# Revisiting Investment–Cash Flow Sensitivity

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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, the importance of manufacturing firms in the U.S. economy, the importance of capital expenditure as the primary type of investment, and the importance of operating cash flow as the primary source of internal funds have all declined. We make three changes that take into account these trends. (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 different 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 at the beginning of the year. Capital expenditure understates true investment, which could lead to underestimating the true investment-cash flow sensitivity. Operating cash flow understates true internal funds, which could lead to overestimating 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. This decline is due to both changing composition of listed firms (primarily new entrants) and changing characteristics of listed firms. Overall, our contribution is to document the importance of using a more comprehensive measure of investments that incorporates 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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**Revisiting Investment–Cash Flow Sensitivity**

A large body of literature, starting with Fazzari, Hubbard, and Petersen (1988), documents that firms' investment is sensitive to their internal funds (termed investment-cash flow sensitivity in the literature). Recent studies (such as Chen and Chen, 2012) document that this sensitivity has declined over time and virtually disappeared in recent years. 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). While most would readily acknowledge that capital expenditure and operating cash flow understate true investment and true source of internal funds, the wedge between the two has grown over time.

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). It is not clear, ex ante, whether this will result in higher or lower investment cash flow sensitivity relative to prior literature. (ii) We broaden the definition of investment to include R&D, SG&A, cash investment in joint ventures/subsidiaries, and the cash used to acquire other firms. Because capital expenditure understates the firm's true investment, we expect that this change will result in higher investment-cash flow sensitivity relative to prior literature. (iii) We broaden the definition of internal funds to include cash holding at the beginning of the year. Because operating cash flow understates the firm's true internal funds, we expect that this will result in lower investment-cash flow sensitivity relative to prior literature. The net impact of all three innovations on the investment-cash flow

sensitivity—both 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 definitions, though the decline is more modest. Importantly, there is no disappearance in sensitivity in recent years as documented by prior literature.

The decline in sensitivity could be because investment has declined holding internal funds constant, or internal funds has increased holding investment constant, or both. Thus, we examine the relation between the ratio of investment to internal funds and investment-cash flow sensitivity. When investment equals capital expenditure (*Capex*) and internal funds equals operating cash flow

(as in prior literature), we find a 93% correlation between the ratio of *Capex* to operating cash flow and the corresponding sensitivity. Thus, the decline in investment-cash flow sensitivity documented by prior literature is due to a decline in the ratio. We then examine whether the decline in the ratio is due to changing composition or due to changing characteristics or both. To examine whether changing composition of firms causes the decline in sensitivity, we sort firms into three groups: those that entered the sample, those that exited the sample, and those that survived. We find that ratio of investment to cash flow is higher for new entrants relative to those that exit the sample, implying that the decline in sensitivity is partly due to change in composition. To examine whether changing characteristics of firms causes the decline in sensitivity, we examine the ratio of investment to cash flow for the same firm 10 years apart. We find that the decline in the ratio for this sample is similar to the decline in the overall ratio, implying that changing firm characteristics also contribute to the decline in investment-cash flow sensitivity.

When we use our broader definitions of investment and cash flow ("total investment" and "total funds"), we find a 68% correlation between the ratio of total investment to total funds and the corresponding sensitivity of investment-to-total funds. The ratio is lower for new entrants relative to those that exit the sample, implying that the decline in sensitivity is partly due to change in composition. Also, the decline in ratio for the same firm over a 10-year period is similar to the decline in the overall ratio, implying that the decline in sensitivity is partly due to change in firm characteristics.

Overall, our contribution is to document that it is important to consider a more comprehensive measure of investment than simply capital expenditure. 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).

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 explain our reasoning below.

### *A. Expand to Include Non-Manufacturing Firms*

With a few exceptions, most papers in this literature examine only manufacturing firms.[1] 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%. 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 such as oil and gas extraction (two-digit SIC 13), coal mining (12), pipelines (46), metal mining (10) etc. In fact, 26 out of the top 27 industries in terms of the ratio of *Capex* to lagged assets are

[1] Examples include Fazzari et al. (1988), Almeida et al., (2004), Allayannis and Mozumdar (2004), and Brown, Hubbard, and Petersen (2009). Chen and Chen (2012) examine the robustness of their main results in a sample of non-manufacturing firms, but they do not consider expanded definitions of investment and cash flow.

in the non-manufacturing sector.[2] The only industry in the manufacturing sector that figures in the top 27 industries by capital expenditure ratio 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 propose that the definition of total investment (*Total Investment*) should include, in addition to *Capex*, R&D expenditure ('*R&D*'), selling and general administrative expenditure ('*SG&A*'), cash investment in subsidiaries and joint ventures ('*SubJV*'), and cash utilized in mergers and acquisitions ('*M&A*'). Below, we provide support for our arguments using prior literature as well as excerpts from corporate statements.

We motivate the broadening of the definition of investment from three different angles. We propose (i) including investment in human capital as a factor of production, (ii) including investments across the entire product life cycle, and (iii) including investments made through the income statement as well as considering the full scope of investments made through the balance sheet.

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 not investment in

[2] This number is based on the most recent five-year period in our sample.

human capital. Investments in human capital are likely to show up in the form of *R&D* and *SG&A* rather than *Capex*.[3]

We also propose that we include *R&D* and *SG&A* because these are investments made across the 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.

A third alternative motivation for the inclusion of *R&D* and *SG&A* can be found in this quote from Aerovironment in its earnings call, where they state that their "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*—an investment in the balance sheet—it ignores investments such as *R&D* and *SG&A*, which are investments through the income statement. *SG&A* includes marketing and advertising expenses, information technology expenses, exploration expenses and geological and geophysical expenses for extractive industries.

Supporting our view that firms consider *R&D* as an investment, the CEO of LinkedIn, in the April 2015 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…our personnel costs totaled 27% of revenues." Such costs of highly-skilled personnel is likely to show up under *R&D*. Consistent with the argument that investment in *R&D*

[3] 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..."

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."[4]

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.[5] These firms have great products but cannot grow without substantial investment in *SG&A* in order to enter new verticals and new geographies.

We consider *R&D*, *Capex*, and *SG&A* collectively as the internal investment of the firm. In addition to internal investment, firms may choose to do external investment. We consider two such investments: (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.

The choice between internal and external investment may depend on the regulatory

[4] 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, investment in subsidiaries and joint ventures etc.) and other sources of internal funds (such as lagged cash holding). Further, the first study includes only high-tech firms, while the second considers only manufacturing firms.

[5] 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." Faro Technologies comments in its earnings call in its April 2015 that the firm "will continue to hire account managers for growing geographies and vertical markets." 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…"

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."

The choice between internal and external investment may also depend on the type of firm, industry, and macroeconomic conditions. Some firms do not rely on acquisition to capitalize on the growth opportunities. For example, 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." For some other firms, *M&A* could substitute for *Capex* and *R&D* and some firms explicitly include M&A in their internal models.[6] Market participants understand this. 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."[7]

Sometimes investment in *M&A* is not to add physical assets but to add personnel quickly (termed "Acquihires" in Wall Street). For example, MercadoLibre (the Ebay of Latin America) in its earnings call in Feb 2015 commented: "we purchased BVision, a 131-person Argentine software solutions provider…This welcome addition grows our development head count over 25% by adding a talented additional pool of engineers."[8]

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[6] For example, an analyst report on Tesco Corp. states: "(the firm's) strategic plan calls for TS revenue to grow from $213mm in 2013 to $540mm in 2018 (a 20% CAGR), with M&A accounting for roughly half of the growth." Cvent in its earnings call from the 1st calendar quarter of 2016 states that they have "made significant investments to enhance our technology through both internal development and acquisitions."

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

[8] Another example…the CEO of The Rubicon Project Inc., in its earnings call in May 2015, has the following comment on the acquisition of Chango: "Chango's technology will accelerate our buyer technology roadmap and hiring plans by more than one year."

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, external investment can have a significant impact on growth. For example, WhiteWave Foods notes: "In 2014 total net sales increased over 35%, which included a robust 12% organic top-line growth."

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

The proportion of the three types of internal investment (*R&D*, *Capex*, *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."[10] 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 all the investments gives true picture of actual investments.

The proportion of each of these investments could also vary by industry, and even within

[9] Cvent in its earnings call in the 1st calendar quarter of 2016 states: "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] Similarly, the CEO of startup Tegile Systems notes: "I would say 75% of the spend now is focused on the selling and marketing."

the same industry, could vary by firm.[11] Thus, once again, it is important to sum up the investments rather than look at individual components.

Generally, to the extent that the individual components of investments are substitutes, it is important to add up the investment instead of examining each separately. In fact, empirically, we find that the correlation between the four components of investments that we introduce and *Capex* is negative (see Section III for details).

### *C. Broaden the Definition of Internal Funds*

Finally, we propose that the definition of internal funds ('*Internal Funds*') should include, in addition to operating cash flow ('*Operating CF'*), the lagged cash holding ('*Lagged Cash Holding*'). 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. 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*.

[11] For example, within the semiconductor chip industry, there are three types of firms: (i) firms like Qualcomm 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 2.6%, 21.5%, and 10.9% for the three firms for 2014) and so is their *R&D*/Assets (12.4%, 4.2%, and 12.5%).

Supporting the idea that firms view *Lagged Cash Holding* as an important source of capital for 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."

## 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 and traded on the NYSE, AMEX, and NASDAQ, (ii) exclude finance firms and utilities, (iii) exclude firms with book assets or sales smaller than one million dollars, and (iv) include only firms with data on all the variables that are needed to estimate *Total Investment*, *Total Funds*, and *q* (the proxy for growth opportunities). *q* is defined as the ratio of market value of assets to the book value of assets. Throughout the paper, we winsorize all variables at the 1$^{st}$ and 99$^{th}$ 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.[12] 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 + Lagged Cash Holding. Lagged Cash Holding* 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 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 *Lagged Cash Holdings*. *Funds for Capex*, as the phrase indicates, is the funds available to undertake investments in *Capex*.

When we consider *Total Investment* as our measure of investment, we modify the cash flow measure by adding *R&D* $\times$(1–T) + *SG&A* $\times$(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*

[12] 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.

*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*. Finally, we add *Lagged Cash Holdings* to *Available CF* to arrive at *Total Funds*, which is the total funds available to make *Total Investment*.

## 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 *Lagged Cash Holding*. 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 58% of the firms are from the 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. 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*, accounts for 8.2% of assets. *Lagged Cash Holding* 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 *Lagged Cash Holding* is very low (= –0.01), though it is statistically significant. *Operating CF* is correlated positively with *Total Funds* (correlation = 31%). *Lagged Cash Holding* appears to be a better proxy for internal funds (relative to *Operating CF*) as it has a higher correlation with *Total Funds* (correlation = 65%).

Overall, the numbers presented here suggest that using the broader definitions of investment and internal funds is important, not just in theory, 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, so our first observation is for the year 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. 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* was higher than *R&D*, *SubJV*, and *M&A* combined, but for the next 20 years (from 1994–2013), it was 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.[13]

Overall, we find that *Total Investment* increased from 38% to 55% at the peak of the

[13] While we view SG&A as an important part of firms' investments, our inferences remain unchanged if we exclude SG&A from the investment measure.

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. While Panel C of Figure 1 shows the time-series pattern in *Operating CF*, Panel A of Figure 3 shows the pattern for *Lagged Cash Holding*. *Operating CF* has declined over time from 10.8% to 5.4%. *Lagged Cash Holding*, in contrast, has increased over time (as in Bates, Kahle and Stulz, 2009) from 8.4% to 21.2%. From 1985 onwards, *Lagged Cash Holding* is higher than *Operating CF*.

Overall, *Total Funds* has increased steadily from about 35% to 50%. 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 ratio of *Operating CF* to *Total Funds* falls from 58% to 39%.

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 *Lagged Cash Holding* 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, in terms of *M&A*, 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%). Relative to *Operating CF, Lagged Cash Holding* is much larger for both types of firms (16.0% vs. 7.6% for manufacturing; 14.9% vs. 8.9% for non-manufacturing).

Just as *Total Investment* scaled by assets is similar across manufacturing and non-

manufacturing firms, *Total Funds* scaled by assets is 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 $\alpha_i$ and $\alpha_t$. $q_{i,t-1}$ is the beginning period market to book ratio, a proxy for investment opportunities. $\beta_1$ measures the sensitivity of investment to cash-flow, and is the focus of our analysis. $\beta_2$ measures the sensitivity of investment to $q$.

Table III reports the results. The t-statistics arebased 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.

While the focus of our paper is not on the sensitivity of investment to *q*, we find it interesting that—both here and in the results that follow—this sensitivity is nearly 200% higher (0.029 vs. 0.010) 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 much more important than *Capex* itself.

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. 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.

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. When true investment is more than what we have used thus far (*Capex*), the investment-cash flow sensitivity, as expected, 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 *OCF*. 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 *Lagged Cash Holdings* 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 (*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 cash flow 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 630%, 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.

Finally, we comment on the $R^2$ from the various regressions. Comparing rows 1 and 2, we find that $R^2$ increases substantially from 39% to 63%, which provides some indirect validation for our motivation to broaden the sample, investment measure, and internal funds measure. Comparing rows 1 and 2, 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. This provides strong support for including non-manufacturing firms in any study of investment-cash flow sensitivity. Finally, comparing rows 1 and 4 reveals that for manufacturing firms, broadening the definition of investment (to *Total Investment*) and internal funds (to *Total Funds*) results in an increase in $R^2$ from 39% to 62%.

## 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.[14]

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 has hovered below 0.1. This trend is evident for non-manufacturing firms also (dotted line). The sensitivity for non-manufacturing firms is almost always higher than that for manufacturing firms. This is consistent with the results from Table III, which showed that non-manufacturing firms have higher overall 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 almost always 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

[14] Brown et al. (2009) estimate sensitivity for different non-overlapping 10-year periods. Chen and Chen (2012) perform regressions for non-overlapping five-year periods.

*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.

## *A. Causes for Declining Trend in Sensitivity*

In this section, we try to understand the reasons for the observed decline in the sensitivity of investment to internal funds. We expect the sensitivity to decline if (i) investment declines while holding internal funds constant or (ii) internal funds increases while holding investment constant or both. That is, if investment declines at a faster rate relative to internal funds, it is possible to observe the decline in investment-cash flow sensitivity. To examine this explanation, we first compute the ratio of investment to internal funds at the aggregate level. Specifically, we link *Capex–Operating CF* sensitivity to the aggregate *Capex–Operating CF* ratio and *Total Investment–Total Funds* sensitivity to the aggregate *Total Investment–Total Funds* ratio.

Panels A and B of Figure 5 plot the two sensitivities along with their corresponding ratios. To be consistent with the regression estimates, we compute the ratios for rolling 5-year periods. In both cases, it is clear that the ratio tracks the sensitivities. We find that the correlation between the *Capex–Operating CF* ratio and the corresponding sensitivity is 93% and the correlation between the *Total Investment–Total Funds* ratio and the corresponding sensitivity is 68%. Thus, it appears that a declining trend in investment-to-internal funds ratio could explain the declining trend in investment to cash flow sensitivity.

### *A.1. Is it Changing Composition or Changing Characteristics?*

Next, we try to understand why these ratios are declining in the economy. Is it because of changing composition of listed firms, changing characteristics of listed firms, or a combination of both?

To examine whether it is changing composition of listed firms, for any given year, we first

put firms into three bins based on whether they joined the sample, exited the sample, or remained in the sample. We use the year 2000 to illustrate how we form our sample. (i) *IPO* group consists of firms that entered in 2000, but were not in the sample in 1999. (ii) *Exit* group consists of firms for whom the last available data is for 2000. (iii) *Survive* group consists of firm that survived 2000; i.e., they were also in the sample in 1999 and 2001. Clearly, we cannot classify firms accurately in 1967 (first year) and 2013 (last year), and hence we drop them. We smooth the time series by computing the average across all firms within each group over rolling 5-year periods. Thus, the ratio for 1972 corresponds to the first 5-year period 1968–1972 and the ratio for 2012 corresponds to the last 5-year period 2008–2012. Panels A and B of Figure 6 plots the mean *Capex–Operating CF* ratio and *Total Investment–Total Funds* ratio for the three groups of firms.

We find that the time trend for the *Survive* group (in both Panels) essentially mirrors the trend for the overall ratio given in Figure 5. It is hard to see this from Figure 6, but when we plot the ratio for the full sample (from Figure 5) and the ratio for the *Survive* group (from Figure 6) in one graph, the two lines are virtually indistinguishable.

We present the formal analysis of a test of changing composition in Table IV. Panel A reports the analysis for *Capex–Operating CF* sensitivity. We report the change in *Capex–Operating CF* ratio from 2012 to 1972 for the overall sample as well as for the three groups. We also report the correlations of the *Capex–Operating CF* ratio with the *Capex–Operating CF* sensitivity. We find that for the *Survive* group, the ratio declines by 50% (vs. 51% for overall sample) and the correlation of *Capex–Operating CF* sensitivity with *Capex–Operating CF* ratio is 92% (vs. 93% for the overall sample). Thus, the *Survive* group is like the overall group.

We find that the ratio declines by 58% for the *IPO* group (vs. 51% for overall sample) but by only 44% for the *Exit* group. Moreover, the correlation of *Capex–Operating CF* sensitivity

with *Capex–Operating CF* ratio for the *IPO* group is 90% (vs. 93% for the overall sample) whereas it is only 72% for the *Exit* group. Thus, it appears the *IPO* group is partly responsible for the decline in the ratio and, hence, the decline in sensitivity. That is, we can attribute the decline in sensitivity to the changing composition of listed firms, particularly the new entrants. This makes sense because it is likely that the new entrants are hi-tech and new economy firms that invest more in *R&D* rather than *Capex* and are also less profitable.

Panel B reports the analysis for *Total Investment–Total Funds* sensitivity. The inferences are similar. The change in ratio and the correlation of the ratio with sensitivity of the *Survive* group is similar to the overall sample. The correlation of the ratio with the sensitivity for the *IPO* group is closer to the overall correlation, while the correlation for the *Exit* group is much lower than that for the overall sample. Thus, once again, the declining sensitivity can be explained partly by the new entrants.

To examine whether changing characteristics of listed firms are partly responsible for the decline in sensitivity, we do a matched firm comparison of the ratios across two time intervals, say, 10 years. One reason that a given firm could reduce its reliance on capital expenditure could be due to outsourcing becoming more profitable over the last few decades. We use the year 2000 to illustrate how we form our sample. For the year 2000, we consider firms that existed in 2000 and 2010 (10 years later) and firms that existed in 2000 and 1990 (10 years earlier). Effectively, we are looking at 10-year survivor sample. We look back 10 years and look ahead 10 years to form our sample, which allows us to identify a larger sample of survivors. Clearly, for any of the first 10 years of the sample (1967–1976), we can only include firms that existed in that year and 10 years later. Similarly, for any of the last 10 years of our sample (2004–2013), we can only include firms that existed in that year and 10 years earlier. Having identified the firms we can

include for any given year in our sample, we then smooth the values by computing the average over rolling 5-year periods. Thus, the ratio for 1972 corresponds to the first 5-year period 1967–1972 and the ratio for 2012 corresponds to the last 5-year period 2008–2012.[15]

Panels A and B of Figure 7 plot the mean of *Capex–Operating CF* ratio and *Total Investment–Total Funds* ratio for the sample of firms that existed for at least 10 years. We do find a decline in ratio in both cases. Table IV reports the decline in ratio over the 1972 to 2012. We observe a 48% decline in *Capex–Operating CF* ratio (vs. 51% decline for the overall sample) and 13% decline in the *Total Investment–Total Funds* ratio (vs. 12% decline for the overall sample). The correlation of the ratio with the sensitivities are 91% (Panel A) and 66% (Panel B). These correlations are similar to that observed for the overall sample (93% and 68%). These imply that changing characteristics are partly responsible for the decline in the overall ratio, and hence the decline in sensitivity.

Overall, we conclude from this analysis is that changing composition and changing characteristics are responsible for the decline in sensitivity.

## VI. 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

[15] We ignore the first and last year to make the time series the same for analysis of change in composition and change in characteristics.

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. We find that this decline is due to both changing composition of listed firms (primarily new entrants) and changing characteristics of listed firms.

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 as a proxy for agency problems. The inferences of these studies may be quite different if broader measures of investment or cash flow are used.

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## Appendix

Definitions of key variables used in the paper. Variable definitions are from Compustat unless otherwise stated.

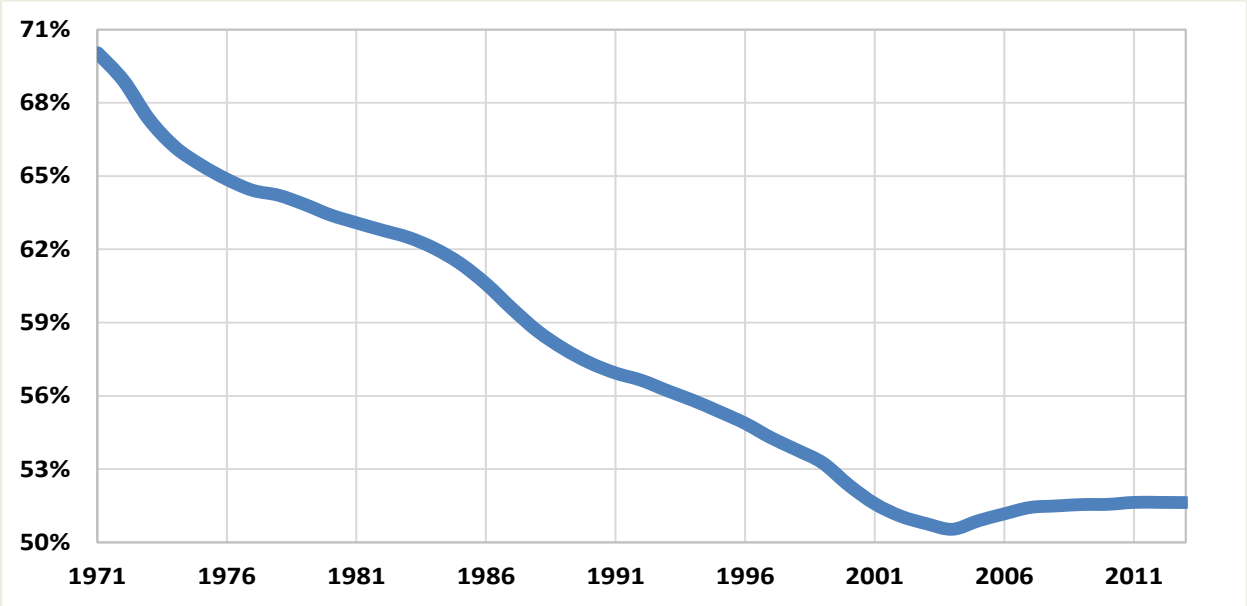
| Variable | Definition | Mnemonic |
|---|---|---|
| Assets | Total Assets | at |
| Sales | Net Sales | sale |
| q | (Assets – Book equity + Market equity) / Assets | (at – ceq + prcc_f×csho) / at |
| *Investment* | | |
| Capex | Capital Expenditure | capx |
| R&D | Research and Development Expense | xrd |
| SG&A[16] | Selling, General and Administrative Expense | xsga – xrd if xsga ≥ xrd<br>xsga if xsga < xrd |
| 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 and amortization | (ib + dp) |
| Lagged Cash Holding | Beginning of period cash holdings | lagged che |
| Funds for Capex | Operating CF + Lagged Cash Holding | |
| Available CF | Operating CF + R&D(1–T) + SG&A(1–T) | |
| Total Funds | Available CF + Lagged Cash Holding | |

[16] 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.

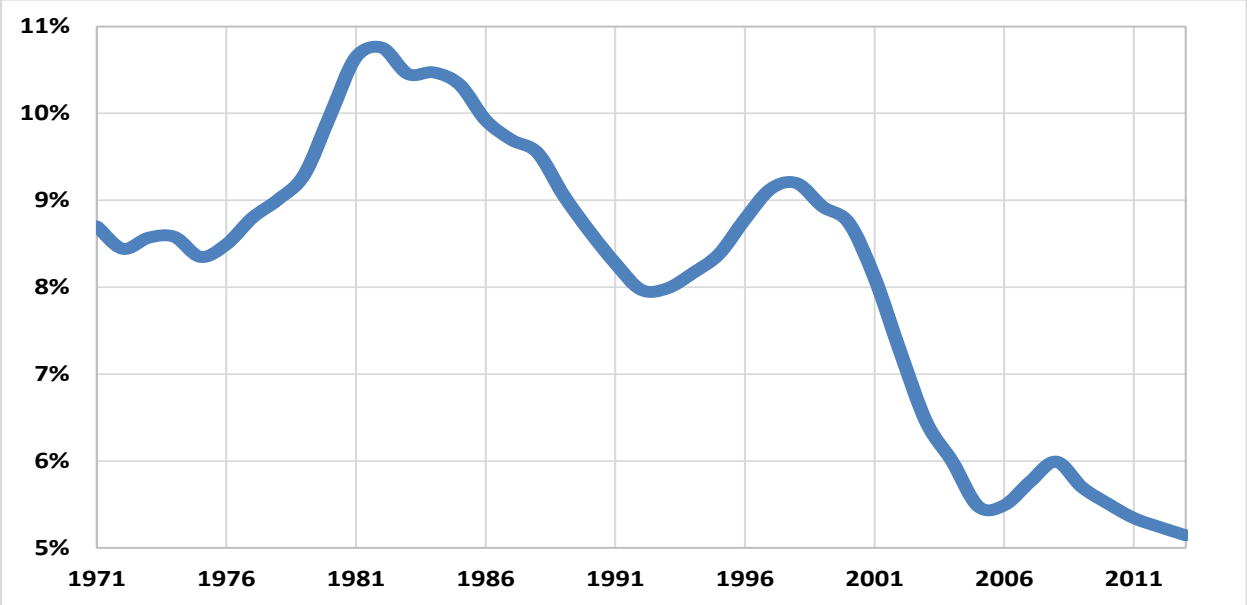
**Figure 1**
**Declining Trend in Key Variables in Investment-Cash Flow Sensitivity**

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**

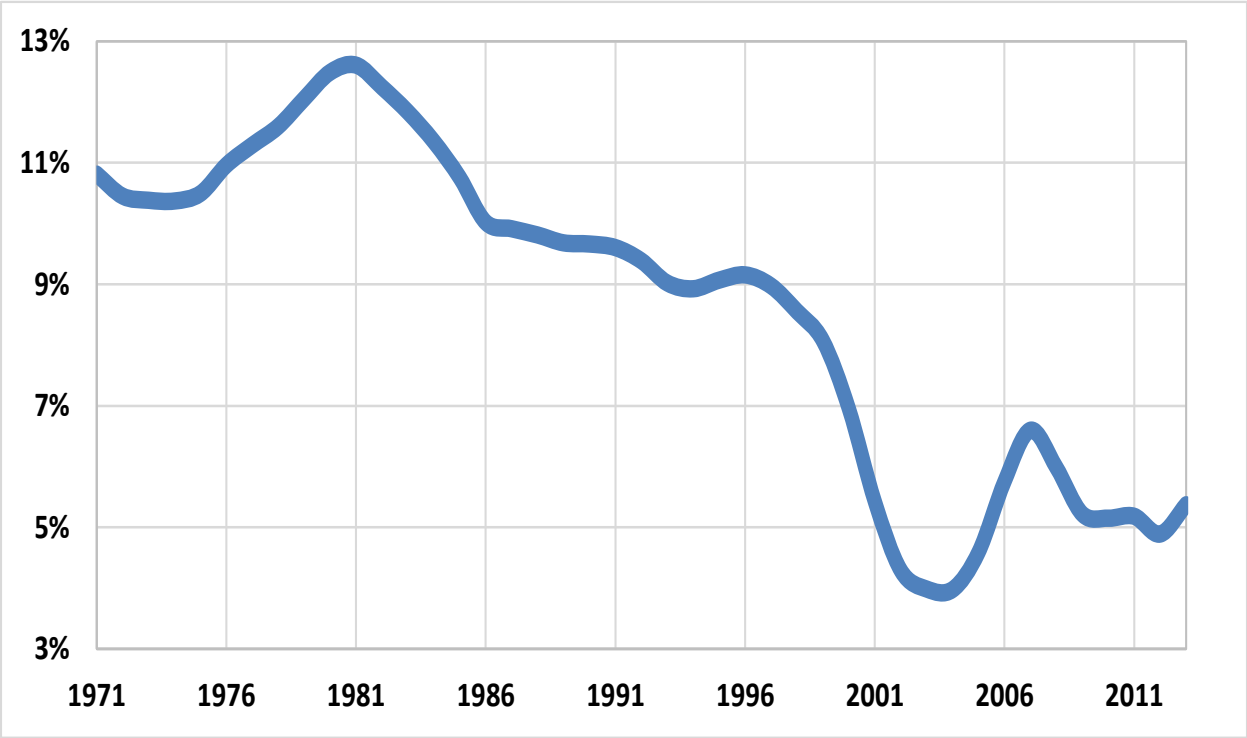
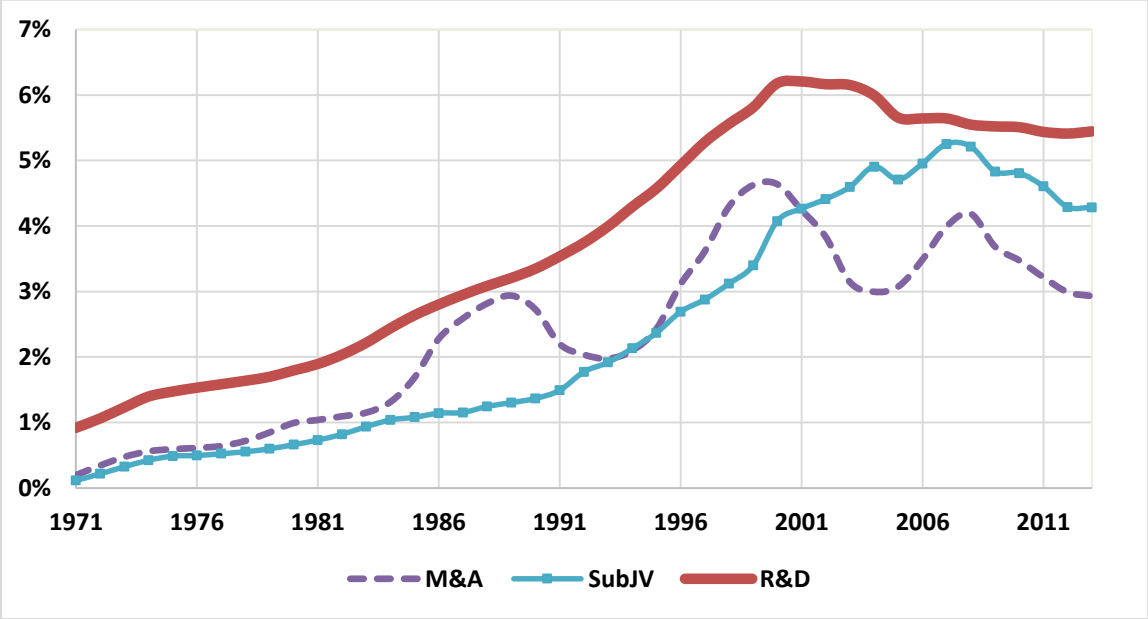


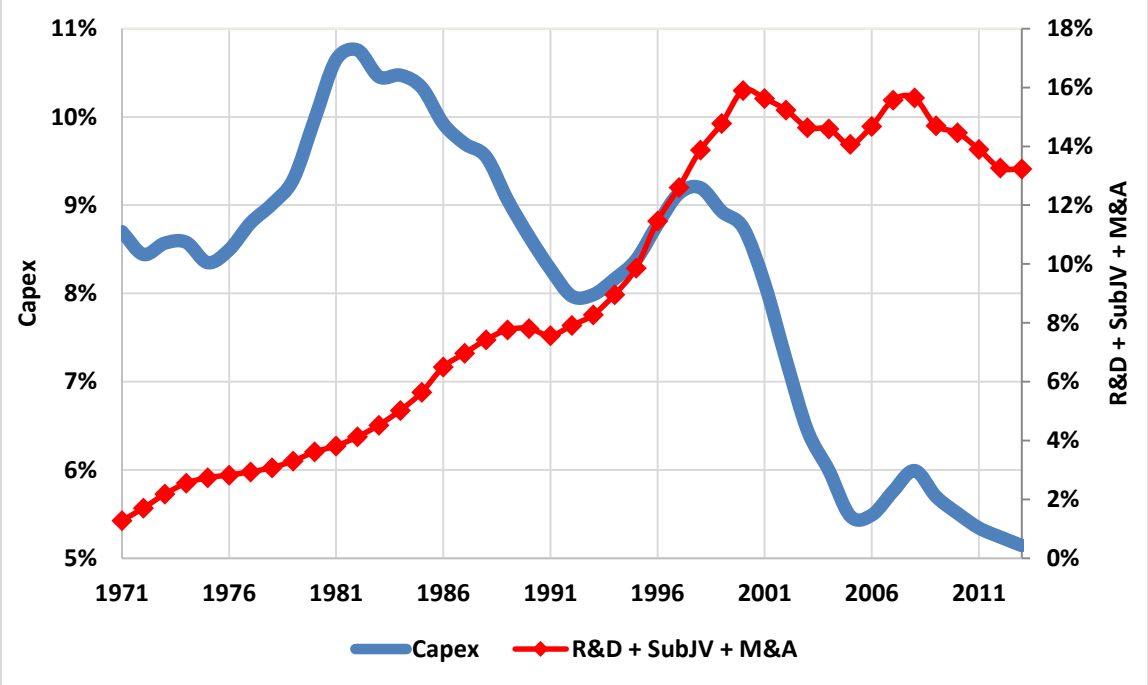
**Figure 2**
**Importance of Various Types of Investment**

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*.

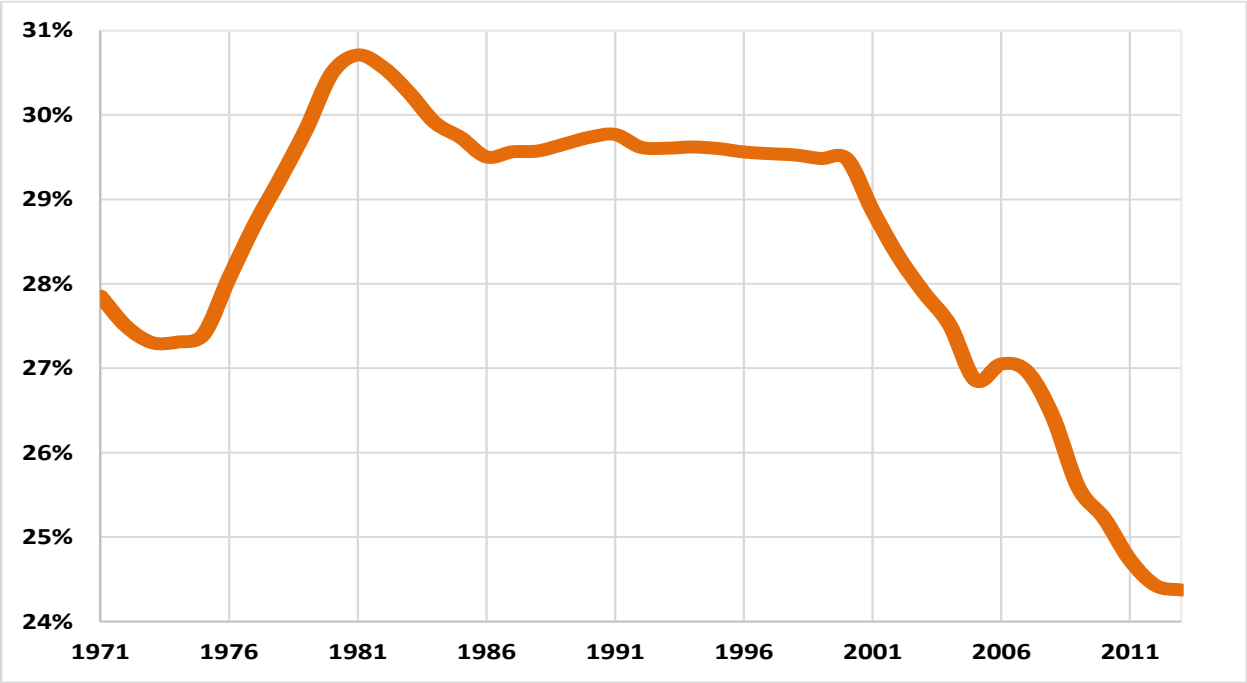
**Panel A: Increasing Non-Capex Investments**



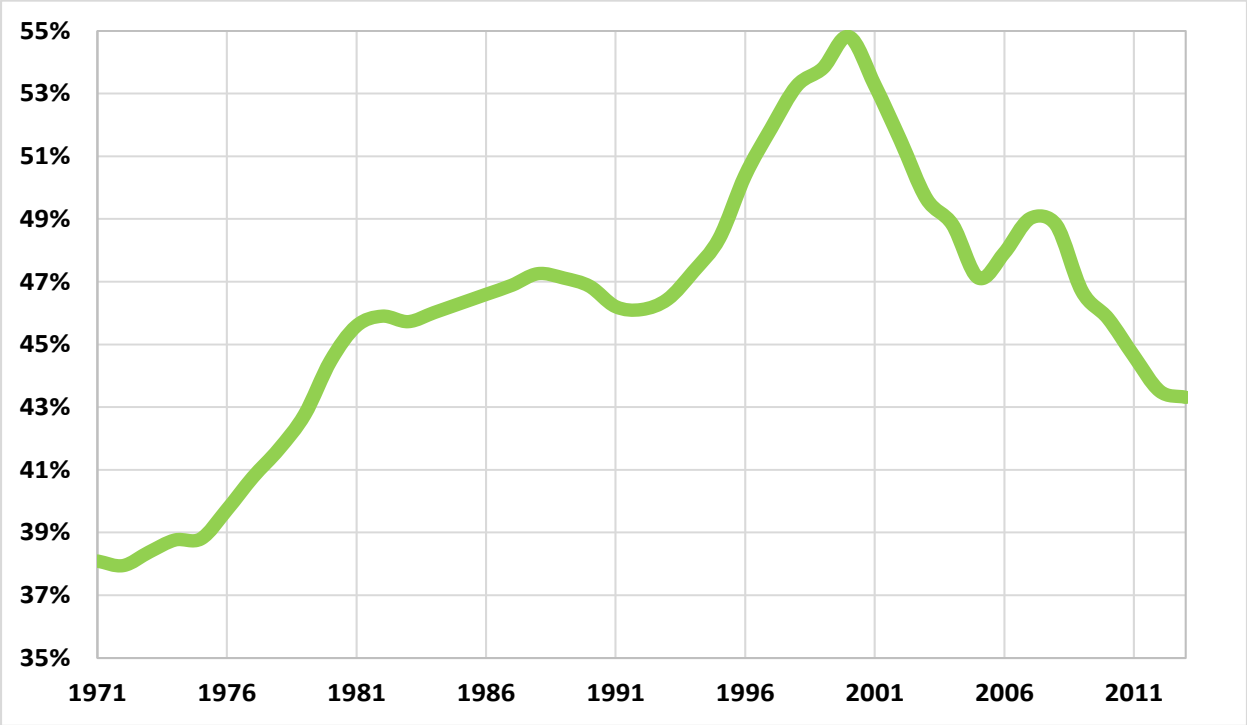

**Panel B: Declining Capex vs. Increasing Non-Capex Investments**



**Panel C: Large and Declining SG&A**




**Panel D: Total Investment**



**Panel E: Relative Importance of Capex**

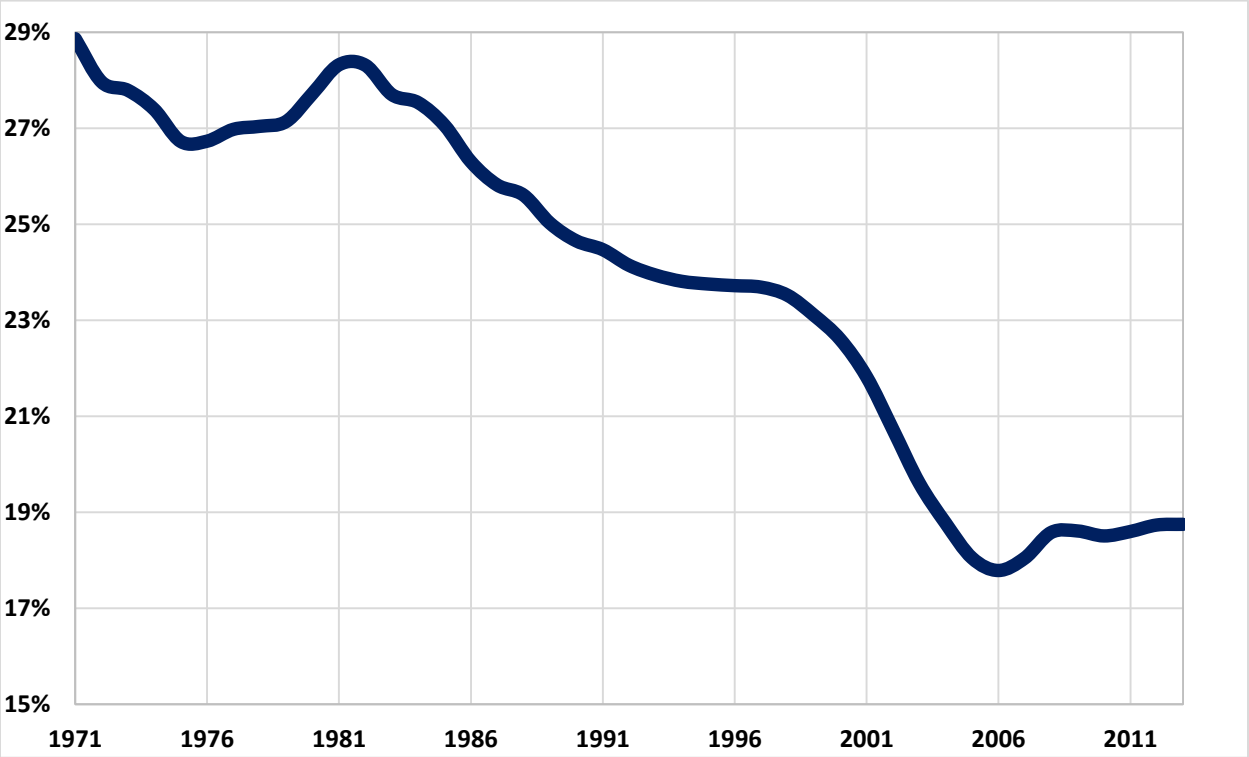
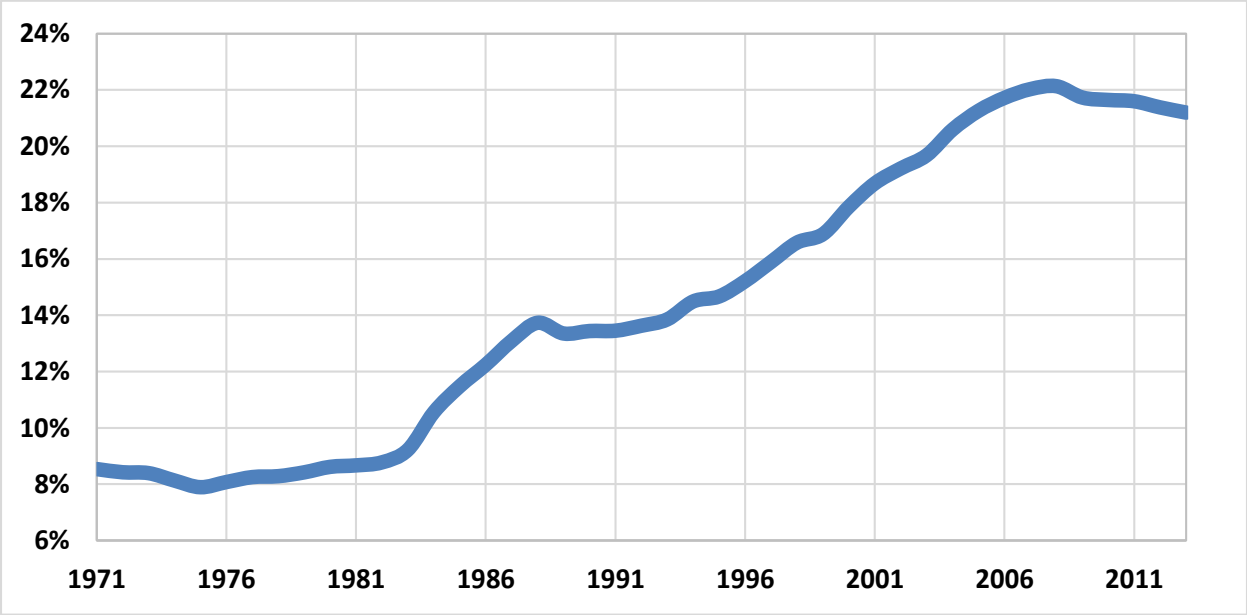


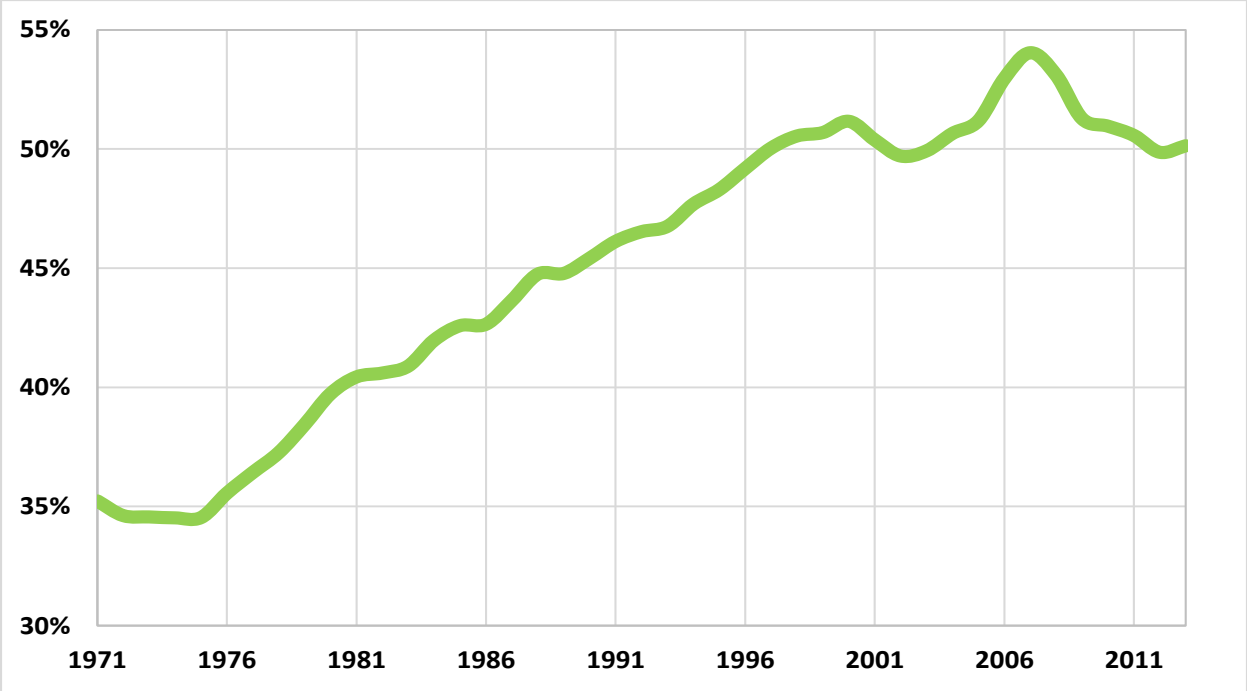
**Figure 3**
**Importance of Various Sources of Internal Funds**

Panels A and B plots the rolling 5-year average of various measures of internal funds, 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 Lagged Cash Holding**




**Panel B: Total Funds**



**Panel C: Relative Importance of Operating CF**

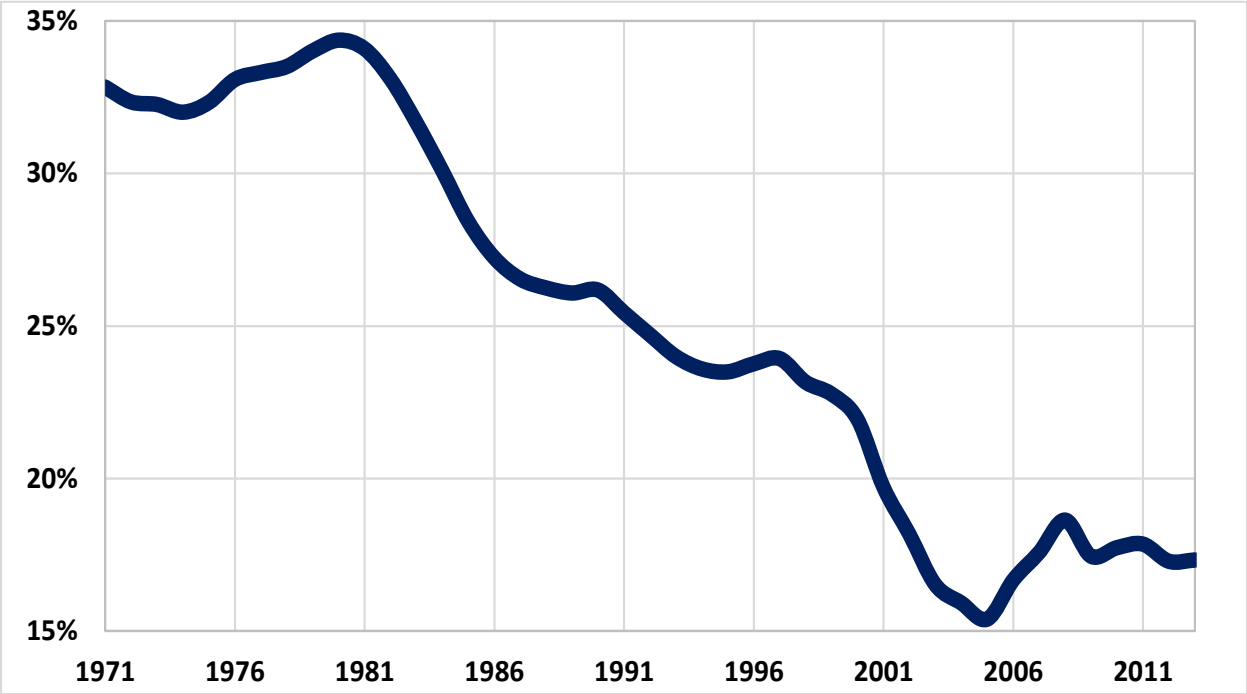


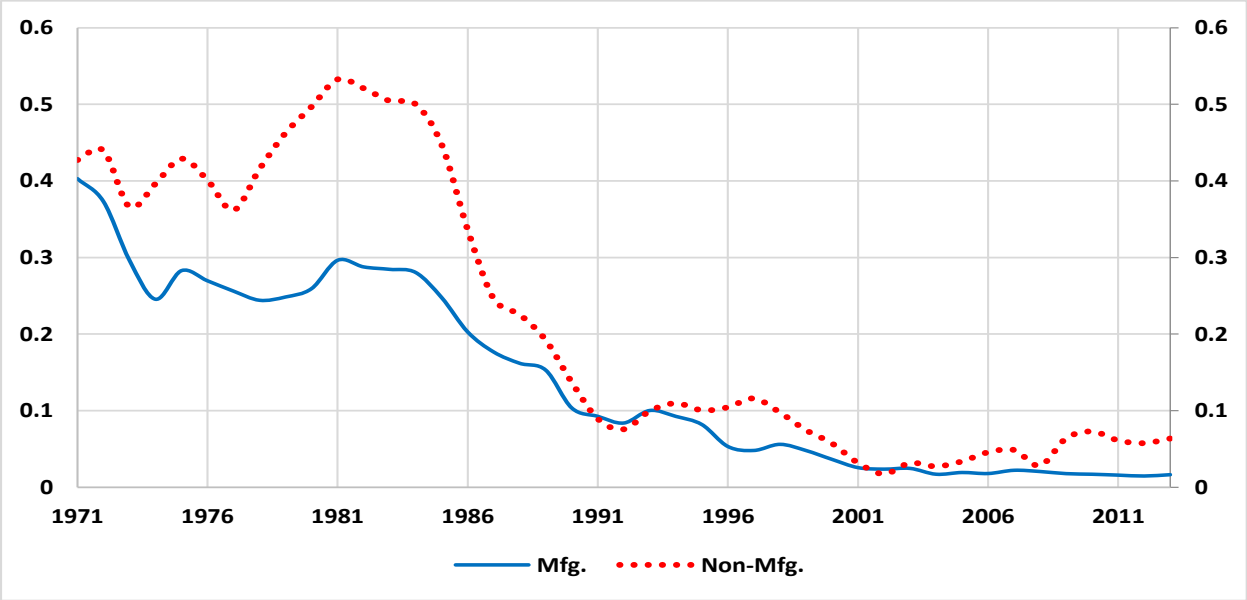
**Figure 4**
**Trend in Investment-Cash Flow Sensitivity**

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

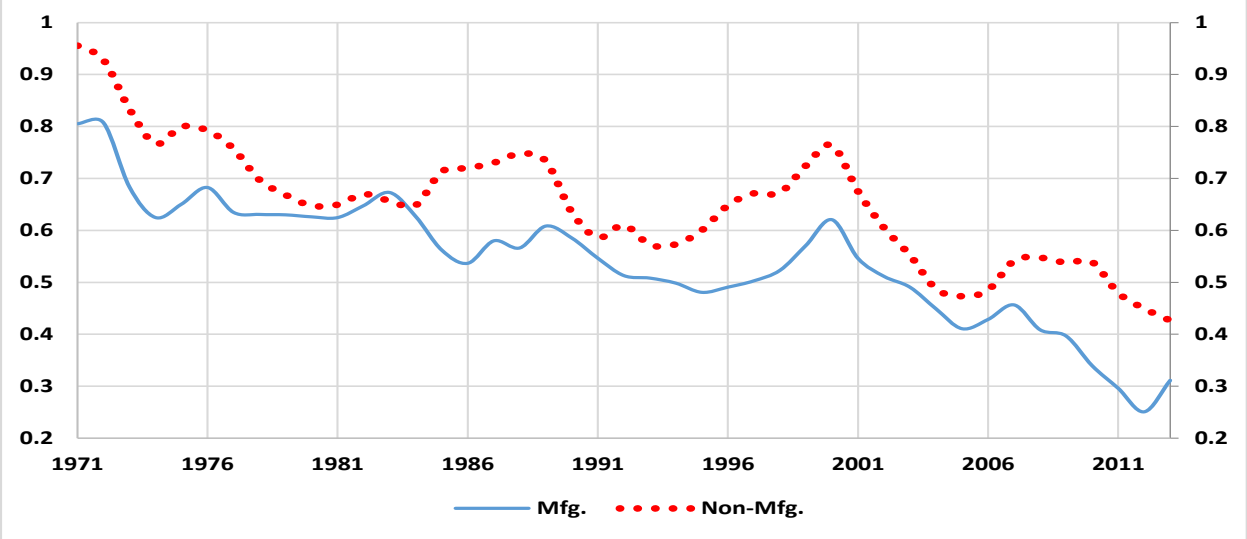
$$Investment_{i,t} = \alpha \quad + \beta_1 Internal\ Funds_{i,t} + \beta_2\, q_{i,t-1} + \alpha_i + \alpha_t + \varepsilon_{it},$$

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. $\alpha_i$ and $\alpha_t$ 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*.

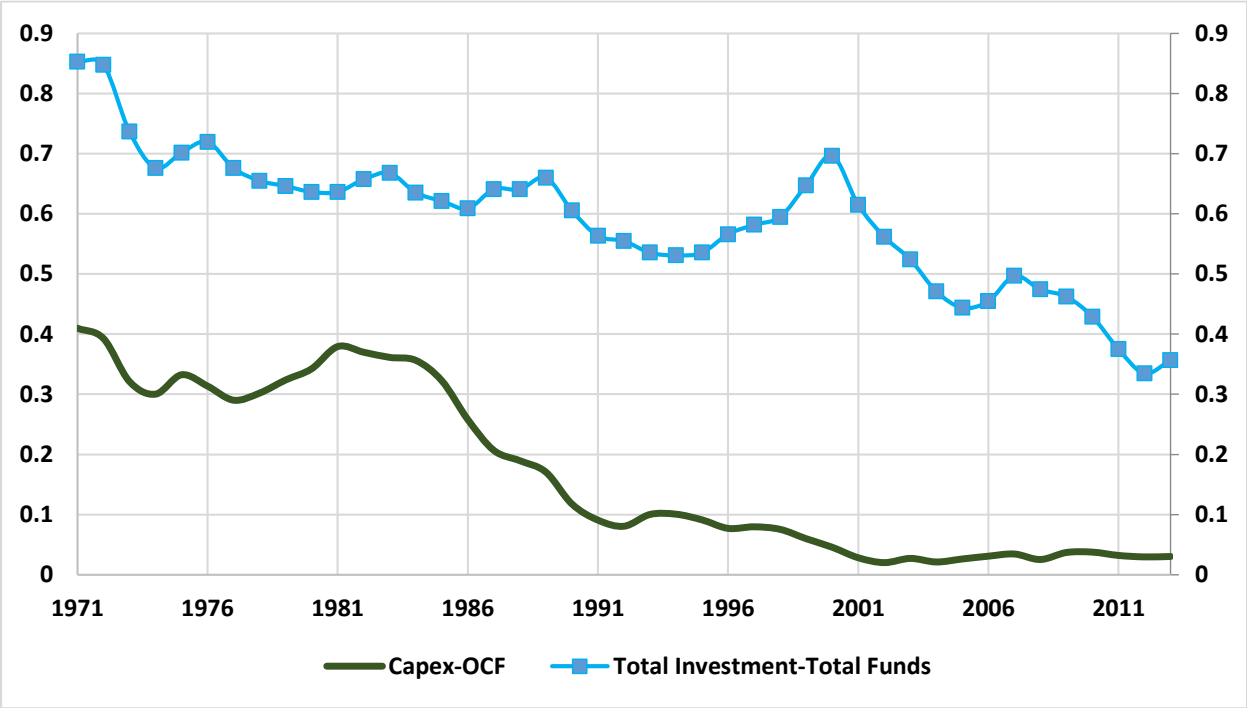
**Panel A: Capex–Operating CF Sensitivity**




**Panel B: Total Investment–Total Funds Sensitivity**



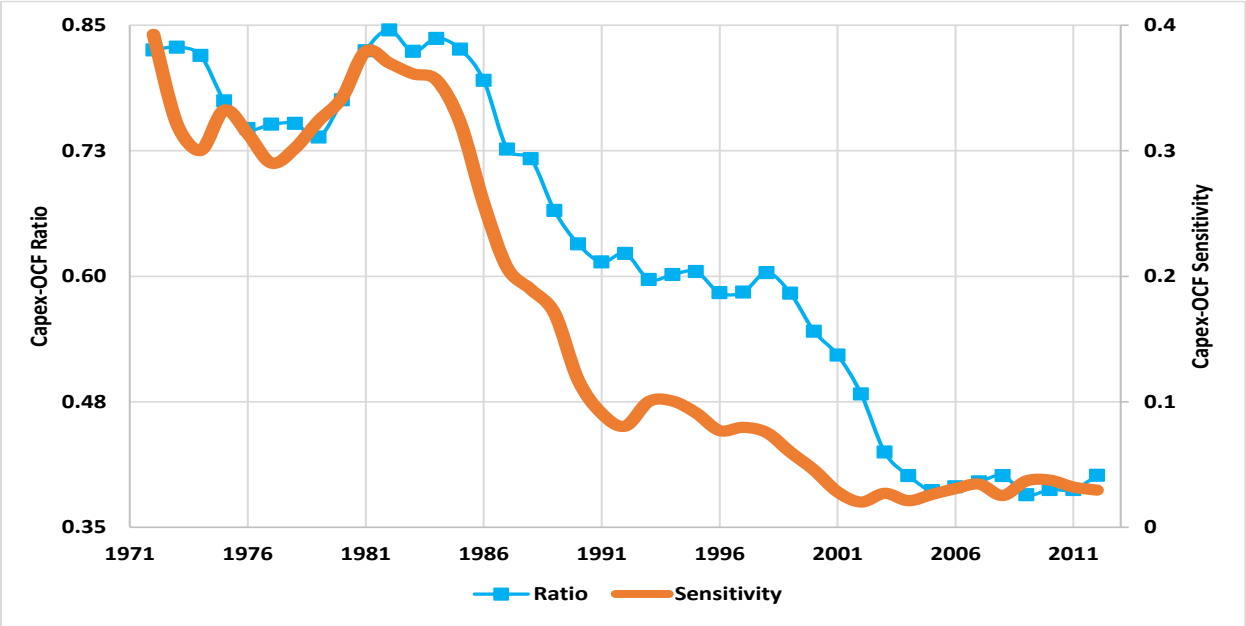
**Panel C: Comparison of Capex–Operating CF Sensitivity and Total Investment–Total Funds Sensitivity**



## Figure 5
## Investment–Cash Flow Sensitivity and Investment–Cash Flow Ratio

The figures plot the investment-cash flow sensitivity from rolling 5-year regressions and the corresponding rolling 5-year averages of investment to internal funds ratios. In Panel A, investment = *Capex* and internal funds = *Operating CF*. In Panel B, investment = *Total Investment* and internal funds = *Total Funds*.

### Panel A: Capex–Operating CF Sensitivity and Capex–Operating CF Ratio




### Panel B: Total Investment–Total Funds Sensitivity and Total Investment–Total Funds Ratio

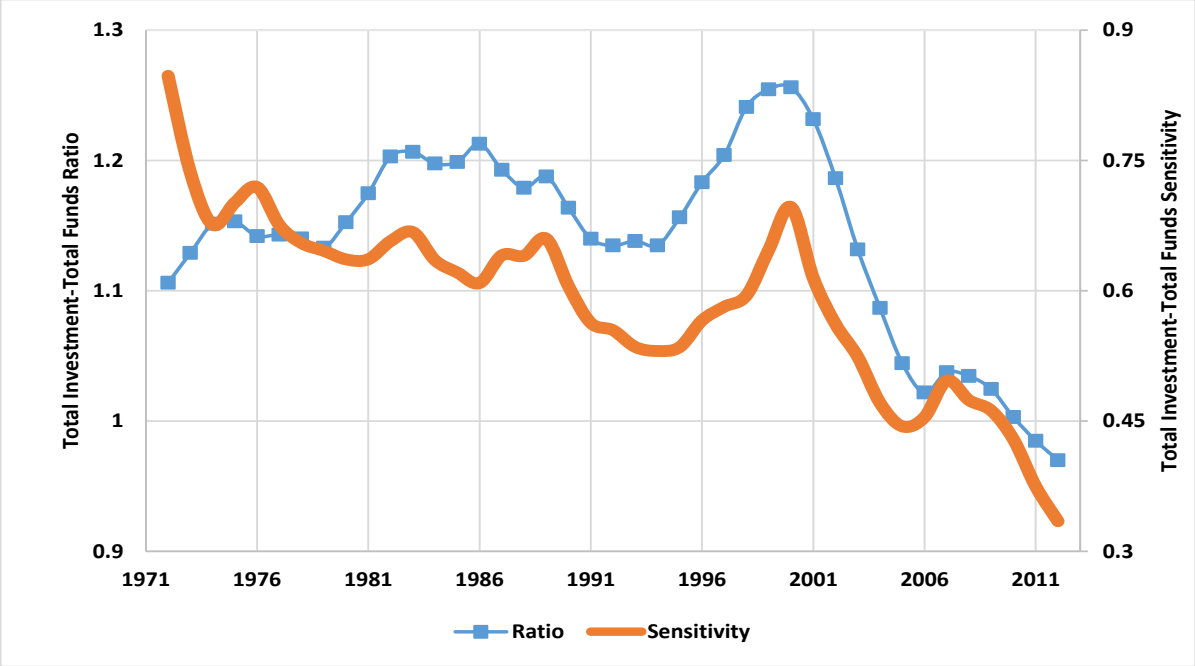
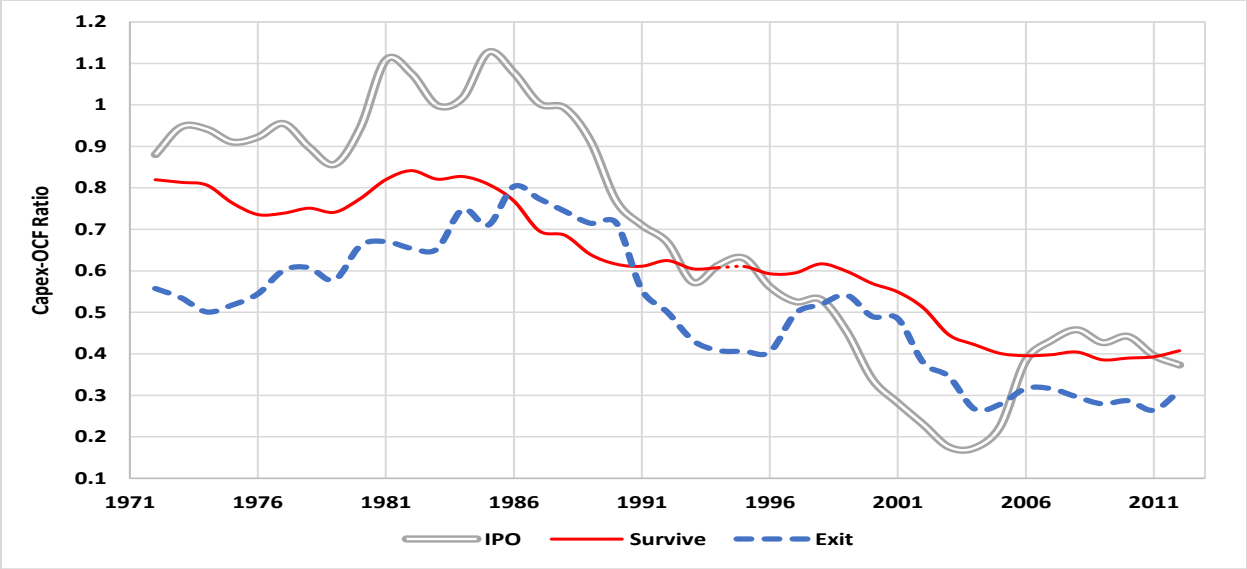


**Figure 6**
**Is the Decline in Sensitivity due to Changing Composition?**

To examine, changing composition of listed firms, for any given year, we first put firms into three bins based on whether they joined the sample, exited the sample, or remained in the sample. We use the year 2000 to illustrate how we form our sample. (i) *IPO* group consists of firms that entered in 2000, but not in the sample in 1999. (ii) *Exit* group consists of firms for whom the last available data is for 2000. (iii) *Survive* group consists of firm that survived 2000; i.e., they were in sample in 1999 and 2001 also. Clearly, we cannot classify firms accurately in 1967 (first year) and 2013 (last year), and hence we drop them. We smooth the time series by computing the average ratio across all firms within a group for rolling 5-year periods. Thus, the first 5-year period is for 1968–1972, and the numbers for this period are plotted under 1972. Panels A and B plot the mean for the three groups of firms for *Capex–Operating CF* ratio and *Total Investment–Total Funds* ratio.

**Panel A: Capex–Operating CF Ratio**




**Panel B: Total Investment–Total Funds Ratio**

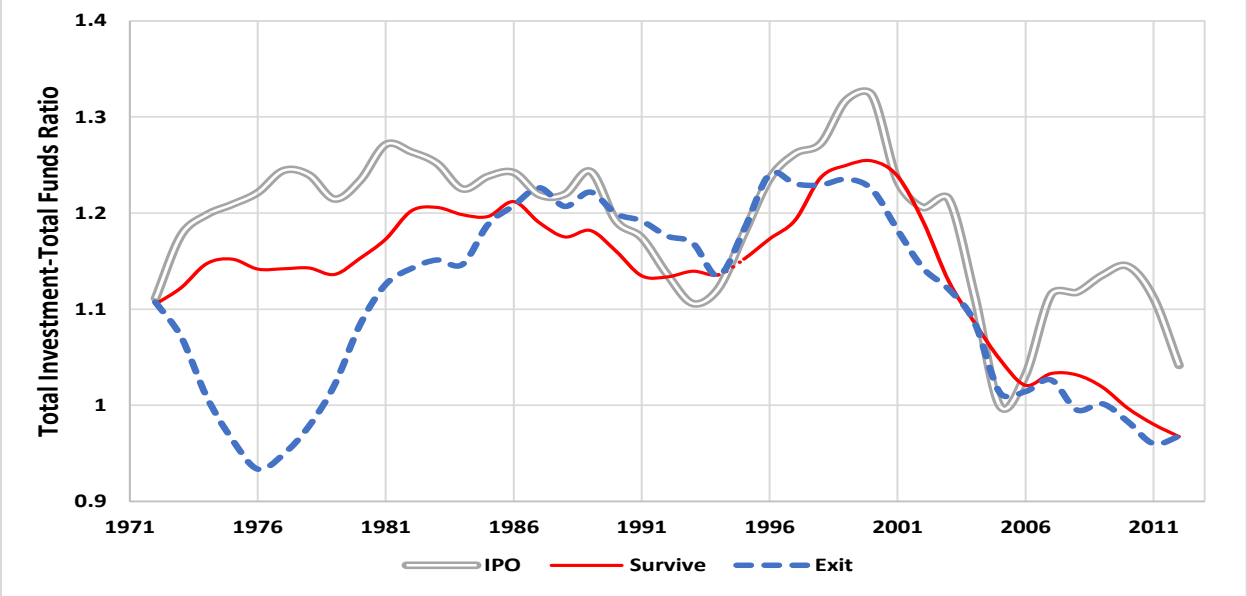
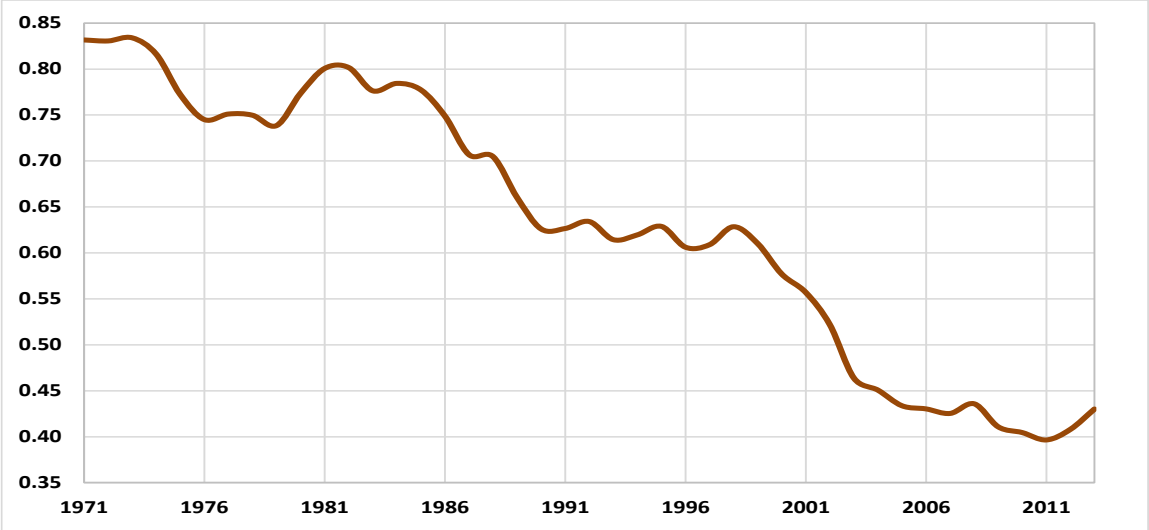


**Figure 7**
**Is the Decline in Sensitivity due to Changing Characteristics?**

To examine, changing characteristics of listed firms, we do a matched firm comparison of the ratio of the investment to internal funds across two intervals, say, 10 years. We use the year 2000 to illustrate how we form our sample. For the year 2000, we consider firms that existed in 2000 and 2010 (10 years later) and firms that existed in 2000 and 1990 (10 years earlier). Effectively, we are looking at 10-year survivor sample. Clearly, for any of the first 10 years of the sample (1967–1977), we can only include firms that existed in that year and 10 years later. Similarly, for any of the last 10 years of our sample, we can only include firms that existed in that year and 10 years earlier. Having identified the firms we can include for any given year in our sample, we then smooth the values by computing the average over rolling 5-year periods. For example, for the year 2000, we compute the ratio using all the firms that met the criteria in the years 1996–2000. Panels A and B plot the mean ratios of our survivor sample for the *Capex–Operating CF* ratio and the *Total Investment–Total Funds* ratio.

**Panel A: Capex–Operating CF Ratio**




**Panel B: Total Investment–Total Funds Ratio**

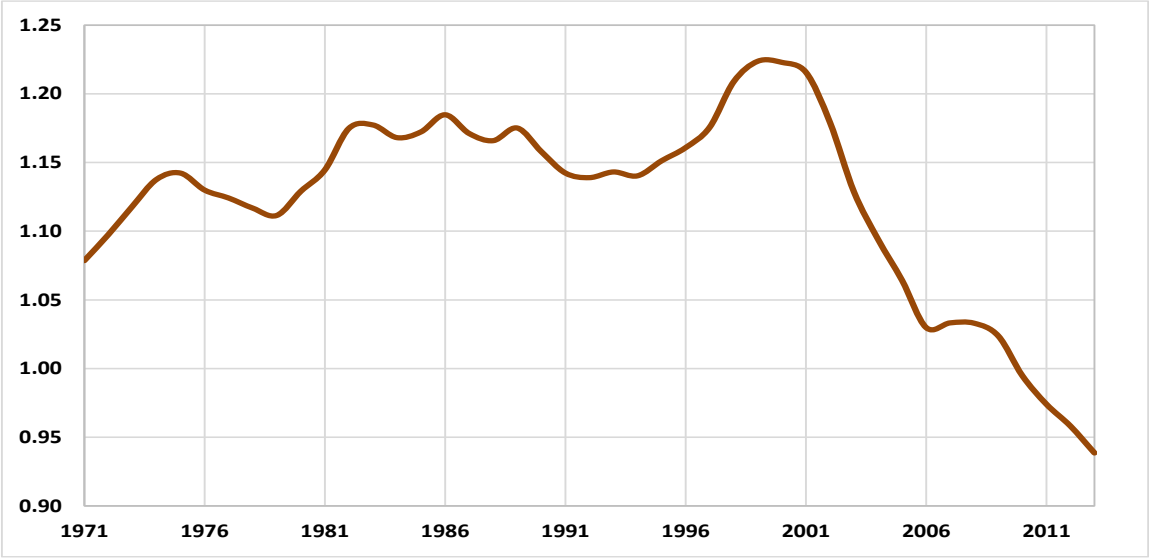


**Table I**
**Summary Statistics**

This table reports the summary statistics for the period 1967 to 2013. Total number of observations is 108,286. *Total Investment = Capex + R&D + SG&A + SubJV + M&A*. *Operating CF* = Net Income + Depreciation and Amortization. *Funds for Capex = Operating CF + Lagged Cash Holding*. *Available CF = Operating CF + R&D* (1–T) + *SG&A* (1–T). *Total Funds = Available CF + Lagged Cash Holding*. We scale all measures by lagged assets. Table A1 provides all variable definitions. Panels B and C provide Spearman correlations.

**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 Manufacturing Firms | 58% | | |
| **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% |
| Lagged Cash Holding | 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 | Lagged Cash Holding | Funds for Capex | Available CF | Total Funds |
|---|---|---|---|---|---|
| Operating CF | 1.00 | | | | |
| Lagged Cash Holding | -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* = Net Income + Depreciation and Amortization. *Funds for Capex = Operating CF + Lagged Cash Holding*. *Available CF = Operating CF + R&D* (1–T) *+ SG&A* (1–T). *Total Funds = Available CF + Lagged Cash Holding*. 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%$^{***}$ |
| Lagged Cash Holding | 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

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

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

where $q_{i,t-1}$ is the beginning period market to book ratio. $\alpha_i$ and $\alpha_t$ denote firm and year fixed effects. *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 + Lagged Cash Holding*. *Available CF = Operating CF + R&D* (1–T) + *SG&A* (1–T). *Total Funds = Available CF + Lagged Cash Holding*. 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.

| Row | | Sample of Firms | Investment Measure | Internal Funds Measure | $\beta_1$ | $\beta_2$ | 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

## Is the Decline in Sensitivities due to Changing Composition or Changing Characteristics?

To examine, changing composition of listed firms, for any given year, we first put firms into three bins based on whether they joined the sample, exited the sample, or remained in the sample. We use the year 2000 to illustrate how we form our sample. (i) *IPO* group consists of firms that entered in 2000, but not in sample in 1999. (ii) *Exit* group consists of firms for whom the last available data is for 2000. (iii) *Survive* group consists of firm that survived 2000; i.e., they were in sample in 1999 and 2001 also. Clearly, we cannot classify firms accurately in 1967 (first year) and 2013 (last year), and hence we drop them. We smooth the time series by computing the average ratio across all firms that meet the criteria for rolling 5-year periods. Thus, the ratio for 1972 corresponds to the first 5-year period 1968–1972 and the ratio for 2012 corresponds to the last 5-year period 2008–2012. We report the change in ratio from 2012 to 1972 for the overall sample as well as the three groups. We also report the correlations of the ratio with the corresponding sensitivity. Panels A and B correspond to the *Capex–Operating CF* ratio and the *Total Investment–Total Funds* ratio. To examine changing characteristics of listed firms, we do a matched firm comparison of the ratio of the investment to internal funds across 10 years. We use the year 2000 to illustrate how we form our sample. For the year 2000, we consider firms that existed in 2000 and 2010 (10 years later) and firms that existed in 2000 and 1990 (10 years earlier). Effectively, we are looking at 10-year survivor sample. Clearly, for any of the first 10 years of the sample (1967–1976), we can only include firms that existed in that year and 10 years later. Similarly, for any of the last 10 years of our sample (2004–2013), we can only include firms that existed in that year and 10 years earlier. Having identified the firms we can include for any given year in our sample, we then smooth the values by computing the average over rolling 5-year periods. Thus, the ratio for 1972 corresponds to the first 5-year period 1968–1972 and the ratio for 2012 corresponds to the last 5-year period 2008–2012. We report the change in ratio from 2012 to 1972. We also report the correlations of the ratio with the corresponding sensitivity.

### Panel A: Capex–Operating CF Ratio

| | Changing Composition | |
|---|---|---|
| | % Change in Ratio from 1972 to 2012 | Correlation of Ratio with Sensitivity |
| Overall | -51% | 93% |
| IPO | -58% | 90% |
| Survive | -50% | 92% |
| Exit | -44% | 72% |
| | Changing Characteristics | |
| Matched firm sample, 10 years apart | -48% | 91% |

### Panel B: Total Investment–Total Funds Ratio

| | Changing Composition | |
|---|---|---|
| | % Change in Ratio from 1972 to 2012 | Correlation of Ratio with Sensitivity |
| Overall | -12% | 68% |
| IPO | -6% | 63% |
| Survive | -12% | 69% |
| Exit | -13% | 26% |
| | Changing Characteristics | |
| Matched firm sample, 10 years apart | -13% | 66% |