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OPERATING LOSSES AND CASH HOLDINGS

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Operating Losses and Cash Holdings

Abstract

Among U.S. firms, operating losses have become substantially more prevalent, persistent, and greater in magnitude since 1970. Such losses create immediate and ongoing liquidity needs that are strongly associated with the rise in cash balances over the same period. Firms exhibiting operating losses comprise an increasing proportion of equity issuers. Moreover, these issuers stockpile the majority of the funds raised in the issue and use these funds to cover subsequent operating losses. We conclude that the growth in cash balances among U.S. firms is not solely a reflection of increased precautionary demands or tax incentives. Rather, such balances increasingly reflect near-term operational needs under an expectation of negative cash flows.

1. Introduction

Bates, Kahle and Stulz (2009) document a substantial rise in the proportion of firm assets held in cash during recent decades and an active strand of literature seeks to understand the motives behind this observation. Although chief financial officers (CFOs) believe that most of their firm's cash is held for operational purposes (Lins, Servaes, and Tufano, 2010), Lins et al. note that "the theory behind holding liquidity in the form of cash is, fundamentally, based on non-operational (i.e. excess) cash holdings, not operational cash holdings." Consistent with this view, the empirical literature that tests explanations for the rise in corporate cash holdings largely focuses on reasons that excess cash has increased. Examples include agency costs (Gao, Harford, and Li, 2013), tax costs associated with repatriating foreign income (Foley et al., 2007), and precautionary motives (Han and Qiu, 2007) such as changing firm characteristics (Bates, Kahle, and Stulz, 2009), firm specialization (Duchin, 2010) and increased refinancing risk (Harford, Klasa, and Maxwell, 2014).

We show, however, that the operational cash needs of U.S. firms have grown dramatically in recent years and are strongly linked with the rise in cash holdings over the same period. In the 1950's about 2% of public firms listed in Compustat reported operating losses (defined as negative cash flow from operations on the firm's Statement of Cash Flow). 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. Moreover, similar patterns exist even if we measure operating cash flow before R&D expenditures have been deducted. Thus these patterns are not due to rising R&D expenditures over time.

We further find that for most firms in recent years, operating losses are not a transitory phenomenon. Firms that lose money on operations this period are likely to lose money next period as well. For example, fewer than 14% of the firms that reported negative CF in 2014 subsequently reported positive CF in 2015 and the median 'run' of negative cash flow is four years. This persistence in operating losses is also a recent phenomenon; up 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.

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. For example, between 1970 and 2015, average cash holdings as a percentage of total assets roughly double for firms in the top 8 deciles of cash flow, where cash flow is typically positive. More strikingly, however, average cash holdings increase by over 800% for firms in the lowest decile of cash flow, where cash flow is negative.

We argue that such cash holdings go well beyond the levels required to meet precautionary needs. According to the precautionary savings theory of Keynes (1936), firms stockpile cash to protect themselves against adverse cash flow shocks, because these shocks could lead to underinvestment, particularly in firms with high and volatile investment (e.g. high R&D firms). Consequently, firms with high R&D expenditures and volatile cash flows tend to hold large precautionary cash balances [see, for example, Bates, Kahle and Stulz (2009)]. Although increasing precautionary needs undoubtedly contribute to the recent growth in cash balances, we show that neither changes in cash flow volatility nor increases in R&D

expenditures are sufficient to capture the additional amount of cash held by negative cash flow firms for planned operational purposes. For example, we analyze cash policies for very high R&D firms and find that cash holdings for high CF/high R&D firms have grown 54%, while cash holdings at low CF/high R&D firms has grown 868%. These results imply that there is more to the story than R&D. Because an increasing number of firms exhibit persistent operational deficits, cash stockpiling for these firms is less about guarding against the possibility of a shock to financing needs or costs, and more about the fact that cash flow is negative *right now* and is likely to remain that way. In other words, the 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 an expectation of negative cash flows.

To explore the source of cash stockpiles in firms with negative operating flows, we analyze debt and equity issuance activity and find that the relative proportions of each have reversed over time. In the 1970's, high CF firms mostly issued equity and low CF firms relied predominantly on debt. By contrast, in the most recent period (2010-2015), low CF firms raise 15 times more equity capital than debt capital. Consistent with Ritter and Welch's (2002) 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).[1] In every year but one since 1989, the majority of firms issuing equity report negative operating cash flows (CF). In the last year of our sample, 2015, negative CF issuers outnumber positive CF issuers by a factor of 2 to 1.

[1] 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).

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 (2016) find that immediate cash needs are an important determinant of equity issues and that firms save 65% of the proceeds from equity issues in cash at year end, on average.

During our sample period, over 1/3 of firms initiating equity issues hold all of the proceeds as cash at year end. Although such behavior is consistent with precautionary motives, we illustrate the importance of operating losses by scaling each equity issuer's post-issue cash balances by the magnitude of the company's cash burn rate.[2] This scaled measure, commonly called "runway" within the venture capital industry, represents an estimate of 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. Presumably, firms with higher levels of precautionary motives would desire longer runways. Contrary to this view, 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 takeaway is that for equity issuers with negative cash flows, the increase in cash holdings is driven in large part by elevated operating needs in the sense that the number of months of operations covered by cash on hand has not changed substantially over time. Large cash holdings to cover commensurately large

[2] 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.

burn rates are not excess cash holdings; rather, they represent an expansion of the operating component.

Our study 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, and for increased costs of repatriating foreign earnings in explaining high cash balances. We show that, in addition to these factors, an increased demand for operational cash to fund predictable, immediate, and ongoing liquidity needs is an important determinant of observed cash balances. 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 those of Kim and Weisbach (2008), DeAngelo, DeAngelo, and Stulz (2010) and McLean (2011) on the motives for equity issuance. 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. Moreover, McLean (2011) reports that the percentage of equity issue proceeds held as cash at the end of the year of issuance has increased substantially over time. These studies imply 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 imply that

equity issues are motivated simultaneously by both cash stockpiling and the funding of near-term investment. Equity issuers in recent years are increasingly characterized by ongoing operating losses and, therefore, high cash burn rates. Thus, they not only have immediate funding needs, but also a need to stockpile cash to fund anticipated near-term future funding shortfalls.

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 in recent years 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 operating loss firms. Section 3 reports results explaining how the rise in corporate cash holdings is related to operating losses. Section 4 reports results on the relation between operating loss firms and cash savings from equity issuance. Section 5 discusses implications of our findings, and Section 6 concludes.

2. Descriptive evidence on operating losses

The main sample consists of all U.S firms with total assets greater than $5 million (in 2014 dollars) between 1970 and 2014. 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. 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 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 mandated to report cash flow from operations. When this figure is missing, we calculate an approximation as described in the Appendix. Figure 1 charts the percentage of the sample that reports negative operating cash flows each year since 1950. The rise is striking. In the early part of the sample, negative operating cash flows are almost non-existent. Despite five recessions between 1950 and 1980 (as defined by the National Bureau of Economic Research (NBER)), the percentage of firms with negative cash flow only exceeds 10% three times. Since the mid-1990's, however, it has rarely been less than 25%. In 2015, the final year in the sample, nearly 1/3 of the sample firms report negative operating cash flows.

One firm characteristic that has changed substantially over time is R&D expenditures (Brown et al., 2009). To investigate whether the rise in negative cash flow firms is driven primarily by high R&D expenditures, we measure OCFRD, which is operating cash flow with R&D added back. As it turns out, there is more to the story than R&D. The proportion of firms with negative OCFRD has also experienced a substantial rise over the same period and by 2015 nearly 1 in 4 firms reported negative operating cash flows *even before subtracting R&D expense*.

Figure 1 shows that negative cash flows are pervasive; however, a related question is whether negative cash flows are transitory. 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 illustrates 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 ¼ of firms that reported negative cash flow in 2014 followed up with positive cash flow in 2015. 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 over 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, they are operating with the intention and expectation of extended cash flow deficits. A likely consequence of this expectation is that corporate policies for such firms, such as cash holdings, will be driven at least as much by a plan to manage expected operating deficits as by factors that induce excess holdings such as precaution against the possibility of a negative shock.

The final characteristic to note is that the magnitude of negative cash flow has grown substantially over time. Table 1, panel A reports average CF/assets for the ten deciles during four subperiods: 1970-1979, 1980-1989, 1990-1999, and 2000-2015. 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 of earnings reported cash flow equal to -11% of assets. During the 2000-2015 subperiod, the average was -58% of assets. Put another way, firms in this decile burn an average of about 5% of assets *per month* even before accounting for capital expenditures.

Taken together, Figures 1 and 2, 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. These findings motivate the inquiry into implications of these transformative shifts in the distribution of cash flows for corporate policy.

3. Operating losses and cash holdings

Numerous studies have documented and offered explanations for the rise of corporate cash holdings. Bates, Kahle, and Stulz (2009) measure the rise in cash holdings from 1980 to 2006 and attribute the increase to precautionary motives rather than agency explanations. Specifically, they point to changing firm characteristics including declines in working capital and capital expenditures, and increases in cash flow volatility and R&D. Younger firms exhibit these characteristics more strongly, and as they enter the economy, the optimal level of cash rises. In Table 2 of their study, they report that the rise in cash holdings for firms with negative earnings has been particularly large. However, it is not obvious a priori that negative cash flows will be associated empirically with higher excess cash. For example, Opler et al. (1999) find that operating losses are the primary explanation for large *decreases* in excess cash for their sample firm over the period 1971-1994. Taken together, these findings motivate a closer examination of the relation between cash and cash flow.

As the prevalence, persistence, and magnitude of negative earnings has increased, cash holdings have grown dramatically. As Figure 3 illustrates and Table 2 reports, the most dramatic increase is within the lowest deciles of operating cash flow, and the point of divergence in the mid 1980's roughly corresponds with the beginning of rapid growth of negative earnings firms in

general in Figure 1. In 1970, cash holdings across the cash flow continuum are similar. The lowest decile held 6.6% of assets in cash, while the highest 8 deciles held an average of 8.4% of assets in cash. During the final year of the sample, 2015, average cash holdings within the lowest decile has grown to over 63% of assets, an increase of 865% over 1970 levels. Cash holdings within the highest eight deciles has also grown, but much more modestly, increasing by 97% over the sample period. Overall, these figures are consistent with Bates et al. (2009), who document a tripling of cash ratios for negative net income firms over 1980-2006. The results in Table 2 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, 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. While the uptick on the right end of the cash flow distribution could be caused by tax considerations, the massive rise on the left is within firms that are not likely to be subject to an offshore cash holdup due to repatriation taxes, because (i) they have negative earnings to offset the tax burden, and (ii) only 8.5% of our sample firms that report operating losses also report foreign income. Similarly, firms on the left side of the distribution are 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 unreported analysis we find that negative cash flow firms have the highest levels of managerial ownership.

Since tax motives and agency concerns are mitigated for these firms, we are left solely with precaution as an explanation for the 865% rise in cash holdings between 1970 and 2015. In recent years, there has been an increased focus on R&D expenditures in the literature. In addition to the 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 cross-sectional 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,

High R&D intensity could impact cash holdings through two (not mutually exclusive) mechanisms. First, disrupting R&D programs is particularly costly (Brown and Peterson, 2011), so the firm may hold extra cash as a precaution. Second, however, many R&D intensive firms also report negative cash flow. R&D represents a cash expense that needs to be covered regardless of the fact that it is R&D, and this is more accurately described as operating cash rather than precautionary excess cash.

To determine whether the operating cash flow effect is simply an overlap with R&D intensive firms, we analyze R&D and cash flow jointly in Table 3. Panel A reports the joint distribution by decile for each measure. Not surprisingly, the largest mass is in the lowest cash flow decile and highest R&D decile, but it only represents 5.5% of the sample. Extending to the three lowest deciles of Cash Flow and the three highest deciles of R&D only comprises 16.1% of the sample. Thus, although there is some overlap, it does not appear that the cash flow effect we study is simply a proxy for the R&D effect studied by others.

Panel B takes a step further to examine 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, cash holdings have grown an average of 59%. In contrast, average cash holdings for high R&D firms in the lowest cash flow decile have grown 868%.

Figure 4 plots the relation between cash holdings and operating cash flow in each of four subperiods. Similar to Figure 3, the most striking increase is observed within firms at the low end of cash flow. However, Figure 4 reveals a more interesting observation, which is that the relation between cash holdings and cash flow deciles 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.

Standard models of cash holdings, in which cash is specified as a linear function of cash flow (and other characteristics), obscure this effect. In such models, the marginal effect of negative earnings on cash is pushed partly into the constant, while the remainder is labeled prediction error. We discuss these implications in greater detail in Section 5.2.

4. Equity Issuance, Cash Savings, and Runway

Anecdotal evidence suggests it has become easier for negative cash flow firms to raise equity capital in recent years.[3] In Table 4, we investigate three mechanisms that firms can utilize to generate cash: equity issues, debt issues, and the sale of fixed assets. We measure each of

[3] 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).

these sources, scaled by total assets, and compare the average values within each cash flow decile at the beginning of the sample and the end of the sample.

In the 1970's, low cash flow firms raised little equity relative to high cash flow firms. On average, a firm in the highest decile of cash flow raised over 10 times as much equity as a percentage of assets compared to a firm in the lowest cash flow decile. For debt, the story is different. Very low cash flow firms raised, on average, three times as much debt capital compared to equity and firms in all deciles other than the highest raised more debt than equity on average. The highest cash flow firms raise four times more equity capital than debt in the 1970's. Additionally, sale of fixed assets appears to be an important source of cash in the 70's for firms with very low cash flow. In the lowest decile of cash flow, sale of fixed assets is the largest source of cash, generating 70% more cash than debt issues and about 4 times as much cash as equity issues.

Almost the exact opposite is true in recent years. Over the past decade, low cash flow firms raise far more cash through equity than through either debt issues or the sale of fixed assets. Relative to assets, equity issues raise, on average, fourteen times the proceeds of debt issues and 186 times the proceeds from the sale of fixed assets in the lowest decile of cash flow. Meanwhile, firms in the highest cash flow decile are now repurchasing both debt and equity, on average. These stylized facts have had a marked impact on capital structure for negative cash flow firms. In untabulated results, we find that average book leverage for firms in the lowest decile of cash flow falls from 0.42 to 0.25 between 1970 and 2015.

Figure 5 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 average equity issuer is burning cash. These results are consistent with the evidence on earnings in Fama and French (2004) showing that earnings become progressively left skewed through time for newly listed firms, and that as these firms integrate into the economy overall profitability becomes left skewed as well.

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. Table 5 reports the results of this analysis. While Figure 5 suggests that a large portion of equity issuances are conducted by low cash flow firms, Table 5 demonstrates the inverse: a large portion of low cash flow firms are equity issuers. In fact, between 2010 and 2015 the lowest decile of cash flow recorded 0.92 firm-initiated issuances *per firm per year*! The high frequency of issuance activity suggests that the observed high rate of savings from equity issuance in recent years could be driven by near term operating needs in addition to precautionary motives.

One of the primary features of precautionary cash savings from equity issuance is the stockpiling of issue proceeds for future use. Following McLean (2011), we measure cash minus issuance (CMI) as cash holdings at the end of the fiscal year minus total proceeds from equity issuances during the year, where we define equity issuance as all firm-initiated equity issues. When this variable carries a positive sign (CMI+), it indicates that the firm stockpiled all the equity proceeds from issues it initiated in a given year. In Figure 6, we plot the time series of CMI+ proportions for equity issuers. Interestingly, it does not display the strong time trend that characterizes average cash holdings. Over the sample period, the percentage of issuers that hold all the proceeds in cash typically varies between 30% and 50% with a mean of 38%. The 1970's and 2000's are in the higher segment of the range while the 1980's and 90's are in the lower

portion of the range. Although several studies report that precautionary motives have risen greatly through the sample period, Figure 6 fails to detect a meaningful trend in cash stockpiling behavior from equity issuance. We therefore posit that it must be the case that there are additional factors influencing cash savings from equity issuance beyond precaution. One such factor is operating needs.

To investigate the size of the cash stockpile relative to the needs of the firm, we borrow a metric from the venture capital industry, where negative cash flows for portfolio firms are commonplace. Within venture-backed firms, a figure that often underlies decisions about cash holdings and equity issuance is the monthly "burn rate," which we define as operating cash flow minus dividends and capital expenditures, divided by 12. Table 6 reports the median burn rate as a percentage of total assets over time for equity issuers with negative cash flow. It is monotonically increasing, rising from about 8% in the 1970's to over 25% in the most recent period. 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 2015 burn rates, a stockpile of that size would be depleted before the ides of March.

Cash holdings divided by the monthly burn rate is often referred to as "runway," or in other words, how many months a company could sustain current operations without an infusion of external capital. Investors can limit runway by staging investment to mitigate overinvestment problems. Hertzel et al. (2012) find that public market staging is particularly strong for firms with high R&D and intangible assets. Additionally, they report that the median length of time before returning to the capital market is 12 months. We extend their findings by analyzing runway length over time to detect whether it has changed in ways similar to average cash holdings. Figure 7 plots the median runway at the time of issuance for negative earnings firms

over the sample period, and shows that it has stayed within the same range for the last 30 years: between 6 and 18 months. 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 aren't saving more relative to their needs; their operational needs have grown.

In a contemporaneous study, McLean and Palazzo (2016) analyze the timing and size of equity issues and report evidence that firms issue not only to cover short term liquidity squeezes, but also to stockpile the proceeds as a precaution against adverse future market conditions. In light of their finding that precautionary considerations can influence issuance size, it seems likely that such considerations contribute to the time-series variation in the median runway we observe after issuance in Figure 7. Nonetheless, the fact that runway exhibits virtually no time trend over recent decades, while the average cash balances of issuers has exploded, points to operating needs, rather than precaution, as the first order factor influencing the time series of cash balances.

5. Other Implications and Discussion

In this section, we discuss other implications of the findings presented in this study, including (i) motivations for equity issuance, (ii) misspecification in models of cash holdings, and (iii) the cash flow sensitivity of cash.

5.1 Motivations for Equity Issuance

Our findings have implications for the literature on motivations for equity issuance. Kim and Weisbach (2008) show that cash holdings are the largest use of equity issuance proceeds for an international sample of over 30,000 IPOs and SEOs between 1990 and 2003. McLean (2011) extends this result by documenting that the percentage of equity issuance proceeds held as cash at the end of the year of issuance has increased over time. Specifically, he reports that in the 1970's firms retained an average of $0.23 in cash for each dollar of issuance, but that this figure rises to $0.60 for the period 2000-2007. In a separate study, DeAngelo, DeAngelo and Stulz (2010) report that 62% of the SEO issuers in their sample would run out of cash by the end of the following year without the issuance. They attribute SEO decisions primarily to a "lifecycle theory that predicts young firms with high market-to-book (M/B) ratios and low operating cash flows sell stock to fund investment." Overall, our findings suggest that cash savings and lifecycle motives are not mutually exclusive.

For example, under the lifecycle explanation we should observe a disproportionate number of equity issuances at the low end of the cash flow spectrum, and this is exactly what we see in recent years. Table 7 reports the distribution of firm-initiated equity issues for the first ten years and the last ten years of the sample period to compare how the joint distribution of equity issues and cash flow has changed over time. In the first ten years of the sample, equity issuance frequency is skewed towards high cash flow firms. However, during the most recent period, from 2006-2015, equity issuances are dominated by negative CF firms: the lowest decile of CF accounts for 31% of all equity issues and the lowest two deciles comprise 52% of all equity

issues. Consistent with the lifecycle theory, these two deciles have the youngest average age and high average M/B ratios.

These results, coupled with the results on burn rates, reconcile the findings in previous studies. For firms with positive burn rates, which make up the majority of equity issuers in recent years, it is possible to observe both a high savings rate in the year of issuance (as in McLean (2011)), as well as a full depletion of pre-issuance cash (as in DeAngelo, DeAngelo, and Stulz (2010)) during the following year. The issuances are topping up the stockpile on a regular basis, but the firms are burning through the stockpile rapidly. A portion of the stockpile is undoubtedly related to precaution, but the savings from issuance are also driven by near term operating needs.

5.2 Models of Cash Holdings

Nonlinearity in the association between cash holdings and cash flow implies that models of cash holdings that estimate such holdings as a linear function of cash flow are increasingly misspecified. One econometric option to deal with convexity is to add a squared term to the specification. However, it is primarily nonlinearity on the left side of the cash flow distribution that is the focus of this study. 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). Specifically,

$$\frac{Cash}{Assets_{i,j,t}} = \alpha + \beta_1 \frac{CF}{Assets_{i,t}} + \beta_2 \ln(ME)_{i,t} + \beta_3 \overline{CF\ Vol}_{j,t} + \beta_4 I(R\&D\ Intense)_{i,t} + \beta_5 \frac{M}{B}_{i,t} + \beta_6 \frac{CapEx}{Assets_{i,t}} + \beta_7 \frac{Debt}{Assets_{i,t}} + \varepsilon_{i,t} \quad (1)$$

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

Both specifications control for factors related to precaution. Specifically, *Size* to capture financing constraints, *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.

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 coefficient on *Cash Flow* reverses and is highly significant in the opposite direction. One implication is that

the model with the negative earnings variables should also improve model fit at the other end 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. All of the precautionary variables carry the same sign and significance as the first model, suggesting that the role of negative earnings is not simply an alternative mechanism to capture precaution.

A common variation of Equation (1) adds fixed effects to capture variation through time and/or across industries. 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. In both cases, 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, implying that the relation between cash flow and cash holdings depends greatly on the sign of the cash flows.

In Figures 8A and 8B we detail the effects of functional form misspecification on prediction error. Figure 8A 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 convexity of the 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 not do a good job of characterizing the relation between cash and cash flow.

Figure 8B 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 8 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. 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. Overall, the results support the use of the indicator and interaction terms and suggest caution in estimating fixed effects models in which movement in the dependent variable is driven in part by an unspecified nonlinear component of one of the explanatory variables.

Finally, in Table 9, we use the augmented cash holdings model to provide a 'back of the envelope' estimate of the relative contribution of the cash flow variables to predicted cash holdings for low 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 in the lowest cash flow decile, where the growth in cash holdings has been the most extreme. The predicted contribution to cash holdings, reported in the final two columns, is the product of the coefficients and median observed values.

The predicted cash holdings for this group rise from 0.062 to 0.588, an 843% increase, very similar to observed figures in Table 1. The effect of operating cash flow is most clearly revealed by the increase in predicted cash of the cash flow variables. In this example, the cash flow variables contribute nearly as much to the increase in predicted cash as the precautionary

motive variables. Predicted cash holdings rise .196 due to cash flow variables versus .213 due to changes in *Industry CF Volatility* and *R&D Intensity*.

5.3.Cash Flow Sensitivity of Cash

Our findings speak primarily to cash *levels*, but a related facet of corporate policy is how cash *changes* with cash flow. Almeida, et al. (2004) measure the cash flow sensitivity of cash holdings using a sample of manufacturing firms over 1971-2000. They find that cash is sensitive to cash flow for financially constrained firms, but not for financially unconstrained firms. Such findings are consistent with constrained firms saving cash out of cash flow in high cash flow states and drawing down cash holdings when cash flow is negative.[4]

Our evidence implies, however, that in recent years, an increasing proportion of firms exhibit negative cash flows and *increase* their cash holdings by stockpiling a portion of the funds raised through equity issues. Such behavior will attenuate the positive cash flow sensitivity of cash documented in earlier periods and failing to control for the different sensitivity of negative cash flow firms could have a material impact on measured cash-cash flow sensitivities.[5]

To investigate this possibility, Table 10 reports the results of tests in which we estimate the cash flow sensitivity of cash over the first ten years of our sample period (1970-1979) and the last ten years of the sample period (2006-2015). In columns (1) and (3), we constrain the cash flow sensitivity of cash to be the same for firms with positive and negative cash flow, while in Columns (2) and (4) we allow the sensitivity to differ. During the 1970-1979 subperiod, negative cash flow firms are less common (Figure 1). Not surprisingly, therefore, we find in

[4] Also consistent with this view, Opler et al. (1999) find that operating losses are the primary explanation for large *decreases* in excess cash for their sample firm over the period 1971-1994.

[5] This possibility is recognized by Almeida et al. (2004) and they show that the sensitivity they document is robust to exclusion of negative cash flow firms.

Column (2) that allowing sensitivities to differ for negative earnings firms has only a modest impact on the estimated cash-cash flow sensitivities of positive cash flow firms. In other words, pooling positive and negative cash flow firms has little impact on inferences.

By contrast, Column 4 reveals that sensitivities for positive cash flow firms are substantially higher once cash flow sensitivities are allowed to differ for positive and negative cash flow firms in the 2006-2015 subperiod. The reason for this is clear. Negative cash flow firms account for an increased proportion of the sample and these firms do not exhibit the same positive sensitivity of cash to cash flow.

6. Conclusion

The population of U.S. firms is increasingly comprised of firms with persistent, large negative cash flows. Such characteristics create 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 these firms than for the rest of the population. Perhaps most strikingly, we find that over the past four decades, average cash holdings have risen by over 800% for firms in the bottom decile of cash flow, where cash flow is negative. Our evidence thus supports the view that the recent growth in cash balances among U.S. firms is not solely a reflection of increased precautionary demands, increased disincentives to repatriate foreign earnings, or increased agency problems. Rather, for an increasing proportion of firms, higher cash balances reflect near-term operational needs under an expectation of negative cash flows.

Additionally, we find that equity issuance activity is increasingly dominated by firms with negative cash flows. Although firms are saving a higher proportion of equity issuance

proceeds in cash, they are also burning cash at an unprecedented rate, reconciling the observation of high cash savings rates from equity issues (McLean, 2010) with the observation that most issuers would run out of cash by the end of the following year (DeAngelo, DeAngelo, Stulz, 2010) in the absence of an equity issue.

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Appendix A: Variable Descriptions

Cash Holdings	CHE/AT
EBITDA	EBITDA/AT
EBITDARD	[EBITDA+XRD]/AT. XRD is coded to 0 if missing.
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.
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. Coded to 0 if missing.
Leverage	[DLTT+DLC]/AT
Firm-initiated Equity Issuance	SSTK when [SSTK/MKTVAL]>0.03
Employee-initiated Equity Issuance	SSTK when [SSTK/MKTVAL]<0.02
Net Equity Issuance	SSTK-PRSTK
Net Debt Issuance	$[DLTT+DLC]_t$-$[DLTT+DLC]_{t-1}$
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 227,745 firm year observations over the period 1970-2015. Values are averaged over all firm year observations within the decile during the specified subperiod.

CF decile	1970-79	1980-89	1990-99	2000-15
1	(0.11)	(0.24)	(0.41)	(0.58)
2	0.04	(0.01)	(0.11)	(0.15)
3	0.07	0.04	(0.03)	(0.03)
4	0.10	0.08	0.01	0.02
5	0.12	0.11	0.04	0.05
6	0.14	0.13	0.07	0.07
7	0.16	0.16	0.09	0.10
8	0.19	0.20	0.12	0.12
9	0.24	0.25	0.16	0.16
10	0.36	0.44	0.25	0.25

Table 2

Evolution of average cash holdings by cash flow decile

This table reports mean values of cash/assets for cash flow deciles formed annually. The full sample is 227,745 firm year observations over the period 1970-2015. Values are averaged over all firm year observations within each decile each year.

	Deciles		
	1	2	3-10
1970	0.066	0.061	0.084
1971	0.068	0.070	0.092
1972	0.069	0.068	0.093
1973	0.064	0.062	0.083
1974	0.053	0.054	0.074
1975	0.059	0.058	0.093
1976	0.057	0.064	0.096
1977	0.058	0.058	0.090
1978	0.055	0.055	0.086
1979	0.056	0.059	0.081
1980	0.058	0.057	0.095
1981	0.063	0.060	0.108
1982	0.088	0.072	0.111
1983	0.083	0.099	0.142
1984	0.132	0.118	0.110
1985	0.148	0.113	0.115
1986	0.149	0.142	0.126
1987	0.182	0.130	0.121
1988	0.162	0.095	0.114
1989	0.170	0.105	0.112
1990	0.222	0.106	0.107
1991	0.266	0.132	0.121
1992	0.320	0.143	0.122
1993	0.367	0.176	0.128
1994	0.342	0.151	0.123
1995	0.365	0.179	0.133
1996	0.418	0.266	0.144
1997	0.409	0.249	0.147
1998	0.456	0.297	0.139
1999	0.465	0.355	0.150
2000	0.414	0.344	0.148
2001	0.442	0.335	0.150
2002	0.468	0.332	0.155
2003	0.519	0.292	0.173
2004	0.529	0.324	0.182
2005	0.533	0.320	0.186
2006	0.533	0.328	0.186
2007	0.551	0.309	0.184
2008	0.508	0.265	0.169
2009	0.491	0.280	0.184
2010	0.552	0.254	0.186
2011	0.586	0.273	0.175
2012	0.598	0.315	0.166
2013	0.576	0.432	0.171
2014	0.612	0.454	0.172
2015	0.633	0.476	0.165
Growth: 1970 to 2015	865%	679%	97%

Table 3

Cash Flow and R&D

Panel A reports the joint distribution of cash flow and R&D deciles over the sample period. The full sample is 227,745 firm year observations over the period 1970-2015. Panel B reports average cash holdings by cash flow decile for the top two deciles of R&D.

Panel A: Joint Distribution of Cash Flow and R&D Deciles

		Lowest CF									Highest CF
		1	2	3	4	5	6	7	8	9	10
	1	0.5%	0.8%	1.1%	1.3%	1.4%	1.2%	1.0%	1.1%	0.9%	0.7%
	2	0.4%	0.7%	0.9%	1.2%	1.3%	1.3%	1.3%	1.2%	1.0%	0.7%
	3	0.6%	0.8%	0.9%	1.0%	1.1%	1.2%	1.3%	1.3%	1.0%	0.8%
R&D	4	0.6%	0.9%	1.0%	1.0%	1.0%	1.2%	1.2%	1.2%	1.1%	0.9%
Decile	5	0.7%	0.9%	1.0%	0.9%	1.0%	1.1%	1.1%	1.1%	1.1%	1.0%
	6	0.8%	1.1%	1.0%	0.9%	0.9%	0.9%	1.0%	1.1%	1.1%	1.1%
	7	1.0%	1.3%	1.0%	0.8%	0.8%	0.9%	1.0%	0.9%	1.1%	1.2%
	8	1.4%	1.5%	1.0%	0.7%	0.7%	0.7%	0.8%	0.8%	1.0%	1.2%
	9	2.8%	1.6%	0.9%	0.6%	0.6%	0.5%	0.6%	0.7%	0.8%	1.1%
	10	5.5%	0.9%	0.4%	0.3%	0.3%	0.3%	0.3%	0.4%	0.5%	1.0%

Panel B: Average Cash Holdings for High R&D Firms

		1970-1979	2006-2015	Growth
	1	0.06	0.60	868%
	2	0.06	0.30	377%
	3	0.07	0.17	167%
Cash Flow	4	0.07	0.12	77%
Decile	5	0.07	0.11	50%
	6	0.08	0.10	31%
	7	0.09	0.11	32%
	8	0.10	0.12	27%
	9	0.11	0.15	32%
	10	0.14	0.22	54%

Table 4

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 227,745 firm year observations over the period 1970-2015. The first ten years and last ten years of the sample are reported for comparison.

		1970-79			2006-15		
		Net Equity /Assets	Net Debt /Assets	Sale of PPE /Assets	Net Equity /Assets	Net Debt /Assets	Sale of PPE /Assets
Cash Flow Decile	1	0.003	0.010	0.017	0.392	0.026	0.002
	2	0.002	0.025	0.011	0.152	0.024	0.003
	3	0.002	0.025	0.010	0.055	0.025	0.003
	4	0.002	0.023	0.009	0.025	0.027	0.003
	5	0.003	0.025	0.009	0.012	0.022	0.003
	6	0.004	0.021	0.009	0.008	0.015	0.003
	7	0.005	0.020	0.010	0.002	0.011	0.003
	8	0.007	0.019	0.009	(0.004)	0.007	0.004
	9	0.011	0.021	0.010	(0.013)	0.002	0.004
	10	0.033	0.007	0.013	(0.022)	(0.014)	0.004

Table 5

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 1985-2015.

		1985-1989	1990-1999	2000-2009	2010-2015
Cash Flow Decile	1	0.33	0.75	0.70	0.92
	2	0.24	0.49	0.39	0.56
	3	0.21	0.34	0.23	0.25
	4	0.20	0.27	0.18	0.15
	5	0.18	0.23	0.14	0.12
	6	0.17	0.18	0.12	0.12
	7	0.16	0.15	0.10	0.08
	8	0.17	0.13	0.08	0.07
	9	0.23	0.12	0.08	0.06
	10	0.29	0.13	0.08	0.06

Table 6

Annual Burn Rate for Equity Issuers

This table reports the percentage of assets depleted annually by equity issuers with positive burn rates. Burn rate is defined as [-Operating Cash Flow+dividends+capital expenditures]. The full sample is 227,745 firm year observations over the period 1970-2015.

Period	% burned
1971-75	8.2%
1976-80	7.8%
1981-85	13.1%
1986-90	12.5%
1991-95	13.6%
1996-2000	18.8%
2001-05	21.5%
2006-10	23.2%
2011-15	25.9%

Table 7

Distribution and Characteristics of Firm-initiated Equity Issues by Cash Flow decile

This table reports the distribution of equity issuers by cash flow decile over the period 1971-1980 and 2006-2015. Mean market-to-book asset ratios and mean firm age is reported for the period 2006-15.

			Lowest CF									Highest CF
Year		N	1	2	3	4	5	6	7	8	9	10
1971-1980	Eq Iss Distribution	3,492	8%	7%	7%	8%	9%	9%	9%	10%	12%	21%
	Cumulative		8%	15%	22%	31%	40%	49%	58%	67%	79%	100%
2006-2015	Eq Iss Distribution	6,864	31%	21%	12%	8%	6%	5%	5%	4%	4%	4%
	Cumulative		31%	52%	63%	71%	77%	82%	87%	92%	96%	100%
	Mean M/B		3.64	2.34	1.68	1.49	1.47	1.54	1.66	1.86	2.20	2.99
	Mean Age		9.9	13.3	16.3	19.5	21.1	22.4	22.9	23.0	21.8	17.1

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 227,745 firm year observations over the period 1970-2015. 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 respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Cash Flow	-0.129 ***	0.110 ***	-0.127 ***	0.122 ***	-0.113 ***	0.114 ***
	(<0.001)	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*
I(CF<0)		0.039 ***		0.037 ***		0.034 ***
		(<0.001)		*(<0.001)*		*(<0.001)*
CF x I(CF<0)		-0.315 ***		-0.325 ***		-0.296 ***
		(<0.001)		*(<0.001)*		*(<0.001)*
Size	-0.007 ***	-0.005 ***	-0.008 ***	-0.006 ***	-0.008 ***	-0.006 ***
	(<0.001)	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*
Industry CF Vol	0.548 ***	0.533 ***	0.551 ***	0.515 ***	0.23 ***	0.215 ***
	(<0.001)	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*
I(R&D Intense)	0.068 ***	0.063 ***	0.066 ***	0.062 ***	0.063 ***	0.06 ***
	(<0.001)	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*
M/B	0.037 ***	0.032 ***	0.037 ***	0.032 ***	0.034 ***	0.029 ***
	(<0.001)	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*
Cap Ex	-0.206 ***	-0.246 ***	-0.202 ***	-0.235 ***	-0.235 ***	-0.266 ***
	(<0.001)	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*
Leverage	-0.260 ***	-0.254 ***	-0.261 ***	-0.255 ***	-0.265 ***	-0.259 ***
	(<0.001)	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*
Constant	0.147 ***	0.111 ***	0.148 ***	0.116 ***	0.159 ***	0.143 ***
	(<0.001)	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*	*(<0.001)*
Fixed Effects	*None*	*None*	*Year*	*Year*	*Year, Industry*	*Year, Industry*
N	174,231	174,231	174,231	174,231	174,231	174,231
R2	0.409	0.416	0.410	0.418	0.434	0.441

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) 2011-2015 using coefficients from OLS regressions of cash holdings (cash/assets) on various determinants defined in the appendix. The full sample is 227,745 firm year observations over the period 1970-2015. Predicted cash is the product of the coefficients and median values for each respective subperiod.

	Coefficients		Median Values CF dec=1		Predicted Cash			
	1970-1979	2006-2015	1970-1979	2006-2015	(1)	(2)		
Cash Flow	0.120	0.285	-0.061	-0.544	(0.007)	(0.155)		
I(CF<0)	0.012	0.070	1	1	0.012	0.070		
Cash Flow x I(CF<0)	-0.160	-0.543	-0.061	-0.544	0.010	0.295		
Size	-0.004	-0.002	2.072	4.158	(0.009)	(0.010)		
Industry CF Vol	0.253	0.299	0.028	0.294	0.007	0.088		
I(R&D Intense)	-0.018	0.132	0	1	-	0.132		
M/B	0.024	0.027	0.914	3.213	0.021	0.086		
Cap Ex	-0.079	-0.387	0.041	0.011	(0.003)	(0.004)		
Leverage	-0.140	-0.219	0.401	0.057	(0.056)	(0.013)		
Constant	0.087	0.099			0.087	0.099		
							Increase	%
Predicted cash					0.062	0.588	0.526	
Contribution from operating cash flow variables					0.015	0.211	0.196	37%
Contribution from precautionary variables (CF Vol, R&D)					0.007	0.220	0.213	40%
Contribution from other factors					0.040	0.157	0.117	22%

Table 10

Cash Flow Sensitivity of Cash

This table reports results from OLS regressions estimated over the 1st 10 years and last 10 years of the sample (1970-79 and 2006-2015). Columns 1 and 3 report change in cash/assets regressed on cash flow and a constant. Columns 2 and 4 allow for non-linearity when cash flow 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. Columns 5 and 6 constrain the sample to the lowest three deciles of size (constrained firms) and estimate the model separately for positive and negative cash flow firms. Variables are defined in the appendix. Standard errors are clustered by firm and year. *, **, and *** indicate significance at the 10%, 5% and 1% levels respectively.

	1970-79		2006-2015			
	1	2	3	4	5	6
	All	All	All	All	Size Dec<=3 CF<0	Size Dec<=3 CF>0
Cash Flow	0.081 ***	0.119 ***	0.078 ***	0.161 ***	0.055 ***	0.278 ***
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
I(CF<0)		0.004 ***		0.000		
		(0.009)		*(0.943)*		
CF x I(CF<0)		-0.139 ***		-0.112 ***		
		0.000		*0.000*		
M/B	-0.004 ***	-0.006 ***	0.004 ***	0.002 ***	0.006 ***	-0.001
	(0.008)	*(0.003)*	*0.000*	*(0.004)*	*0.000*	*(0.759)*
ln(Assets)	0.001	0.001 *	-0.002 ***	-0.003 ***	0.010 ***	(0.007) ***
	(0.429)	*(0.095)*	*0.000*	*0.000*	*0.000*	*(0.001)*
Constant	-0.01 **	-0.018 ***	0.002	-0.003	-0.052 ***	0.009
	(0.035)	*0.000*	*(0.652)*	*(0.511)*	*0.000*	*(0.334)*
N	28,243	28,243	33,955	33,955	5,354	4,062
R2	0.036	0.047	0.025	0.029	0.021	0.069

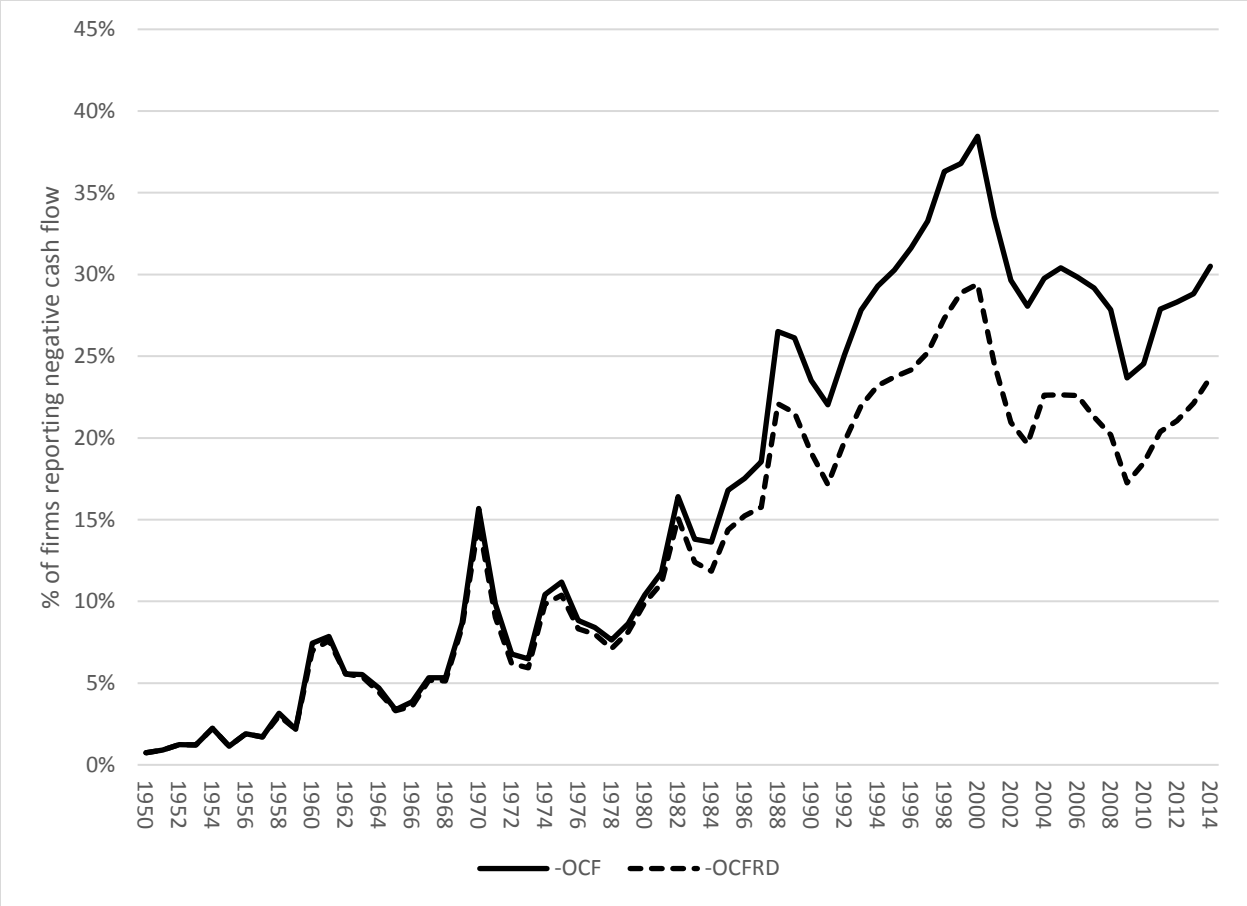


Figure 1. Prevalence of Negative Cash Flow. This chart reports the percentage of Compustat listed firms that report negative operating cash flow. –OCF is negative operating cash flow, -OCFRD is negative operating cash flow after adding back R&D expense. Detailed variable descriptions are available in the appendix.

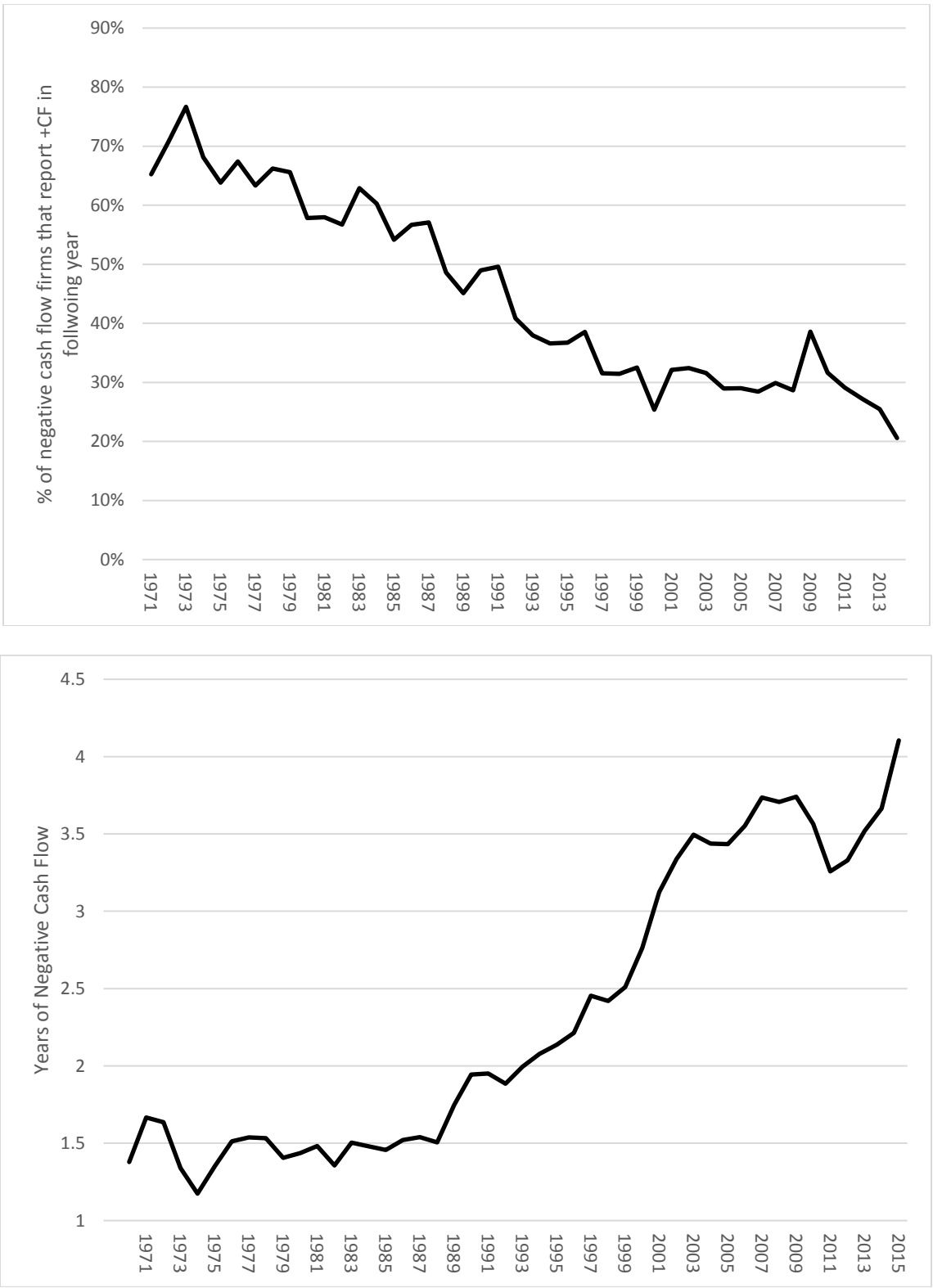


Figure 2. Persistence of Negative Cash Flow. Panel A: Proportion of Negative cash flow firms that report positive cash flow in the following year. Panel B: Average number of consecutive years of negative cash flow for firms that report negative cash flow.

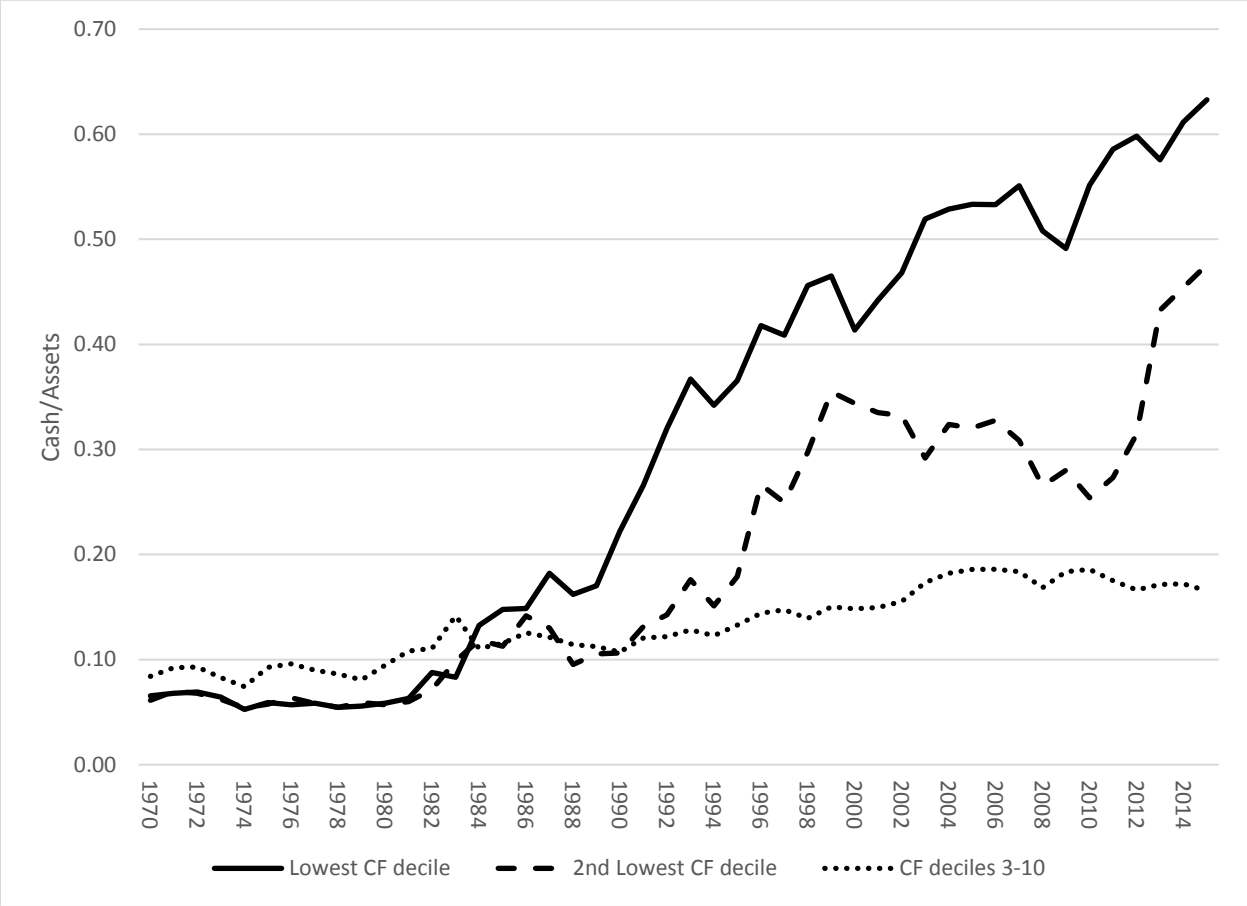


Figure 3. Evolution of Cash Holdings by Cash Flow Decile. This chart reports mean values of cash/total assets annually for three subgroups: (i) those firms in the lowest decile of operating cash flow, (ii) those firms in the second lowest decile of operating cash flow, and (iii) firms in operating cash flow deciles three through 10.

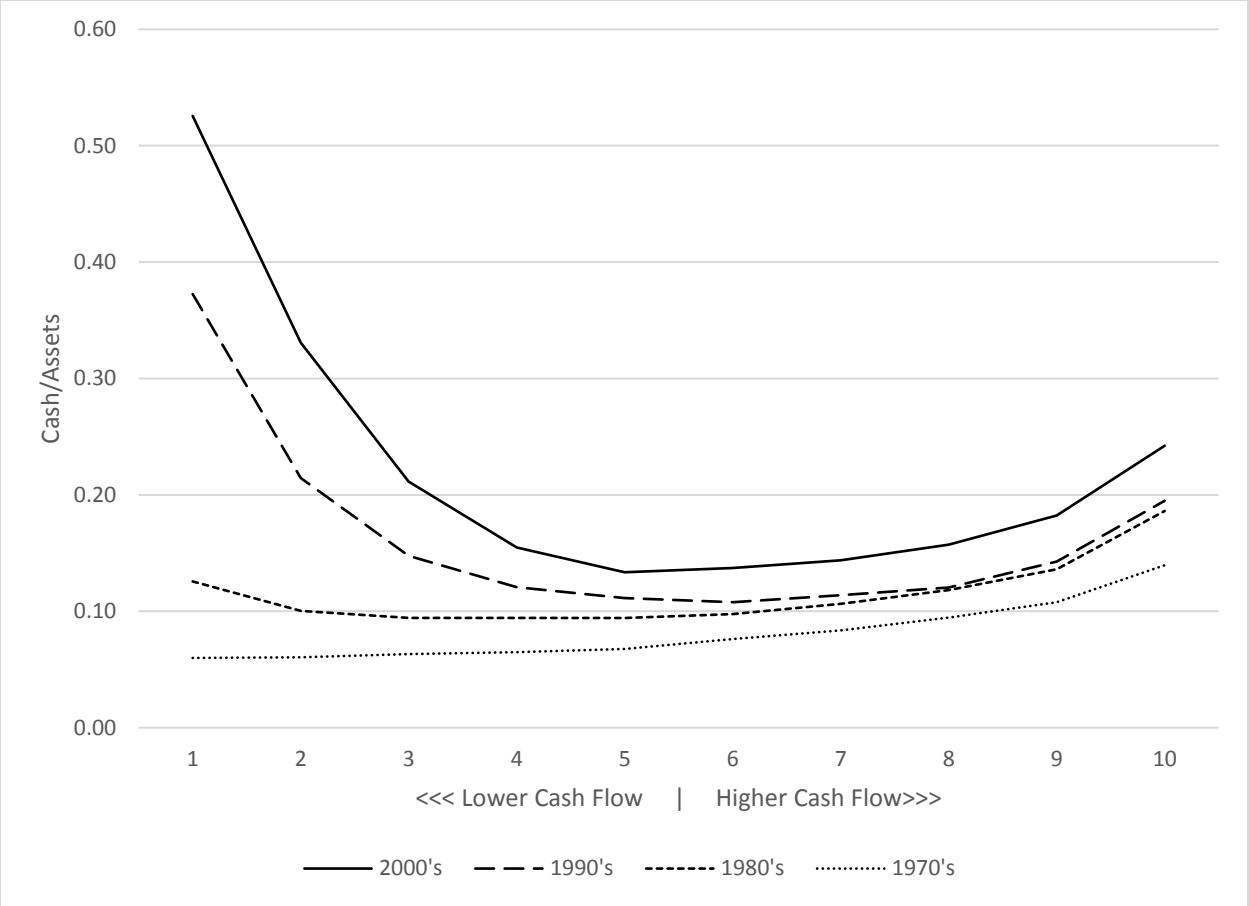


Figure 4. Convexity in the Relation Between Cash Holdings and Cash Flow Deciles. This chart reports mean values of cash/total assets for each decile of operating cash flow during four subperiods: (i) 1970-79, (ii) 1980-89, (iii) 1990-99, and (iv) 2000-2015.

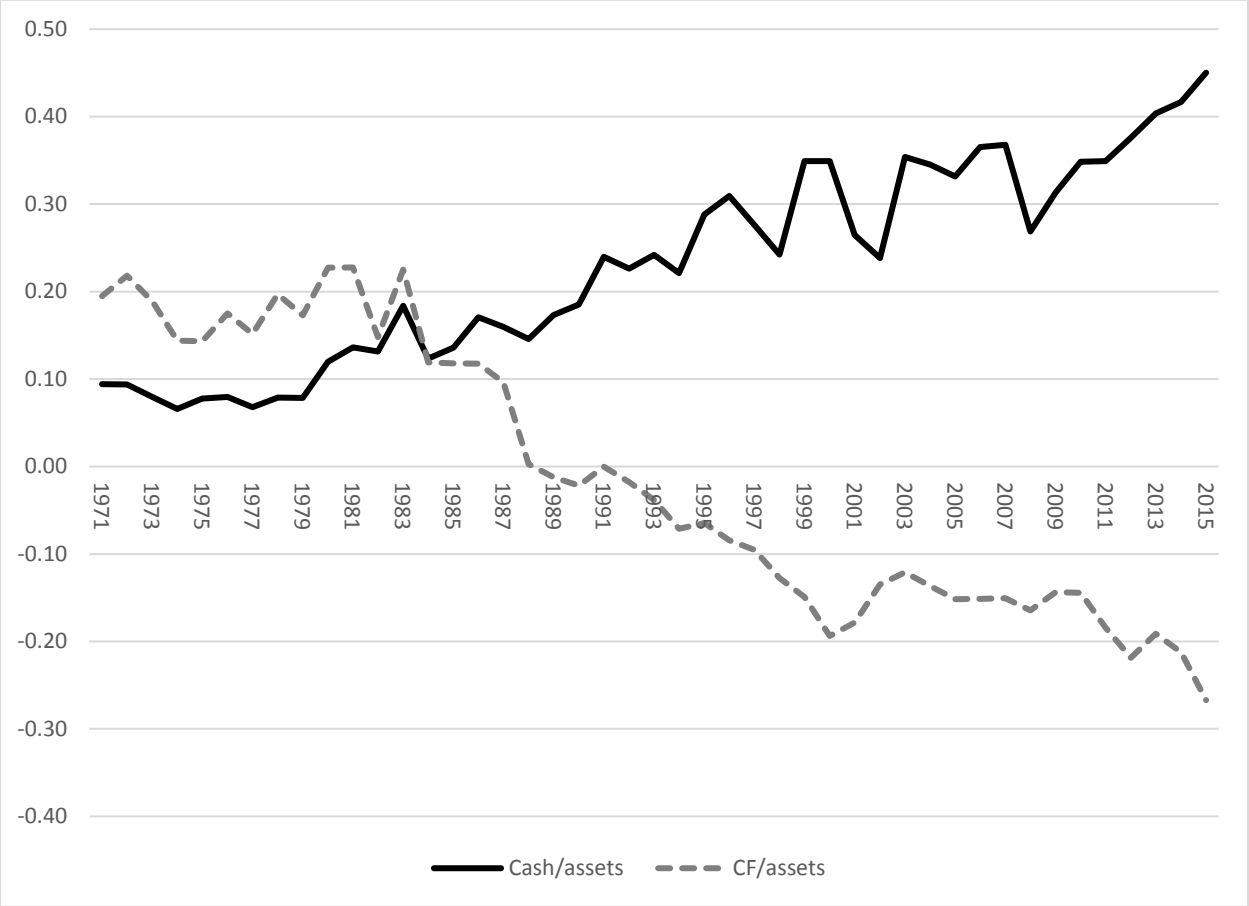


Figure 5. Equity Issuer Characteristics. This chart reports mean values of cash holdings and operating cash flow for all firms that initiate an equity issuance in a given year.

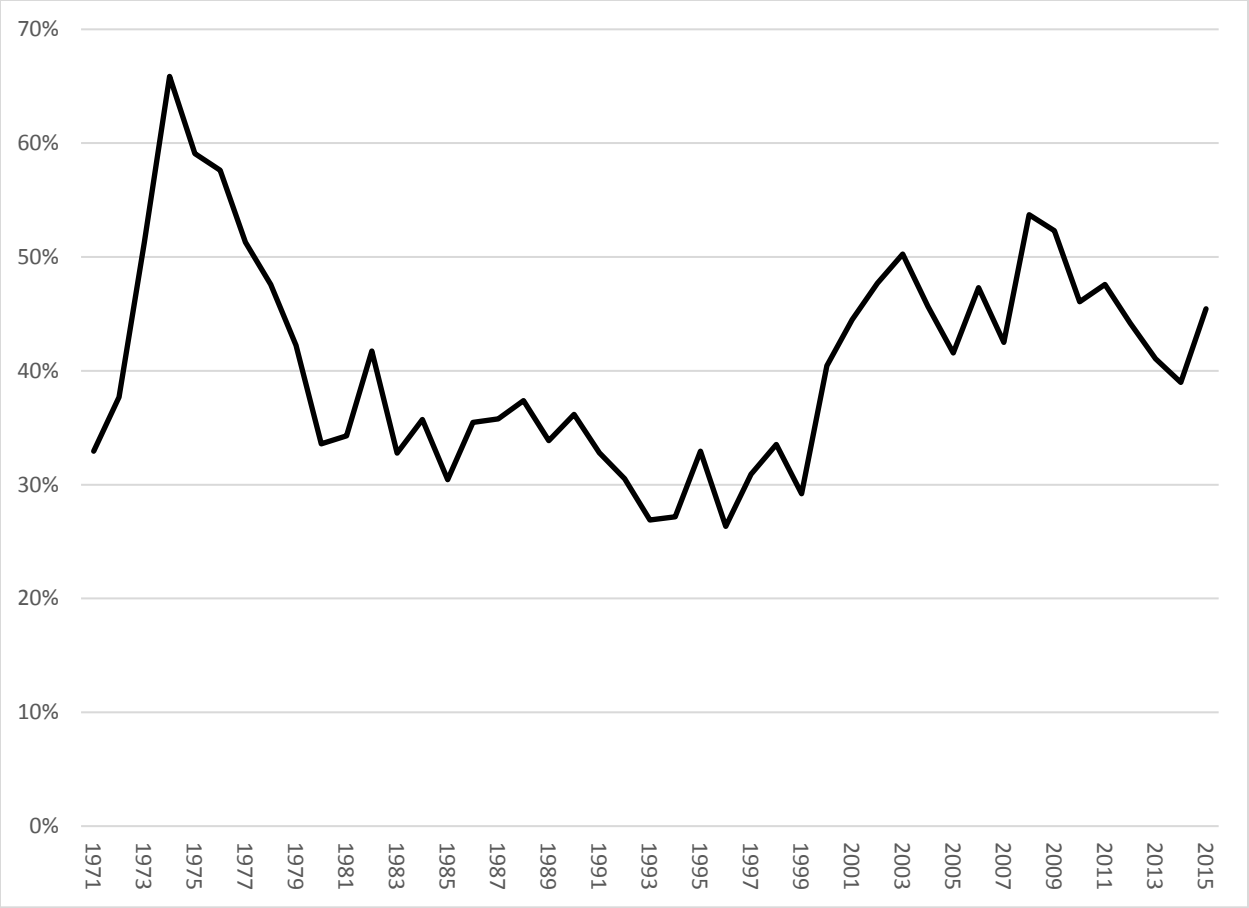


Figure 6. Cash Minus Issuance. This chart reports the proportion of equity issuers that held all proceeds in cash at the end of the year during which the issuance occurs.

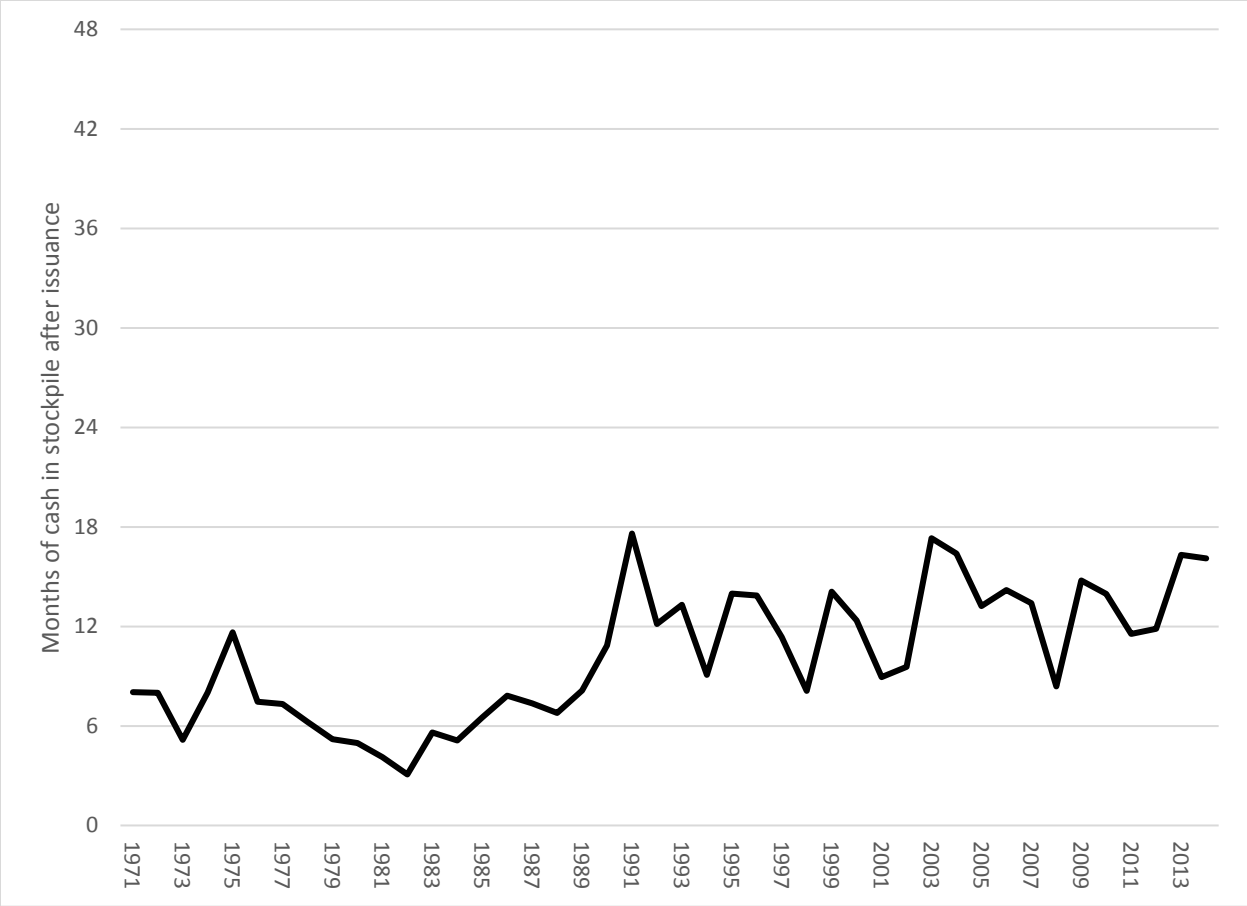
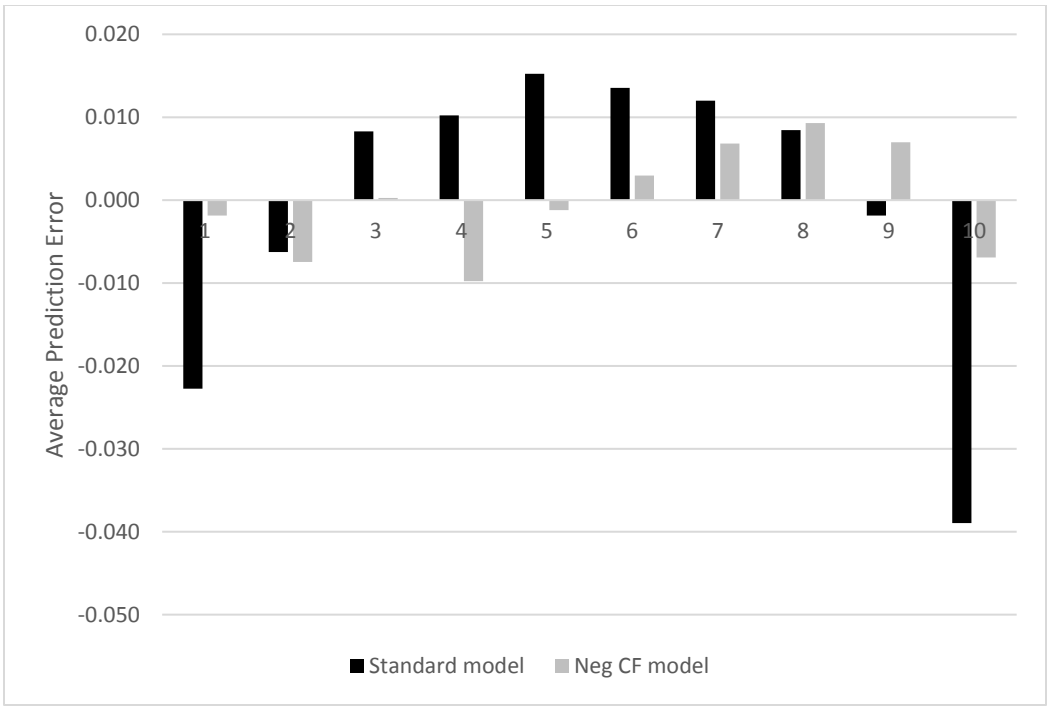


Figure 7. Median Runway for Equity Issuers with Negative Cash Flow. This chart reports the mean number of months of continued operations that could be sustained given current cash holdings. The sample includes all firms that both initiate an equity issuance and report negative cash flow in a given year.



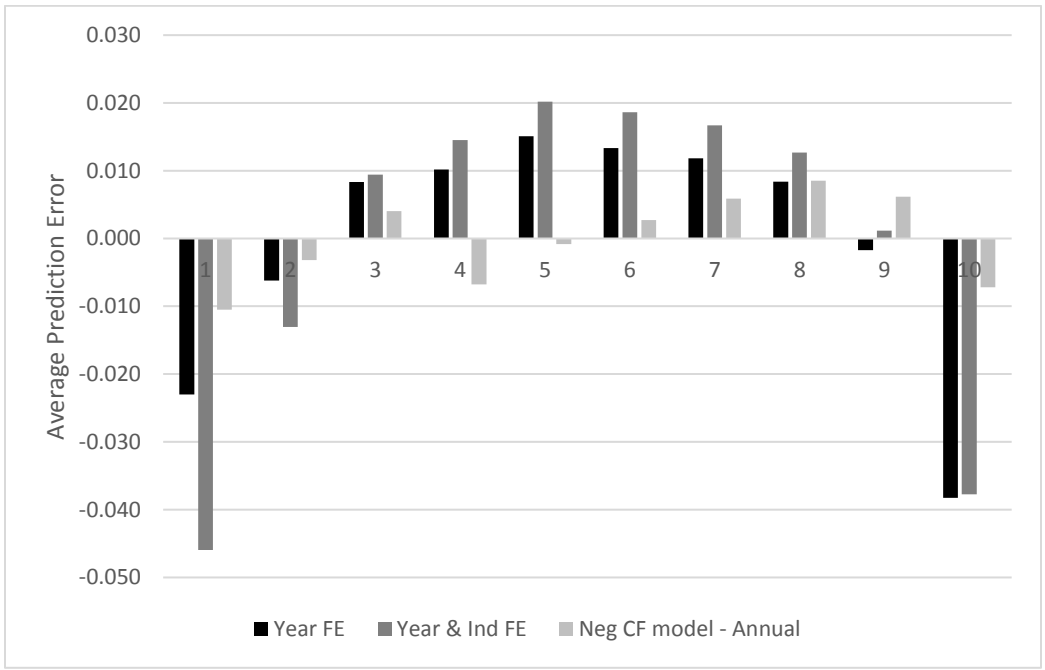


Figure 8. Prediction Error in Models of Cash Holdings. Panel A reports average prediction error from a standard model of cash/assets including cash flow, size, leverage, R&D intensity, industry cash flow volatility, capital expenditures and market-to-book ratio. The second series in panel A adds an indicator 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.