods, in its June 2012 conference call, states "we don't have M&A in our internal models that help us build the scale, but certainly if those opportunities were there they would help us get there sooner." Market participants understand this substitution. For example, hedge fund manager Chanos notes:

"(Hewlett Packard has) done $36 billion in acquisitions…those are maintenance capital expenditures or maintenance R&D hidden as acquisitions."[12]

To the extent that the individual components of investments are substitutes, it is important to add up the investment instead of examining each separately. Empirically, we find that the correlation between the four components of investments that we introduce and *Capex* is negative.

C. Broaden the Definition of Internal Funds

We propose that the definition of internal funds ('*Internal Funds*') should include, in addition to operating cash flow ('*Operating CF*'), the opening balance of cash holding ('*Opening Cash*'). The premise behind the use of *Operating CF* is that external capital is costly because of information asymmetry (Fazzari, Hubbard, and Petersen (1988)). This, however, ignores beginning-of-year cash holdings, an important source of internally available funds that has no information asymmetry problems.[13] Firms that face temporary cash flow shortfalls could still capitalize on their growth opportunities if they have built up a sufficient cash buffer by either saving from cash flows (Almeido, Campello, and Weisbach, 2004) or from having raised debt or equity financing in prior years. Indeed, firms raise money at the IPO, which will increase cash reserves, for the very purpose of taking advantage of growth opportunities. Sevilir, Shivdasani, and Ugur (2010) find that newly public firms use their IPO proceeds to make acquisitions, and that acquisitions are as important for their growth as *R&D* and *Capex*.

Supporting the idea that firms view cash balance as an important source of capital for

[12] http://blogs.barrons.com/techtraderdaily/2012/07/18/hp-purchased-rd-makes-it-a-short-says-chanos/

[13] It is true that all of the cash balances are not available for investment because firms need part of the cash for normal business operations. We could have used a cross-sectional regression model to estimate the normal cash holdings and use the residual as proxy for excess cash available for investment. The estimated excess cash depends on the model and we wanted to avoid such subjectivity.

investment, FireEye, Inc. mentions in its 2014 annual report "our cash and cash equivalents of $146.4 million were held for working capital, capital expenditures, investment in technology and business acquisition purposes." National Oilwell Varco in its earnings call in Aug 2015 states that they will conserve their cash for acquisitions: "we were going to dial back the rate of share repurchases in view of M&A opportunities." Similarly, ARM Holdings, in its 2016 first quarter earnings call notes: "we're committed to having a net cash balance over the medium term and this reflects our commitment to maintaining the investment that's necessary for our roadmap…Given the expected rates of cash generation and the pipeline of opportunities that we can see today, I wouldn't expect us to resort to external financing market for any acquisitions in the near future."

Chen and Chen (2006), as a robustness check, control for cash in the investment regressions and then interpret the coefficient on operating cash flow as the investment-cash flow sensitivity. The discussion above suggests that this lead to mis-estimation of investment-cash flow sensitivity because firms view their total available cash for investments as the sum of cash and cash from operations. Thus to obtain the total available cash as perceived by firms, we need to add up these two sources rather than control for them separately in regressions.

II. Data

We start with all firms on *Compustat*. Our sample period is from 1967–2013. As with prior literature, we (i) include only firms incorporated in the United States that trade on either the NYSE, AMEX, or NASDAQ, (ii) exclude finance firms and utilities, (iii) exclude firms with book assets or sales less than one million dollars, and (iv) include only firms with data on all the variables needed to estimate *Total Investment*, *Total Funds*, and q (the proxy for growth

opportunities). *q* is the ratio of market value of assets to the book value of assets. We winsorize all variables at the 1st and 99th percentiles at the yearly level to minimize the influence of outliers. We define our main variables below. We provide the corresponding *Compustat* pneumonics in the Appendix.

A. Investment

Our investment measure, *Total Investment*, is the sum of *Capex*, *R&D*, *SG&A*, *SubJV*, and *M&A*. As noted earlier, *Capex* is the firm's capital expenditure, *R&D* is the research and development expenditure, *SG&A* is the selling, general, and administrative expense, *SubJV* is the cash investment in joint ventures and subsidiaries, and *M&A* is the cash used in acquisition.[14] We obtain *SubJV* and *M&A* from the cash flow statement. As in Coles, Daniel, and Naveen (2006), we treat missing *Capex* and missing *R&D* as zero. As in Eisfeldt and Papanikolaou (2013), we treat missing *SG&A* as zero. Finally, if firms do not have any cash investment in subsidiaries or do not use cash in M&A, these measures may have missing values, and as such, we treat missing values of *SubJV* and *M&A* as zero.

B. Internal Funds

In keeping with the literature, we define *Operating CF* as income before extraordinary items plus depreciation and amortization. To examine the impact of broadening the definition of internal funds on prior literature, we define a measure termed, *Funds for Capex*, which equals *Operating CF* + *Opening Cash*. *Opening Cash* is the beginning-of-the-year value of cash and short-term investments and is taken from the balance sheet. Ideally, we would like to use excess

[14] To the extent that the *Compustat* item that we use to measure *SubJV* ("IVCH"), includes "Sale of property held for sale when included as an investment on the Balance Sheet" we estimate *SubJV* with error.

cash holdings, which is cash holdings less the cash holdings necessary to operate the business. This adjustment requires use of an empirical model and its associated problems. Thus, for simplicity, we use *Opening Cash*. *Funds for Capex*, as the phrase indicates, is the funds available to undertake investments in *Capex*.[15]

When we consider *Total Investment* as our measure of investment, we modify the cash flow measure by adding *R&D* × (1–T) + *SG&A* × (1–T) to *Operating CF*, where T is the effective tax rate in the prior fiscal year and is constrained to be between 0 and 1. This is because *Total Investment* includes *R&D* and *SG&A* and these are already expensed in the income statement before *Operating CF* is computed. We term this *Available CF*, which is the cash flow available for making *Total Investment*. Studies that consider R&D-cash flow sensitivity do a similar adjustment to cash flow (see Himmelberg and Petersen, 1994; Brown et al., 2009). Finally, we add *Opening Cash* to *Available CF* to arrive at *Total Funds*, which is the total funds available to make *Total Investment*.

Does adding back *R&D* and *SG&A* to *Operating CF* induce a mechanical relation between investment and internal funds? The short answer is "No." Consider a simple firm with no depreciation (because it has no *Capex*) and Net Income = \$60. Thus *Operating CF* = \$60. Assume tax rate of 40%, which implies its Earnings before Tax = \$100. Assume its combined *R&D* and *SG&A* is \$50. Thus, the firm's Earnings before *R&D*, *SG&A*, and Tax = \$100 + \$50 = \$150. This is the pre-tax funds available for the firm but it has to pay 40% tax on this income, therefore, the after-tax availability of funds = 140 × (1–40%) = \$84. This is what we term as *Available CF*. Several firms can all have the same \$84 in *Available CF*. If the growth opportunities are different

[15] As a robustness, we compute excess cash for each firm-year as the difference between the actual and the predicted (from a regression) level of cash. We find that our results are qualitatively similar when we use this definition of cash.

for these firms, then the firm with greater investment opportunities may need to invest $150 in *R&D* and *SG&A* while the firm with lower investment opportunities may need to invest only $50 (as in above example). Thus, there is no mechanical relation between investment and internal funds. Only when the internal funds is a binding constraint will the investment be a function of *Available CF*.

For robustness, we ignore this adjustment and compute *Total Funds = Operating CF + Opening Cash*. Our main results are robust to this measure.

III. Empirical Evidence Supporting our Innovations

In Section I, we provided the economic rationale for broadening the sample and the measures of investment and internal funds. We now provide data to assess whether the changes we propose are significant in empirical terms. We first examine, for the overall sample, the relative importance of manufacturing firms in the economy, the relative importance of *Capex* versus other types of investment, and the relative importance of *Operating CF* versus *Opening Cash*. We then examine how this importance has changed over time.

A. Overall Averages

Table I provides the summary statistics. Our sample consists of 108,286 firm-year observations. We find that 42% of the firms are from the non-manufacturing sector. Thus, by excluding non-manufacturing firms, we are excluding a big part of the economy.

Consistent with prior literature, we scale all investment cash flow, and funds measures by lagged book value of assets. As can be seen from Table I, the average values of *Capex*, *R&D*, and *SG&A* are 7.9%, 4.2%, and 28.2% of assets respectively. The average cash investment in joint ventures and subsidiaries (*SubJV*) is 2.7% and cash used in M&A (*M&A*) is 2.6% of assets. *Capex*

is still the largest in terms of magnitude after *SG&A*, but the average values of *R&D*, *SubJV*, and *M&A* are economically significant. Further, even if we exclude *SG&A*, the other three investment measures account for 9.5% of assets, which is still greater than *Capex* (= 7.9%). Thus, ignoring these additional components severely underestimates the true investment.

This problem of underestimation is more serious because the correlation between *Capex* and the various investment types is not positive (see Panel B of Table I). In fact, *Capex* has a significant negative correlation with all the other investment types (correlations range from –0.01 to –0.13). Overall, *Capex* has only a 21% correlation with *Total Investment.* If anything, it appears that *SG&A* and *R&D* are better proxies for total investment (relative to *Capex*) as they have higher correlations with *Total Investment* (76% and 27%).

In terms of internal funds, the typical measure of cash flow used in the literature, *Operating CF*, amounts to 8.2% of assets. *Opening Cash* accounts for 15.6% of assets, almost twice the level of *Operating CF*. In terms of correlation, we find that the correlation between *Operating CF* and *Opening Cash* is very low (= –0.01), though it is statistically significant. *Operating CF* is correlated positively with *Total Funds* (correlation = 31%). *Opening Cash* appears to be a better proxy for internal funds (relative to *Operating CF*) as it has a higher correlation with *Total Funds* (correlation = 65% vs. 31%).

Overall, the numbers presented here suggest that using the broader definitions of investment and internal funds is important, not just theoretically and anecdotally, but empirically too.

B. Time Series

We present the data on the time-series graphically for the convenience of the reader. The

data represent means from rolling 5-year averages. Thus, for the year 1971, the number represents the average over the 5-year period 1967–1971. We use rolling averages rather than simple annual means to smooth out any fluctuations in the data; also, in the regressions that follow, we use rolling 5-year periods.

B. 1. Declining Importance of Manufacturing Firms

Panel A of Figure 1 shows the time-series pattern in the proportion of manufacturing firms in our sample. We find that the proportion of manufacturing firms falls over time from 70% to 52%. By the early 2000s, manufacturing firms constitute only half the economy. In untabulated results, we find that this trend remains when we examine the proportion of manufacturing firms in terms of their market capitalization also.

B.2. Declining Importance of Capital Expenditure

We next examine how the importance of the various types of investment has changed over time. All the investment measures are scaled by lagged assets. From Panel B of Figure 1, we observe that *Capex* has decreased over time, from a peak of 10.8% in 1982 to 5.1% in 2013. Figure 2 graphs the time series patterns for various types of investment. Panel A shows the pattern for *R&D*, *SubJV*, and *M&A*, Panel B shows the pattern for *Capex* and the three components (*R&D*, *SubJV*, and *M&A*) combined, and Panel C shows the pattern for *SG&A*.

We find that *R&D*, *SubJV*, and *M&A* have all increased (Panel A). Taken together, these three components increased from 1.2% in 1971 to 12.7% in 2013 (Panel B). For the first 23 years (from 1971–1993), *Capex* is higher than *R&D*, *SubJV*, and *M&A* combined, but for the next 20 years (from 1994–2013), it is lower. Clearly, firms are substituting away from *Capex* into other forms of investment. Thus, the importance of *Capex* is declining, while the importance of other

types of investment is increasing.

Panel C shows that there is no particular trend in *SG&A*. It increased from about 27% to about 31% (in 1982) and came back to 24% by the end of the sample period. Thus, while *SG&A* is an economically important part of investment, its importance does not appear to have changed over time.[16]

Overall, we find that *Total Investment* increased from 38% to 55% at the peak of the internet bubble (year 2000) and then gradually declined to 43% (Panel D). Taken together with the decline in *Capex*, it is evident that the relative importance of *Capex* has declined over time. The ratio of *Capex* to *Total Investment* declines from 28% to 18% (Panel E).

B.3. Declining Importance of Operating Cash Flow

We next examine how the measures of internal funds have changed over time. All measures of internal funds are also scaled by lagged assets. Panel C of Figure 1 shows the time-series pattern in *Operating CF*. It is clear that *Operating CF* as a percentage of lagged assets has declined significantly over time, from 10.8% at the start of the sample to half the value (5.4%) at the end of the sample period. Panel A of Figure 3 shows that, in contrast, *Opening Cash* has increased over time from 8.4% to 21.2%. This trend is consistent with Bates, Kahle, and Stulz (2009). From 1985 onwards, *Opening Cash Holding* is higher than *Operating CF*.

Overall, *Total Funds* has increased steadily from about 35% to 50% (Panel B of Figure 3). Given the decline in *Operating CF* and the increase in *Total Funds*, it is not surprising that the relative importance of *Operating CF* as a proportion of internal funds has declined over time. The

[16] In part, this could be due to the lack of granularity in SG&A data. While we would like to isolate the long-term investment components of SG&A, the data do not accommodate this type of analysis. As mentioned earlier, our inferences remain unchanged if we exclude SG&A from the investment measure.

ratio of *Operating CF* to *Total Funds* falls from 58% to 39% (Panel C of Figure 3).

To sum up, the results in this section indicate that considering only manufacturing firms in the sample, using *Capex* as the only measure of investment, and using *Operating CF* as the only measure of internal funds could lead to misleading inferences. This is because manufacturing firms, *Capex*, and *Operating CF*, have declined in importance over time, while non-manufacturing firms, other types of investment such as *R&D*, *SG&A*, *SubJV*, and *M&A*, and other types of internal funds such as *Opening Cash* have gained importance over time.

C. Difference between Manufacturing and Non-Manufacturing Firms

We next investigate whether the types of investment or the sources of internal funds differ across manufacturing and non-manufacturing firms. Table II presents the average values of the components of *Total Investment* (top panel) and *Total Funds* (bottom panel).

We find that the ratio of *Capex* to lagged assets for manufacturing firms is lower than the corresponding number for non-manufacturing firms (6.6% vs. 9.5%), and the difference is statistically significant at the 1% level. While these results appear surprising at first glance, they highlight what we mention earlier: that non-manufacturing firms include firms that are capital intensive, such as firms in oil and gas exploration, in metal mining, coal mining etc.

The results indicate that even if we consider only *Capex* as the measure of investment, non-manufacturing firms should be included as they have significantly higher levels of *Capex*. Moreover, we find that both manufacturing and non-manufacturing firms are similar in terms of *Total Investment*; for both types of firms, investment is between 45% and 48% of their lagged assets. This underscores more strongly the need to include non-manufacturing firms to get the true picture of investment-cash flow sensitivity.

In terms of *R&D*, we find that the pattern is reversed: manufacturing firms have higher *R&D* relative to non-manufacturing firms (5.7% vs. 2.2%). *SG&A* is similar for both types of firms (27.1% vs 29.6%). *SubJV* is roughly the same for both types of firms (2.9% vs. 2.6%), although the difference is statistically significant. Finally, manufacturing firms have lower *M&A* relative to non-manufacturing firms (2.3% vs. 3.1%, difference significant at 1%).

In terms of the components of *Total Funds, we* find that *Operating CF* (scaled by lagged assets) is slightly lower for manufacturing firms relative to their non-manufacturing counterparts (7.6% vs. 8.9%, difference significant at 1%). For both manufacturing and non-manufacturing firms, however, *Opening Cash* is much larger than *Operating CF* (16.0% vs. 7.6% for manufacturing; 14.9% vs. 8.9% for non-manufacturing).

Interestingly, just as *Total Investment* scaled by assets is similar across manufacturing and non-manufacturing firms, *Total Funds* scaled by assets is also similar (46.7% vs. 45.9%). Thus, manufacturing firms and non-manufacturing firms are not different in terms of the either their investment intensity or the availability of internal funds. However, the underlying components are different. That is why we cannot use *Capex* and *Operating CF* as the primary measures of investment and internal funds.

IV. Overall Investment-Cash Flow Sensitivity

Following Fazzari, Hubbard, and Petersen (1988), we estimate the investment-cash flow sensitivity as follows:

$$Investment_{i,t} = \alpha_i + \alpha_t + \beta_1 Internal\ Funds_{i,t} + \beta_2 q_{i,t-1} + \varepsilon_{it} \quad (1)$$

where $Investment_{i,t}$ is the firm's investment, measured as either *Capex* (based on prior literature) or *Total Investment* (our measure), both scaled by lagged assets. $Internal\ Funds_{i,t}$ is the firm's availability of internal funds, measured as either *Operating CF* (based on prior literature) or *Total Funds* (our measure), both scaled by lagged assets. Firm and year fixed effects are denoted by α_i and α_t. $q_{i,t-1}$ is the beginning period market to book ratio, a proxy for investment opportunities. β_1 measures the sensitivity of investment to cash-flow, and is the focus of our analysis. β_2 measures the sensitivity of investment to *q*.

Table III reports the results. The t-statistics are based on standard errors that are heteroskedasticity-consistent and clustered at the firm level. Panel A compares the results from prior literature with the results using all three innovations that we introduce. Panels B and C present the results for each in isolation.

We start by comparing results based on prior literature versus results based on all of our three innovations. Consistent with prior literature, for manufacturing firms, we find (in row 1) that *Capex* is sensitive to *Operating CF*. When we include non-manufacturing firms and broaden the definition of investment and internal funds, we find (in row 2) that *Total Investment* is highly sensitive to *Total Funds.* The investment-cash flow sensitivity is higher by 570% (0.523 vs 0.078), and (in untabulated results) this difference is statistically significant at the 1% level.

Panel B presents results where we introduce one innovation at a time. Our first change is to consider non-manufacturing firms. Row 3 presents results. We find that the sensitivity of *Capex* to *Operating CF* for non-manufacturing is 0.125, which is 60% higher than that for manufacturing firms (= 0.078, Row 1). The results point to the importance of including non-manufacturing firms in the sample. The sensitivity of *Capex* to *q* is comparable across the two samples (0.012 vs.

0.010).

In row 4, we use our more comprehensive definition of investment. Note that we replace *Operating CF* with *Available CF* because *Total Investment* includes *R&D* and *SG&A* and the *Operating CF* has to be adjusted for these investments that are made through the income statement. Consistent with our expectation, when the true investment is higher than that used in prior literature (*Capex*), the investment-cash flow sensitivity increases. Comparing rows 4 and 1, we find that the sensitivity increases by 740% from 0.078 to 0.658. The increase in sensitivity is because (i) *Capex* understates the true investment and (ii) at least one of the other components of investment (such as *R&D*, *SG&A*, *SubJV*, *M&A*) is sensitive to internal funds. Indeed, Brown et al. (2009) document that R&D is sensitive to *Operating CF*. Thus, broadening the definition of investment has a significant impact on estimated investment-cash flow sensitivity.

In row 5, we use our more comprehensive definition of internal funds. Since we hold the investment constant (at *Capex*), we simply add *Opening Cash* to *Operating CF*. This is the *Funds for Capex* measure. When true availability of internal funds is more than what we have used thus far in the literature (*Operating CF*), the investment-cash flow sensitivity, as expected, decreases. Comparing rows 5 and 1 reveals that the sensitivity decreases by 40% from 0.078 to 0.047. The decrease in sensitivity is because (i) *Operating CF* understates the true internal funds available, and (ii) investment is sensitive to cash holding. Thus, broadening the definition of internal funds affects the estimated investment-cash flow sensitivity, but not to the same extent as broadening the definition of investment.

Panel C reports results that help us understand the impact of broadening the definition of investment and internal funds using all firms. Row 6 sets the base case, which includes

manufacturing and non-manufacturing firms, and applies the definition of investment and internal funds based on existing literature. As expected, the sensitivity is higher than that for manufacturing firms (Row 1) because non-manufacturing firms have a 60% higher sensitivity (as seen in Row 2). Row 7 reports the results where we change the definition of investment from *Capex* to *Total Investment.* As before, we have to change the definition of internal funds from *Operating CF* to *Available CF* to account for the investments in *R&D* and *SG&A.* Comparing rows 7 and 6, we find that the sensitivity increases, as expected. The increase is 640%, which is similar to the 740% increase observed in Panel B.

Row 8 reports the results where we hold investment constant (= *Capex*) and therefore, change the definition of *Total Funds* from *Operating CF* to *Funds for Capex.* Comparing rows 8 and 6, we find that the sensitivity decreases, as expected. The decrease is 35%, similar to the 40% decline observed in Panel B.

While the focus of our paper is not on the sensitivity of investment to *q*, we find it interesting that this sensitivity is nearly 200% higher (0.029 vs. 0.010; comparing rows 1 and 2) when we use *Total Investment* rather than *Capex*. This is consistent with the non-*Capex* components of investment also being sensitive to *q*. This result indicates that the non-*Capex* components of investment, on aggregate, are at least as important as, if not more important than, *Capex*.

Finally, comparing rows 1 and 2, we find that R^2 increases substantially from 39% to 63%, which provides some indirect validation for our innovations. It appears that R^2 increases substantially because of non-manufacturing firms even when we use *Capex* and *OCF*: R^2 is 39% for manufacturing firms but is 54% for non-manufacturing firms (rows 1 and 3). This provides

strong support for including non-manufacturing firms in any study of investment-cash flow sensitivity. Thus, including non-manufacturing firms increases R^2 from 39% to 50% (compare rows 6 and 1). When we broaden the definition of investment, R^2 increases from 50% to 66% (compare rows 6 and 7), whereas when we broaden the definition of internal funds, there is no increase in R^2 (compare rows 6 and 8). Once again, broadening the definition of investment seems to have the most significant effect on the results.

V. Time Series Trend in Investment-Cash Flow Sensitivity

Recent studies document a decline in the sensitivity of *Capex* to *Operating CF* (Allayanis and Mozumdar, 2004; Brown et al., 2009; Chen and Chen, 2012). We start, therefore, by reproducing this declining trend. We then examine the effect of broadening the sample as well as the measures of investment and internal funds.

Panel A of Figure 4 shows the trend in investment-cash flow sensitivity using *Capex* and *Operating CF* respectively. In other words, Panel A illustrates the time trend in the results shown in row 1 of Table III. Panel B of Figure 4 shows the trend in investment-cash flow sensitivity using *Total Investment* and *Total Funds* respectively. In other words, Panel B illustrates the time trend in the results shown in row 2 of Table III. We use rolling five-year regressions to estimate the investment cash-flow sensitivity for a given year. Given that our data starts in 1967, the first sensitivity we can estimate is for 1971, which we estimate using data from 1967–1971. Our figure thus shows estimates from 1971 to 2013.

Consistent with the literature, Panel A of Figure 4 indicates that, for manufacturing firms (solid line), there is a decline in investment-cash flow sensitivity using *Capex* and *Operating CF*.

For the last 30 years or so, the sensitivity is low and is below 0.1. This trend is evident for non-manufacturing firms also (dotted line). The sensitivity for non-manufacturing firms is usually higher than that for manufacturing firms. This is consistent with the results from Table III, which showed that non-manufacturing firms, on average, have 60% higher sensitivity. We find that in the last 22 years (since 1991), the difference in investment-cash flow sensitivity between manufacturing and non-manufacturing firms has narrowed.

Panel B reports the results when we use *Total Investment* and *Total Funds* as our measure of investment and internal funds. Similar to what we observed in Panel A, we find that the sensitivity of *Total Investment* to *Total Funds* also shows a decline over time for both manufacturing firms (solid line) and non-manufacturing firms (dotted line). As before, the sensitivities for non-manufacturing firms are usually higher. There is an important difference, however, from Panel A. The rate of decline is smaller and, importantly, the sensitivity remains statistically and economically significant. Even in the recent years, sensitivity is between 0.3 and 0.4.

Given that manufacturing and non-manufacturing firms follow the same trend, we hereafter combine both into one sample. Panel C plots the sensitivity of *Capex* to *Operating CF* (prior literature) and the sensitivity of *Total Investment* to *Total Funds* (our estimate). It is clear that the sensitivity of *Total Investment* to *Total Funds* is much higher than the sensitivity of *Capex* to *Operating CF*. Both show a decline but the sensitivity of *Total Investment* to *Total Funds* even in the most recent period is above 0.3.

Overall, the results indicate that, when more appropriate measures of investment and internal funds are considered, investment-cash flow sensitivity declines over time, but remains

economically and statistically significant. In untabulated results, we find that, for most years in the sample, the sensitivities calculated using *Total Investment* and *Total Funds* are about 3 times higher than that calculated using *Capex* and *Operating CF*.

VI. Robustness: Alternative Definitions of Investment and Cash Flow

Our main results relate to the overall investment cash flow sensitivity and the time-trends in investment-cash flow sensitivity. In this section, we show that our results are qualitatively similar when we use various alternative definitions of investment and cash flow.

A. Overall Investment Cash-Flow Sensitivity: Robustness

In this subsection, we examine the robustness of our results as they relate to overall investment-cash flow sensitivity. Row 1 of Table IV presents our baseline results (reproduced from row 2 of Table III)

A.1 Inclusion of Deal Value of M& A

Our baseline measure of investment includes only the cash portion of the M&A. The idea is that the cash used to finance M&A is free of information asymmetry problems. One could argue, however, that the entire value of the acquisition is the correct measure of investment from the firm's point of view. This is because the value of assets purchased equal deal value. We, therefore, include the deal value of the M&A as part of the investment. Specifically, *Total Investment = Capex + R&D + SubJV + Deal Value of M&A.* Row 2 of Table IV presents the results. Given that investment is higher than the base case, as expected, the sensitivity of investment to *q* is larger (0.066 versus 0.029 for our baseline). The investment-cash flow sensitivity is 0.531, which is also

higher than our baseline result of 0.523, though very similar in economic terms. The number of observations is smaller in this case because we obtain the deal value of the M&A from SDC, which is available only from 1982.

A. 2. Inclusion of Equity Compensation to Employees in Total Funds

The investment cash flow literature uses cash from operations as the source of cash flow based on the idea that this source is least affected by information asymmetry issues. Fama and French (2005) however, argue that there are two sources of equity characterized by much lower information asymmetry problems and transactions costs (relative to other sources such as SEOs, convertible bonds etc.). The first of these two is equity compensation to employees. Murphy (2012) notes that "options were particularly attractive in cash-poor start-ups (such as in the emerging new economy firms in the early 1990s), which could compensate employees through options without spending any cash." By using equity compensation to attract and retain highly skilled employees, firms reduce their reliance on cash compensation and thus overcome financial constraints imposed by their cash flows.[17] Indeed, Fama and French (2005) find that the value of stock issued to employees is significantly larger than the value of stock issued through SEOs and private placements. Stock options can also be a significant source of cash when employees exercise these options.[18] Babenko, Lemmon, and Tserlukevich (2011) find that these cash inflows can substitute for costly external

[17] For example, Amazon, in its 1st quarter 10Q in 2015 states "operating expenses without stock-based compensation have limitations due to the fact that they do not include all expenses primarily related to our workforce. More specifically, if we did not pay out a portion of our compensation in the form of stock-based compensation, our cash salary expense ...would be higher." Similarly, VMware, a software firm, notes in its 10Q in 2015: "if VMware did not pay out a portion of its compensation in the form of stock-based compensation... the cash salary expense included in operating expenses would be higher, which would affect VMware's cash position."

[18] For example, Salesforce.com, a leading cloud software firm, received $309 million (for the fiscal year ended Jan 2015) from employees exercising options, which was greater than its *Operating CF* of $185 million.

finance. Specifically, they document that firms increase investment by $0.34 for every additional dollar received from employee stock option exercise, and this sensitivity is more pronounced in firms that face more costly external financing.

Following this literature, we broaden our measure of internal funds to include the value of equity compensation issued to employees. Specifically, *Total Investment* is the same as our baseline measure and *Total Funds* = *Operating CF* + *R&D* (1–T) + *SG&A* (1–T) + *Opening Cash* + *Equity_Empl*, where *Equity_Empl* is the value of equity compensation (options + stock) granted to all employees.

We estimate the approximate value of *Equity_Empl* using data available on *Execucomp*. *Execucomp* covers the firms in the S&P 1500, which account for about 90% of the market capitalization of all listed firms. *Execucomp* provides compensation data from 1992 for the named executive officers (NEOs) of the firm, who are typically the top five highest paid executives. SEC changed compensation disclosure guidelines starting in fiscal 2006, and FASB introduced a rule change in 2005 (FAS 123R) that required firms to expense stock option grants. This changed how firms reported their compensation from 2006 onwards. We therefore restrict our analysis of *Equity Empl* to the period 1992–2005.

We first compute the value of option grants to all employees, which is not reported but can be inferred. Specifically, we rely on the *Execucomp* variable *NUMSECUR* (number of options awarded to an NEO in a tranche) and *PCTTOTOPT (the* fraction of the firm's total stock option grants awarded to that executive in that tranche) to estimate the value of options granted to all employees. Following Call, Kedia, and Rajgopal (2012), for each firm-year-NEO-tranche, we estimate the total number of options issued by the firm for that year as *NUMSECUR* divided by *PCTTOTOPT*. For example, for a given executive, *if NUMSECUR* is 10,000 and *PCTTOTOPT* is 0.05, that means that the total awards at the firm level

was 200,000 (=10,000/0.05). This estimate should be the same for each tranche, but is not. We drop firm-years where the total number of options estimated using each tranche is not within 3% of each other.

To estimate the value of options granted to all employees, we use the (i) the total number of options granted to all employees (estimated from previous step), (ii) total number of options granted to the NEOs, which is the sum across all tranches across all NEOs, and (iii) the total value of all options granted to the NEOs, which is the sum across all tranches across all NEOs. Up to 2005, Execucomp calculated the value of option grants at the tranche level as the Black-Scholes value of stock options for dividend paying stocks, based on assumptions about the grant date and estimates of the risk-free rate, volatility, and dividend yield. For example, if the total value of options granted to all named executive officers in a given year is $100 million and the option awards to NEOs constituted 50% of all option awards, then the value of options granted to all employees = $200 million. Clearly, this is not a precise estimate for several reasons, but we believe that this is not systematically biased in any way.

We next aggregate the value of all restricted stock grants across all NEOs each year to get the total stock grant value. We do not know how much stock was issued to all employees as a whole. Our measure therefore understates the restricted stock grant issued at the firm level. *Equity Empl* is the sum of the option value and restricted stock value as computed above.

Row 3 presents the results. The sample is much smaller because we are limited to a smaller sample of firms (S&P 1500) for fewer years (1992–2005), as explained earlier. The results, however, are qualitatively very similar to our baseline results. The investment-cash flow sensitivity is 0.501, which is lower than 0.523 in the baseline. This is not surprising, given that availability of internal funds as per this definition is greater than in the baseline.

A.3. Inclusion of Equity Portion of M&A in Total Funds

Fama and French (2005) also suggest that equity issued by the acquirer as part of stock-financed mergers is a potential source of funds for firms that is less vulnerable to information asymmetry problems. This is because most mergers are friendly, and are typically negotiated between informed parties. Moreover, target shareholders often have investment advisors to advise them. Information asymmetry will be even lower if the bidder and target are in the same industry or supply chain.

Based on this notion, we include equity issued to target shareholders as part of stock-financed acquisitions as a source of internal funds. Specifically, *Total Funds = Operating CF + R&D(\-T) + SG&A (1-T) + Opening Cash + Equity_M&A*, where *Equity_M&A* is the value of equity issued to the target shareholders as part of the M&A transaction. Broadening the definition of internal funds also necessitates broadening the definition of investment as follows: *Total Investment = Capex + R&D + SG&A + SubJV + Deal Value of M&A.*

Row 4 of Table IV presents the results. The investment-cash flow sensitivity is now much higher than the baseline (= 0.817 versus 0.523), while the investment-*q* sensitivity and R^2 are about the same as the baseline (= 0.031 and 0.64 versus 0.029 and 0.63 for the baseline). As with Row 2, the number of observations is slightly smaller because we need data from SDC.

A.4. Adjusting for Tax Deductibility of R&D and SG&A

In our baseline results, the definition of *Total Investment = Capex + R&D + SG&A + SubJV + M&A.* It is possible, however, that because *R&D* and *SG&A* are tax-deductible expenditures, firms only consider the post-tax values of these as their investment. To account for this, we define *Total Investment = Capex + R&D(1-T) + SG&A (1-T) + SubJV + M&A.* The measure of *Total Funds* is the same as that used in the baseline. Row 5 of Table IV presents the results. The investment-cash flow sensitivity, as expected, is lower than the baseline (= 0.512 versus 0.523).

A.5 Excluding SG&A from Total Investment measure

As mentioned earlier, SG&A includes marketing and advertising expenses, employee training costs, exploration expenses etc., which are all more appropriately viewed as long-term investments as the benefits are received over multiple future periods. SG&A, however, also includes expenses such as wages to employees, administration expenses etc., which are period costs. Ideally, we would like to include only the long-term investment part of SG&A, but the data do not allow us to do so. We, therefore, examine whether our inferences change when we exclude SG&A from the definition of investment. Specifically, *Total Investment = Capex + R&D + SubJV + M&A* and *Total Funds = Operating CF+ R&D* (1–-T) + *Opening Cash.* Row 6 of Table IV presents the results. As expected, the investment-cash flow sensitivity is 0.208. While this is smaller in magnitude compared to our baseline result, it is still much bigger than the sensitivity obtained using the definition from prior literature (= 0.078, see Table III). The coefficient on *q* is similar to the baseline result, and the overall R^2 is much smaller when we exclude SG&A from the investment measure (=0.43 compared to 0.63 in the baseline).

B. Time Trends in Investment-Cash Flow Sensitivity: Robustness

In this subsection, we examine the effect of alternative definitions of investment and internal funds on the time trend in investment-cash flow sensitivity. For each of the definitions of *Total Investment* and *Internal Funds* discussed in subsection A, we examine how investment-cash flow sensitivity changes with time. Figure 5 presents the results. We find that the results using the alternative definitions are qualitatively similar to our baseline result (also shown in the Figure). As mentioned earlier, we have fewer years of data when we use SDC data or Execucomp data. The corresponding graphs in these cases are therefore for a shorter time period. In all cases, however, the pattern looks similar to our baseline result.

Also, in all cases, we find that the investment-cash flow sensitivity has declined, but has remained statistically and economically significant unlike the results using the prior definitions in the literature (shown in graph).

Overall, the results in this section indicate that our main findings with regard to level and trends in investment-cash flow sensitivity are robust to various alternative definitions of investment and internal funds.

VII. Conclusions

Fazzari, Hubbard, and Petersen (1988) theorize that in the presence of costly external financing, a firm's investments will be sensitive to the availability of its internal funds. This is because internal funds are not vulnerable to information asymmetry problems and, therefore, less costly compared to external funds. Following their study, a large and rich literature has emerged in this area. Typically, studies in this area examine a sample of manufacturing firms, use capital expenditure as a measure of a firm's investment, and use operating cash flow as a measure of a firm's internal funds. Several trends in the population of U.S. firms, however, suggests that the literature needs to reconsider, and broaden, both the sample as well as the measures used.

First, the proportion of non-manufacturing firms has increased significantly, from 32% to 49%. Additionally, non-manufacturing firms, on average, have capital expenditures that are significantly higher than the capital expenditures of manufacturing firms. Second, the importance of capital expenditure as an investment type has declined, while R&D and SG&A has gained prominence over time because firms have become more human-capital intensive (and investments in human capital take the form of R&D and SG&A). Moreover, cash investment in subsidiaries

and joint ventures and cash investment in mergers and acquisitions have also increased over time. Thus, we broaden the definition of investments to include these four additional investments.

Finally, the importance of operating cash flow as a source of internal funds has declined while that of cash holdings has increased significantly over time. Cash held at the beginning of the year, similar to operating cash flow, is free from asymmetric information problems. It can, therefore, substitute as a source of internal funds for firms in keeping with the premise of Fazzari et al. (1988).

Our contribution in this study is to document that when we use the broader sample and economically more intuitive measures of investment and cash flow, we find that investment is highly sensitive to cash flow. Indeed, the investment-cash flow sensitivity is 570% higher than that obtained using definitions based on prior literature—and this higher sensitivity is primarily due to the broadening of the definition of investment. Further, while the investment-cash flow sensitivity has declined over time, the decline is modest and, importantly, the sensitivity is still economically and statistically meaningful.

In addition to contributing to the investment-cash flow sensitivity literature, our study has implications for papers that use capital expenditure as a measure of investment to analyze overinvestment or those that use free cash flow (= operating cash flow less capital expenditures) as a proxy for agency problems. The inferences of these studies may be quite different if broader measures of investment or internal funds are used.

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Appendix

Variable definitions are from Compustat unless otherwise stated.

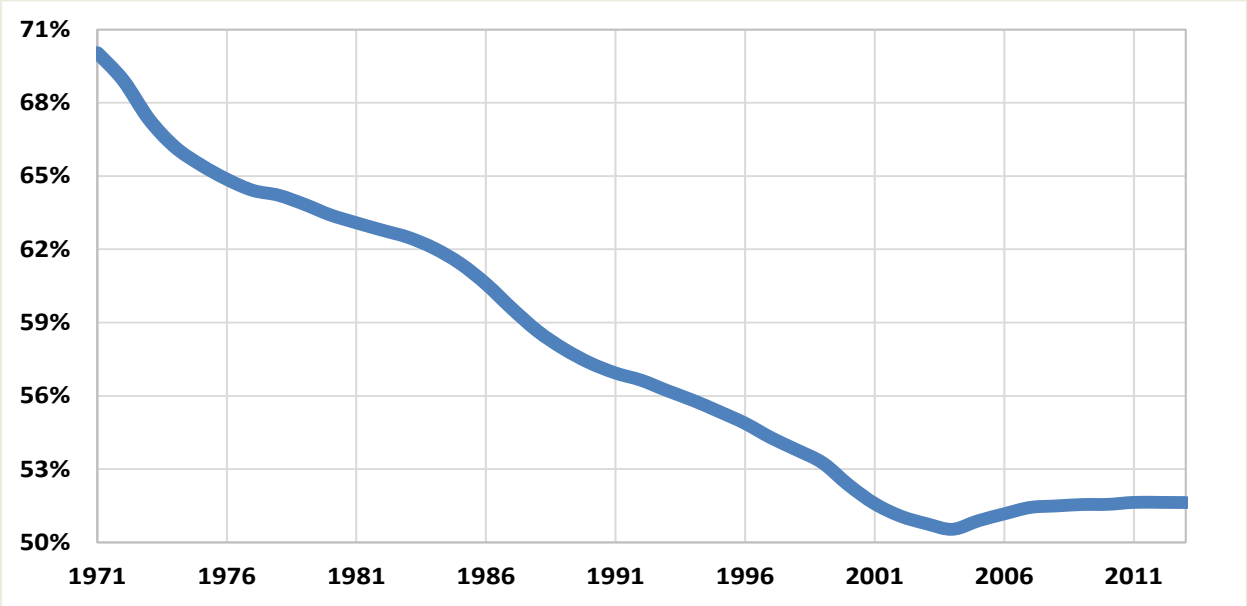
Variable	Definition	Mnemonic
Assets	Total Assets	at
Sales	Net Sales	sale
q	(Assets – Book equity + Market equity) / Assets	(at – ceq + prcc_f×csho) / at
Investment		
Capex	Capital Expenditure	capx
R&D	Research and Development Expense	xrd
SG&A[19]	Selling, General and Administrative Expense	xsga – xrd if xrd ≥ 0 xsga if xrd not reported
SubJV	Cash investments in unconsolidated subsidiaries and joint ventures, from Statement of Cash Flow	ivch
M&A	Cash used in merger and acquisition, from Statement of Cash Flow	aqc
Total Investment	CAPEX + R&D + SG&A + SubJV + M&A	
Internal Funds		
Operating CF	Income before Extraordinary Items + Depreciation & Amortization	(ib + dp)
Opening Cash	Beginning of period cash holdings	lagged che
Funds for Capex	Operating CF + Opening Cash	
Available CF	Operating CF + R&D× (1–T) + SG&A× (1–T)	
Total Funds	Available CF + Opening Cash Holding	

[19]R&D is included in SG&A by *Compustat* as long as the firm reports R&D separately. If the firm reports R&D as part of COGS, then *Compustat* does not add R&D to SG&A. See *Compustat* explanation for xsga for more details.

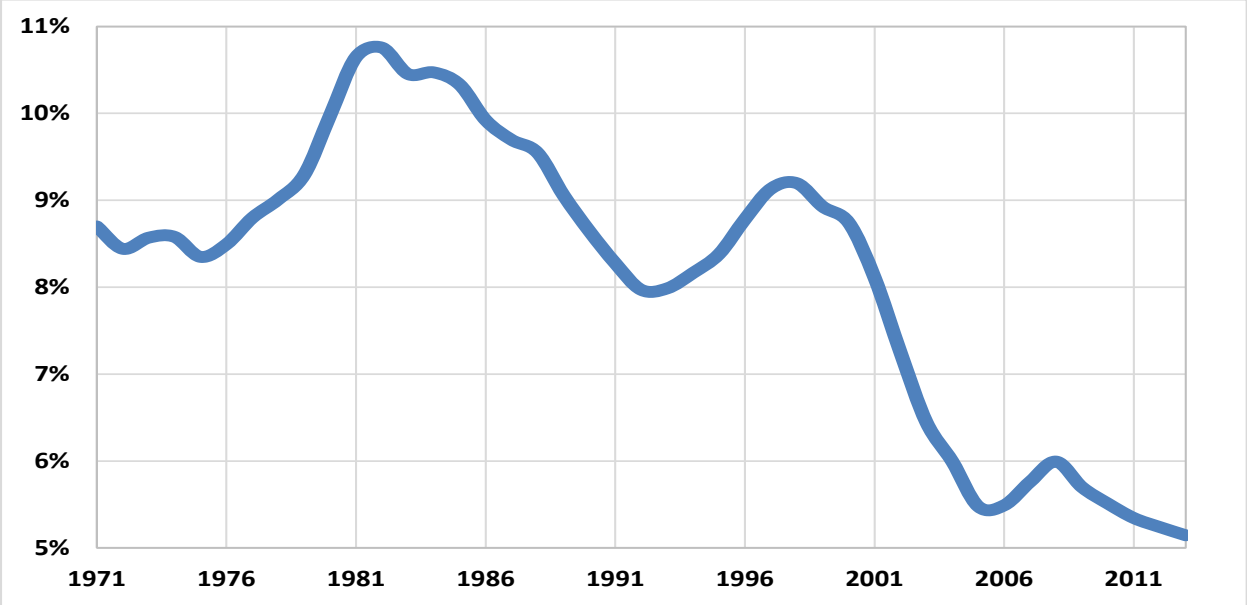
Figure 1
Declining Trend in Key Variables in Investment-Cash Flow Sensitivity

The figure plots the rolling 5-year average of the proportion of manufacturing firms in the sample (Panel A), *Capex* scaled by lagged assets (Panel B), and *Operating CF* scaled by lagged assets (Panel C). For example, for 1971, the number represents the pooled average for firms in the 1967-1971 period. Manufacturing firms are firms with a 2-digit SIC code ranging from 20 to 39.

Panel A: Declining Importance of Manufacturing Firms



Panel B: Declining Capex



Panel C: Declining Operating CF

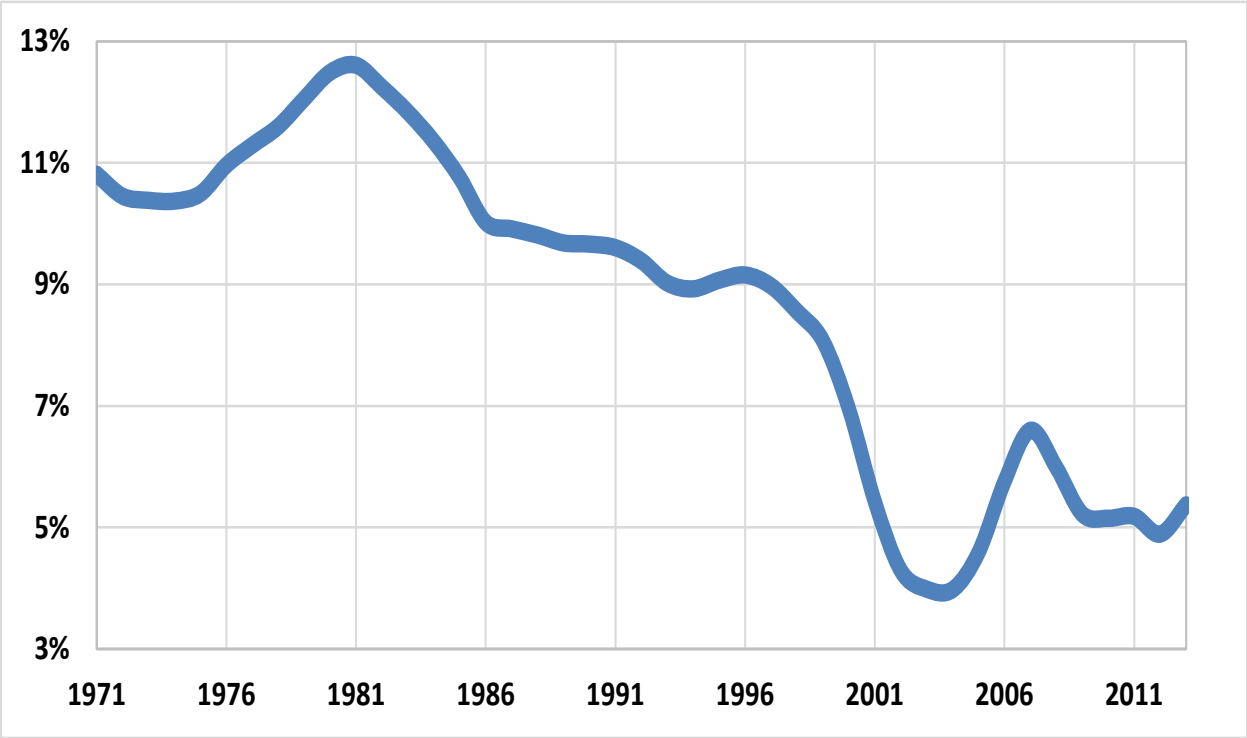
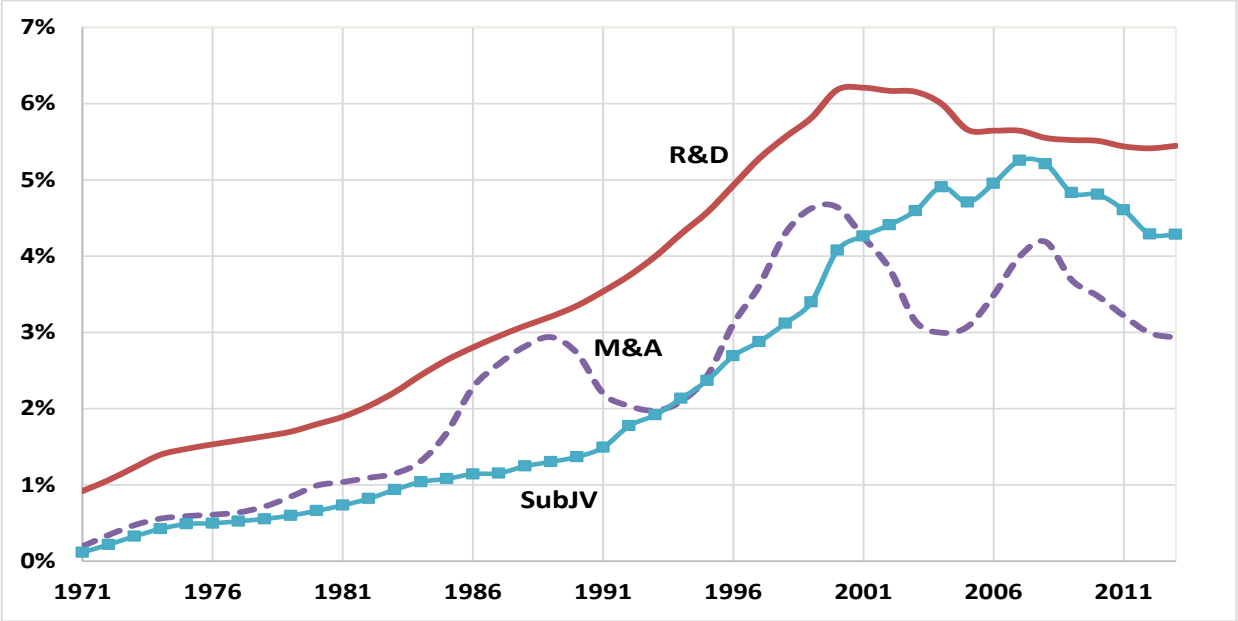


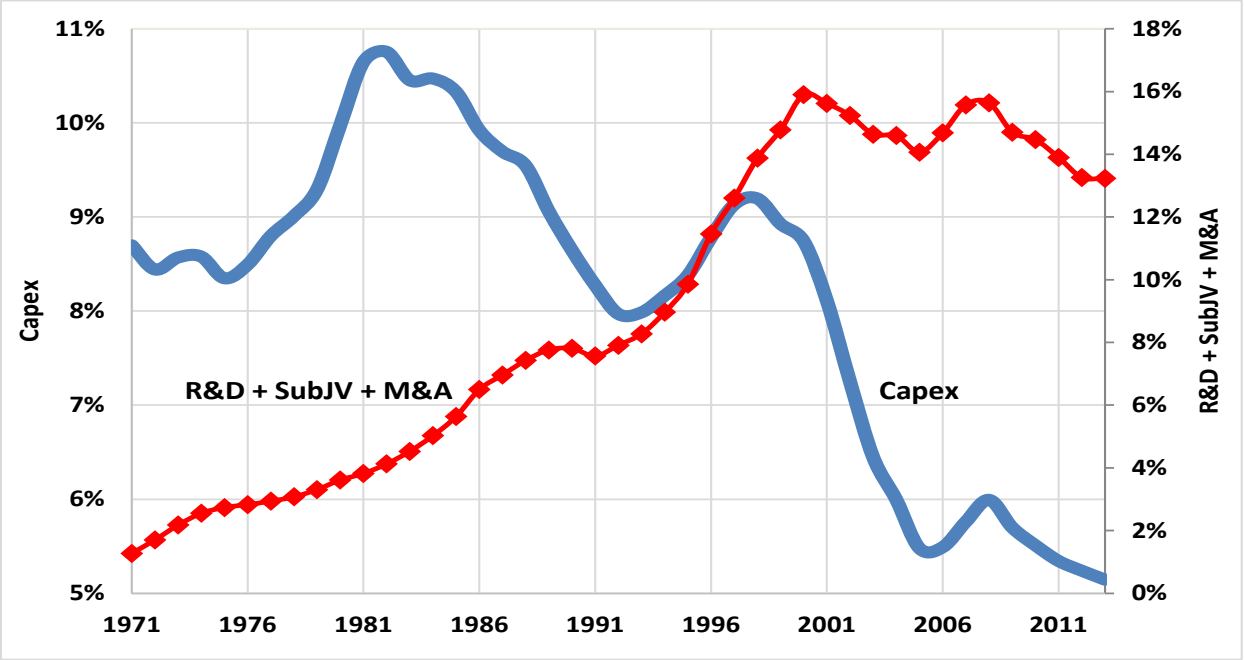
Figure 2
Importance of Various Types of Investment

Panels A to D plots the rolling 5-year average of various types of investment, all scaled by lagged assets. For example, for 1971, the number represents the pooled average of the investment measure of all the firms that exist in the 1967-1971 period. Panel E plots the rolling 5-year average of the ratio of *Capex* to *Total Investment*.

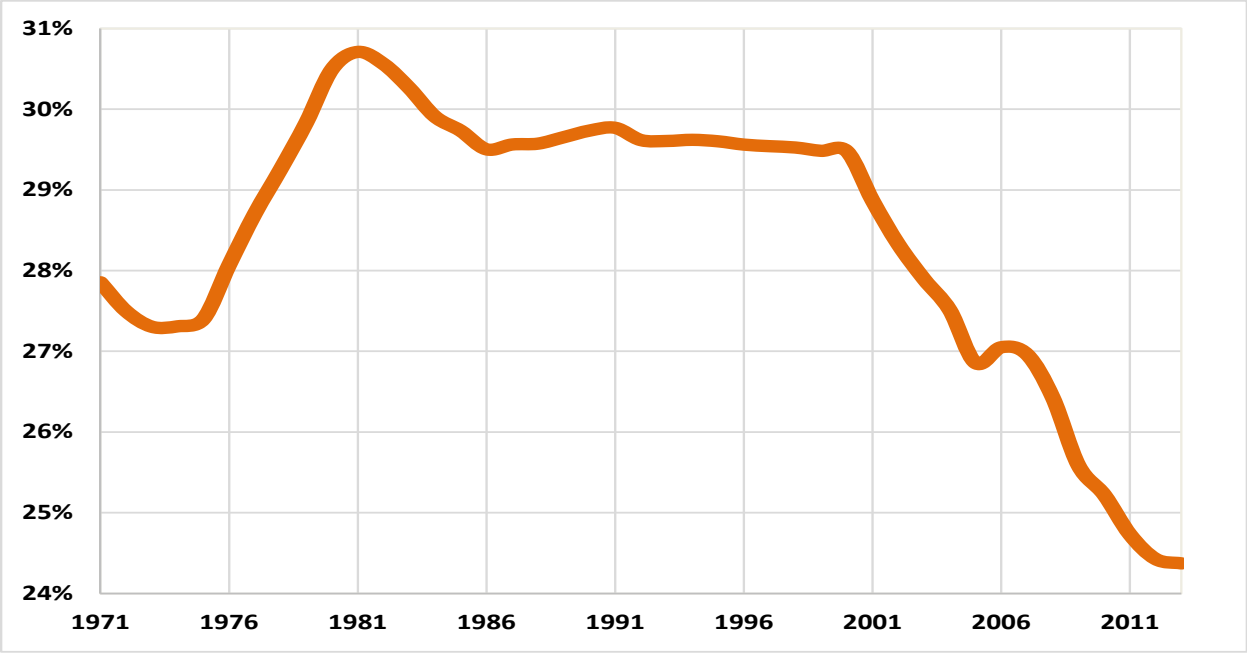
Panel A: Increasing Non-Capex Investments



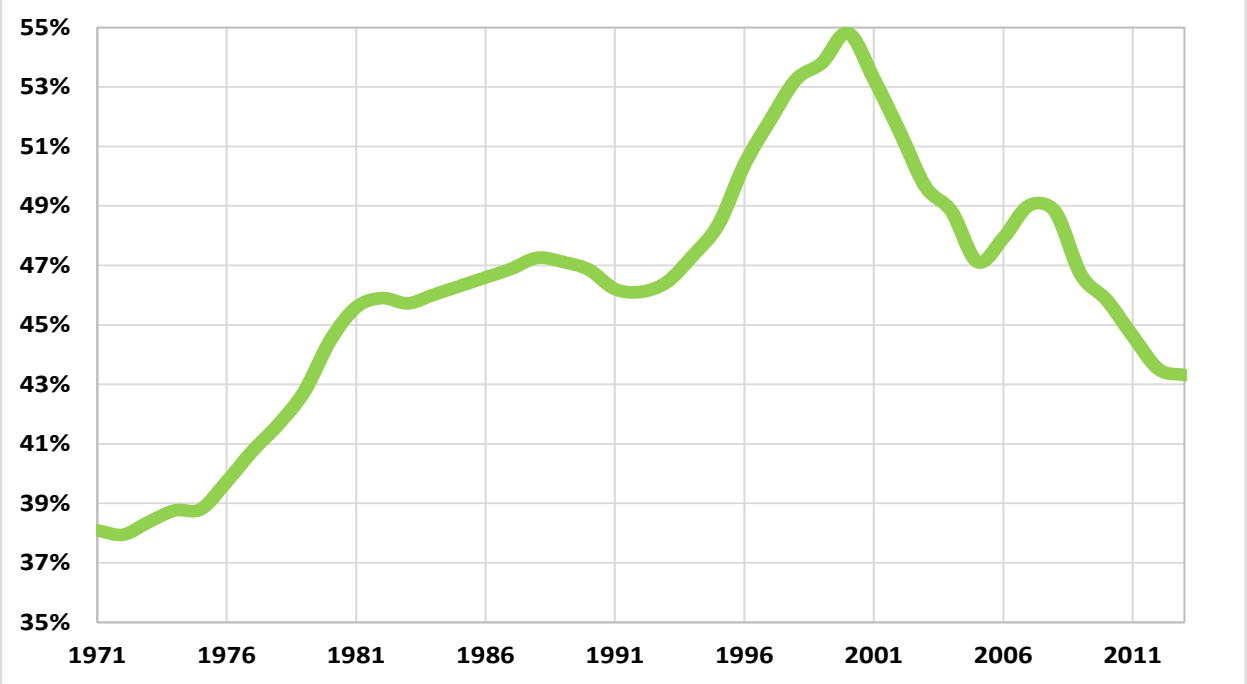
Panel B: Declining Capex vs. Increasing Non-Capex Investments



Panel C: Large and Declining SG&A



Panel D: Total Investment



Panel E: Declining Relative Importance of Capex

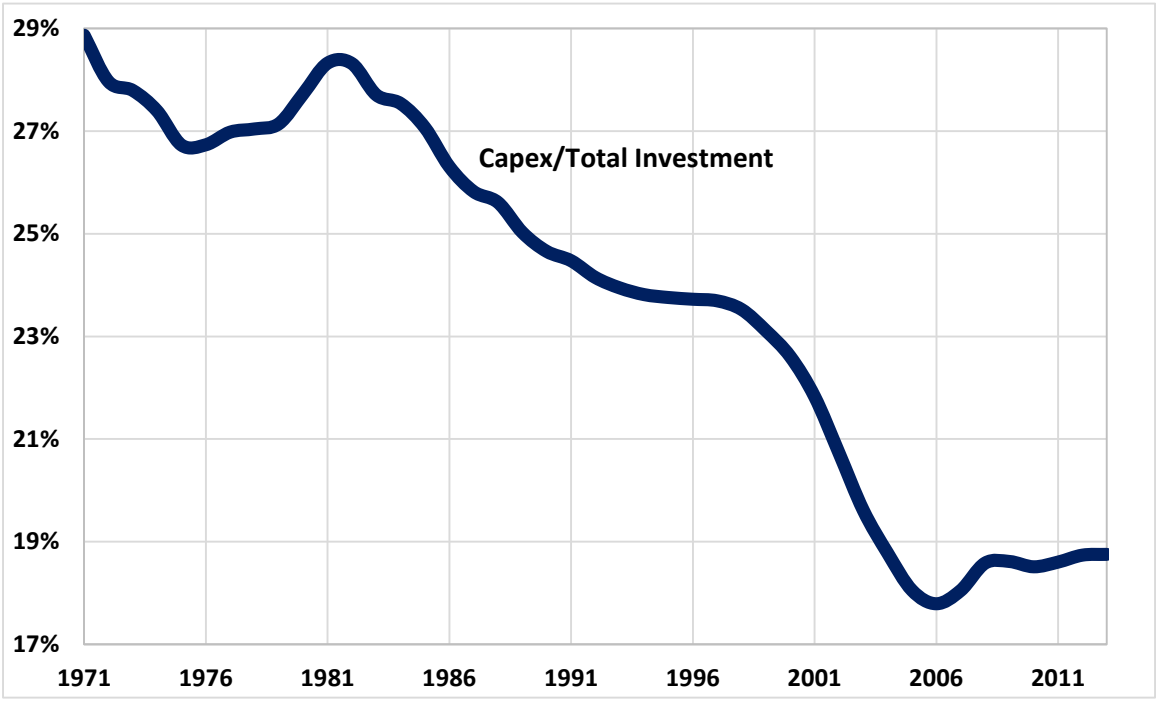
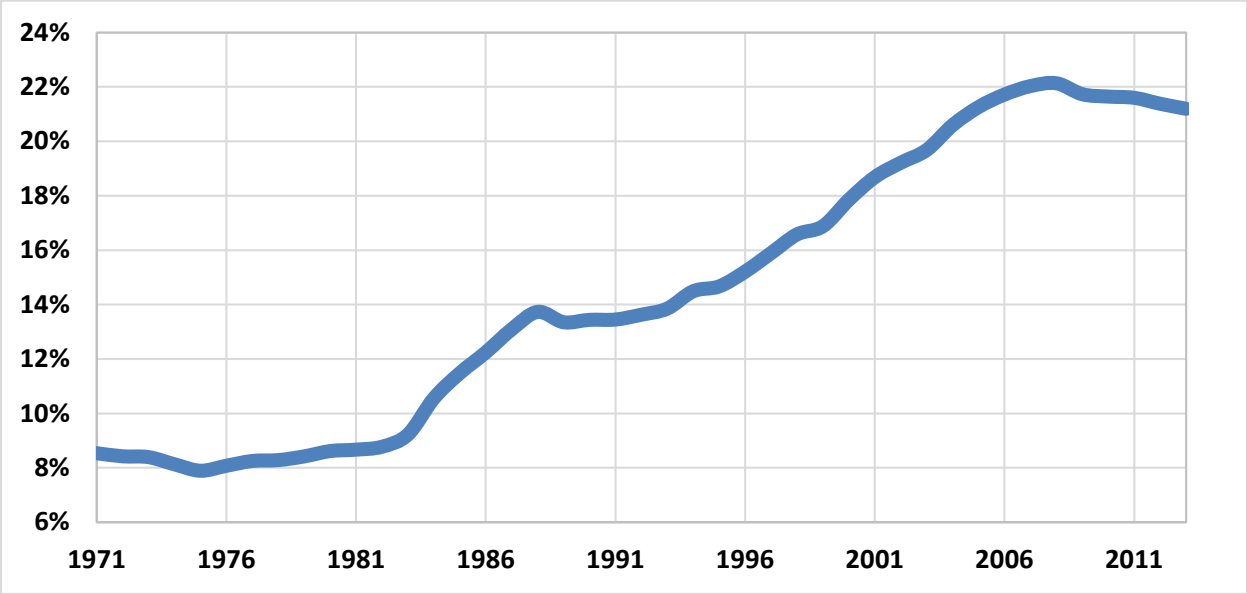


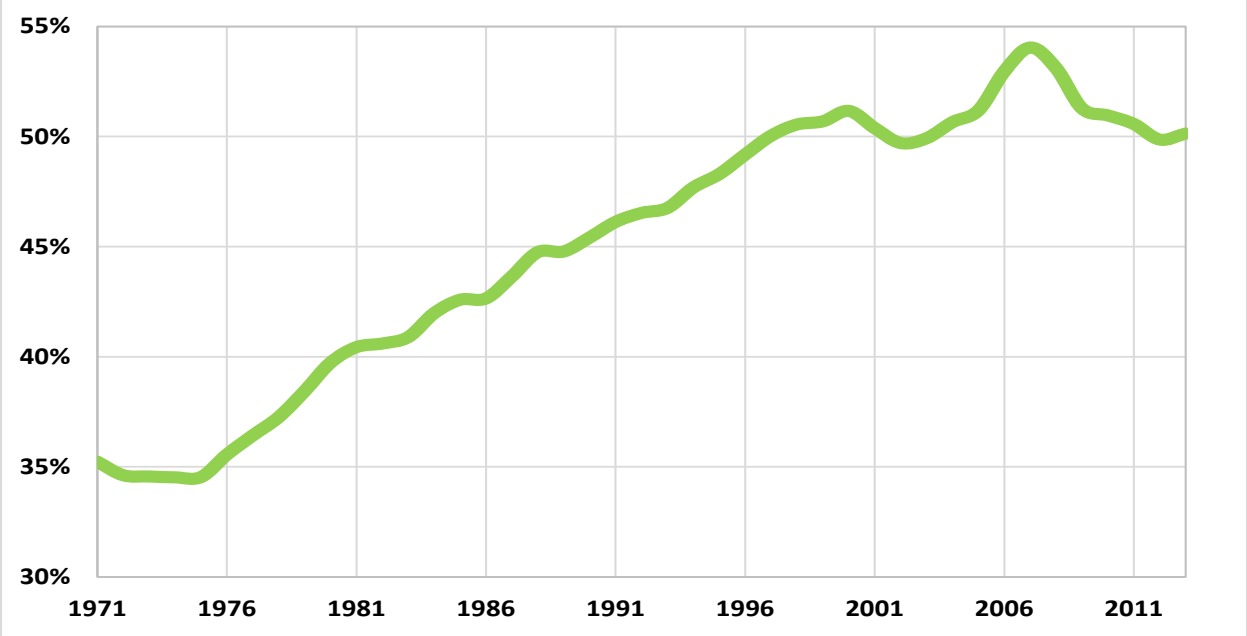
Figure 3
Importance of Various Sources of Internal Funds

Panels A and B plots the rolling 5-year average of *Opening Cash* and *Total Funds*, both scaled by lagged assets. For example, for 1971, the number represents the pooled average of the measure of internal funds of all the firms that exist in the 1967-1971 period. Panel C plots the rolling 5-year average of the ratio of *Operating CF* to *Total Funds*.

Panel A: Increasing Opening Cash



Panel B: Increasing Total Funds



Panel C: Declining Relative Importance of Operating CF

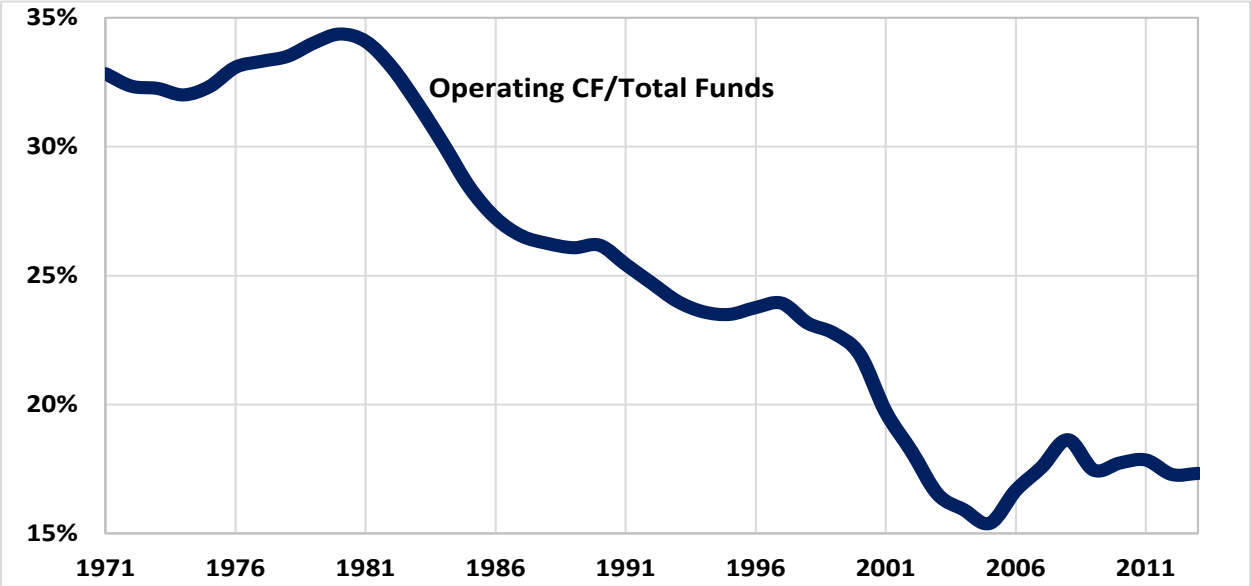


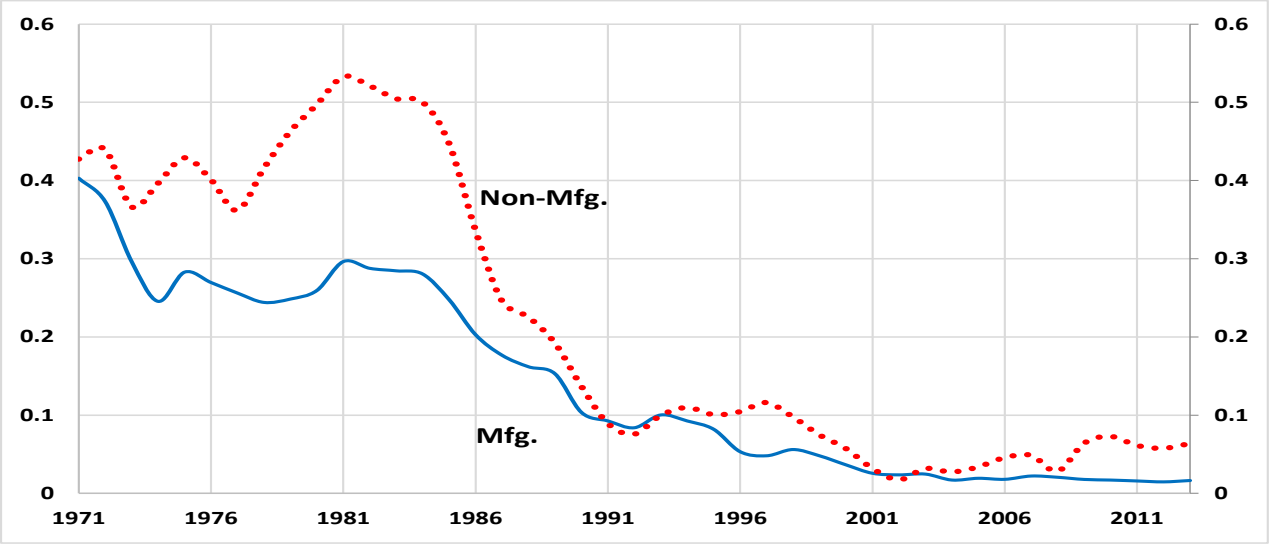
Figure 4
Trend in Investment-Cash Flow Sensitivity

The figures plot the investment-cash flow sensitivity (β_1) from rolling 5-year regressions of:

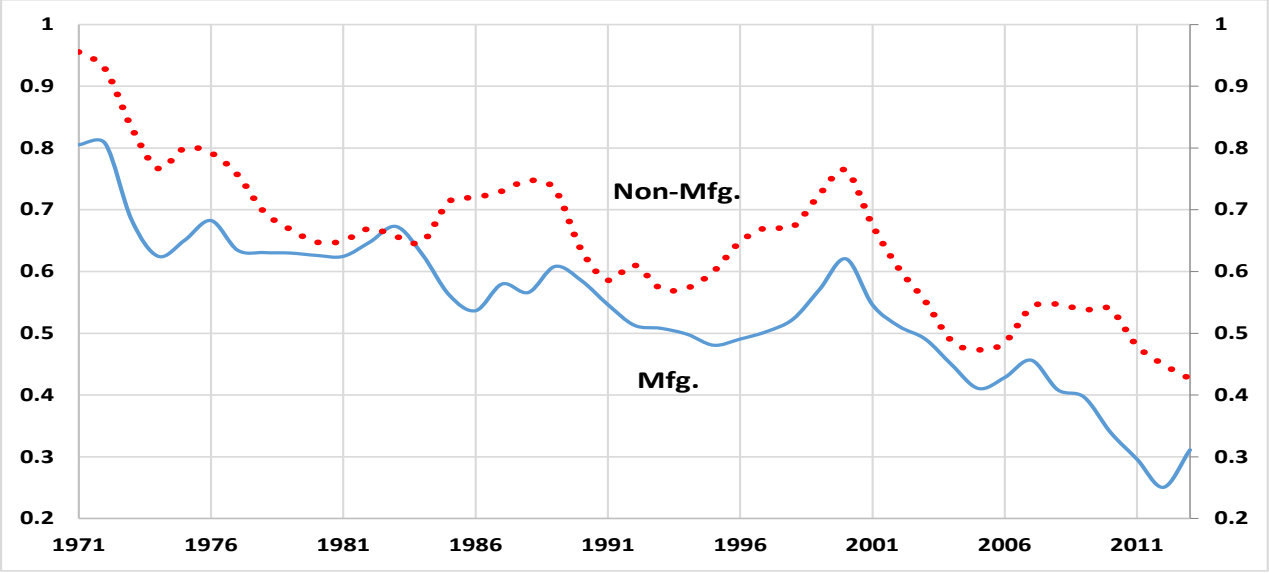
$$Investment_{i,t} = \alpha_0 + \beta_1 Internal\ Funds_{i,t} + \beta_2\, q_{i,t-1} + \alpha_i + \alpha_t + \varepsilon_{it},$$

For example, for 1971, the number represents the sensitivity from pooled regression using all firms that existed in the 1967-1971 period. $q_{i,t-1}$ is the beginning period market to book ratio. α_i and α_t denote firm and year fixed effects. *Investment* is either *Capex* (prior literature) or *Total Investment*. *Internal Funds* is either *Operating CF* (prior literature), or *Total Funds*. *Total Investment = Capex + R&D + SG&A + SubJV + M&A. Available CF = Operating CF + R&D* (1–T) + *SG&A* (1–T). *Total Funds = Available CF + Lagged Cash Holding*.

Panel A: Capex–Operating CF Sensitivity



Panel B: Total Investment–Total Funds Sensitivity



Panel C: Comparison of Capex–Operating CF Sensitivity and Total Investment–Total Funds Sensitivity

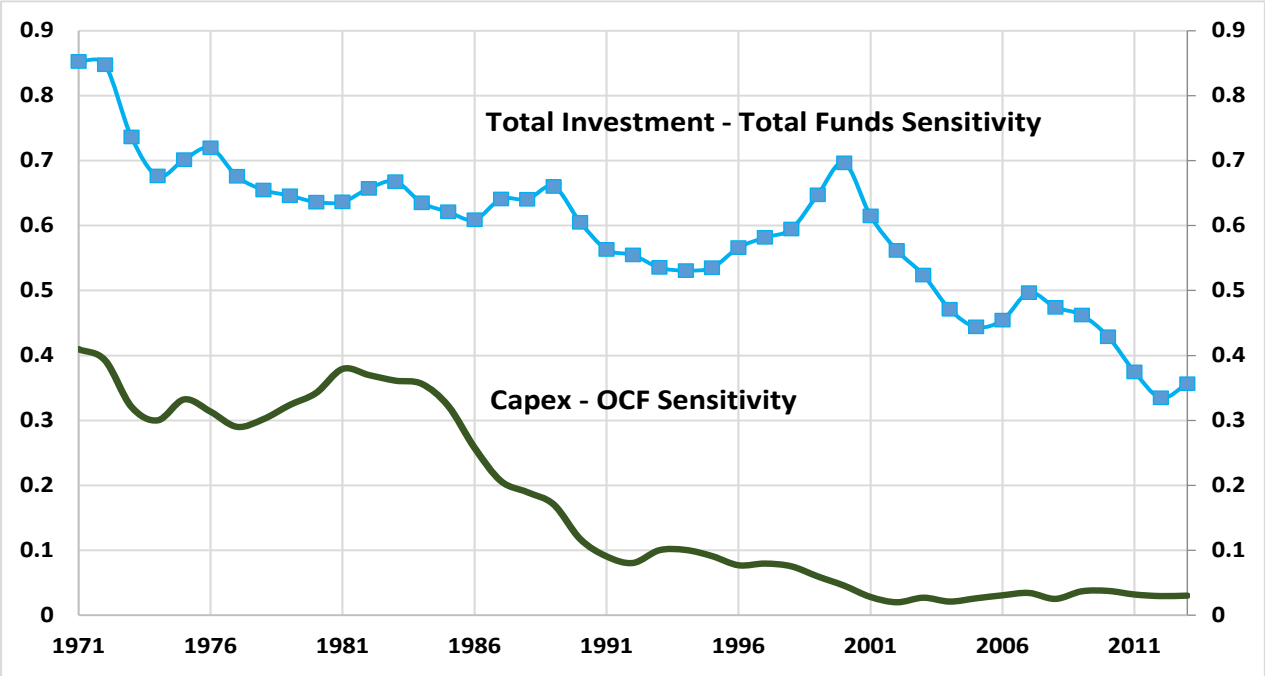


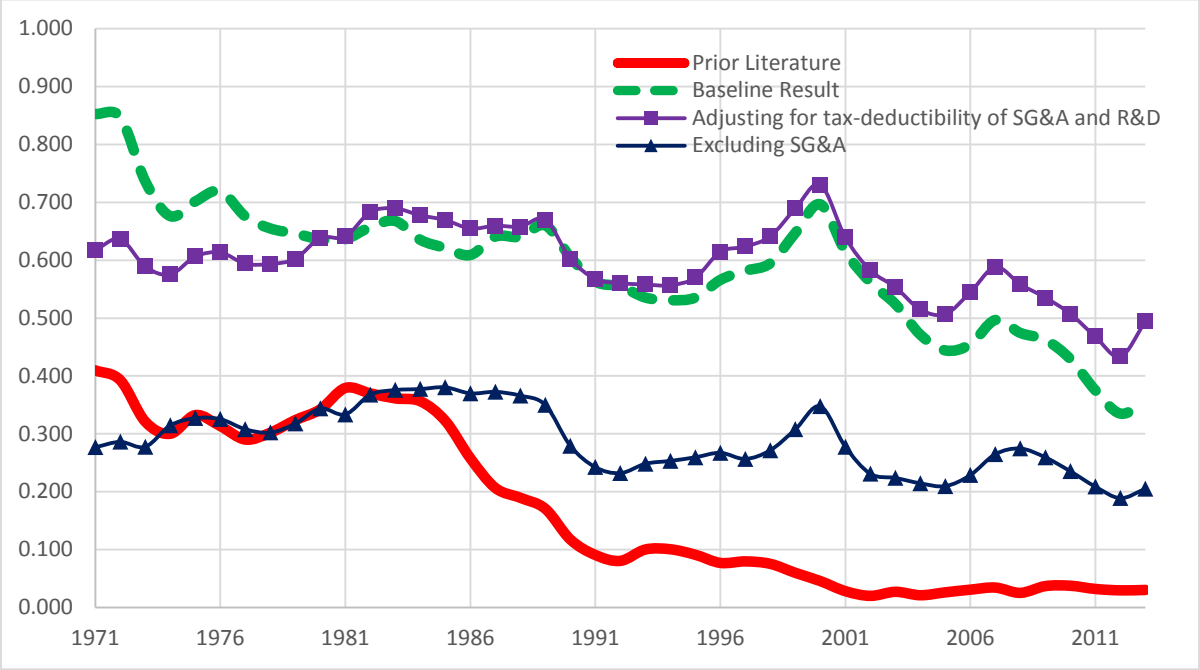
Figure 5
Trend in Sensitivity: Alternative Definitions of Investment and Internal Funds

The figures plot the investment-cash flow sensitivity (β_1) from rolling 5-year regressions of:

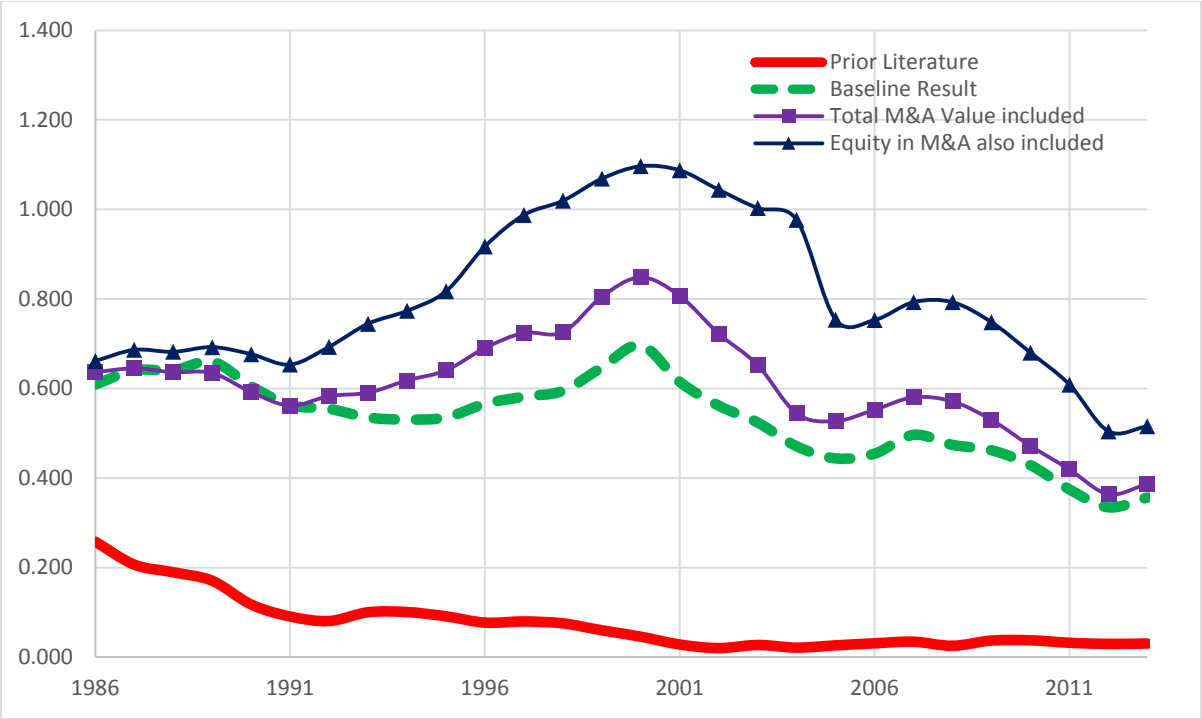
$$Investment_{i,t} = \alpha_0 + \beta_1 Internal\ Funds_{i,t} + \beta_2\, q_{i,t-1} + \alpha_i + \alpha_t + \varepsilon_{it}$$

α_0 is the intercept. α_i and α_t denote firm and year fixed effects. $q_{i,t-1}$ is the beginning period market to book ratio. For prior literature, *Investment = Capex; Internal Funds = Operating CF*. For the baseline result, *Investment = Capex + R&D + SG&A + SubJV + M&A*; *Internal Funds = Operating CF + R&D* (1–T) + *SG&A* (1–T) + *Opening Cash*. In Panel A, we include results when we adjust post-tax portion of *R&D* and SG&A, where *Investment = Capex + R&D (1–T) + SG&A (1–T) + SubJV + M&A*; *Internal Funds = Operating CF + R&D (1–T) + SG&A (1–T) + Opening Cash* and results when we exclude SG&A, where *Investment = Capex + R&D + SubJV + M&A*; *Internal Funds = Operating CF + R&D (1–T) + Opening Cash*. In Panel B, we include results when we include total deal value as part of investments, where *Investment = Capex + R&D + SubJV + Deal M&A*; *Internal Funds = Operating CF + R&D (1–T) + SG&A (1–T) + Opening Cash* and results when we also include the equity portion of the M&A as funds available, where *Investment = Capex + R&D + SubJV + Deal M&A*; *Internal Funds = Operating CF + R&D (1–T) + SG&A (1–T) + Opening Cash + Equity Issued in M&A*. In Panel C, we include the value of equity-based compensation issued by the firm to employees as part of funds available for investment, where *Investment = Capex + R&D (1–T) + SG&A (1–T) + SubJV + M&A*; *Internal Funds = Operating CF + R&D (1–T) + SG&A (1–T) + Opening Cash + Value of Equity-Based Compensation to Employees.*

Panel A



Panel B



Panel C

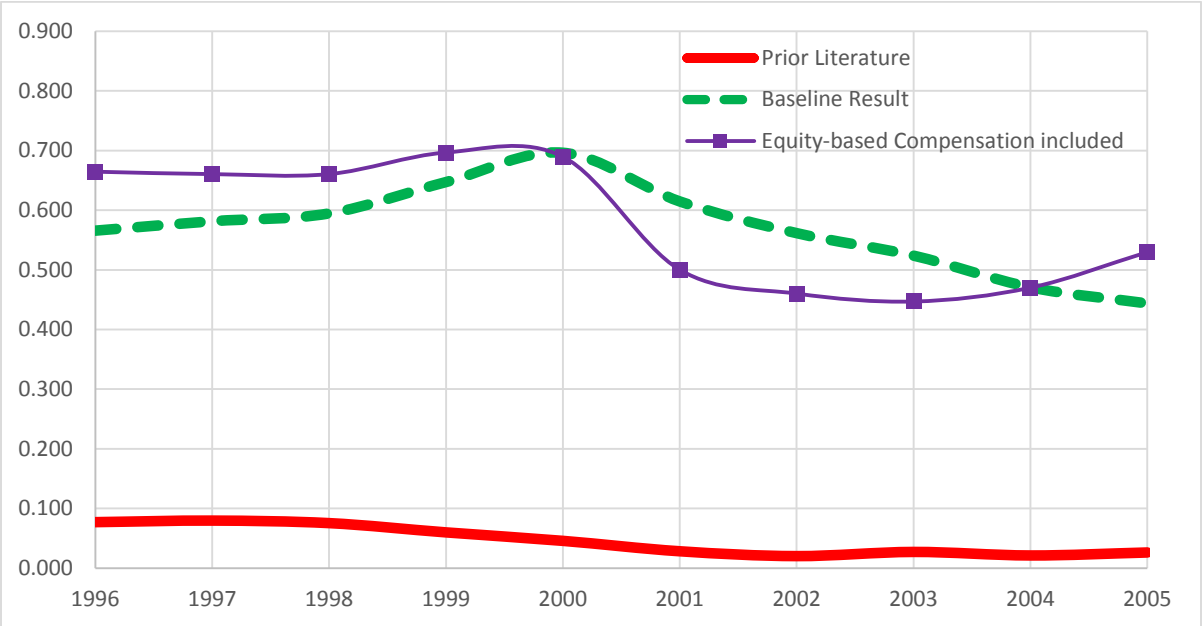


Table I
Summary Statistics

This table reports the summary statistics for the period 1967 to 2013. Total number of observations is 108,286. Assets and Sales are in $ Millions. *Total Investment = Capex + R&D + SG&A + SubJV + M&A*. *Operating CF* = Earnings before Extraordinary Items + Depreciation & Amortization. *Funds for Capex = Operating CF + Opening Cash*. *Available CF = Operating CF + R&D* (1–T) + *SG&A* (1–T). *Total Funds = Available CF + Opening Cash*. We scale all measures by lagged assets. Table A1 provides all variable definitions. Panels B and C provide Spearman correlations. ***, **, and * represent significance at 1%, 5%, and 10% levels of significance.

Panel A: Descriptive Statistics

Variable	Mean	Median	Std. Dev.
Assets	1514.0	172.5	5302.8
Sales	1484.4	191.8	5008.4
Q	1.8	1.3	1.3
% of Non-Manufacturing Firms	42%		
Investment			
Capex	7.9%	5.2%	8.8%
R&D	4.2%	0.0%	8.5%
SG&A	28.2%	22.5%	24.5%
SubJV	2.7%	0.0%	11.9%
M&A	2.6%	0.0%	8.8%
Total Investment	46.7%	38.6%	34.4%
Internal Funds			
Operating CF	8.2%	9.9%	14.9%
Opening Cash	15.6%	7.7%	18.9%
Funds for Capex	23.8%	19.0%	20.7%
Available CF	30.8%	26.8%	22.4%
Total Funds	46.4%	38.8%	30.7%

Panel B: Correlations among Investment Measures

	Capex	R&D	SG&A	SubJV	M&A	Total Investment
Capex	1.00					
R&D	-0.13***	1.00				
SG&A	-0.01***	0.11***	1.00			
SubJV	-0.02***	0.06***	-0.14***	1.00		
M&A	-0.03***	-0.02***	0.003	0.07***	1.00	
Total Investment	0.21***	0.27***	0.76***	0.06***	0.13***	1.00

Panel C: Correlations among Internal Funds Measures

	Operating CF	Opening Cash	Funds for Capex	Available CF	Total Funds
Operating CF	1.00				
Opening Cash	-0.01***	1.00			
Funds for Capex	0.56***	0.72***	1.00		
Available CF	0.52***	0.15***	0.41***	1.00	
Total Funds	0.31***	0.65***	0.77***	0.73***	1.00

Table II

Investment and Internal Funds: Manufacturing vs. Non-Manufacturing

This table reports the means of the components of investment and internal funds for manufacturing and non-manufacturing firms. The data are from 1967-2013. *Total Investment = Capex + R&D + SG&A + SubJV + M&A. Operating CF* = Earnings before Extraordinary Items + Depreciation & Amortization. *Funds for Capex = Operating CF + Opening Cash*. *Available CF = Operating CF + R&D* (1–T) + *SG&A* (1–T). *Total Funds = Available CF + Opening Cash*. We scale all measures by lagged assets. Table A1 provides all variable definitions. *, **, and *** indicate that the mean for the non-manufacturing firms is significantly different from that for manufacturing firms at the 10%, 5%, and 1% significance levels.

	Manufacturing	**Non-Manufacturing**
Investment		
Capex	6.6%	9.5%***
R&D	5.7%	2.2%***
SG&A	27.1%	29.6%***
SubJV	2.9%	2.6%***
M&A	2.3%	3.1%***
Total Investment	45.5%	48.3%***
Internal Funds		
Operating CF	7.6%	8.9%***
Opening Cash	16.0%	14.9%***
Funds for Capex	23.7%	23.9%*
Available CF	30.7%	30.9%*
Total Funds	46.7%	45.9%***

Table III
Investment-Cash Flow Sensitivities: Main Results

The table provides the coefficient estimates from the following regression specification:

$$Investment_{i,t} = \alpha_0 + \beta_1 Internal\ Funds_{i,t} + \beta_2\ q_{i,t-1} + \alpha_i + \alpha_t + \varepsilon_{it}$$

α_0 is the intercept. α_i and α_t denote firm and year fixed effects. $q_{i,t-1}$ is the beginning period market to book ratio. *Investment* is either *Capex* (prior literature) or *Total Investment*. *Internal Funds* is *Operating CF* (prior literature), *Funds for Capex*, *Available CF*, or *Total Funds*. *Total Investment = Capex + R&D + SG&A + SubJV + M&A. Funds for Capex = Operating CF + Opening Cash. Available CF = Operating CF + R&D* (1–T) + *SG&A* (1–T). *Total Funds = Available CF + Opening Cash*. Table A1 provides all variable definitions. *, **, and *** indicate the 10%, 5%, and 1% significance levels.

Row		Compare Rows	Sample of Firms	Investment Measure	Internal Funds Measure	β_1	β_2	N	R^2
				Panel A: Our Results vs. Prior Results					
1	Prior Results		Manufacturing	Capex	Operating CF	0.078*** (17.5)	0.010*** (19.9)	61,206	0.39
2	Our Results		All	Total Investment	Total Funds	0.523*** (50.0)	0.029*** (16.3)	108,286	0.63
				Panel B: Introducing one Innovation at a Time (Relative to Prior Literature)					
3	Considering Non-Mfg.	3 vs 1	Non Manufacturing	Capex	Operating CF	0.125*** (16.2)	0.012*** (18.7)	47,080	0.54
4	Broadening Investment	4 vs 1	Manufacturing	Total Investment	Available CF	0.658*** (41.2)	0.029*** (12.2)	61,206	0.62
5	Broadening Internal Funds	5 vs 1	Manufacturing	Capex	Funds for Capex	0.047*** (10.6)	0.009*** (19.4)	61,206	0.39
				Panel C: Introducing one Innovation at a Time (for All Firms)					
6	Including Non-Mfg.	6 vs 2	All	Capex	Operating CF	0.097*** (23.4)	0.011*** (27.5)	108,286	0.50
7	Broadening Investment	7 vs 6	All	Total Investment	Available CF	0.715*** (62.7)	0.030*** (17.3)	108,286	0.66
8	Broadening Internal Funds	8 vs 6	All	Capex	Funds for Capex	0.063*** (23.9)	0.010*** (26.3)	108,286	0.50

Table IV
Investment-Cash Flow Sensitivities: Robustness

The table provides the coefficient estimates from the following regression specification:

$$Investment_{i,t} = \alpha_0 + \beta_1 Internal\ Funds_{i,t} + \beta_2\, q_{i,t-1} + \alpha_i + \alpha_t + \varepsilon_{it},$$

α_0 is the intercept. α_i and α_t denote firm and year fixed effects. $q_{i,t-1}$ is the beginning period market to book ratio. *Investment* measure used is *Total Investment* and the measure of *Internal Funds* is *Total Funds.* Row 1 results reflect the effect of our three innovations. For Row 1, the sample includes all firms; *Total Investment = Capex + R&D + SG&A + SubJV + M&A*; *Total Funds = Operating CF + R&D (1–T) + SG&A (1–T) + Opening Cash*. Row 2 presents the results after including the full deal value of the M&A, rather than just the cash portion, as an investment. Thus, for Row 2, the sample includes all firms; *Total Investment = Capex + R&D + SubJV + Deal M&A*; *Total Funds = Operating CF + R&D (1–T) + SG&A (1–T) + Opening Cash*. Row 3 includes the value of equity-based compensation issued by the firm to employees as part of funds available for investment. Thus, for Row 3, the sample includes only firms for which we have data on compensation (*Execucomp* firms for the time period 1992-2013), *Total Investment = Capex + R&D (1–T) + SG&A (1–T) + SubJV + M&A*; *Total Funds = Operating CF + R&D (1–T) + SG&A (1–T) + Opening Cash + Value of Equity-Based Compensation to Employees*. Row 4 considers the full deal value of the M&A, rather than the cash portion, as an investment, and includes the equity portion of the M&A as funds available. Thus, for Row 4, the sample includes all firms, *Total Investment = Capex + R&D + SubJV + Deal M&A*; *Total Funds = Operating CF + R&D (1–T) + SG&A (1–T) + Opening Cash + Equity Issued in M&A*. Row 5 allows for the fact that management may view only the post-tax portion of *R&D* and *SG&A* as the actual, effective investment. Thus, for Row 5, the sample includes all firms, *Total Investment = Capex + R&D (1–T) + SG&A (1–T) + SubJV + M&A*; *Total Funds = Operating CF + R&D (1–T) + SG&A (1–T) + Opening Cash*. Row 6 presents the results excluding *SG&A* as an investment. Thus, for Row 6, the sample includes all firms; *Total Investment = Capex + R&D + SubJV + M&A*; *Total Funds = Operating CF + R&D (1–T) + Opening Cash*. Table A1 provides all variable definitions. *, **, and *** indicate the 10%, 5%, and 1% significance levels.

Row	Specification	β1	β2	N	adj. R2
1	Our Baseline Results	0.523***	0.029***	108,286	0.63
		(50.0)	(16.3)		
2	Inclusion of Deal Value of M&A	0.531***	0.066***	83,655	0.51
		(30.5)	(14.1)		
3	Inclusion of Equity-Based Compensation	0.501***	0.017***	10,627	0.67
		(13.0)	(3.4)		
4	Inclusion of M&A Equity	0.817***	0.031***	83,655	0.64
		(56.2)	(10.5)		
5	Adjusting for tax deductibility	0.512***	0.023***	108,286	0.58
	of R&D and SG&A	(52.4)	(13.2)		
6	Exclusion of SG&A	0.208***	0.027***	108,286	0.43
		(23.3)	(17.6)		