PERSISTENT OPERATING LOSSES AND CORPORATE FINANCIAL POLICIES*

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June, 2018

We thank Harry DeAngelo, Diane Denis, Will Gornall, Matt Gustafson (discussant) David Haushalter, Rongbing Huang, Andy Koch, Leming Lin, David McLean (discussant), Jay Ritter, Frederik Schlingemann, Rene Stulz, and participants at the SFS Cavalcade, Florida State University Sun Trust Conference, University of Alberta Banff Frontiers of Finance Conference, Mississippi State University Magnolia Finance Conference, Pacific Northwest Finance Conference, Baruch University, George Washington University, London Business School, NOVA School of Business and Economics, North Carolina State University, Rutgers University, TCU, Tsinghua School of Economics and Management, Tsinghua PBC, University of British Columbia, University of California-Berkeley, University of Delaware, University of Illinois-Chicago, University of Oklahoma, University of Porto, University of Texas-Dallas, and University of Wisconsin-Milwaukee for helpful comments.

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Abstract

Coincident with a rise in intangible investment, operating losses have become substantially more prevalent, persistent, and greater in magnitude since 1970. Loss firms now make up over 30% of the Compustat universe and such losses continue for a median of four years. Firms with negative operating cash flows account for more than half of the rise in average cash balances over the sample period. Further, firms exhibiting operating losses are now the majority of equity issuers. These companies issue frequently, primarily through private placements, and use the funds raised in the issue to cover current and subsequent operating losses. We conclude that the immediate and expected ongoing liquidity needs of public firms with persistent operating losses have substantially altered corporate financial policies.

1. Introduction

A growing body of research reports secular changes in the composition and characteristics of publicly traded U.S. companies. Over the past several decades, U.S. companies have evolved from manufacturing entities to more service and high-tech firms (Kahle and Stulz (2016)). Coincident with this shift, U.S. companies spend less on physical capital, such as property, plant and equipment, and more on intangible capital, such as human capital, product innovations, patents, brand names, information technology, distribution systems, and customer relationships. Recent studies (e.g., Falato, Kadyrzhanova, and Sim (2016)) estimate that intangible capital now makes up more than 50% of net assets for the average company.

Investment in intangibles differs from investment in physical capital in two important respects. First, while expenditures on physical capital are initially capitalized on the firm's balance sheet and then depreciated over time, expenditures on intangibles are expensed immediately and, therefore, have a direct impact on firm profitability. Second, while investments in physical capital tend to scale with sales in an approximately linear fashion, multiple years of intangible investment are often required before yielding positive increments to sales and, ultimately, profits.

In this study, we show that the shift to more intangible capital is associated with dramatic changes in profitability patterns and corporate financing policies among U.S. public companies. Specifically, we document that not only have operating cash flows become more volatile (as reported in Bates, Kahle, and Stulz (2009)), they are now much lower for a considerable subset of U.S firms. In the 1950s, about 2% of public firms listed in Compustat reported operating losses (defined as negative cash flow from operations). In contrast, the period since 1980 has been characterized by an explosion in the percentage of public firms with negative cash flow (CF), rising from 9% in 1979 to over 30% in several recent years.

We further show that for most firms in recent years, operating losses are not a transitory phenomenon. Until approximately 1990, firms that reported an operating loss in one year had a greater than 50% chance of reporting positive operating earnings in the following year. However, it is increasingly the case that firms that lose money on operations this period are likely to lose money next period as well. For example, less than 25% of the firms that reported negative CF in 2015 subsequently reported positive CF in 2016, and the median 'run' of negative cash flow is now four years. Furthermore, the magnitude of operating losses has grown substantially over time. In the 1970s, firms in the bottom decile of operating cash flow exhibited annual losses equal to 11% of assets, on average. In the 2000s, these average losses have ballooned to 58% of assets.

Finally, we report that the characteristics of firms exhibiting negative cash flow have changed substantially as well. In the 1970s, the typical company with negative cash flows displayed characteristics typically associated with financially troubled firms: e.g., low market/book, high leverage, and negative growth rates in revenues and employees. By contrast, as negative cash flows have become more pervasive, persistent, and larger in magnitude, the characteristics of firms with negative cash flows have evolved to resemble those of more highly valued, growth firms: e.g., high market/book, low leverage, high investment in intangibles, and high growth rates in sales and employees.

Because the number of listed companies has sharply decreased in recent years [Doidge, Karolyi, and Stulz (2017)], we argue that these patterns are unlikely to be due to an increased supply of unprofitable firms going public at an earlier life cycle. Similarly, our own evidence on rates of delistings through acquisitions suggests that the profitability patterns that we document are not due to the disappearance of profitable firms through going private transactions. The data most strongly support the view that the evolution of profitability is driven by the growth in

intangible investment. Indeed, if we measure operating cash flow before estimates of intangible investment have been deducted, growth in the frequency of operating losses over the past forty years is virtually nonexistent.

Persistent operating losses create immediate and ongoing liquidity needs that must be met by existing internal resources or external finance (or both). We show that firms expecting such losses behave differently than firms with positive cash flow on several dimensions of corporate financial policy such as cash holdings, equity issuance frequency, and cash savings from issuance. Between 1970 and 2015, average cash holdings as a percentage of total assets increase by a striking 580% (from 6.6% of assets to 45% of assets) for firms with negative operating cash flow, as compared with 90% (8.6% of assets to 16.3% of assets) for firms exhibiting positive cash flow. Firms with negative cash flow thus account for more than half of the increase in average cash balances of U.S. firms reported in Bates, Kahle, and Stulz (2009).[1]

Traditionally, the precautionary demand for cash, dating back to Keynes (1936), has been framed within a context focused on the second moment of the distribution of cash flow. That is, in the presence of financing frictions, firms stockpile cash from past profits as insurance against possible future adverse cash flow shocks that could lead to underinvestment. However, when the first moment of the cash flow distribution is negative, it is likely that the demand for cash stems more from the expected level of cash flow than from its volatility. In other words, the cash stockpile is not solely a precaution against the possibility of underinvestment induced by unexpected financing needs. It is a deliberate plan to finance near term operational needs under

[1] Note that we are referring to increases in average cash balances. See Faulkender, Hankins, and Petersen (2017) for evidence on the role of repatriation taxes in explaining the rise in aggregate cash balances among U.S. firms. We later show that our findings are not affected by the repatriation tax issue.

an expectation of negative cash flows. Moreover, rather than the source of this cash being past profits that have been stockpiled, firms with persistent losses are forced to raise funds externally.

Consistent with Gao, Ritter, and Zhu's (2013) findings for IPOs and Fama and French's (2004) evidence on new lists, we find that over the past four decades, negative cash flow firms represent an increasing proportion of firm-initiated equity issuances (IPOs, SEOs, and private placements).[2] In every year but one since 1989, the majority of firms issuing equity report negative operating cash flows (CF) for that fiscal year. In the last year of our sample, 2016, negative CF issuers outnumber positive CF issuers 2 to 1. In addition, we find that equity issues of firms with negative operating cash flow are overwhelmingly private placements in recent years. Such private placements account for approximately 90% of the equity issues for negative cash flow firms in the last five years of our data. By contrast, the majority of equity issues for positive cash flow firms over the same period are public seasoned equity offerings (SEOs).

Firm-initiated equity issues typically represent a substantial cash inflow to the firm and McLean (2011) argues that cash savings from equity issuance has been increasing over time. Additionally, Huang and Ritter (2017) find that immediate cash needs are an important determinant of equity issues and that firms save, on average, 65% of the proceeds from equity issues in cash at year-end.

We illustrate the importance of operating losses to these patterns by scaling each equity issuer's post-issue cash balances by the magnitude of the company's cash burn rate.[3] This scaled measure, commonly called "runway" within the venture capital industry, represents an estimate of

[2] Firm-initiated equity issues are defined as stock issuances that exceed 3% of market equity. This definition captures the vast majority of IPOs, SEOs, and private placements while excluding most employee-initiated issuances such as ESPPs and the exercise of stock options (McKeon, 2015).

[3] We define monthly burn rate as –[Operating CF-Dividends-Capital Expenditures] divided by twelve. For example, a firm that reports negative CF of $100MM and capital expenditures of $20MM annually has a monthly burn rate of $10MM. Firms generating positive free cash flows do not have a burn rate.

how many months a firm with negative cash flows can continue to operate at the same rate without an infusion of external capital. Ceteris paribus, equity issuers could increase runway by increasing issuance size and stockpiling cash. However, we find that the median runway after issuance has stayed within the same range for decades, typically between 6 and 18 months, and, most notably, exhibits no time trend over the past two decades, a period during which average cash balances have exploded. In other words, cash savings from issuance have increased substantially, but burn rates have also risen concomitantly. The implication is that firms with high burn rates rapidly deplete their cash balances, but frequently replenish these holdings through private equity financings. We confirm this in simulations demonstrating that within a given calendar year, cash balances of negative operating cash flow equity issuers range between 25% and 82% of assets.

Ours is not the first study to document secular decreases in the profitability of publicly-traded U.S. firms. Fama and French (2004) report that the profitability of newly listed firms has become increasingly left-skewed and that, as these firms are integrated into the economy, overall profitability becomes more left-skewed as well. Similarly, Kahle and Stulz (2017) document a decline in average profitability rates among U.S. firms, though aggregate profits have not declined [see DeAngelo, DeAngelo, and Skinner (2004)] and are increasingly concentrated among the largest, most profitable firms. We extend this literature by (i) showing that the secular trend in profitability is not just a 'new lists' effect; (ii) documenting the increased persistence and magnitude of operating losses; and (iii) linking these trends to the growth in intangible investment and to secular changes in corporate financial policies.

Other prior studies have investigated financial policies in firms exhibiting losses. For example, DeAngelo, DeAngelo, and Skinner (1992) find that dividend decreases are strongly associated with the presence of losses, particularly if these losses are persistent. Other studies

(e.g., Duchin Ozbas, Sensoy (2010) and Campello, Graham, and Harvey (2011)) show that financially weaker firms have difficulties raising capital, particularly in market downturns. In contrast to the troubled firms analyzed in these prior studies, we show that in recent years, firms with persistent operating losses are high-growth firms that are able to frequently raise equity capital.

Our study also contributes to three related strands of the literature. The first seeks to understand the magnitude of cash balances among U.S. firms and why average balances have grown so dramatically in recent years. Our findings complement and extend those from studies that ascribe a role for increased precautionary demands due to uncertainty in future financing needs [e.g. Bates, Kahle, and Stulz (2009)], and for increased costs of repatriating foreign earnings [e.g., Faulkender, Hankins, and Petersen (2017)] in explaining high cash balances. We show that, in addition to these factors, an increased demand for operational cash to fund immediate, and expected ongoing liquidity needs is an important determinant of observed cash balances. In this sense, our findings complement those of Begenau and Palazzo (2017) and Falato, Kadyrzhanova, and Sim (2016) who link the growth in cash balances to the growth in R&D and other forms of intangible capital. Our study differs in that we show that the cash accumulation among firms with high intangible investment does not represent precautionary savings from past profits, but rather is a byproduct of firms raising equity finance in advance of predictable, large operating losses. Our findings also provide a potential explanation for the finding in Pinkowitz, Stulz, and Williamson (2016) that differences in average cash balances between U.S. firms and their foreign counterparts are driven by a small set of U.S. firms with very high R&D expenditures. We show that high cash balances of high R&D firms are concentrated among those firms with persistent operating losses.

Second, our findings extend the literature on the motives for equity issuance and sources of equity finance. Kim and Weisbach (2008) report that additions to cash holdings are the primary use of equity issue proceeds in a large international sample of IPOs and SEOs, which implies that cash stockpiling is an important motive for equity issuance. DeAngelo, DeAngelo, and Stulz (2010) report that most SEO issuers would have been unable to fund current operating plans in the absence of the equity issue. They thus attribute the issuance decision to the need to fund near-term investment. Our findings indicate that equity issuers in recent years are increasingly characterized by ongoing operating losses and, therefore, high cash burn rates. They not only have immediate funding needs, but also a need to stockpile cash to fund anticipated near-term future funding shortfalls. Nonetheless, this stockpile is of short duration, requiring the firms with persistent operating losses to issue equity far more frequently than has been documented in the prior SEO literature. The issuances are topping up the stockpile on a regular basis, but the firms are burning through the stockpile rapidly. The frequency of issuance is consistent with a staging of capital infusions of the type reported for newly public firms in Hertzel, Huson, and Parrino (2012).

In addition, the predominance of private placements as a source of finance for negative cash flow firms in our data complements prior studies of private investments in public equity (PIPEs) showing that PIPEs are more common for firms that are likely to face substantial frictions in the public debt and equity markets.[4] Our data indicate that such firms are now the typical equity issuer and that more than 90% of the equity issues of negative cash flow firms in recent years are private placements. Unlike the PIPE issuers of prior studies, however, the typical negative cash flow equity issuer in recent years is not a financially troubled firm. They are investing heavily in intangibles, are growing rapidly, and exhibit substantial future growth opportunities.

[4] See, for example, e.g. Brophy, Ouimet, and Sialm (2009) and Lim, Schwert, and Weisbach (2017).

Finally, our findings have implications for the empirical literature that models cash balances as a linear function of firm, country and institutional characteristics. These studies typically include contemporaneous cash flow among the set of variables that capture the firm's sources and uses of funds and, therefore, its operating cash needs. Our findings imply that such models have become increasingly misspecified as the distribution of firms has shifted towards firms with persistent operating losses. Because these firms exhibit unusually high cash balances, existing models that ignore this nonlinearity systematically underestimate 'normal' cash holdings for firms with persistent negative cash flows.

The rest of the study progresses as follows: Section 2 documents the rise in firms with negative operating cash flows. Section 3 reports results explaining how the rise in corporate cash holdings is related to operating losses. Section 4 analyzes the external financing patterns of firms with operating losses. Section 5 discusses implications of our findings, and Section 6 concludes.

2. Descriptive evidence on operating losses

In this section, we present descriptive evidence on the frequency, persistence and magnitude of operating losses, discuss potential underlying reasons for these patterns, and document changes over time in the characteristics of firms exhibiting operating losses.

2.1. Patterns in operating losses

The main sample consists of all publicly-traded U.S firms with total assets greater than $5 million (in 2016 dollars) between 1970 and 2016. The data are obtained from the Compustat database, Industrial Annual file. Historically regulated firms such as financial firms (SIC codes 6000–6999) and utilities (SIC codes 4900–4999) are excluded, as are firms missing data necessary for the calculation of cash ratios. We exclude pre-IPO data by requiring the observation to have a

market price. Within this sample, we identify firm-initiated equity issues such as IPOs, SEOs, and private placements, using the method detailed in McKeon (2015); specifically, those issues in which proceeds from common stock issuance are greater than 3% of end-of-period market equity.

We begin by documenting the prevalence of operating losses over time. We define an operating loss as a negative cash flow from operations as reported on the statement of cash flows. Prior to 1987, firms were not required to report cash flow from operations. When this figure is missing, we calculate an approximation as described in the Appendix. Figure 1 plots the percentage of the sample that reports negative operating cash flows each year since 1960. The rise is striking. In the early part of the sample, negative operating cash flows are almost non-existent. Despite four recessions between 1960 and 1980 (as defined by the National Bureau of Economic Research (NBER)), the percentage of firms with negative cash flow exceeds 10% only three times. Since 1990, however, it has rarely been less than 25%. By 2016, the final year in the sample, nearly 30% of the sample firms report negative operating cash flows.

In addition to the increased prevalence of negative cash flows, we find that it is increasingly the case that firms are experiencing persistent negative cash flows rather than negative cash flows that occur due to a temporary shock. Figure 2 illustrates a strong time trend in the persistence of negative cash flows. Panel A reports that in the 1970's and 80's most firms that experienced negative cash flows returned to positive cash flows in the following year. By contrast, less than one-fourth of firms that reported negative cash flow in 2015 followed up with positive cash flow in 2016. Panel B reports the average number of years, including the current year, of consecutive negative cash flows. By construction, the lower bound of 1.0 represents a situation in which every firm reporting negative cash flow in a given year had positive cash flow in the prior year. Consistent with panel A, this measure exhibits a strong time trend, peaking in the last year of the

sample at nearly four years. This implies that the occurrence of negative cash flows is not likely to be surprising or unexpected for most firms in recent years. Rather, these firms are operating with the intention and expectation of extended cash flow deficits.

To provide more formal evidence on the persistence of negative cash flows, we estimate a 1st order autoregressive (AR(1)) model of cash flow (*CF*). Specifically,

$$CF_t = \alpha + \varphi CF_{t-1} + \varepsilon_t$$

We estimate the AR(1) model annually on the sample of firms that report negative cash flow at time t. The coefficients (φ) and 95% confidence bands are plotted in Figure 3. Similar to Figure 2, the AR(1) model indicates increasing persistence in negative cash flows over time. In the 1970's and 80's, prior year cash flow had little explanatory power for observations of negative cash flow. Starting in the 1990's, prior year cash flow became a very strong determinant of negative cash flow in the current year.

Finally, it is noteworthy that the magnitude of negative cash flow has grown substantially over time. Table 1 reports average CF/assets for the ten deciles during four subperiods: 1970–1979, 1980–1989, 1990–1999, and 2000–2016. All deciles report lower cash flows over time, but within the lowest decile the change is most dramatic. In the 1970's the average firm in the lowest decile reported cash flow equal to -11% of assets. During the 2000–2016 sub period, the average was -58% of assets. Put another way, firms in this decile burn an average of almost 5% of assets *per month* even before accounting for capital expenditures.

Taken together, Figures 1 through 3, and Table 1 highlight three stylized facts about the evolution of firms reporting negative cash flows: Negative cash flows are vastly more prevalent, more persistent, and the magnitude of average negative cash flows within the lowest decile has grown fivefold. Further, Figure 4 charts the distribution of cash flow for two sub periods at the beginning and end of the sample period and reveals that not only has the density in the center of

the distribution shifted to the left, but there has been dramatic increase in the proportion of firms with very large negative operating cash flows. In the 2000s, five percent of the firm-year observations exhibit operating losses of at least 50% of the book value of the firm's assets.

2.2. Why have operating losses grown over time?

One possible explanation for the growth in the proportion of firms with negative operating cash flow is that it has become easier for negative cash flow firms to raise equity capital in public markets in recent years.[5] If firms are increasingly going public at an earlier stage of their life cycle, the patterns that we document could be due to an increased supply of young, unprofitable firms in the publicly traded universe. Contrary to this view, however, Doidge, Kahle, Karolyi, and Stulz (2018) report that the number of listed firms in the U.S. has fallen dramatically since 1997, as has the propensity of smaller firms to list. Moreover, Kahle and Stulz (2017) report that the median firm age among public firms has more than doubled in the past twenty years. Over this same period, the proportion of firms with negative operating cash flow has remained high and the persistence of these losses has increased.

Another possibility is that firms with positive, stable profits might disproportionately be targets of buyouts or other acquisition attempts. However, we find no evidence that this is the case. In untabulated results, we observe that delisting rates attributed to M&A are similar for negative and positive cash flow firms throughout the sample period.

The most plausible explanation for the growth in negative cash flow firms is that investment has shifted over time from investment in tangible assets to investment in intangible

[5] For example, Jay Ritter notes that "In the early Eighties, the major underwriters insisted on three years of profitability. Then it was one year, then it was a quarter. By the time of the Internet bubble, they were not even requiring profitability in the foreseeable future." (*Rolling Stone*, April 5, 2010).

assets.[6] Intangible investment includes not only investments in knowledge capital (e.g., R&D), but also investments in organizational capital (e.g., human capital development, customer relations, brand name, information technology). The latter are likely to be a component of the company's selling, general, and administrative (SG&A) expenses.[7] Importantly, these investments in intangible assets are expensed immediately and, therefore, reduce operating cash flows. By contrast, investments in tangible assets (e.g. property, plant, and equipment) are capitalized in the balance sheet, then gradually depreciated over time. Moreover, because intangible investments are more commonly multi-year in nature, a shift from tangible to intangible investment will increase both the observed frequency of firms with negative operating cash flow and the persistence of those negative cash flows.

To demonstrate the empirical link between increased intangible investment and negative operating cash flows, Figure 5 plots the evolution of R&D/Assets (Panel A) and SG&A/Assets (Panel B) for firms in the top and bottom deciles of operating cash flow each year. The results indicate that among high cash flow firms, there has been little to no increase in intangible investment. By contrast, among firms in the bottom decile of operating cash flow, intangible investment has grown substantially over time. In the early part of our data, there is little difference between the R&D and SG&A expenditures of high cash flow and low cash flow firms. By the end of our sample, intangible investment expenditures of low cash flow firms are many times higher than those of low cash flow firms.

[6] Kahle and Stulz (2017), for example, report that average capital expenditures as a percentage of assets has declined by 50% since 1975, while average R&D expenditures have risen five-fold so that average expenditures on R&D now exceed those of capital expenditures.

[7] See, for example, Lev and Radhakrishnan (2005), Eisfeldt and Papanikolaou (2013), and Falato, Kadyrzhanova, and Sim (2015). In addition, Cook, Kieschnick, and Moussawi (2018) argue that these firms are more likely to use operating leases to obtain operating assets than to purchase assets. Such operating lease expenses also appear in the company's SG&A expenses.

In Figure 6, we demonstrate that the growth in intangible investment (particularly in the form of SG&A expenditures) is the primary driver behind the rising frequency of negative operating cash flow firms. We first compute a measure of operating cash flow before R&D expenditures (OCFRD) and document the percentage of firms with negative OCFRD over time. Not surprisingly, as R&D expenditures have grown over time, the proportion of firms with negative OCFRD becomes much smaller than the proportion of firms with negative cash flow. Nonetheless, the fact that the percentage of firms with negative OCFRD has grown over time and is between 20% and 30% over the past two decades suggests that the increased frequency of negative operating cash flow firms that we observe is not solely a byproduct of rising R&D expenditures over time.

Therefore, we next compute a second measure of operating cash flow before any expenditures on R&D or the portion of SG&A that captures intangible investment. We label this measure OCFRDSGA. Because we are unable to identify precisely the portions of SG&A that represent operating costs that support current profits and those that represent intangible investment, we assume that the operating cost component of SG&A is constant over time and equal to 30% of total assets (approximately the level of SG&A in the early years of the sample). We then categorize any SG&A over 30% of total assets as being intangible investment.[8] As shown in Figure 6, if we measure the percentage of firms reporting negative operating cash flow before any expenditures on R&D or other intangibles, there is little change over time in the proportion of firms with negative operating cash flow. We conclude, therefore, that the growth in the frequency,

[8] Prior studies (e.g. Hulten and Hao (2008), Eisfeldt and Papanikolaou (2014), Zhang (2014), and Peters and Taylor (2017) similarly have to make assumptions about the mix of operating costs and intangible investment in SG&A. These studies assume that SG&A is comprised of 70% operating costs and 30% intangible investment. Because we observe large increases over time in SG&A and can see no reason why operating costs would increase over time, we do not assume a constant mix of operating costs and intangible investment. Rather, our approach assumes that the growth in SG&A is due to growth in intangible investment.

persistence, and magnitude of negative operating cash flows is tied closely with the shift away from tangible investment and towards intangible investment.

2.3. Characteristics of firms with operating losses

A related question is whether other characteristics of negative cash flow firms have changed. Table 2 reports summary statistics on a variety of firm level variables for firms with negative cash flows. Notably, firm age, measured as number of years as a public firm in Compustat, has increased. The average age of negative cash flow firms in the 1970's is 6.5 years, rising to 11 years in the 2000's, suggesting that the increased prevalence of negative cash flow firms is not due solely an influx of unprofitable newly listed firms.[9] In terms of size, loss firms have become smaller over time at the median in term of total assets, but larger in terms of market capitalization. It follows that the market-to-book ratio is substantially higher in recent years, averaging 1.16 in the 1970's versus 2.70 in the 2000's. Leverage has fallen sharply, whether measured as book or market leverage. Also, consistent with aggregate patterns, capital expenditures have fallen, while both R&D and SG&A expenditures as a percentage of assets have increased substantially.

Growth patterns have also changed. In the 1970's, firms with negative cash flows exhibit signs of distress, with declining revenues and declining headcount, on average. In the 1990's and 2000's the opposite is true; negative cash flow firms are growing rapidly on average, both in terms of revenues and employee growth. Finally, payout policies have changed. In the 1970's, negative cash flow firms maintained a dividend yield above 1% in the year of the loss. By the 2000's, this figure had declined to less than 0.2%. Overall, these data indicate that as negative cash flows have become more prevalent, persistent and larger, the characteristics of these firms have changed as

[9] Fama and French (2004) report that the profitability of newly listed firms has become increasingly left-skewed.

well. In recent years, firms with negative cash flows are more commonly highly valued, growth firms that invest heavily in intangibles.

The industry concentration of negative cash flow firms has also changed over time. In the 2000's, four industries (Drugs, Business Services, Chips, Medical Eq) account for over 50% of the observations of negative cash flow. By contrast, the top four industries in the 1970's (Wholesale, Retail, Business Services, Machinery) account for only 26% of the observations. It is noteworthy, however, that this is not solely a composition effect whereby the increase is attributable to a rise in the number of firms within industries that are characterized by operating losses. It is also the case that the prevalence of operating losses has increased within every industry. For example, Drugs moved from 9% of firms reporting losses in the 1970's to 70% of firms reporting loses in the 2000's. (These results are not reported in a separate table.)

3. Operating losses and cash holdings

If the growth in intangible investment leads to persistent, large operating losses, this creates immediate and ongoing needs for liquidity that firms must meet through either internal resources, external finance, or both. In this section, we explore the implications of the evolution in investment and profitability for the evolution of corporate cash polices, while in the following section we document the evolution of external financing patterns.

3.1. The growth in cash balances in negative cash flow firms

Numerous studies have documented and offered explanations for the rise of corporate cash holdings since the 1970s.[10] In Figure 7, we plot average cash holdings for the full sample (gray,

[10] Azer et al. (2017) note that cash holdings were also elevated in the 1940's and 1950's and find evidence for carrying cost as an influential determinant. Similarly, Graham and Leary (2016) document a substantial run-up in cash holdings in the 1930s and 1940s, followed by a decline between 1945 and 1970. Because our sample begins in 1970, our study

solid curve) and subsamples of positive (black, dashed curve) and negative (black, solid curve) cash flow firms. First, our findings confirm the dramatic rise in average cash balances over time, from 8.3% of total assets in 1970 to 24.5% of total assets in 2016. When we split the sample into positive and negative cash flow firms, the data indicate that the rise in average cash balances is tied closely to the increase in the prevalence, persistence, and magnitude of negative operating cash flows that we report in Section 2. In 1970, cash holdings for negative cash flow firms were slightly lower than those for positive cash flow firms. However, by the mid-1980s, this pattern is reversed and negative cash flow firms exhibit cash balances that are substantially greater than those of positive cash flow firms. Moreover, it is noteworthy that the point of divergence between positive and negative cash flow firms in the mid-1980s corresponds with the beginning of the rapid growth of negative cash flow firms (see Fig. 1).

Between 1970 and 2015, the growth in cash balances among negative cash flow firms is a striking 580%, which is more than six times the growth of cash balances in positive cash flow firms. If negative cash flow firms are removed from the sample, the growth in cash holdings over 1970-2015 is less than half as large as the growth in cash holdings for the full sample (90% vs 196% increase).[11]

The patterns that we document for negative cash flow firms are similar to those reported in Bates, Kahle, and Stulz (2009), who document a tripling of cash ratios for negative net income firms over 1980–2006. Our findings indicate that the growth has not retreated in the years since 2006. The takeaway is that in order to understand the rise in average cash holdings generally,

is silent on the determinants of cash holdings prior to that time. We also note that Graham and Leary study both average and aggregate cash holdings while we focus on average levels exclusively.

[11] In untabulated results, we also measure growth in cash holdings using market assets as the scaling variable. The nominal figures are reduced because negative cash flow firms also have high M/B ratios, but the overall relation holds. The growth rate in cash holdings for negative cash flow firms is approximately five times that of positive cash flow firms.

more attention needs to be paid to the left side of the cash flow distribution where the rise is most evident.

Three traditional explanations for holding excess cash include repatriation taxes, agency problems, and precautionary motives.[12] While the uptick in cash holdings for positive cash flow firms could be caused by tax considerations, the massive rise for negative cash flow firms is unlikely to be due to an offshore cash buildup due to repatriation taxes, because (i) these firms have negative earnings to offset the tax burden, and (ii) only 8.5% of the sample firms that report operating losses also report foreign income.[13] Similarly, negative cash flow firms exhibit characteristics that would make them less prone to agency problems. In their study of the effect of agency problems on cash holdings, Nikolev and Whited (2014) cite three factors commonly associated with agency concerns: size, perquisite consumption, and limited managerial ownership. Negative cash flow firms are the least susceptible on all three counts. They are, on average, the smallest firms in the economy, they are subject to equity capital raising on a regular basis (as we later show), and are monitored more closely than mature high cash flow firms. Finally, in untabulated results, we find that negative cash flow firms have the highest levels of managerial ownership.

Although tax motives and agency concerns are mitigated for firms with negative cash flows, precaution remains as a potential explanation for the substantial rise in cash holdings between 1970 and 2016. In recent years, there has been an increased focus in the literature on R&D expenditures as a source of increased precautionary demands for cash. In addition to the

[12] For evidence on the agency motive, see, for example, Bates, Kahle and Stulz (2009), Harford (1999) and Harford, Mansi, and Maxwell (2013), and Dittmar and Marhrt-Smith (2007). For evidence on the repatriation tax motive, see Foley, Hartzell, Titman, and Twite (2007), Faulkender and Petersen (2012) and Faulkender, Hankins, and Petersen (2017).

[13] Our results are virtually identical if we exclude multinational companies from the analysis in Figure 7.

Bates, Kahle, and Stulz (2009) study cited earlier, Falato and Sim (2015) use state-level changes in R&D tax credits to show that firms increase their cash-to-asset ratios when their home state increases R&D tax credits. Begenau and Palazzo (2016) link the rise in cash holdings with the propensity of newly public firms to hold more cash at entry, particularly those with high R&D intensity. Pinkowitz, Stulz, and Williamson (2016) find that differences in average cash balances between U.S. firms and their foreign counterparts are driven by a small set of U.S. firms with very high R&D expenditures. Because firms with negative operating cash flow are disproportionately high R&D firms, the rise in cash balances for these firms might simply reflect increased precautionary demand.

In addition to this traditional precautionary demand, however, our earlier findings indicate that negative cash flow firms spend heavily on other intangible investment, resulting in operating losses that are large and persistent. Consequently, these firms likely require large cash balances to fund known expenditures in the near-term rather than strictly as a precaution against the possibility of needing funds in the future. In other words, cash holdings intended to cover near term operations are more accurately described as a response to the first moment of cash flow rather than the second moment.[14]

To demonstrate that the high cash balances of negative cash flow firms are not solely due to the traditional precautionary demand of high R&D firms, Table 3 examines cash holdings at high R&D firms, defined as those within the top two deciles. The results indicate that growth in cash holdings for high R&D firms is heavily dependent on the firm's cash flow position. Specifically, for high R&D firms in cash flow deciles 3-10, where cash flow is typically positive,

[14] Note that the traditional precautionary demand for cash holdings and the near-term operational demand that we describe are not meant to be mutually exclusive. To the extent that firms will have negative operating cash flows for a period of uncertain duration, part of the observed cash balance is likely to include a precautionary amount that is correlated with the uncertainty of the future need for funds.

cash holdings have grown an average of 43%. In contrast, average cash holdings for high R&D firms in the lowest cash flow decile have grown 744%. Thus the expectation of persistent near-term losses appears to be important.

3.2. Do firms anticipate persistent negative cash flows?

If persistent operating losses are due to expected expenditures on intangible investment, the losses are at least partially predictable for most negative cash flow firms in recent years. To test this, Table 4 analyzes the association between cash holdings and cash flow realizations prior to, and subsequent to, the first year in which a firm reports negative cash flow. Our analysis is similar to that of DeAngelo, DeAngelo and Skinner (1992), who find that dividend policies of firms that realize negative earnings are associated with the future persistence of the negative earnings. Likewise, we hypothesize that cash policies are similarly responsive to the firm's expectation about the persistence of negative cash flows.

Table 4 reports median cash holdings for four subgroups based on the persistence of future negative cash flows and history of previous cash flows. The *Persistent* category consists of firms that are entering a run of negative cash flow that is at least three years in duration. The *Transitory* subgroup is made up of firms that return to positive cash flow the following year. *New Firms* are those that are less than three years old. *Fallen Angels* are firms that reported at least five years of positive cash flow before entering the negative cash flow sample.

The results in Table 4 indicate that firms behave as if they have some foresight about the persistence of negative cash flows. We find that in recent years, firms entering a run of persistently negative cash flow realizations hold substantially more cash than firms experiencing a transitory negative cash flow shock. This is true not only for new firms, but also those that have previously reported a long stretch of positive cash flows. These results are consistent with the notion that the

persistence of the negative cash flows matters for observed cash balances and that firms can forecast persistence *ex ante*.

3.3. Time-series changes in the association between cash and cash flow

Our earlier results hint at a dramatic shift over time in the association between cash and cash flow as negative firms have increased cash holdings at a much higher rate than have positive cash flow firms. Specifically, Figure 7 shows that in the 1970s, firms with negative cash flow generally held less cash than firms with positive cash flow, but that this changed in the mid-1980s, coinciding with the rise in intangible investment and persistent operating losses. Figure 8 demonstrates this shift more explicitly by plotting the relation between cash holdings and operating cash flow levels in each of four sub periods. Similar to Figure 7, the most striking increase is observed within firms at the low end of cash flow. In addition, however, Figure 8 reveals that the relation between cash holdings and cash flow has become increasingly nonlinear over time. While the relation between cash holdings and cash flow was roughly flat in the 1970's, each subsequent decade has increased in convexity (i.e., become more u-shaped). Thus, it is not the case that the increase in cash holdings in the time series is driven exclusively by the increasing prevalence and magnitude of negative earnings; the persistence is also important. For any given level of cash flow to the left of zero, the median firm in the 2000s holds more cash than does the median firm in the 1990s, which holds more than the median firm in the 1980s. What has changed over time is the duration of the negative cash flows. A firm reporting negative cash flow in 1970 is expecting to revert to positive cash flows soon while a firm in the 2000s reporting the very same level of negative cash flow is more likely to be expecting that level to persist for an extended period of uncertain duration. This creates an additional demand for liquidity over and above traditional precautionary demands.

4. Operating losses and external financing patterns

The evidence in the prior section indicates that firms with persistent operating losses build large cash balances to fund these losses. However, it is unclear how they amass such large cash holdings. Although firms with persistent losses exhibit large and ongoing liquidity needs, they also likely face large frictions in the market for external funds, particularly if these losses are associated with increases in investment in intangible assets. The uncertainty as to the duration of negative cash flows, the lack of pledgeable assets, and the possibility of large information asymmetries all contribute to these frictions if a firm seeks to raise a substantial amount of funds in the capital market.

In this section, we investigate the sources of external finance in our sample firms and analyze how financing patterns have evolved to mitigate financing frictions as firms have become increasingly characterized by persistent operating losses.

4.1. Sources of external finance

In Table 5, we investigate three external sources of funds: equity issues, debt issues, and the sale of fixed assets. We measure each of these sources, scaled by total assets, for different subsamples based on realized cash flows.

In the 1970's, cash flow realizations below -25% of total assets are rare. Firms with cash flows this low raise external funds through a mix of equity issuance and the sale of property, plant, and equipment. Consistent with these firms being financially troubled and downsizing, the net proceeds raised through equity issues and assets sales is substantially less than the magnitude of the operating losses. Higher levels of cash flows are associated with more debt financing, less

equity financing, and fewer asset sales, with the exception of very high levels of cash flow (>30% of total assets) where equity financing again becomes the primary source of external funds.

The right panel of Table 5 depicts a very different pattern of financing in the most recent years of the sample. Over the past decade, in which persistent, large operating losses are most pervasive, firms with the lowest cash flow realizations raise far more cash through equity than through either debt issues or the sale of fixed assets. For example, for firms in the lowest cash flow bin, in which operating cash flows are below -45% of total assets, net equity issues average 44.9% of total assets. For these firms, net debt issues average only 1.5% of total assets, while sales of property, plant, and equipment are virtually non-existent. These patterns are consistent with the rise in intangible investment making it difficult to raise funds through either debt sources or through asset sales. At the other end of the cash flow distribution, firms with the highest cash flows repurchase both debt and equity, on average. As shown in the summary statistics reported in Table 2, these stylized facts have had a marked impact on capital structure for negative cash flow firms, as such firms are now substantially less levered than in prior decades.

4.2. Evolution in the equity financing market

Figure 9 illustrates that over the same time period as the rise in cash holdings and overall prevalence of operating loss firms, the characteristics of equity issuers have changed, particularly with regards to cash flow. In the 1970's and 1980's, firms issuing equity are cash flow positive on average, but in every year since 1989, the typical equity issuer is a negative cash flow firm.

To further analyze the relation between cash flow and equity issuance frequencies, we calculate the mean number of firm-initiated issuances per year for each cash flow decile based on quarterly data.[15] Table 6 reports the results of this analysis. While Figure 9 suggests that a large

[15] Due to limitations on the availability of quarterly issuance data, this analysis begins in 1985.

portion of equity issuances are conducted by low cash flow firms, Table 6 demonstrates the inverse: a large portion of low cash flow firms are equity issuers. In fact, between 2010 and 2016, firms in the lowest decile of cash flow recorded 0.93 firm-initiated issuances *per firm per year*.

In addition to variation in issue frequencies, positive and negative cash flow firms also differ in their choice of equity issuance mechanisms. Table 7 reports the proportion of firm-initiated equity issues that are issued to the public via an SEO versus issued through a private placement.[16] Both positive and negative cash flow firms exhibit a positive trend in the use of private placements over time, but for negative cash flows firms this mechanism makes up the vast majority of equity issues. Over the last five years for which we have data (2009–2013), private placements comprise over 88% of all issues in every year for negative cash flow firms, rising as high as 93% in 2011. In addition, we find in untabulated results that of the few SEOs issued to the public by negative cash flow firms, the majority are shelf offerings.

The combination of increased issuance frequency and increased rate of private placements among negative cash flow firms is consistent with the view that negative cash flow firms face substantial frictions in the equity issuance market. These frictions are potentially mitigated by a staging of capital infusions much like what is observed for private firms receiving venture capital financing. Consistent with this notion, we find that 60% of the private placements for which we have investor identities are characterized by a repeat investor.[17]

Frequent equity issues are puzzling in the presence of large fixed issuance costs in the market for seasoned equity offerings. Our evidence suggests, however, that the staging of equity

[16] We categorize Confidentially Marketed Public Offerings (CMPOs) as "Private" as they are closer in nature to private placements than to traditional SEOs. We note that CMPOs only constitute 8% of the sample of issuances.
[17] In a related study of newly-public firms, Iliev and Lowry (2017) report that 13% of such firms raise equity capital from venture capitalists in the first three years following an initial public offering. They argue that venture capitalists have a comparative advantage in overcoming frictions in the equity issuance market.

capital infusions for negative cash flow firms is increasingly done through the private placement mechanism in which fixed issuance costs are much lower.[18] In untabulated results, we find that firms issuing privately are smaller and that cash flow is more negative compared with the firms issuing publicly, consistent with traits that would otherwise lead to higher issuance costs. Additionally, we find that private investment rounds are comparatively smaller; these firms have an average of 12 months of cash following financing events, as compared with 23 months for public issuers.

Overall, these patterns are consistent with negative cash flow firms mitigating financing frictions by staging equity infusions through private placements. In this sense, the equity financing market for public firms increasingly resembles that of private firms raising equity funds through staged rounds of venture capital financing [see, for example, Gompers (1995)]. In a study of newly public firms, Hertzel, Huson, and Parrino (2012) find similar evidence consistent with staging in the timing and size of equity financing in IPO and initial follow-on equity offerings.

4.3.Equity issuance, cash savings, and runway

Kim and Weisbach (2008) report that a large fraction of the proceeds of equity issues is saved as cash and several studies link this savings behavior to precautionary motives.[19] That is, firms issue equity and stockpile a portion of the issue proceeds for possible future use. To investigate the evolution in the size of the post-equity issue cash stockpile relative to the needs of the firm, we borrow a metric from the venture capital industry and compute a firm's cash *Runway* as its cash holdings divided by the monthly cash *Burn Rate*, where *Burn Rate* for negative cash

[18] Several papers also document an evolution in issuance methods in the SEO market that serve to reduce fixed issuance costs. See, for example, Bortolotti, Megginson, and Smart (2008), Gao and Ritter (2010), and Gustafson (2017) for evidence that a greater fraction of SEOs are now conduced on an accelerated basis, often overnight. Similarly, Billett, Floros, and Garfinkel (2016) find that an increasing proportion of SEOs are at-the-market (ATM) offerings, which forego the use of an underwriter and dribble out shares to investors over many months.

[19] See, for example, McLean (2011), Bolton, Chen and Wang (2012), Warusawitharan and Whited (2016), Eisfeldt and Muit (2016), Huang and Ritter (2017), McLean and Palazzo (2016), and McLean and Zhao (2017).

flow firms is defined as operating cash flow minus dividends and capital expenditures, divided by 12. Not surprisingly, given our findings in Section 2, burn rates have increased monotonically over time, rising from about 8% of total assets in the 1970's to over 25% in the most recent decade. In the 1970's, the median level of cash holdings for negative cash flow equity issuers was less than 5% of assets at year end. At 2016 burn rates, a stockpile of that size would be depleted before the end of March.

Figure 10 plots the median runway immediately following equity issuance for negative operating cash flow firms over the sample period. In the early years of the sample when operating losses were rare, runways for operating loss firms were shorter, typically around 6 months. Beginning in the late 1980's, twelve months of runway is more typical and the chart shows that it has remained between 6 and 18 months for the last 30 years. (We scale the chart by 48 months since this is the median duration of losses at the end of the same period.) We also note that many other firm characteristics have changed, such as those associated with precautionary cash balances (e.g., R&D intensity and cash flow volatility), but these factors have not altered the median runway of equity issuers in meaningful ways. For negative cash flow firms, having about a year's supply of cash is the norm. These firms are not stockpiling more cash relative to their needs; but their operational needs have grown substantially.

The picture that emerges from these findings is one in which firms with high cash burn rates rapidly deplete their cash balances, but frequently replenish these holdings through private equity financings. In fact, in our data, annual burn rates and annual equity issuance are nearly identical for this set of firms. This implies large intra-year variation in cash balances for firms with high burn rates. Because such variation is unobservable to the econometrician analyzing annual data, we present simulated cash holdings in Figure 11 for such a firm over a 24 month

period. We calibrate the values on cash holdings, burn rates, and equity issuance to the average observed values for firms in the highest decile of cash holdings that issued equity during 2007-2016. As illustrated in Figure 11, year-end cash balances are relatively stable; however, within the year, cash balances fluctuate between 25% and 82% of assets as burn rates deplete reserves and equity issues replenish them. What emerges is a saw-toothed pattern to cash holdings within individual firms over time.

Such a pattern complements the precautionary motives for savings out of equity issuance analyzed in prior studies.[20] These studies predict that firms are likely to issue and save when stock prices are high in order to have cash available for future periods in which external finance is costly. Such considerations undoubtedly affect the timing of equity issues in our data and the time-series variation in the median post-issue runway that we report in Figure 10. In addition to these timing considerations, however, our findings indicate that in recent years, the near-term operating needs of firms issuing equity has become a first-order driver of issuance behavior and that such needs are a predominant factor in explaining the time-series of cash balances.

4.4. Staging in debt financing through debt maturity structure

Although negative cash flow firms predominantly raise funds through equity financing, and the staging of capital infusions is typically associated with the equity market, Hertzel, Huson, and Parrino (2012) note that the use of short maturities in debt financing can also be viewed as a form of staged financing. Companies with short maturity debt are forced to renegotiate with creditors to roll over existing debt claims, thereby offering creditors the ability to adjust the terms of debt contracts based on perceptions of company performance and growth opportunities.

[20] See the studies cited in footnote #18.

In Figure 12, we plot the median percentage of debt maturing in more than three years for our sample companies. Consistent with the findings in Custodio et al. (2013), we find that debt maturity significantly declines from the 1970's to 2008. When we split the sample into positive and negative cash flow firms, we find that the percentage of debt maturing in more than three years is always substantially less for negative cash flow firms than for positive cash flow firms. In fact, since 1997, the median negative cash flow firm has no debt maturing in more than three years.

Following the financial crisis in 2008, interest rates dropped precipitously and many firms rushed to issue low cost long term debt. However, although median debt maturity has increased markedly for positive cash flow firms since 2008, the median percentage of debt maturing in greater than three years remains at 0% for negative cash flow firms. These findings are consistent with negative cash flow firms using short maturities to stage debt infusions, even in the presence of historically low interest rates. Moreover, our findings imply that a large portion (though not all) of the systematic decrease in debt maturity documented in Custodio et al. (2013) is associated with the increasing proportion of firms exhibiting negative cash flow.

5. Implications for models of cash holdings

As depicted earlier in Figure 8, the relation between cash holdings and cash flow has become increasingly convex over time. Because standard empirical models of cash holdings specify cash as a linear function of cash flow and other characteristics, the implication of this pattern is that such models are misspecified. One econometric option to deal with convexity is to add a squared term to the specification. However, as was shown in Figure 8, it is primarily nonlinearity on the left side of the cash flow distribution that has changed over time. For this reason, we employ an indicator for negative values of cash flow, and an interaction term between

this indicator and the value of cash flow/assets to capture the magnitude of the losses. These variables allow for inference of differential effects for negative and positive cash flow firms.

Table 8 reports results from OLS regressions of cash holdings on standard determinants used in the literature (equation 1) plus the new variables we describe above to capture the effects of negative cash flow on cash policy (equation 2).[21] Specifically,

$$\frac{Cash}{Assets}_{i,j,t} = \alpha + \beta_1 \frac{CF}{Assets}_{i,t} + \beta_2 \ln(ME)_{i,t} + \beta_3 \overline{CF\ Vol}_{j,t} + \beta_4 I(R\&D\ Intense)_{i,t} + \beta_5 \frac{M}{B}_{i,t} + \beta_6 \frac{CapEx}{Assets}_{i,t} + \beta_7 \frac{Debt}{Assets}_{i,t} + \beta_8 I(Dividend)_{i,t} + \beta_9 \frac{Inventory}{Assets}_{i,t} + \beta_{10} Cost\ of\ Carry_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$\frac{Cash}{Assets}_{i,j,t} = \alpha + \beta_1 \frac{CF}{Assets}_{i,t} + \beta_2 I(CF<0)_{i,t} + \beta_3 \left[I(CF<0) * \frac{CF}{Assets} \right]_{i,t} + \beta_4 \ln(ME)_{i,t} + \beta_5 \overline{CF\ Vol}_{j,t} + \beta_6 I(R\&D\ Intense)_{i,t} + \beta_7 \frac{M}{B}_{i,t} + \beta_8 \frac{CapEx}{Assets}_{i,t} + \beta_9 \frac{Debt}{Assets}_{i,t} + \beta_{10} I(Dividend)_{i,t} + \beta_{11} \frac{Inventory}{Assets}_{i,t} + \beta_{12} Cost\ of\ Carry_{i,t} + \varepsilon_{i,t} \quad (2)$$

Both specifications control for traditional factors related to the precautionary demand for cash. Specifically, we include *Size* (market value of equity) to capture financing constraints,

[21] See Bates, Kahle, and Stulz (2009), Graham and Leary (2016), Kulchania and Thomas (2017), and Azer, Kagy, and Schmalz (2016) for examples of regression models of the determinants of cash balances.

Industry Cash Flow Volatility to capture probability of a negative shock to cash flow, an indicator of *high R&D intensity* and *market-to-book* ratio, both of which are related to growth opportunities. To isolate the effect of precaution related to R&D from the cash flow effect of R&D, we control for the existence of an R&D intensive investment agenda, but not the level of R&D, which is an operating expense. Finally, following prior literature, we include capital expenditures, leverage, an indicator for dividends, inventory, and cost of carry as controls.

In column 1 of Table 8, *Cash Flow* carries a large negative coefficient, consistent with several prior studies, but challenging to interpret in light of the nonlinearity between cash flow and cash. Column 2 reveals the importance of including variables that capture operating needs. Both the negative earnings indicator and the interaction term are highly significant determinants of corporate cash holdings. Moreover, after controlling for operating losses, the size of the coefficient on *Cash Flow* reverses and is highly significant. One implication is that the model with the negative earnings variables should also improve model fit on the right side of the cash flow distribution, where large positive cash flows are otherwise penalized in predictions of cash holdings if cash flow is forced into a linear specification where it carries a negative coefficient.

Columns 3 and 4 add year fixed effects to the models and columns 5 and 6 add year and industry fixed effects. Neither fixed effects specification picks up the impact of negative cash flow firms. Columns 7 and 8 report Fama-MacBeth regressions with similar results. In both the fixed effects models as well as the Fama-MacBeth models, the sign of the coefficient on *Cash Flow* in the linear specification is negative and significant, whereas the specification with indicators for negative cash flow flips the sign on the *Cash Flow* variable. These findings imply that the relation between cash flow and cash holdings depends greatly on the sign of the cash flows.

In Figures 13A and 13B, we detail the effects of functional form misspecification on prediction error. Figure 13A compares average prediction error within each decile in the full sample panel regressions. The comparison is between the standard model and the model that captures nonlinearity by adding the negative indicator and interaction term as in (2). The improvement is most evident in the tails of the distribution, which is not surprising due to the convex relation. Overall, improvement is noted in seven of the ten deciles. These results are consistent with the finding in Table 8 that the linear specification does a poor job of characterizing the relation between cash and cash flow.

Figure 13B compares three prediction models designed to account for time varying changes in cash holdings. The first is the standard model with year fixed effects added, the second adds both year and industry fixed effects. The third is the nonlinear model estimated in annual cross-sections for each year of the sample to allow the coefficients to vary through time, similar to the technique used in Harford et al. (2009) to predict leverage targets.

Both fixed effects models create larger prediction errors in most deciles, again particularly in the tails. In the case of year fixed effects, the annual cross sections perform better in eight of the 10 deciles, and when compared to the model with year and industry fixed effects the annual cross sections perform better in every decile but one. The reason is intuitive: the lion's share of the increase in cash holdings has occurred in the tails of cash flow, but year fixed effects impact the predicted value uniformly across the distribution.

Finally, in Table 9, we use the augmented cash holdings model to provide a 'back of the envelope' estimate of the relative contribution of cash flow levels versus cash flow volatility to predicted cash holdings for negative cash flow firms. The first two columns report coefficients from estimating Equation (2) over five-year subperiods at the beginning (1970–1974) and end

(2011–2015) of the sample period: The third and fourth columns report the subperiod median values of each variable for firms that report negative operating cash flow. The predicted contribution to cash holdings, reported in the final two columns, is the product of the coefficients and median observed values.

The effect of cash flow levels on predicted cash holdings is revealed by the cash flow variables. In this example, the level variables contribute nearly twice as much to the increase in predicted cash as the volatility variable. 26% of the increase in predicted cash/assets is attributable to cash flow levels, while 14% of the increase is attributable to cash flow volatility.

6. Conclusion

We document that, coincident with the previously documented rise in intangible investment, U.S. public firms exhibit substantially different patterns in profitability and corporate financing behavior. The population of U.S. public firms increasingly consists of firms with persistent, large, negative cash flows. This creates ongoing liquidity needs that are directly tied to current and near-term operations. Correspondingly, we find that cash balances have increased much more substantially in recent decades for negative cash flow firms than for the rest of the population. Our evidence thus supports the view that the recent growth in average cash balances among U.S. firms is not solely a reflection of increased precautionary demands due to cash flow volatility, increased disincentives to repatriate foreign earnings, or increased agency problems. Rather, for an increasing fraction of firms, higher average cash balances reflect additional precautionary demand due to near-term operational needs and an expectation of future negative cash flows for an uncertain duration.

Additionally, we find that equity issuance activity is increasingly dominated by firms with negative cash flows. Although firms are saving a substantial proportion of equity issuance proceeds in cash, they are also burning cash at an unprecedented rate. These patterns have two implications. First, as a result of the offsetting effects of increased cash savings from issuance and higher burn rates, there is virtually no time trend in estimates of cash runway over the last 25 years. Second, the high burn rates imply that high average cash balances for negative cash flow firms obscure substantial intra-firm volatility in cash over time. Indeed, we estimate that within a given year, cash balances of negative cash flow firms fluctuate between 25% and 82% of assets. Since 2000, firms with negative operating cash flows issue equity almost once every year and appear to mitigate the large fixed costs of SEOs by primarily raising equity through private placements. Such behavior is consistent with a supply-driven public market staging of finance of the type studied in Hertzel et al. (2012).

The strong association between patterns in intangible investment and the patterns in profitability that we report are suggestive of a shift in the underlying economics of new economy firms, particularly with regards to growth patterns. Historically, firms have grown linearly with investment. Investments in property, plant, and equipment converted to sales relatively quickly. In recent years, however, investment more often takes the form of R&D, organizational capital, and other types of intangibles. There can be a long lag between investment in intangibles and resultant sales and profits; however, intangible assets can scale in ways that tangible assets cannot. Growth can be quite rapid many years after the investment. The result is convexity in the relation between sales/profits and investment. Although our analysis is focused on profitability patterns and their impact on the evolution of corporate financing behavior, we believe that the shift towards intangible investment has many other potentially interesting implications for tests of investment

efficiency, the allocation of capital, the information content of earnings, and the distribution of long-term stock returns.[22]

[22] See, for example, Peters and Taylor (2017), Lee, Shin, and Stulz (2018), Gu and Lev (2017), and Bessembinder (2018).

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Appendix A: Variable Descriptions

Cash Holdings	CHE/AT
Operating Cash Flow	OANCF. If missing, replaced by NI+DPC+TXDC+ESUBC+SPPIV+FOPO+FSRCO+WCAPC+APALCH+INVCH+RECCH
I(CF<0)	Indicator that takes a value of 1 when Cash Flow<0, and 0 otherwise
Cash Flow x I(CF<0)	Interaction that takes the value of Cash Flow when Cash Flow<0, and 0 otherwise
Size	Natural Log of AT
Industry CF Vol	Standard deviation of cash flows is measured for each firm over up to 10 years (minimum 3). Values are averaged based on Fama French 48 industries annually.
R&D	XRD. Coded to 0 if missing.
I(R&D Intense)	Indicator that takes a value of 1 when [XRD/AT]>0.02, and 0 otherwise
M/B	(AT+MKTVAL-SEQ)/AT. MKTVAL is replaced by CSHO*PRCC_C if missing.
Capital Expenditures	CAPX/AT. Coded to 0 if missing.
Leverage	[DLTT+DLC]/AT
Inventory	INVT/AT
Cost of Carry	(CHE-CH)*3-month T-bill rate
Revenue Growth	$[REV_t-REV_{t-1}]/REV_{t-1}$
Employee Growth	$[EMP_t-EMP_{t-1}]/EMP_{t-1}$
Dividend Yield	DVC/MKVALT
Firm-initiated Equity Issuance	SSTK when [SSTK/MKTVAL]>0.03
Net Equity Issuance	SSTK-PRSTK
Net Debt Issuance	$[DLTT+DLC]_t-[DLTT+DLC]_{t-1}$
Sale of Assets	SPPE
Burn Rate	-[Operating Cash Flow-DVC-CAPX]. Divided by 12 for monthly burn rate.
Runway	CHE/Monthly Burn Rate

All variable mnemonics are from Compustat, Industrial Annual File
All ratios are winsorized at the 1st and 99th percentiles.

Table 1

Evolution of cash flow by decile

This table reports mean values of CF/assets for deciles formed annually. The full sample is 188,368 firm year observations over the period 1970-2016. Values are averaged over all firm year observations within the decile during the specified subperiod.

CF decile	1970-79	1980-89	1990-99	2000-16
1	(0.11)	(0.36)	(0.43)	(0.58)
2	0.04	(0.05)	(0.12)	(0.15)
3	0.07	0.03	(0.03)	(0.03)
4	0.10	0.07	0.01	0.02
5	0.12	0.10	0.04	0.05
6	0.14	0.13	0.07	0.07
7	0.17	0.16	0.09	0.10
8	0.19	0.20	0.12	0.12
9	0.24	0.26	0.16	0.16
10	0.36	0.45	0.24	0.25

Table 2

Summary statistics for negative cash flow firms

This table reports mean *(median)* values for firms with negative cash flow. All variables are defined in the appendix. The full sample is 188,368 firm year observations over the period 1970-2016.

	1970's	1980's	1990's	2000's
N	2,846	8,290	15,861	20,272
Firm Age	6.5	7.7	7.7	11.0
	6	*5*	*5*	*8*
Total Assets (2016$)	436	276	249	482
	110	*33*	*42*	*54*
Mkt Cap (2016$)	104	119	292	387
	33	*25*	*56*	*70*
M/B	1.16	1.87	2.73	2.70
	0.92	*1.23*	*1.73*	*1.71*
Book Leverage	0.386	0.347	0.248	0.224
	0.382	*0.327*	*0.180*	*0.095*
Mkt Leverage	0.387	0.273	0.170	0.138
	0.403	*0.245*	*0.093*	*0.046*
R&D/TA	0.015	0.041	0.092	0.150
	0.000	*0.000*	*0.007*	*0.063*
CapEx/TA	0.063	0.080	0.056	0.039
	0.038	*0.042*	*0.033*	*0.019*
SG&A/TA	0.318	0.386	0.445	0.511
	0.262	*0.320*	*0.366*	*0.420*
Revenue Growth	-1.7%	16.1%	35.0%	28.9%
	-3.8%	*-1.2%*	*10.4%*	*2.8%*
Employee Growth	-5.7%	0.6%	18.7%	7.5%
	-6.7%	*-4.5%*	*5.3%*	*0.0%*
Dividend Yield	1.07%	0.46%	0.19%	0.17%
	0.0%	*0.0%*	*0.0%*	*0.0%*

Table 3

Cash Flow and R&D

This table reports average cash holdings by cash flow decile for the top two deciles of R&D over the sample period. The full sample is 188,368 firm year observations over the period 1970-2016.

		1970-1979	2007-2016	Growth
	1	0.07	0.59	744%
	2	0.07	0.29	336%
	3	0.07	0.17	153%
Cash Flow	4	0.07	0.13	82%
Decile	5	0.07	0.11	57%
	6	0.08	0.11	29%
	7	0.09	0.12	35%
	8	0.10	0.13	26%
	9	0.12	0.15	27%
	10	0.15	0.22	43%

Table 4

Cash Holdings in First Year of Negative Cash Flow

This table reports median values of cash/assets observed in the first year that the firm reports negative cash flow. The subgroups are formed for each decade based on the persistence of negative cash flows and cash flow history. The full sample is 188,368 firm year observations over the period 1970-2016. The Persistent category is made up of firms that are entering a run of negative cash flow that is at least three years in duration. The Transitory subgroup is made up of firms that return to positive cash flow the following year. New Firms are those that are less than three years old. Fallen Angels are firms that reported at least five years of positive cash flow before entering the negative cash flow sample.

	Persistent				Transitory			
	New Firms		Fallen Angels		New Firms		Fallen Angels	
	N	Cash/TA	N	Cash/TA	N	Cash/TA	N	Cash/TA
1970s	202	0.040	343	0.046	390	0.044	741	0.043
1980s	961	0.118	897	0.075	1,231	0.080	1,410	0.055
1990s	2,158	0.386	2,292	0.359	1,357	0.128	1,686	0.091
2000s	1,442	0.553	1,957	0.409	898	0.157	1,827	0.111

Table 5

Proceeds from the Sale of Debt, Equity and PPE

This table reports the average annual proceeds from equity issuance, debt issuance, and the sale of fixed assets, scaled by total assets, for firms in each cash flow decile. The full sample is 188,368 firm year observations over the period 1970-2016. The first ten years and last ten years of the sample are reported for comparison.

		1970-79				2007-16			
		N	Net Equity /Assets	Net Debt /Assets	Sale of PPE /Assets	N	Net Equity /Assets	Net Debt /Assets	Sale of PPE /Assets
Cash Flow Bin	<(.45)	38	0.064	(0.012)	0.028	1,528	0.449	0.015	0.002
	(.45)-(.40)	64	0.039	0.014	0.026	252	0.343	0.052	0.002
	(.40)-(.35)	132	0.034	(0.040)	0.026	294	0.316	0.034	0.001
	(.35)-(.30)	122	0.021	0.004	0.020	296	0.313	0.018	0.002
	(.30)-(.25)	69	0.019	(0.036)	0.024	367	0.284	0.029	0.002
	(.25)-(.20)	147	0.011	0.030	0.016	501	0.248	0.021	0.002
	(.20)-(.15)	191	0.017	(0.000)	0.014	624	0.190	0.012	0.002
	(.15)-(.10)	255	0.010	0.013	0.019	837	0.110	0.020	0.003
	(.10)-(.05)	407	0.006	0.003	0.017	1,216	0.065	0.027	0.003
	(.05)-0	809	0.005	0.022	0.012	2,250	0.057	0.023	0.004
	0-.05	1,916	0.003	0.027	0.011	4,411	0.024	0.025	0.003
	.05-.10	4,291	0.003	0.025	0.010	7,222	0.005	0.016	0.003
	.10-.15	5,981	0.003	0.022	0.009	5,938	(0.006)	0.006	0.004
	.15-.20	5,245	0.006	0.021	0.009	3,020	(0.018)	(0.001)	0.004
	.20-.25	3,276	0.009	0.021	0.009	1,373	(0.025)	(0.012)	0.004
	.25-.30	1,851	0.016	0.023	0.010	614	(0.037)	(0.017)	0.003
	.30-.35	927	0.029	0.023	0.012	425	(0.028)	(0.029)	0.002
	>.35	1,431	0.058	(0.001)	0.012	206	(0.027)	(0.051)	0.003

Table 6

Equity Issuance Frequency

This table reports the average number of firm-initiated equity issuances per firm per year, compiled from quarterly data. Quarterly issuance data is available over the period 1985-2016.

		1985-1989	1990-1999	2000-2009	2010-2016
Cash Flow Decile	1	0.41	0.73	0.73	0.93
	2	0.29	0.49	0.44	0.53
	3	0.22	0.34	0.27	0.24
	4	0.21	0.26	0.20	0.15
	5	0.19	0.22	0.15	0.12
	6	0.18	0.18	0.13	0.12
	7	0.16	0.15	0.11	0.08
	8	0.19	0.12	0.09	0.07
	9	0.23	0.12	0.08	0.06
	10	0.31	0.12	0.08	0.07

Table 7

Equity Issuance Mechanisms

This table reports the proportion of seasoned equity issuances that are public versus private placements. The full sample is 188,368 firm year observations over the period 1970-2016. Data on equity issuance mechanisms is available from 1995 to 2013.

	Negative CF		Positive CF	
Year	Public	Private	Public	Private
1995	77%	23%	95%	5%
1996	80%	20%	95%	5%
1997	60%	40%	94%	6%
1998	45%	55%	96%	4%
1999	40%	60%	91%	9%
2000	30%	70%	77%	23%
2001	21%	79%	67%	33%
2002	16%	84%	72%	28%
2003	19%	81%	64%	36%
2004	22%	78%	64%	36%
2005	22%	78%	60%	40%
2006	20%	80%	62%	38%
2007	19%	81%	57%	43%
2008	14%	86%	46%	54%
2009	12%	88%	67%	33%
2010	12%	88%	51%	49%
2011	7%	93%	58%	43%
2012	9%	91%	51%	49%
2013	12%	88%	71%	29%

Table 8

Determinants of cash holdings

This table reports results from OLS regressions of cash holdings (cash/assets) on various determinants. The full sample is 188,368 firm year observations over the period 1970-2016. Columns 1, 3, and 5 use a linear specification for cash flow while columns 2, 4, and 6 allow for non-linearity when earnings are negative by adding an indicator of negative earnings and an interaction that takes the value of CF/assets when it is negative and zero otherwise. Variables are defined in the appendix. Standard errors are clustered by firm and year. *, **, and *** indicate significance at the 10%, 5% and 1% levels

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cash Flow	-0.098 ***	0.160 ***	-0.107 ***	0.144 ***	-0.088 ***	0.143 ***	-0.070 ***	0.166 ***
	(<0.001)	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*
I(CF<0)		0.041 ***		0.041 ***		0.039 ***		0.037 ***
		(<0.001)		*(<0.001)*		*(<0.001)*		*(<0.001)*
CF x I(CF<0)		-0.335 ***		-0.315 ***		-0.287 ***		-0.292 ***
		(<0.001)		*(<0.001)*		*(<0.001)*		*(<0.001)*
Size	-0.009 ***	-0.006 ***	-0.007 ***	-0.005 ***	-0.009 ***	-0.007 ***	-0.007 ***	-0.006 ***
	(<0.001)	*(0.068)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*
Industry CF Vol	0.371 ***	0.353 ***	0.432 ***	0.399 ***	0.238 ***	0.223 ***	0.235 ***	0.196 ***
	(<0.001)	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(0.001)*
I(R&D Intense)	0.071 ***	0.066 ***	0.069 ***	0.064 ***	0.064 ***	0.061 ***	0.054 ***	0.053 ***
	(<0.001)	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*
M/B	0.025 ***	0.021 ***	0.025 ***	0.021 ***	0.023 ***	0.02 ***	0.027 ***	0.023 ***
	(<0.001)	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*
Cap Ex	-0.347 ***	-0.391 ***	-0.37 ***	-0.399 ***	-0.326 ***	-0.352 ***	-0.359 ***	-0.39 ***
	(<0.001)	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*
Leverage	-0.277 ***	-0.27 ***	-0.278 ***	-0.271 ***	-0.27 ***	-0.264 ***	-0.25 ***	-0.245 ***
	(<0.001)	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*
I(Dividend)	-0.024 ***	-0.026 ***	-0.030 ***	-0.029 ***	-0.027 ***	-0.027 ***	-0.025 ***	-0.025 ***
	(<0.001)	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*
Inventory	-0.333 ***	-0.333 ***	-0.340 ***	-0.336 ***	-0.419 ***	-0.416 ***	-0.304 ***	-0.301 ***
	(<0.001)	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*
Cost of Carry	0.001 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.002 ***	0.002 ***
	(<0.001)	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*
Constant	0.168 ***	0.128 ***	0.165 ***	0.129 ***	0.181 ***	0.162 ***	0.140 ***	0.114 ***
	(<0.001)	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*
Fixed Effects	*None*	*None*	*Year*	*Year*	*Year, Industry*	*Year, Industry*	*FM*	*FM*
N	185,268	185,268	185,268	185,268	185,268	185,268	185,268	185,268
R^2	0.459	0.473	0.463	0.475	0.490	0.500	0.445	0.460

Table 9

Numerical example: What drives growth in cash holdings in low cash flow firms?

This table reports predicted cash holdings for the median firm characteristics from the lowest decile of CF/assets during the periods (i) 1970-74 and (ii) 2012-2016 using coefficients from OLS regressions of cash holdings (cash/assets) on various determinants defined in the appendix. The full sample is 188,368 firm year observations over the period 1970-2016. Predicted cash is the product of the coefficients and median values for each respective subperiod.

	Coefficients		Median Values CF<0		Predicted Cash			
	1970-1974	2012-2016	1970-1974	2012-2016	(1)	(2)		
Cash Flow	0.114	0.306	-0.069	-0.177	(0.008)	(0.054)		
I(CF<0)	0.011	0.063	1	1	0.011	0.063		
Cash Flow x I(CF<0)	-0.136	-0.550	-0.069	-0.177	0.009	0.098		
Industry CF Vol	-0.109	0.350	0.032	0.139	(0.003)	0.048		
Size	-0.008	-0.002	2.000	4.400	(0.016)	(0.010)		
R&D	-0.011	0.119	0.000	1.000	-	0.119		
M/B	0.022	0.019	0.949	2.009	0.021	0.038		
Cap Ex	-0.205	-0.491	0.040	0.012	(0.008)	(0.006)		
Leverage	-0.163	-0.221	0.385	0.089	(0.063)	(0.020)		
I(Dividend)	0.000	-0.036	0	0	-	-		
Inventory	-0.155	-0.284	0.260	0.011	(0.040)	(0.003)		
Cost of Carry	0.001	0.001	0.000	0.000	-	-		
Constant	0.167	0.163			0.167	0.163		
							Increase	%
Predicted cash					0.070	0.437	0.367	
Contribution from cash flow level					0.013	0.107	0.094	26%
Contribution from cash flow volatility					(0.003)	0.048	0.052	14%

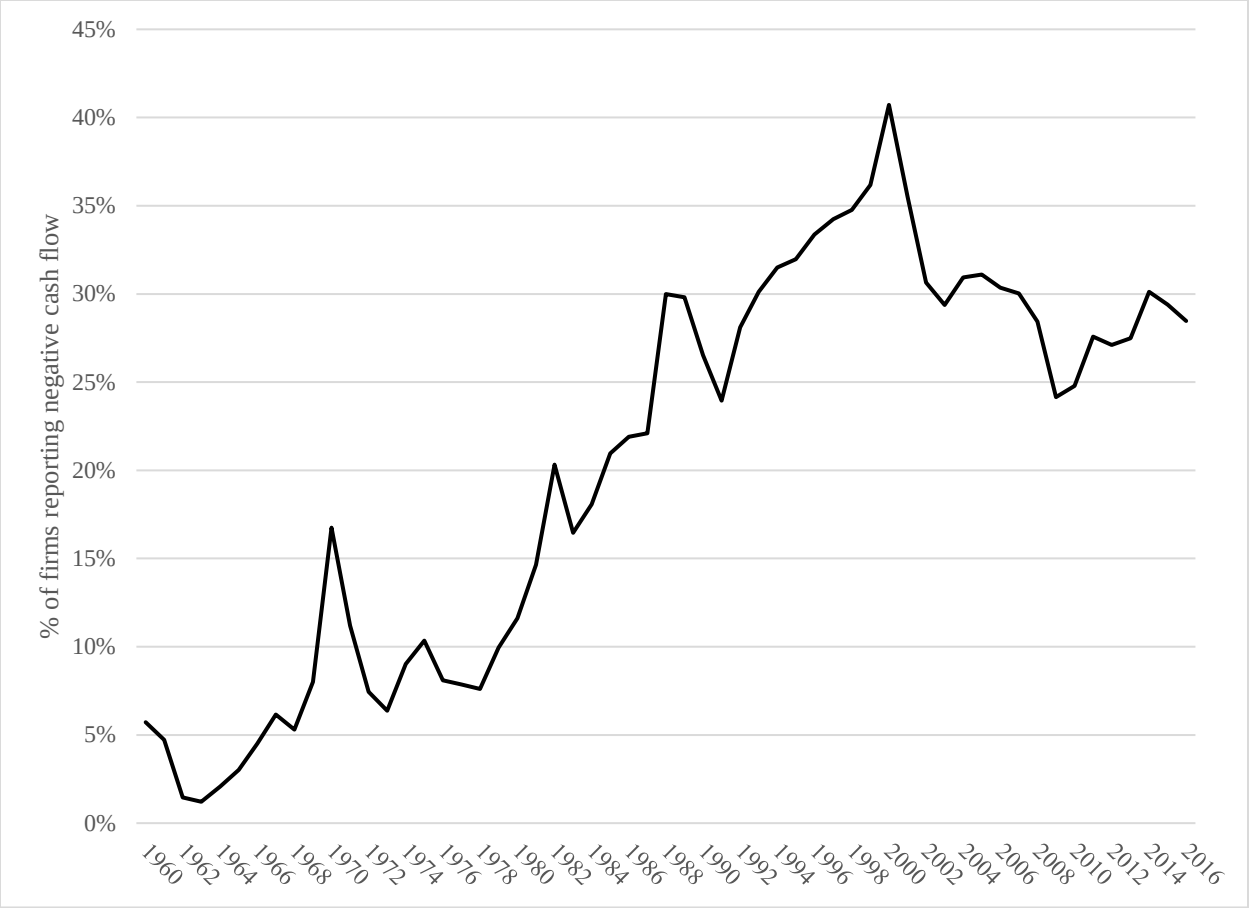

Figure 1. Prevalence of Negative Cash Flow. This chart reports the percentage of Compustat listed firms that report negative operating cash flow. Detailed variable descriptions are available in the appendix.

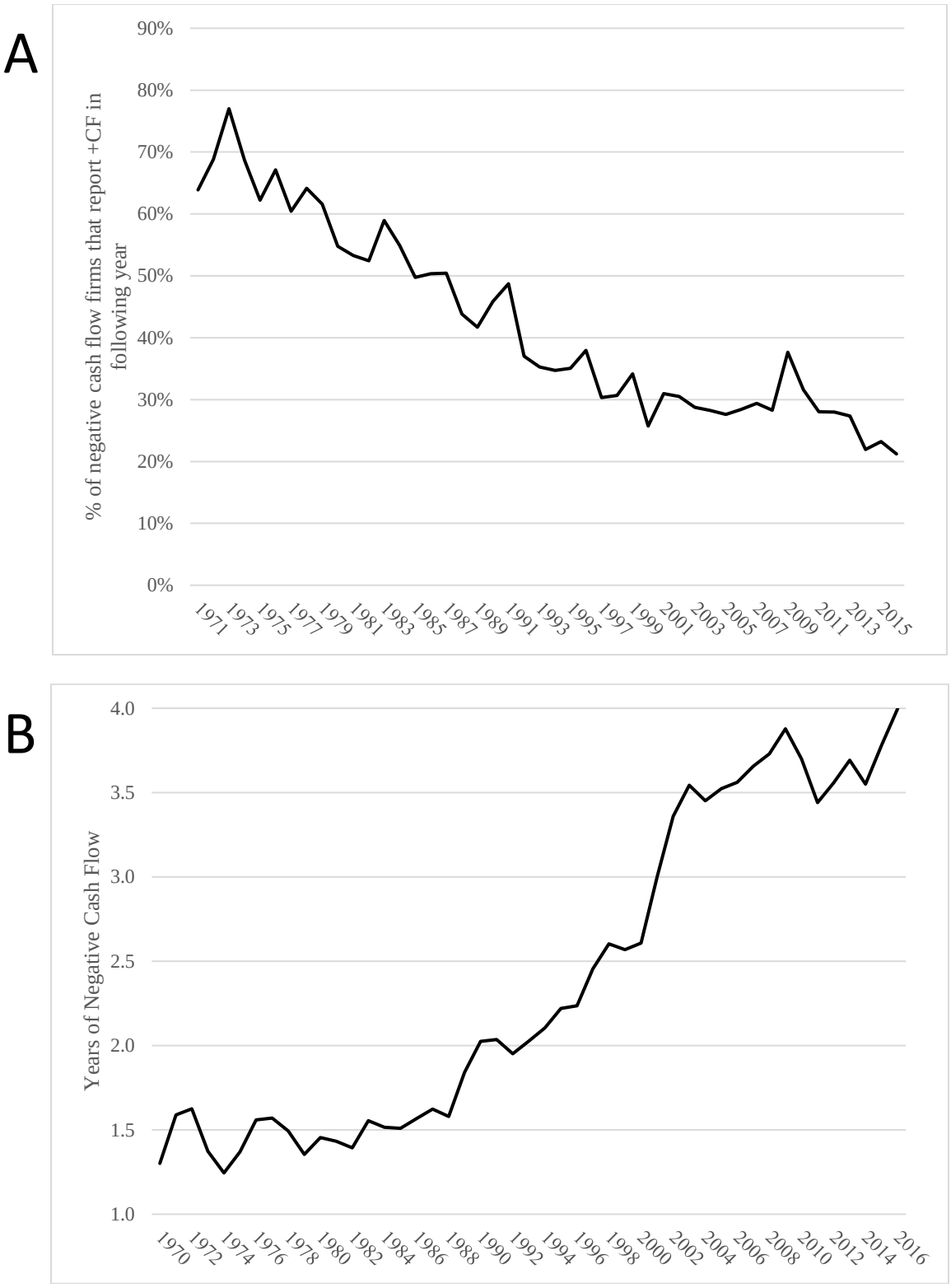

Figure 2. Persistence of Negative Cash Flow. Panel A: Proportion of Negative cash flow firms that report positive cash flow in the following year. Panel B: Average number of consecutive years of negative cash flow for firms that report negative cash flow.

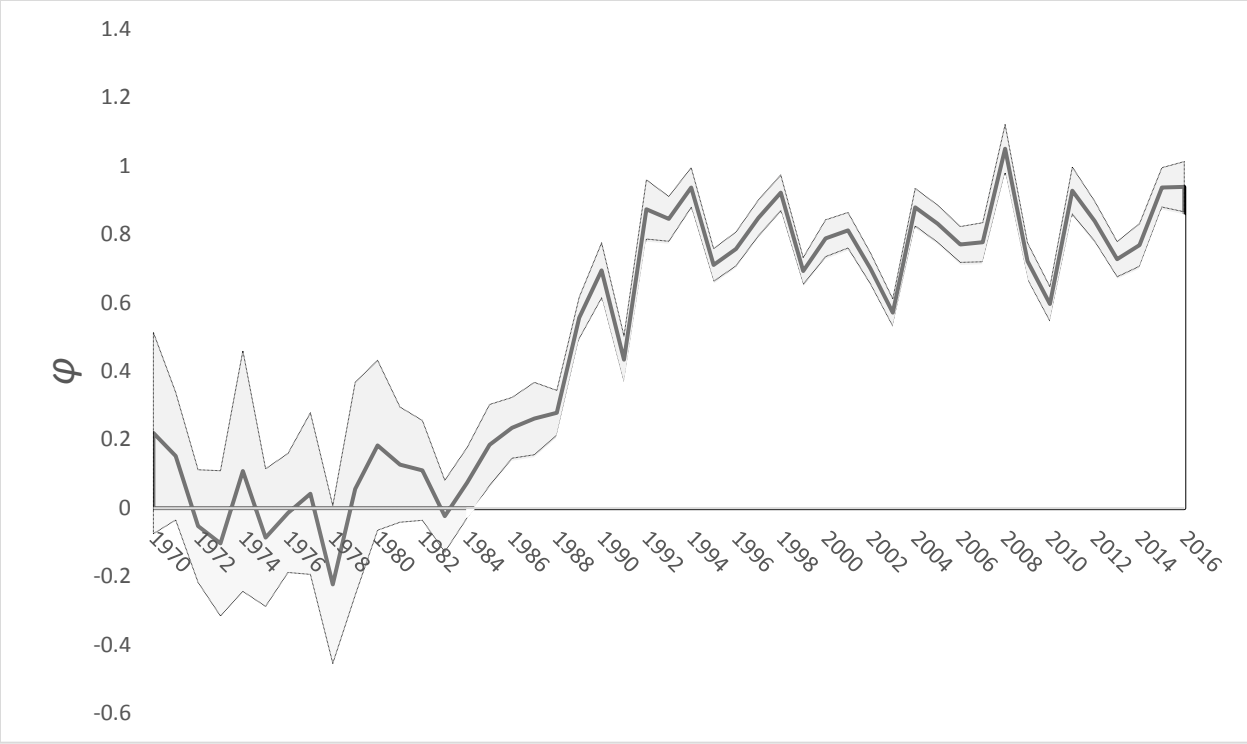

Figure 3. AR(1) model coefficients. This chart reports the coefficient on lagged cash flow (φ) in the autoregressive model: $CF_t = \alpha + \varphi CF_{t-1} + \varepsilon_t$ when estimated annually over the sample period on the subset of firms that report negative cash flow at time t. The gray shaded area represents the 95% confidence interval.

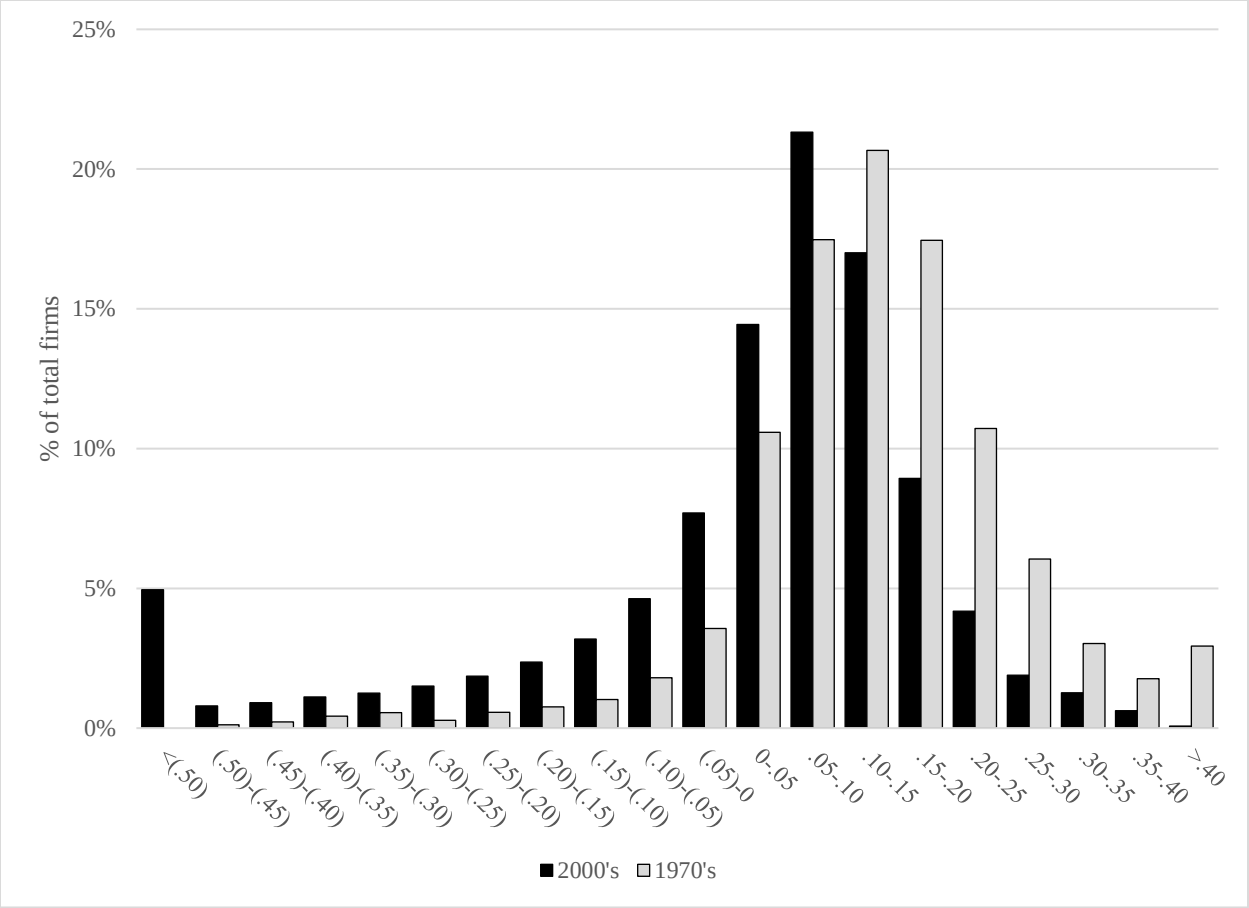

Figure 4. Distribution of Firms by Cash Flow over time. This chart reports the percentage of firm-year observations within each bin of operating cash flow during two subperiods: (i) 1970-79, (ii) 2000-2015.

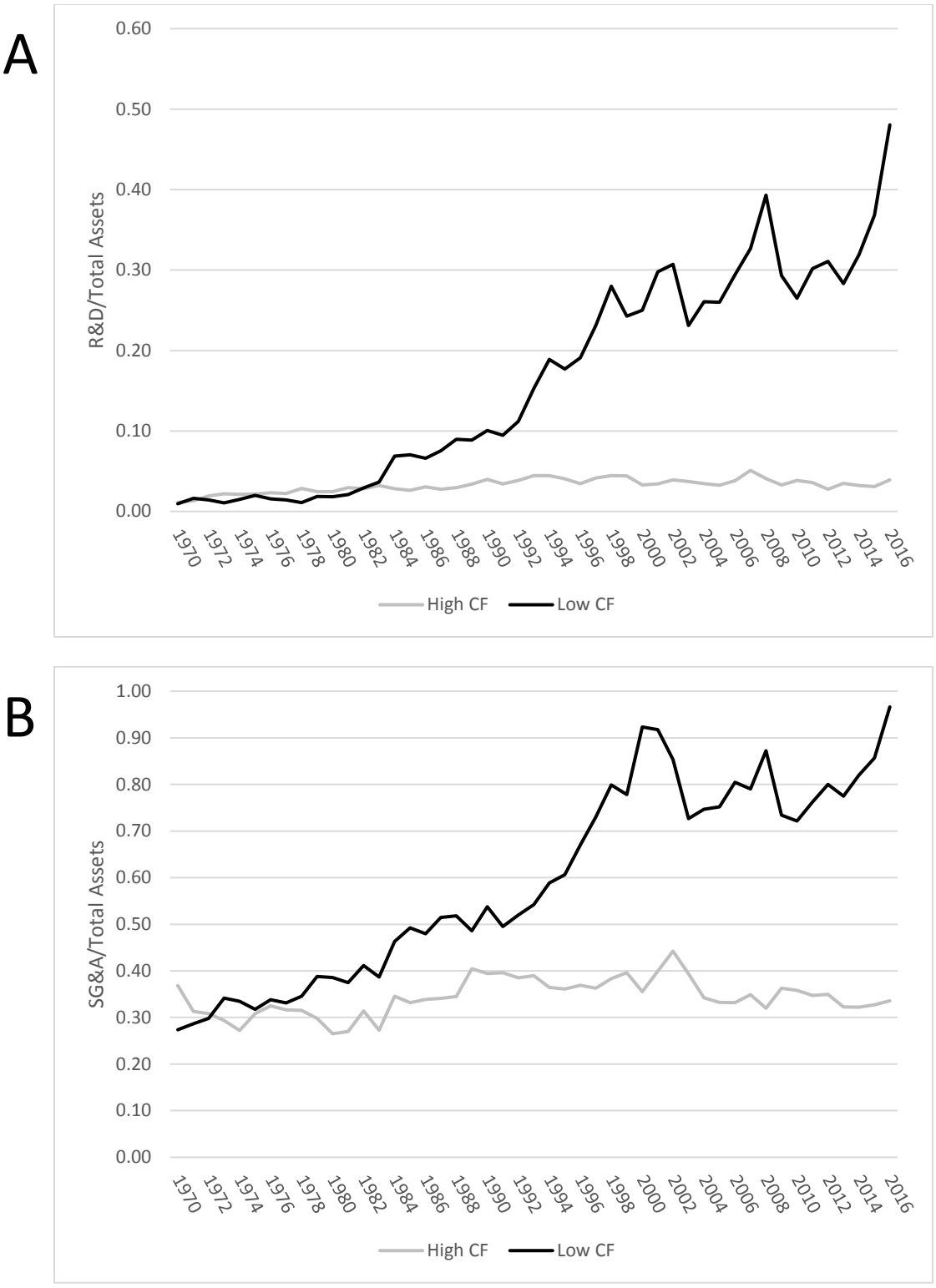

Figure 5. Evolution of Intangible Investment. This chart reports mean values of R&D/total assets (panel A) and SG&A/total assets (panel B) annually over 1970-2016 for firms in the highest decile of operating cash flow (black line) as well as firms in the lowest decile of operating cash flow (gray line).

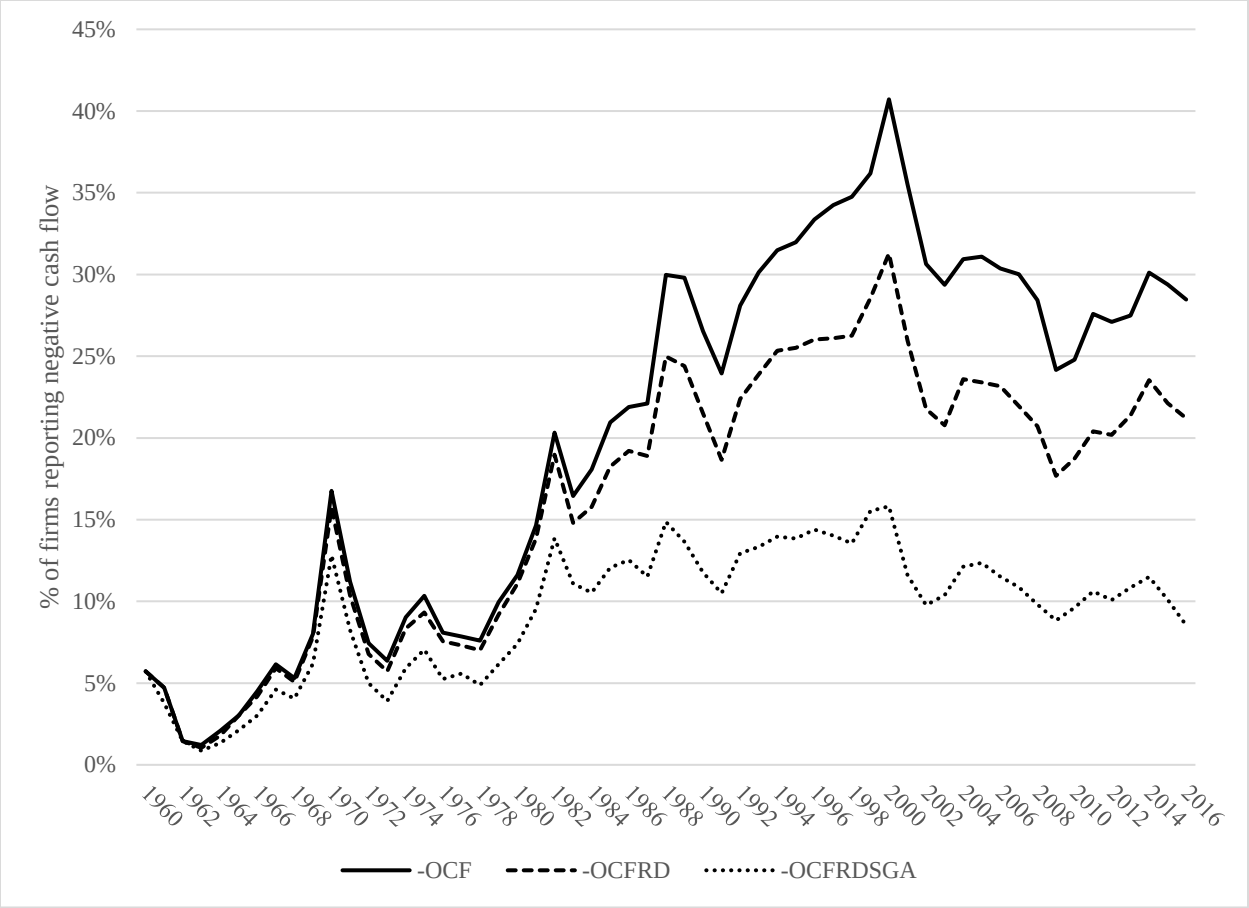

Figure 6. Prevalence of Negative Cash Flow. This chart reports the percentage of Compustat listed firms that report negative operating cash flow. –OCF is negative operating cash flow, -OCFRD is negative operating cash flow after adding back R&D expense. –OCFRDSGA is negative operating cash flow after adding back both R&D and abnormal SG&A expenses, where abnormal SG&A is an SG&A over 30% of total assets. Detailed variable descriptions are available in the appendix.

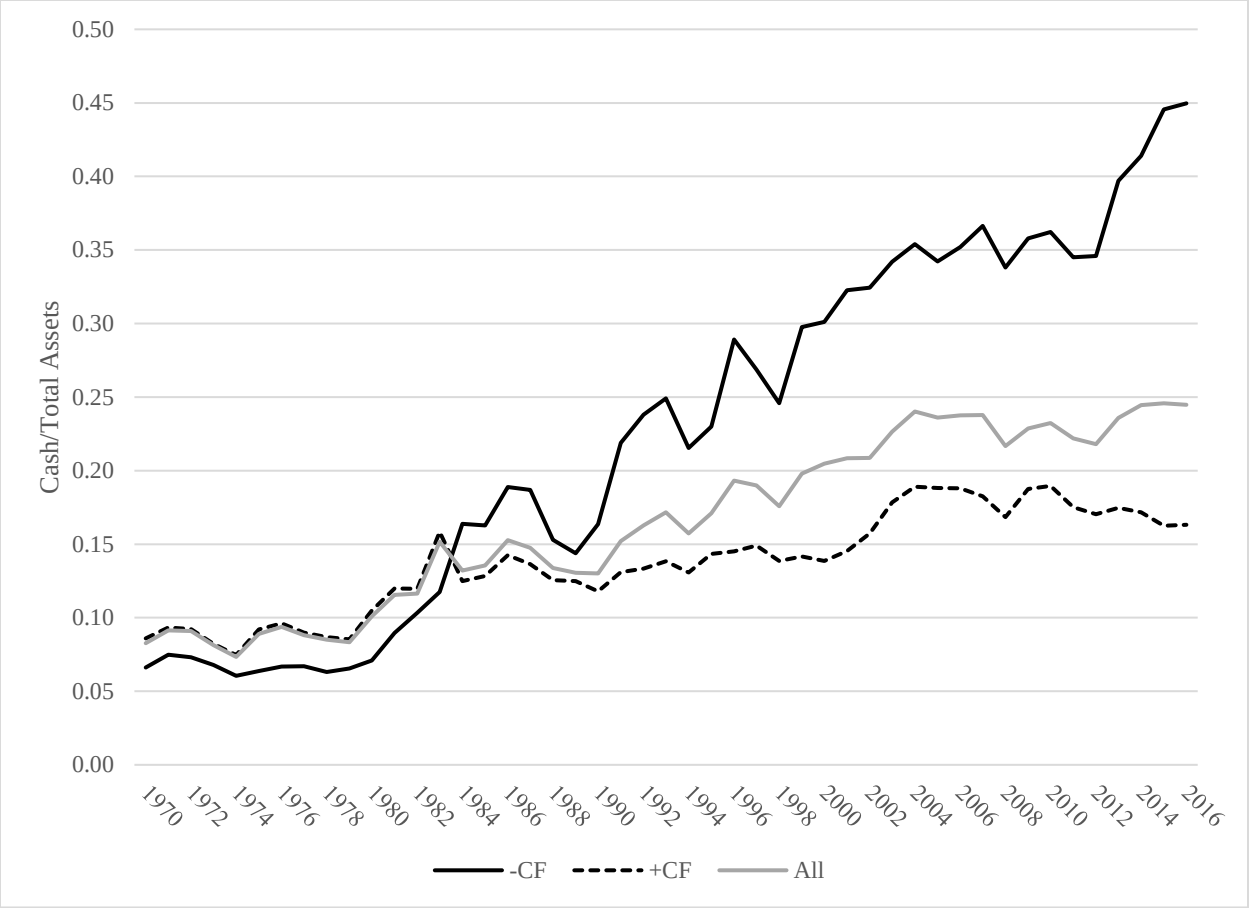

Figure 7. Evolution of Cash Holdings. This chart reports mean values of cash/total assets annually over 1970-2015 for the full sample (gray line) as well as two subsamples: positive cash flow firms (dotted line) and negative cash flow firms (solid black line).

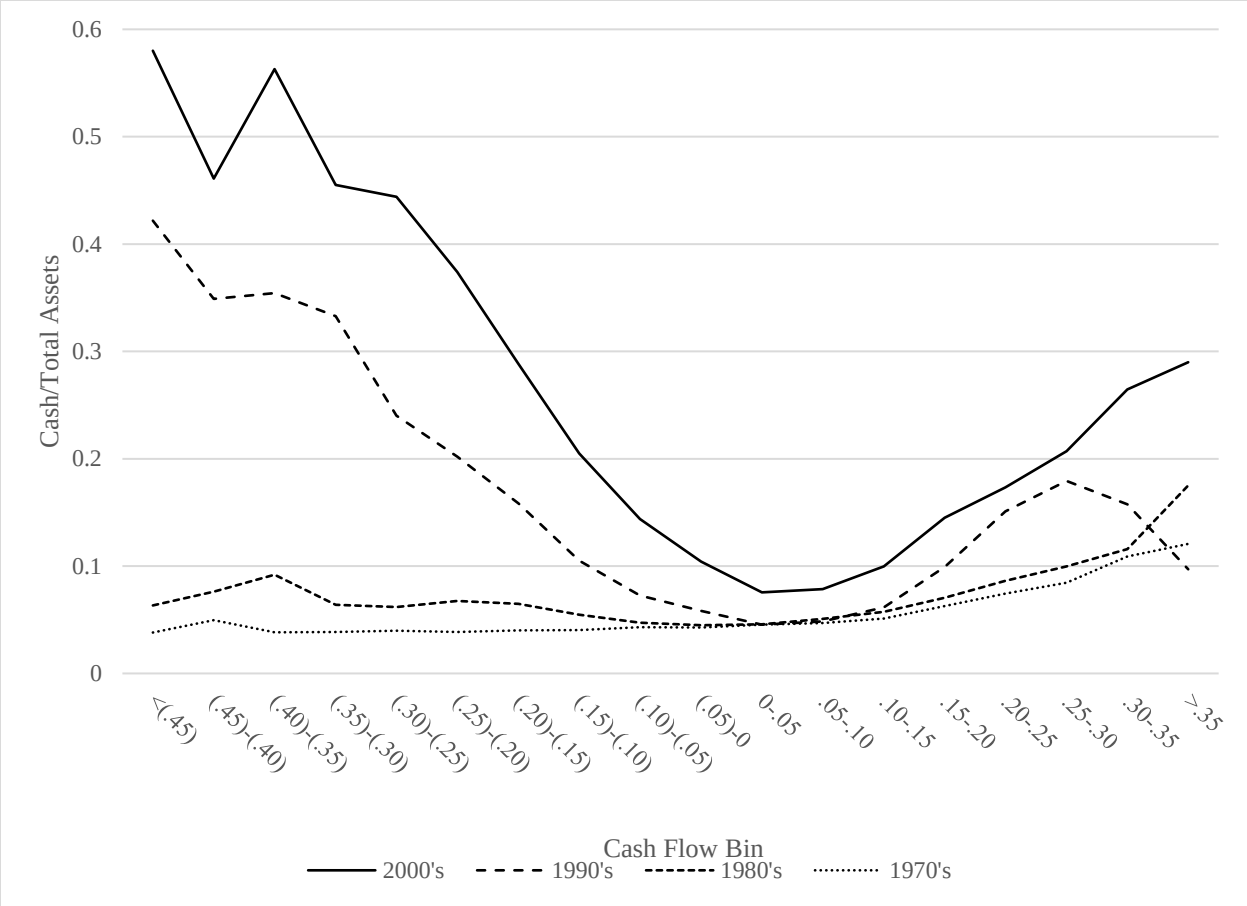

Figure 8. Convexity in the Relation between Cash Holdings and Cash Flow. This chart reports median values of cash/total assets for each bin of operating cash flow during four subperiods: (i) 1970-79, (ii) 1980-89, (iii) 1990-99, and (iv) 2000-2015.

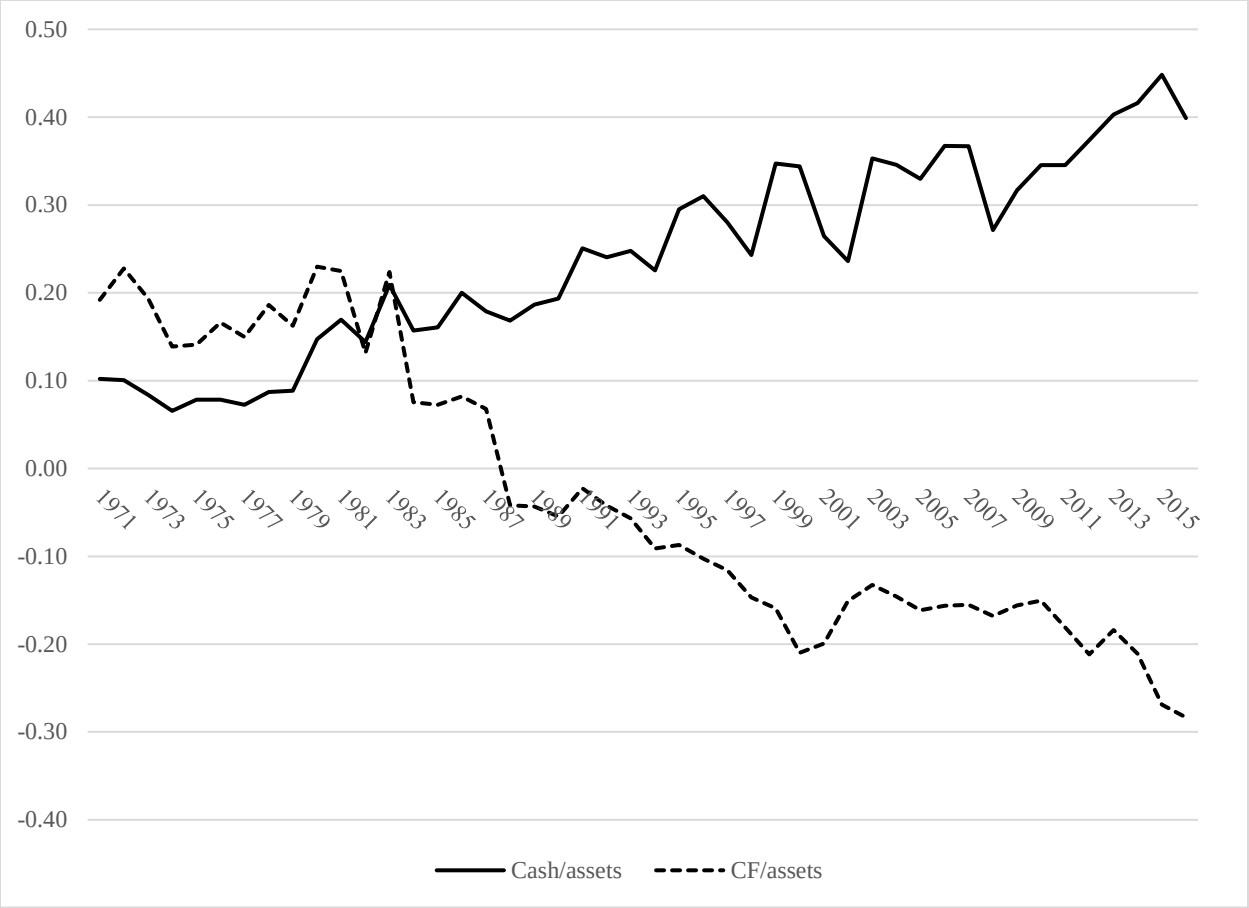

Figure 9. Equity Issuer Characteristics. This chart reports mean values of cash holdings and operating cash flow for all firms that initiate an equity issuance in a given year.

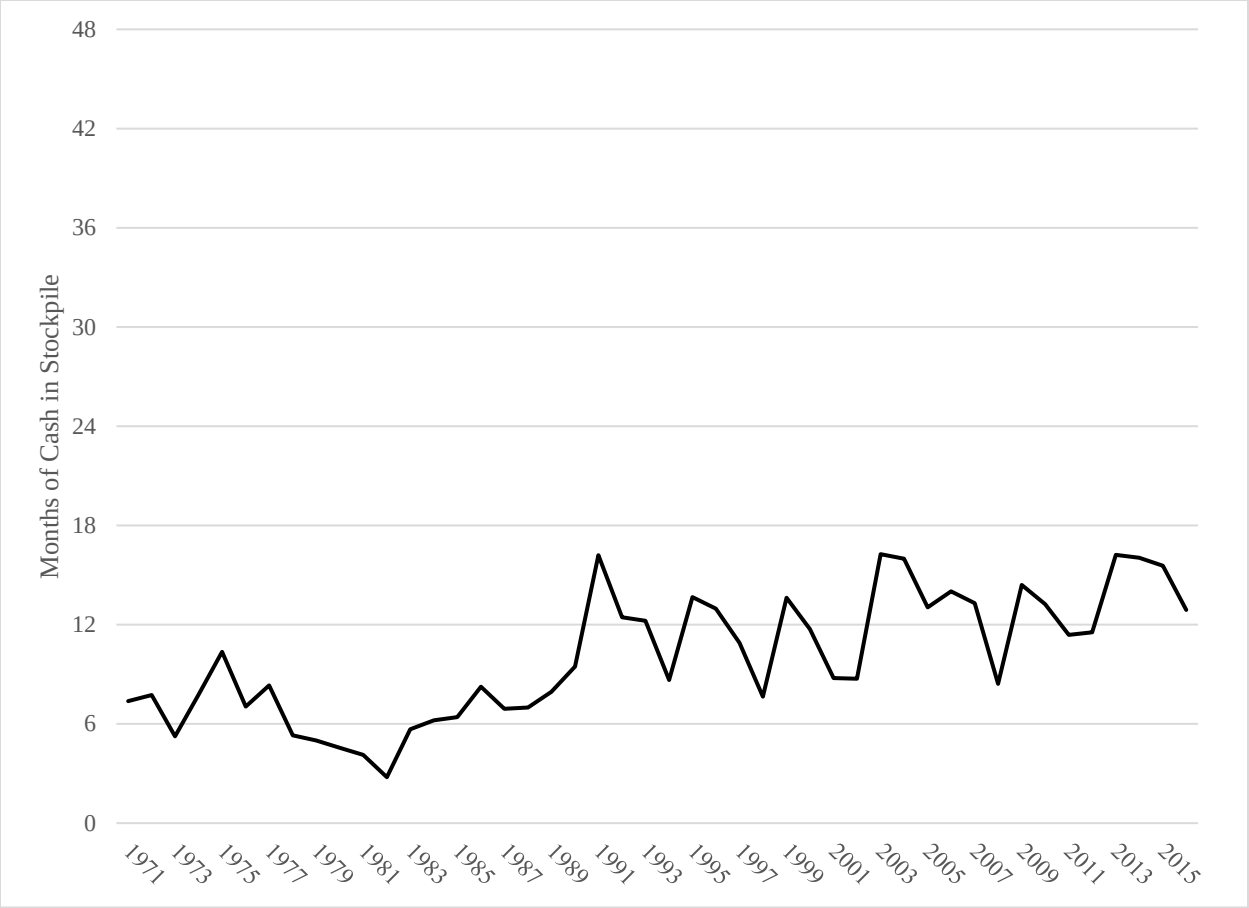

Figure 10. Median Runway for Equity Issuers with Negative Cash Flow. This chart reports the mean number of months of continued operations that could be sustained given the level of cash holdings immediately following the equity issue. The sample includes all firms that both initiate an equity issuance and report negative cash flow in a given year.

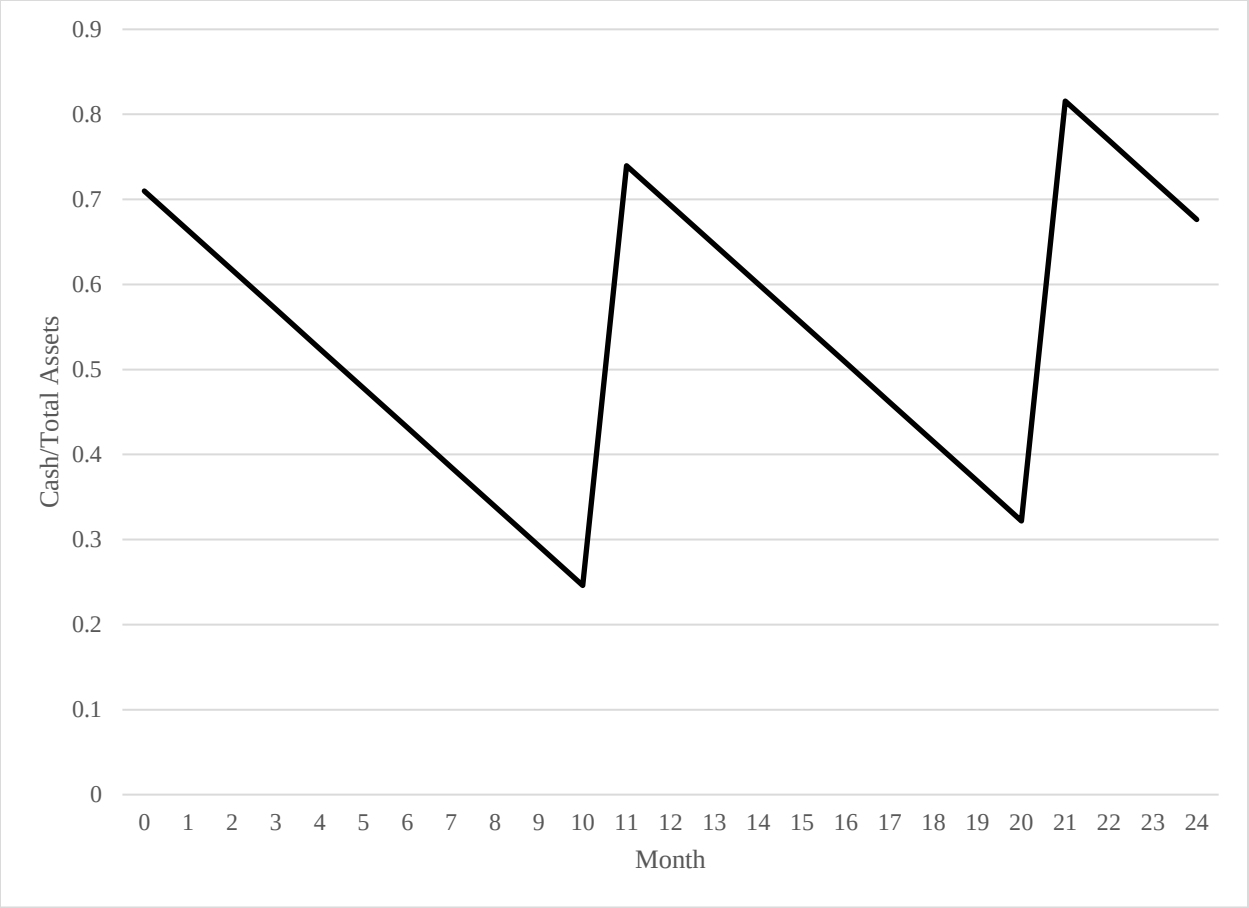

Figure 11. Simulated Cash Holdings of Equity Issuers. This chart reports a stylized model of the evolution of cash holdings over 24 months. Values are calibrated to observed average figures for high cash equity issuers over the last decade of the sample.

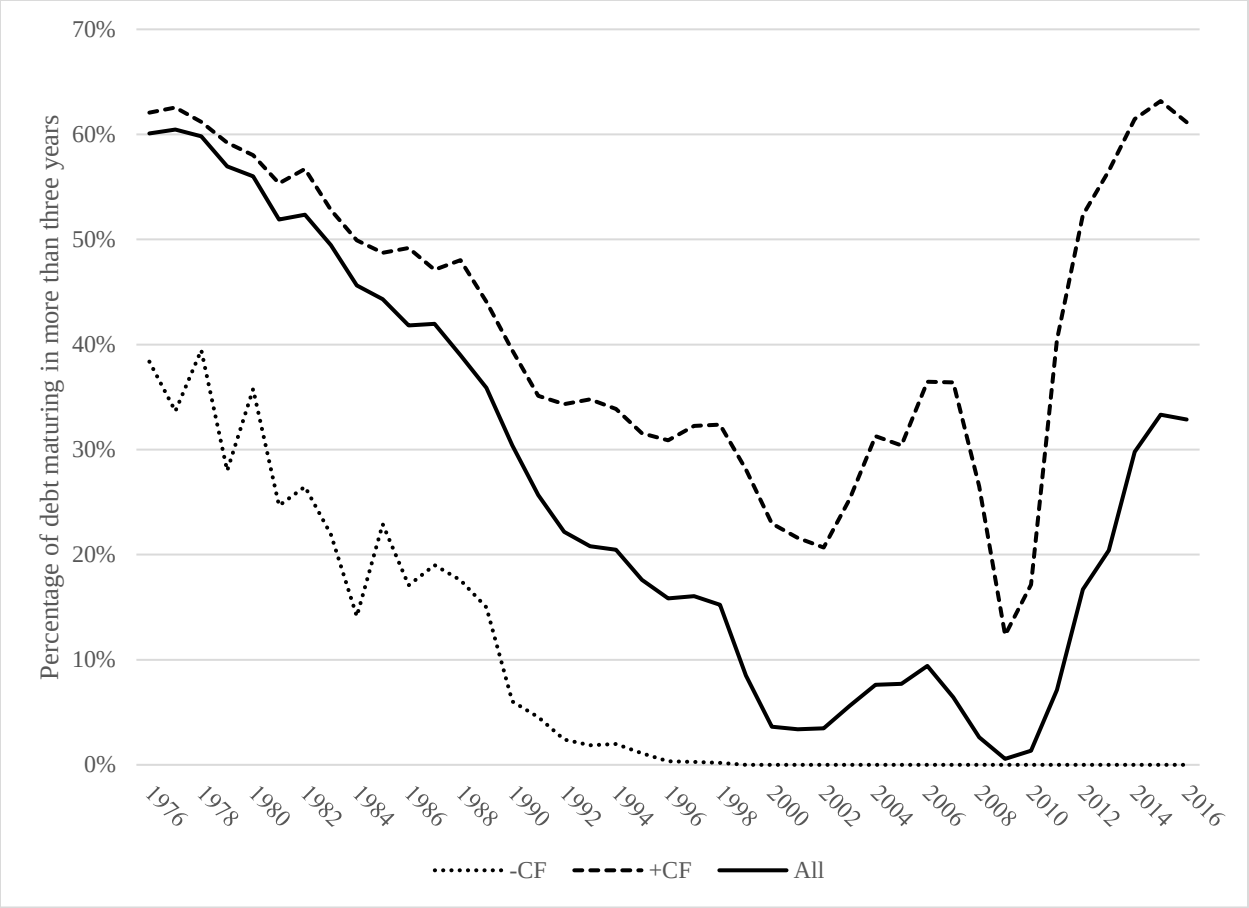

Figure 12. Debt maturity. This chart reports the median percentage of debt that matures in more than three years for the full sample, as well as the negative and positive cash flow subgroups.

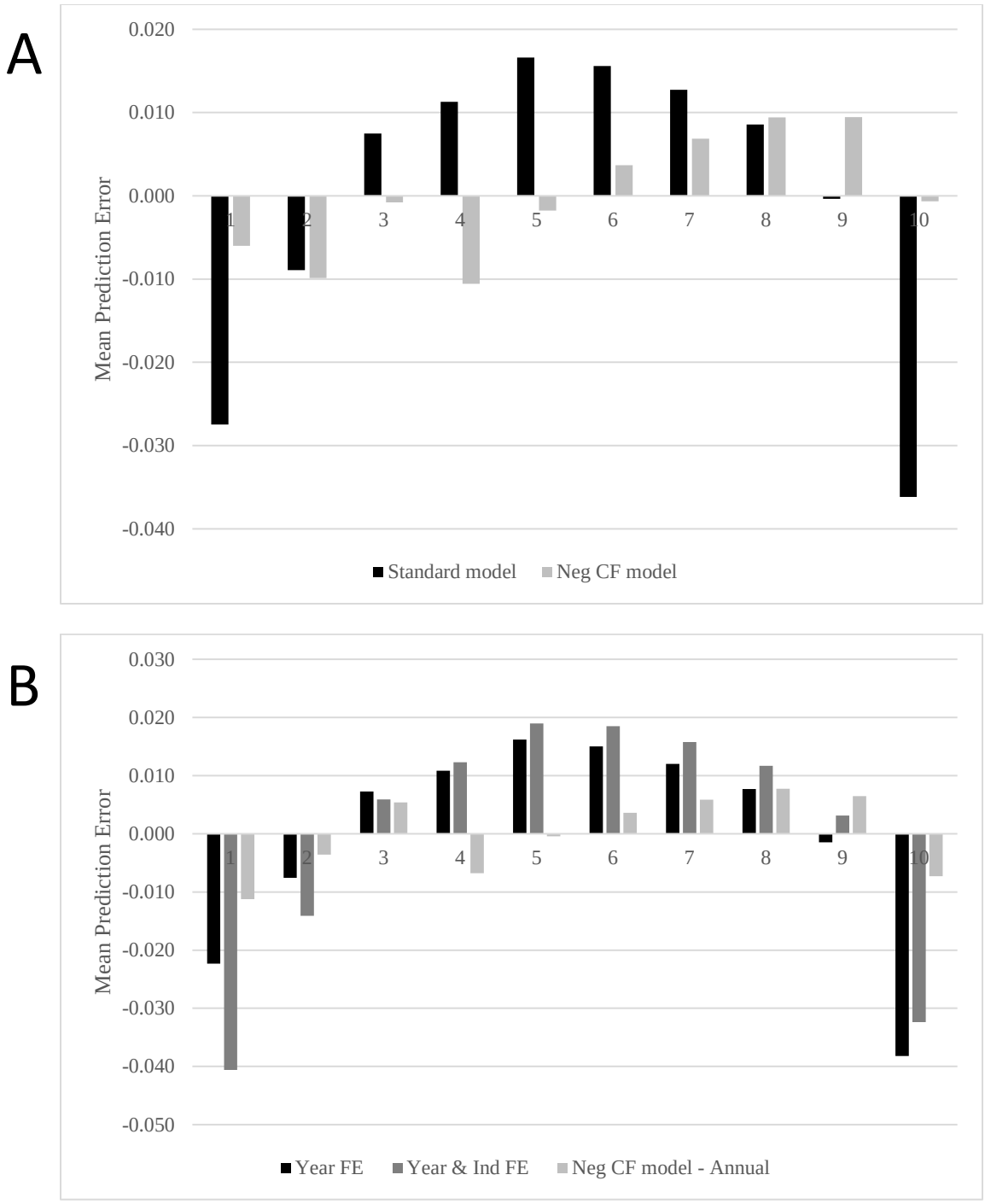

Figure 13. Prediction Error in Models of Cash Holdings. Panel A reports average prediction error from a standard model of cash/assets including cash flow, size, leverage, R&D intensity, industry cash flow volatility, capital expenditures and market-to-book ratio. The second series in panel A adds an indicator variable for negative cash flow and an interaction between negative cash flow and level of cash flow. Panel B reports prediction error from estimates using (i) the standard model with year fixed effects, (ii) year and industry fixed effects, and (iii) the negative earnings model from panel A estimated on annual cross sections. Both panels report average error sorted by cash flow decile where 1 is the lowest level of cash flow and 10 is the highest.