

Intangible Capital, Negative Cash Flow and Corporate Policy: International Evidence

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ABSTRACT

This study explores how intangible investments with negative operating cash flows (OCFs) affect corporate policies in a large sample of firms from 60 economies. First, while intangible investments have caused negative OCFs to increase in developed economies, both have remained unchanged in developing economies. Second, while intangible-intensive firms with negative OCFs account for the secular rise in cash holdings in developed economies, no significant rise has occurred in developing economies. Third, intangible-intensive firms with negative OCFs have become the majority of equity issuers. In sum, negative OCFs induced by intangible investments have altered corporate policies but solely in advanced economies.

Keywords: intangible investment, operating cash flow, cash holding, equity issue, developed economy, developing economy.

JEL classification: D25, G31, G32.

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Over the past five decades, U.S. firms have experienced a major transformation from traditional manufacturing industries to high-tech and service-oriented industries.¹ This transformation has been accompanied by a shift in the nature of investment from tangible to intangible capital.² Intangible investment now outweighs tangible investment. Similar patterns have occurred in non-U.S. developed economies, whose productive capital structure and composition of investment are somewhat similar to those of the U.S.³ In contrast, developing economies are structurally different. Their firms still operate with more tangible capital and higher tangible investment rate. Over time, their stock of intangible capital has also increased due to R&D activities and new product market developments but at a much slower pace.

Investment in intangible capital differs from investment in tangible capital in three major aspects. First, while expenditures on tangible capital are initially capitalized on the firm's balance sheet and then gradually depreciated over time, expenditures on intangible capital are immediately expensed and thus directly negatively impact firm profitability. Second, while expenditures on tangible capital tend to scale almost linearly with profits and cash flows, expenditures on intangible capital typically have longer lags and thus require some years before yielding positive increments to profits and cash flows. Third, expenditures on intangible capital represent a sunk cost, which refers to the inability to get the investment back after it is spent. Therefore, although investment in intangible capital is likely to be scalable in the long run (this scalability allows large and profitable firms to emerge), it puts significant downward pressure on profits and cash flows in the short run.

¹Brown et al. (2009), Bates et al. (2009), Kahle and Stulz (2017), Moshirian et al. (2017), Vadilyev (2020), Falato et al. (2021), among others.

²Tangible capital refers to property, plant, and equipment, while intangible capital – to IT, human capital, brand recognition, and product innovation. Tangible capital dominates in manufacturing industries (“old economy”), while intangible capital – in high-tech and service industries (“new economy”).

³There is a number of reasons for the growth of intangible investment, including the changing balance of services and manufacturing in the economy, globalization, liberalization of financial markets, new technologies and management practices, and the changing input costs of services.

In this study, I show that (i) the shift to intangible capital in the U.S. and other developed economies causes the size, frequency and persistence of negative operating cash flows (OCFs) to increase and the firms' policies to change, but (ii) the little shift to intangible capital in developing economies causes almost no changes in negative OCFs and the firms' policies.^{4,5} *First and foremost*, I find that cash flows are now much smaller for a large group of firms from developed economies. The percentage of U.S. firms with negative OCFs has risen from 5% in the early 1970s to 35% in the late 2010s. This percentage for firms from other developed economies has risen from 10% in the late 1980s to 30% in the late 2010s. In contrast, this percentage for firms from developing economies has fallen from the peak of 30% in the mid-1990s to below 20% in recent years. Unsurprisingly, the average cash flow profitability of developed economy firms has dropped from 15% of assets to below zero, while that of developing economy firms has remained stable at about 5% of assets.

I document that for most firms in developed economies in recent years, negative cash flows are not a transitory or short-lived phenomenon. In the early part of the sample (1970s and 1980s), firms that reported negative OCFs in one year had at least a 50% chance of reporting positive OCFs in the following year. However, in the later part of the sample (2000s and 2010s), it is increasingly the case that firms that lose cash flow this year are likely to lose cash flow next year. Particularly, only 15% of the U.S. and 30% of the non-U.S. developed economy firms that reported negative OCFs in 2018 reported positive OCFs in 2019, and the median run of their negative cash flow exceeds four years. Conversely, the chance of reporting positive cash flow in the following year has remained high and stable at above 50% for firms from developing

⁴Intangible investments are generally a component of R&D expenses or SG&A expenses. Both are components of operating cash flow. If an intangible investment passes the feasibility test, it can be capitalized on a balance sheet and then written off through amortization or impairment.

⁵“Negative operating cash flow” and “cash flow loss” are used interchangeably in this study. Also, “negative cash flow firm” and “loss firm” are synonyms.

economies. The median run of their negative cash flow is merely two years.

To provide formal evidence on the persistence of negative cash flow, I estimate a first-order autoregression $AR(1)$ of cash flow in the subsample of firms that report negative OCFs. Although the autoregression indicates a steadily increasing cash flow persistence for firms from developed economies, there is no increase in the persistence for firms from developing economies.

The magnitude of negative cash flow has grown dramatically over time in the U.S. and other developed economies. Not only firms from developed economies report declining cash flow across all deciles, but the decline is most evident within the bottom decile. In the 1970s, the U.S. firms in the bottom decile exhibited cash flow losses equal to 15% of assets, on average. In the 2010s, these losses have ballooned to 60% of assets. In the 1980s, the most unprofitable firms from other developed economies exhibited losses equal to about 29% of assets, on average. In the 2010s, these losses have reached 50% of assets. Still, firms from developing economies report stable cash flow across all deciles. The most unprofitable of them never exhibited losses greater than 18% of assets, on average.

The reported cash flow patterns in economically developed countries are not due to an increased supply of loss firms going public at an earlier stage of life cycle. Further, the evidence suggests that the patterns are not due to the disappearance of profitable firms through going-private transactions. The data support the notion that the evolution of negative cash flow is mostly driven by the growth in intangible investment. Indeed, if I measure operating cash flow *before* estimates of intangible investment, the growth in the frequency and magnitude of negative cash flow is virtually non-existent in developed economies, but the growth is further negative in developing economies.

Second, negative cash flows in economically developed countries create immediate and ongoing liquidity needs that must be met by either internal resources or external

finance. Between 1971 and 2019, cash holdings as a percentage of assets increase, on average, by a striking 500% (from 8% to 48% of assets) for U.S. firms with negative OCFs, as compared to a modest 70% (from 9% to 15% of assets) for those with positive OCFs. Similarly, between 1990 and 2019, cash holdings increase from 17% to 30% of assets for non-U.S. developed economy firms with negative OCFs and from 13% to 20% of assets for those with positive OCFs. It is evident that in advanced economies, negative cash flow firms account for the largest share of the growth in cash holdings. Conversely, cash holdings increase only modestly from 8% to 13% and from 9% to 16% of assets, respectively, for developing economy firms with negative and positive cash flows. Their cash holdings are small and, importantly, concentrated mostly in positive cash flow firms.

In developed economies, firms behaved as if they could foresee the persistence of negative cash flow. Since the 1980s, developed economy firms entering a run of persistently negative cash flow hold significantly more cash than those experiencing a transitory (short-lived) negative cash flow shock. This difference is evident not only for new firms but also for those that have previously reported a long record of positive cash flow. The persistence of negative cash flow appears to matter for cash policies. However, the results are sharply different for developing economy firms. Their cash policies do not respond to the expectation of negative cash flow. No response occurs because their negative cash flow shocks are expected to be small and mostly transitory, on average.

Third, rather than the source of cash reserves being current cash flow, firms with negative cash flow are forced to raise funds externally. Because firms from developed economies experience large and persistent cash flow losses, they need to regularly raise external funds. In contrast, because firms from developing economies are on average more profitable and less exposed to cash flow volatility, they do not need to regularly

tap external funds. Their operational needs are at least partially satisfied by current and future cash flows.

As predicted, negative cash flow firms represent an increasing and the largest proportion of equity issues in economically developed countries. In the 1970s, only 8% of the U.S. firms in the bottom decile of cash flow issued equity. In the 2010s, however, this proportion has ballooned to 76%. For comparison, these proportions for the U.S. firms in the top decile of cash flow were 21% and 15% in the 1970s and the 2010s, respectively. Firms from other developed economies issue equity in the proportions roughly similar to those of their U.S. counterparts. However, among firms from developing countries, equity issuers never exceeded 24% and 9% of the number of firms in the bottom and top deciles of cash flow, respectively.

I then compare three major sources of external finance, namely equity issues, debt issues, and the sale of fixed assets. Developed economy firms with negative OCFs raise far more cash through equity issues than through debt issues or the sale of fixed assets. These patterns are consistent with *high* intensity of intangible capital, making it difficult for firms to raise external funds through debt and asset sale. Developing economy firms with negative OCFs raise relatively small amounts of cash through a mix of equity and debt issues. These patterns are consistent with *low* intensity of intangible capital, making it unnecessary to raise large funds. Moreover, the latter firms operate with more tangible (pledgeable) assets, so they find it easier to raise debt.

In the U.S. literature, equity issues are the major source of cash for cash-hungry firms (McLean, 2011; Huang and Ritter, 2020). To illustrate the contribution of negative cash flow to this phenomenon, I scale the firm's cash balances by the size of its cash burn rate. This runway measure estimates the number of months a firm with negative cash flow can continue to operate at the same burn rate without an infusion

of external capital. I find that firms have increased their runway *globally* but for a *different* reason. In advanced economies, the median runway has increased from 6 months to about 24 months over the past decades. During this period, cash balances have exploded, and burn rates have risen. The implication here is that advanced economy firms rapidly deplete cash reserves but frequently replenish them through equity raisings. Simulations further confirm that cash balances of firms with negative OCFs range widely between about 0% and 60% of assets within a given year. In contrast, in developing economies, although the median runway has increased from 6 months to 18 months, cash balances have risen modestly, and burn rates have dropped. The implication here is that developing economy firms tend not to deplete cash balances and not to necessitate frequent equity raisings. As a result, in simulations, cash balances of firms with negative OCFs range narrowly between about 0% and 30% of assets within a given year.

Fourth, I formally explore the mechanism through which (i) a country's intensity of intangible capital contributes to negative cash flow of its firms, and (ii) the erosion in cash flow profitability contributes to firms' savings. To this end, I propose a 3SLS test in which intangible investment is instrumented by a country's innovation development metrics, namely the International Property Rights Index and the Global Innovation Index (the first stage). Cash flow profitability is then regressed on the instrumented intangible investment (the second stage), and cash holdings are regressed on the instrumented cash flow profitability (the third stage). In the first stage, a country's innovation development significantly contributes to the intensity of its firms' intangible capital. In the second stage, intangible investment erodes firms' cash flow profitability. In the third stage, negative cash flow significantly predicts firms' savings. Therefore, the 3SLS analysis provides some formal support for the argument for developed economies: intangible investments contribute to negative cash flows, which

in turn account for the increase in cash holdings. The opposite argument holds true for developing economies: low intensity of intangible capital is associated with small negative cash flows and small demand for cash.

Finally, my findings have implications for the literature that models cash holdings as a linear function of firm, industry, and country characteristics. The earlier studies typically include cash flow among the set of variables that capture the firm's sources and uses of cash. These standard regression models have become increasingly misspecified as the distribution of developed economy firms has shifted towards those with negative cash flow. Because intangible-intensive firms with negative cash flow account for most of the increase in cash balances, existing models that ignore this nonlinearity systematically underestimate cash balances.

Although this study is not the first to document a sharp drop in U.S. profitability, it is the first study to explain the *cross-country* differences in firms' cash flow profitability and their effect on firms' policies. Fama and French (2004) show that the profitability of newly listed U.S. firms became progressively more left-skewed. Kahle and Stulz (2017) find that U.S. public firms' profitability has declined over time, but small firms drive this pattern. Recently, Denis and McKeon (2021) report that the growth in intangible investment accounts for the increased size and frequency of U.S. firms' negative cash flow. I extend this U.S.-centered literature by showing that these patterns are *only* evident in the U.S. and, to some limited extent, in other developed economies. These patterns are, however, virtually non-existent in the majority of developing economies. Over the past few decades, firms in developing economies have *not* invested intensively in intangible capital, and as such, their profits and cash flows have *not* been impaired. They have operated with smaller liquidity needs and smaller external capital raisings. That is, the link between large intangibles, deep losses, and savings previously established in the U.S. does not hold in developing economies.

This paper contributes to two related strands of the literature. The first aims to understand why average cash holdings have grown so dramatically in the U.S. but not in many other economies. This study shows that, in addition to the precautionary motive due to uncertainty in future financing (Bates et al., 2009) and repatriation tax costs (Foley et al., 2007; Faulkender et al., 2017), negative cash flows induced by intangible investment are a first-order driver. As documented, negative cash flow firms with large investments in intangible capital account for the sharp rise in cash holdings in the U.S. and other advanced economies. In contrast, this driver is irrelevant to the liquidity policy of firms from developing economies.

The second strand of the literature aims to explore the motives for equity issuance. Kim and Weisbach (2008) and DeAngelo et al. (2010) attribute the firm's issuance decision to the need to fund operational and investment activity. My findings indicate that equity issuers from advanced economies are increasingly characterized by large negative cash flows and high cash burn rates. Their cash reserves are therefore of short duration, requiring them to issue equity frequently. The issuances top up the reserves regularly, but the firms burn through the reserves rapidly. Notably, no such motives are found for firms from developing economies. Because the latter firms generate positive cash flows on average, they do not burn cash rapidly and do not need to stash cash through frequent equity raisings.

The rest of the paper is organized as follows. Section I reports the cross-country differences in the size, frequency, and persistence of negative cash flow. Section II shows how negative cash flow contributes to the rise in cash holdings in developed economies and why cash holdings remain small in developing economies. Section III explains how negative cash flow defines the cross-country sources of external financing. Section IV establishes the causality relationship between intangible investment, negative cash flow, and savings. It also discusses some empirical implications for cash

models. The last section concludes.

I. Negative cash flows

This section presents descriptive evidence on the cross-country differences in the frequency, magnitude, and persistence of negative cash flow, discusses the reasons for the differences, and reports the key characteristics of negative cash flow firms.

A. *Cross-country patterns in cash flow profitability*

The sample includes 27 developed and 33 developing economies. U.S. data are from the S&P's Compustat North America, Industrial Annual Files. International data are from the S&P's Compustat Global. U.S. dataset covers the years 1970 to 2019. The dataset for non-U.S. developed economy firms covers the years 1980 to 2019, while that for developing economy firms – 1990 to 2019. Table 1 presents the country/economy classification.

Financial (SIC codes 6000 to 6999) and utility firms (SIC codes 4900 to 4999) are excluded, as are firms missing data necessary to calculate cash ratios and cash flow profitability measures. The observations for years in which total assets, cash holdings, and sales revenue are nonpositive are also removed. I require the observation to have a market price. Table 2 defines the variables.

I begin by documenting the significant cross-country differences in the size and frequency of negative cash flow. Figure 1 plots (i) the percentage of sample firms that report negative OCFs and (ii) the size of operating cash flow as a percentage of total assets. The rise in the number of firms reporting negative OCFs is evident in both the U.S. and non-U.S. developed economies. In the early part of the sample, the percentage of U.S. firms with negative OCFs rarely exceeded 10%. Since the 1980s,

however, it has never been less than 20%. By 2019, the last year in the sample, 35% of U.S. firms report negative OCFs. Similarly, this percentage for firms from non-U.S. developed economies has risen from 10% in the early 1980s to 30% in the late 2010s. Not surprisingly, the average cash flow profitability of developed economy firms has plummeted from 15% of total assets to below zero during the sample period.

In contrast, the percentage of developing economy firms with negative OCFs has dropped from the peak of 30% in the mid-1990s to below 20% in 2019. The average cash flow profitability has remained stable at about 5% of total assets throughout the sample period.

Figure 2 (top chart) plots the proportion of negative cash flow firms in the current year that report positive cash flow in the following year. The chart illustrates a strong persistence of negative cash flow for U.S. and non-U.S. developed economy firms. In the 1970s to 1980s, at least 50% of firms that experienced negative cash flow in the current year returned to positive cash flow in the following year. However, only about 15% of U.S. and 30% of non-U.S. developed economy firms that reported negative cash flow in 2018 returned to positive cash flow in 2019. By contrast, among loss firms from developing economies, the chance of reporting positive cash flow in the coming year has remained high and stable at above 50% throughout the sample period.

The bottom chart plots the average number of years of consecutive negative cash flows, including the current year.⁶ Among firms from developed economies, the average run exhibits a strong upward trend, peaking at four and more years in 2019. This trend implies that negative cash flows are not surprising; instead, the firms are operating under the expectation of an extended cash flow deficit. Conversely, among firms from developing economies, the average run of negative cash flow is merely two years in 2019. For these firms, the expectation of an extended cash flow deficit is low.

⁶By construction, the lower bound of 1 represents a situation in which a firm reporting negative cash flow in the current year had positive cash flow in the previous year.

To provide formal evidence on the persistence of negative cash flow, I estimate a first-order autoregression $AR(1)$ of the ratio of operating cash flow to total assets in the subsample of firms that report negative OCFs in the current year. The $AR(1)$ estimations are performed annually. Figure 3 plots the autoregressive coefficients with 95% confidence bands. The autoregression results confirm the increasing persistence of negative cash flow in the group of developed economy firms. From the early 1970s to mid-1980s, cash flow in the previous year had little predictive power for negative cash flow in the current year (i.e., the autoregressive coefficients vary from 0.2 to 0.4). Starting from the 1990s, cash flow in the previous year has become a more significant determinant of negative cash flow in the current year (i.e., the autoregressive coefficients vary from 0.6 to 0.8). However, in the group of developing economy firms, the autoregression indicates no significant persistence of negative cash flow (i.e., the autoregressive coefficients vary from 0.1 to 0.3).

Table 3 reports the mean values of the ratio of operating cash flow to total assets across its deciles. The cash flow deciles are formed annually and then averaged during five subperiods. The magnitude of negative cash flow has grown substantially in developed economies. Although all deciles report notably lower cash flows over time, the drop is most evident within the lowest deciles. In the 1970s, the U.S. firms in the bottom decile exhibited cash flow losses equal to 15% of assets, on average. In the 2010s, these average losses have ballooned to 60% of assets. In the 1980s, the least profitable firms from non-U.S. developed economies exhibited losses equal to 29% of assets, on average. In the 2010s, these losses have reached almost 50% of assets. Still, firms in developing economies generate stable cash flows across *all* deciles. The least profitable of them never exhibited losses greater than 18% of assets, on average.

Last, Figure 4 plots the distribution of operating cash flow at the beginning and the end of the corresponding sample period. The figure shows that not only has the

density of the cash flow distribution shifted to the left in the group of U.S. firms, but there has been a significant jump in the proportion of firms with large negative OCFs. Specifically, in the 2010s, about 10% of firm-years exhibited negative OCFs of at least 30% of total assets. Although less skewed to the left tail and more dense around the center, the distribution is somewhat similar in the group of firms from other developed economies. However, the distribution is sharply different in the group of firms from developing economies. It has remained stable over time and, importantly, has a very small proportion of observations (below 2%) with large negative OCFs.

Taken together, the cross-country evidence reported in this section highlight four stylized facts about the evolution of cash flow. In the group of firms from 27 major developed economies, negative cash flows are more prevalent and persistent, the size of cash flow within each decile has decreased over time, but the size of negative cash flow within the lowest decile has decreased the most. Conversely, in the group of firms from 33 major developing economies, cash flows are vastly positive, and have remained stable across all deciles throughout the entire sample period.

B. Cross-country characteristics of negative cash flow firms

An important question is whether key characteristics of negative cash flow firms have changed over time and across countries. Table 4 reports summary statistics on several variables for firms with negative OCFs. Five results are worth mentioning here. First, firm age, measured as the number of years as a public firm in Compustat, has globally increased. The average age of U.S. loss firms is 5.8 years in the 1970s, rising to 10.6 years in the 2010s, suggesting that the increased number of loss firms in the public market is not solely due to an influx of newly listed firms. Similar age patterns are observed in other countries. Second, the market-to-book ratio for U.S. firms is significantly higher in more recent years, averaging 2.94 in the 2010s vs. 1.35 in the

1970s. This ratio has also risen for other developed economy (however, the ratio has dropped at the median) and developing economy firms. Third, leverage has fallen globally. Fourth, capital expenditures have broadly declined, while both R&D and SG&A expenditures have increased over time. These patterns are however less evident for firms in developing economies. Finally, compared to the early part of the sample period, developed economy firms now hold substantially more cash reserves. Their counterparts from emerging economies are less cash-dependent. Overall, as negative OCFs have become larger and more persistent in the developed part of the world, the characteristics of the loss firm have resembled those of the *growth* firm: low leverage, high market-to-book and revenue growth rates, large intangible investments and cash reserves.⁷

C. Why have negative cash flows increased in developed economies but remained stable in developing economies?

One possible explanation for the growing share of public loss firms is that it has become easier for firms with negative cash flow to raise equity capital in financially developed markets. If firms are increasingly going listed at an earlier stage of their life cycle, the patterns I document in the previous section could simply be due to an increased supply of young and loss firms in the public market. However, contrary to this view, Doidge et al. (2018) report that the number of U.S. listed firms has sharply fallen since 1996, as has the propensity of young and loss firms to go public. The picture is similar in other major developed markets.⁸ Moreover, Kahle and Stulz (2017) find that the median age of listed firms has doubled in the past two decades.

⁷Growth patterns have changed (untabulated). In the 1970s to 1980s, loss firms reported declining revenues and assets. In the 1990s to 2010s, loss firms were growing rapidly.

⁸According to the World Bank, the number of listed firms and IPOs (delistings) in the U.S., U.K., and E.U. has been steadily declining (increasing) since 1990s.

Over this same period, in financially developed economies, both the proportion of loss firms and the size of negative cash flow have substantially increased.

Another possible explanation is that firms with positive and stable profits might disproportionately be the targets of buyouts or other M&A deals. Still, there is no evidence to support this claim. Although, since 2000, around 15% of U.S. delistings in terms of market valuation (9% in terms of number) have involved at least one private equity firm, delisting rates attributed to buyouts or other M&A deals are similar for profitable and unprofitable firms (Ljungqvist et al., 2016).

I argue that the most plausible explanation for the steady growth in the number of negative cash flow firms in developed economies is the long-term shift from tangible to intangible capital. Investment in buildings, machinery, and equipment has become less important, while investment in intangibles – essential for growth. Contrary to the shift in the productive capital structures in developed economies, firms in developing economies still operate with more tangible capital and higher tangible investment rate.

To illustrate the link between intangible investment and negative cash flow, Figure 5 plots the evolution of the R&D-to-assets and the SG&A-to-assets ratios for firms in the top two (high cash-flow firms) and the bottom two (low cash-flow firms) deciles of operating cash flow.⁹ The deciles are formed annually. Two results stand out from this analysis. First, in advanced economies, intangible investment has not grown for high cash-flow firms. Intangible investment has grown solely for low cash-flow firms. In the early parts of the sample, there is no difference in the ratios between the two types of firms. By the end of the sample, however, the ratios for low cash-flow firms are jointly three times higher than those for high cash-flow firms. Second, in developing economies, no increase in intangible investment has occurred for *both* types of firms. Intangible investment is insignificant, on average, and thus does not adversely affect

⁹See the definition of intangible investment in Table 2.

firms' cash flow generation.

Next, Figure 6 reveals that the growth in intangible investment is the first-order driver behind the rising number of negative cash flow firms in developed economies. I compute a measure of operating cash flow *before* R&D expenses and the portion of SG&A expenses that represents intangible investment (OCF_{adj}) and report the percentage of firms with negative OCF_{adj} each year. Not surprisingly, as both R&D and SG&A expenses have grown over time, the proportion of firms with negative OCF_{adj} has become much smaller than that with negative OCFs. The share of U.S. firms with negative OCF_{adj} varied between about 10% and 15% over the past few decades and that of other developed economy firms – about 20%. The share of developing economy firms with negative OCF_{adj} has sharply declined. It stands at 33% in 1995 vs. 15% in 2019. Also, because the estimates of intangible investment are insignificant for firms from developing economies, the difference between OCF_{adj} and OCF measures is in fact zero.

II. Negative cash flows and cash policy

As shown in Section I, the growth in intangible investment is associated with large and persistent negative cash flow in advanced economies. This cash flow deficit creates immediate and ongoing liquidity needs that firms must meet by either internal resources or external finance, or the combination of the two. This section explores the implications of the growth in intangible investment and negative cash flow for cash policy.

A. Growth in cash holdings by negative cash flow firms

Figure 7 plots the mean values of cash-to-assets for the full sample, the subsample of positive cash flow firms, and the subsample of negative cash flow firms. As before, the plots are reported separately for three groups of economies.

First, in the U.S., the findings confirm the dramatic rise in average cash balances, from 8% of assets in 1971 to 25.5% in 2019. When I split the sample into positive and negative cash flow firms, the results reveal that the rise in average cash balances is closely tied to the increased size and frequency of negative OCFs. In 1971, cash holdings for negative cash flow firms were smaller than those for positive cash flow firms. However, by the mid-1980s, this pattern reversed, and cash holdings for negative cash flow firms were greater than those for positive cash flow firms. Moreover, the point of divergence in the mid-1980s corresponds to the beginning of the growth in the number of negative cash flow firms (Figure 1).

Between 1971 and 2019, the growth in cash balances by negative cash flow firms is a striking 500% (from 8% to 48% of assets), which is more than seven times the growth in cash balances by positive cash flow firms (from 9% to 15% of assets). If the former firms are removed from the sample, the growth in cash balances is less than a third of the growth for the full sample.

Second, the growth in cash balances is evident for firms from non-U.S. developed economies, from 15% of assets in 1990 to 22% in 2019. Although this growth is not as dramatic as that for U.S. firms, it is also mostly driven by negative cash flow firms. Therefore, I conclude that negative cash flow firms account for the largest share of the increase in cash balances in developed economies.

Third, in the group of firms from developing economies, cash balances increase only modestly, from 8% to 13% and from 9% to 16% of assets, respectively, for firms with negative and positive cash flows. Their cash balances are therefore much smaller than

those in advanced economies; importantly, they are concentrated mostly in positive cash flow firms.

The key takeaway is that in order to understand the steady rise in average cash holdings in developed economy firms, more attention needs to be paid to the left side of the cash flow distribution, in which the rise has been most evident. However, no significant rise in average cash holdings has occurred in developing economy firms whose cash holdings are roughly evenly distributed.

B. What explains growth in cash balances?

The conventional explanations for holding excess cash are repatriation taxes, agency problems, and precautionary motives.¹⁰ However, none of them can satisfactorily explain the rise in average cash holdings in the U.S. and other economically developed countries. First, although the rise in cash holdings by profitable firms could be caused by tax considerations, the rise by loss firms is unlikely to be due to an offshore cash build-up because loss firms have negative earnings to offset tax costs, and only about 10% of the Compustat sample firms that report losses report foreign income. Second, loss firms exhibit characteristics that make them less exposed to agency problems. Nikolev and Whited (2014) propose three factors commonly associated with the agency cost problem: firm size, managerial perquisite consumption, and small managerial ownership. Loss firms are arguably the least exposed to all three factors. On average, they are the smallest firms in the economy; they are subject to regular equity capital raisings (I discuss it below); they are monitored more closely than mature profitable firms; and they have the highest managerial ownership among public firms. Third, the precautionary motive remains a plausible explanation for the rise in cash holdings. Because intangible investments are the major source of precautionary demand for cash

¹⁰Harford (1999), Dittmar and Marhrt-Smith (2007), Foley et al. (2007), Bates et al. (2009), Faulkender and Petersen (2012), Harford et al. (2014), and Faulkender et al. (2017), among others.

(Pinkowitz et al., 2016; Begenau and Palazzo, 2021) and because intangible-intensive firms are often generating negative cash flow, the rise in cash holdings by loss firms might simply reflect the elevated precautionary demand. However, my results suggest that loss firms that spend heavily on intangibles require large cash balances to fund immediate operational needs rather than to insure against the possibility of a funding shortage in the future.¹¹

To illustrate that the large cash holdings of negative cash flow firms in advanced economies are not solely due to the precautionary motive, Table 5 compares cash holdings of high and low intangible-intensive firms, defined as those within the top and the bottom three deciles of R&D expenses, respectively.¹² Cash holdings are reported by cash flow deciles. The deciles are formed annually and averaged over subperiods. The growth in cash holdings for high intangible-intensive firms depends on the firm's cash flow position. In the U.S. and other developed economies, cash holdings for firms in the deciles, in which OCFs are on average positive have grown about 340% and 50%, respectively. Contrarily, cash holdings for firms in the deciles, in which OCFs are on average negative, have grown 790% and 160%, respectively. Therefore, the occurrence of negative cash flow appears to be essential for cash policy of firms with strong precautionary motive.

In developing economies, cash holdings for high intangible-intensive firms in the deciles with average positive OCFs have grown about 94%, while for those in the deciles with average negative OCFs – 74%. The difference in the growth rates is

¹¹The precautionary demand for cash has been traditionally focused on the second moment (volatility) of the cash flow distribution. However, when the first moment (mean) is negative, the demand for cash is driven more by the expected level of negative cash flow rather than by its expected volatility. Thus, the cash reserve is not solely a precautionary measure against the possibility of future adverse shocks; it is a necessity to finance operational needs under the expectation of negative cash flow. Still, the precautionary demand and operational needs are not mutually exclusive. To the extent that the firm has negative cash flow for an uncertain period, part of the observed cash holdings is likely to include a precautionary amount that is correlated with the uncertainty of future funding needs.

¹²The results returned for both R&D and SG&A expenses are almost identical (untabulated).

insignificant because developing economy firms are vastly more profitable. For them, both the precautionary demand for cash and the occurrence of negative cash flow are comparably low.

Similar patterns are found for low intangible-intensive firms. In developed economies, firms with negative OCFs hold disproportionately larger cash balances than those with positive OCFs. However, in developing economies, firms with negative OCFs hold smaller cash balances. For them, negative cash flows are expected to be small and thus do not seem to play an essential role in cash policy.

C. Do firms anticipate negative cash flows by holding more cash?

If growing and persistent negative OCFs among developed economy firms are due to expected spending on intangibles, they should at least be partially predictable. I hypothesize that cash policies should be responsive to the expectation of negative cash flow. To test this conjecture, I explore the relationship between cash holdings and negative OCFs around the first year in which a firm reports negative OCFs.

Table 6 presents median cash holdings for four groups of firms. The *Persistent* category consists of firms entering a run of negative OCFs that is at least three years in duration. The *Transitory* category consists of firms that return to positive OCFs the following year. *New Firms* are those that exist less than three years. *Fallen Angels* are firms that reported at least three years of positive cash flow before entering the negative cash flow domain.

In U.S. and other developed economies, firms behaved as if they could foresee the persistence of negative cash flow *ex-ante*. Since the 1980s, developed economy firms entering a run of persistently negative cash flow hold significantly more cash than those experiencing a transitory negative shock. This is true not only for new firms but also for those that have previously reported a long record of positive cash flow.

The persistence of negative cash flow matters for cash policies. However, the results are sharply different for developing economy firms. Their cash policies do not respond to the expectation of negative cash flow. No response occurs because their negative cash flow shocks are expected to be small and mostly short-lived.

D. Convexity of the relationship between cash holdings and cash flow

Figure 7 above indicates a major shift in the relationship between cash holdings and cash flow: negative cash flow firms in advanced economies have increased cash holdings at a much higher rate than have positive cash flow firms. This shift coincides with the growth in intangible investments and the size of negative OCFs. Still, no such patterns emerged in less advanced economies.

Additionally, Table 5 above illustrates this shift more explicitly by reporting the relationship between cash holdings and cash flow deciles at the beginning and the end of the sample period. In advanced economies, for any given cash flow decile, the average firm at the end of the period holds significantly more cash in reserves than does the average firm at the beginning. Still, the most striking increase in cash reserves occurs at the lower end of cash flow. While the relationship was roughly flat across deciles in the 1970s and 1980s, the 2010's decade has increased in convexity (i.e., become more U-shaped over time). In contrast, in developing economies, cash holdings have increased only modestly across cash flow deciles. The relationship remains about flat throughout the entire sample period.

In summary, what has changed over time in advanced economies is the duration of negative OCFs. A firm reporting negative OCFs in the 1970s or 1980s was expected to revert to positive cash flow soon, while a firm reporting the same level of negative OCFs in the 2000s or 2010s was expected to remain unprofitable for an uncertain period. This shift creates a strong demand for savings over and above traditional

precautionary demand.

III. Negative cash flows and external finance

So far, we have documented that developed economy firms are tilted towards intangible productive capital. They generate large and persistent negative OCFs, which create the necessity to hold large cash balances. Yet, it is unclear how negative cash flow firms build their cash balances. Firms with large investments in intangibles, fewer pledgeable (collateral) assets, and possibly some information asymmetries likely face severe frictions in the market for external finance.

In this section, I explore the sources of external finance and analyze how financing patterns have evolved to mitigate frictions as developed economy firms have become increasingly characterized by negative cash flow. I further shed some light on the cross-country differences in the sources of external finance.

A. Cross-country evolution of external sources of financing

Table 7 explores three major sources of external funds: equity issues, debt issues, and the sale of fixed (PP&E) assets. I measure each of these sources, scaled by total assets, for different bins of cash flow (from below -40% to above 30% of assets). For comparison, the table also reports the cash-to-assets ratio for each cash flow bin.

There are two major takeaways from this analysis. First, over the past decade in developed economies, firms with the lowest cash flow realizations raise far more cash through equity than through debt issues or the sale of fixed assets. For example, for U.S. firms in the lowest (second lowest) cash flow bin, in which cash flows are below -40% (-30%) of assets, net equity issues average 51% (39%) of assets. Net debt issues average 2 to 3% of assets, while sales of PP&E are virtually non-existent. Similar

patterns are documented for firms from other advanced economies. These patterns are consistent with high intensity of intangible capital, making it difficult for firms to raise funds through debt or asset sales. Investing in intangible capital rather than tangible capital affects the value of collateral and debt capacity since intangibles are less likely to be accepted as collateral. At the other end of the cash flow distribution, firms with the highest positive cash flow realizations tend to repurchase debt and issue little-to-no equity.

Second, over the past decade in developing economies, firms with the lowest cash flow realizations raise small amounts of cash through a mix of equity and debt issues. For example, for firms in the lowest (second lowest) cash flow bin, net equity issues average 24% (13%) of assets, and net debt issues average 3% (7%) of assets. Sales of PP&E are non-existent. These patterns are consistent with low intensity of intangible capital, making it unnecessary to raise large amounts of cash. Also, these firms operate with more tangible (pledgeable) assets, so they find it easier to provide collateral and raise debt.

B. Cross-country evolution of equity financing

Figure 8 illustrates that over the same period as the increase in cash holdings and cash flow losses has occurred, the characteristics of equity issuers have changed. In the 1970s to 1980s, developed economy firms issuing equity were cash flow positive, but almost every year since about 1987, the typical equity issuer is a negative cash flow firm. Equity issuers with losses are inevitably cash hungry. Contrarily, equity issuers in developing economies are typically cash flow positive throughout the entire sample period, and therefore are not as cash hungry.

To further analyze the relation between the size of cash flow and the frequency of equity issuance, I calculate the average number of firm-initiated issuances per year in

each cash flow decile. Firm-initiated equity issuance is the sales of stock above 3% of assets. Table 8 reports the results. Two results are worth noting. First, a large portion of negative cash flow firms in economically developed countries is equity issuers. In the 2010s, the U.S. and other developed economy firms in the bottom decile of cash flow recorded 0.76 and 0.63 issuances per firm per year, respectively, whereas developing economy firms – merely 0.23. Second, the frequency of equity issuance by negative cash flow firms in developed (developing) economies has dramatically increased (remained stable) over the sample period. Hence, in developed economies, not only do negative cash flow firms conduct a large portion of equity issues, but equity issuers are typically negative cash flow firms. In developing economies, negative cash flow firms are not frequent equity issuers.

Also, the increased issuance frequency of negative cash flow firms from developed economies may reflect the possibility that the firms face frictions in the equity market. A staging of equity infusions with small frequent investment rounds and issuance costs possibly mitigates these frictions (Hertzel et al., 2012).

C. Cross-country differences in cash burn rate and runway

Several U.S. studies (e.g., Kim and Weisbach, 2008; McLean, 2011; Huang and Ritter, 2020) document that firms issue equity and stash a portion of the proceeds for future needs. To illustrate the contribution of negative cash flow to this phenomenon, I scale the firm’s cash balances by the size of its cash *burn rate*.¹³ This *runway* measure estimates the number of months a typical firm with negative cash flow can continue to operate at the same cash burn rate without an infusion of external capital.

In untabulated results, U.S. monthly burn rates have increased from about 0.5%

¹³The monthly burn rate is defined as negative free cash flow divided by 12. Free cash flow is operating cash flow minus dividends minus capital expenditures. By definition, firms with positive free cash flow do not have a burn rate.

of assets in the 1970s to 1.2% in the late 2010s. At 2019 burn rates, a cash stockpile of at least 15% of assets would be required to support operations during a year. The burn rates for other developed economy firms have remained stable over time, at about 0.6% of assets, whereas those for developing economy firms have declined from about 0.6% of assets in the 1990s to below 0.4% in the late 2010s. For the latter firms, a cash reserve of a mere 5% of assets would be sufficient on average to support operations.

Figure 9 plots the median runway measure for loss firms over the sample period. I reveal that firms have increased runway *globally* but for a *different* reason. In advanced economies, the runway has increased from 6 months to between 18 and 24 months over the past decades. During this period, cash balances and burn rates have exploded. The implication here is that firms could rapidly deplete cash reserves but frequently replenish them through equity raisings. In the late 2010s, having about a year and a half's cash reserve is the norm. Loss firms are not stockpiling cash relative to their operational needs, but their needs have grown substantially. In contrast, in developing economies, although the runway has increased from 6 months to 18 months, cash balances have risen modestly and burn rates have dropped. The implication here is that firms tend not to deplete cash reserves and not to necessitate frequent equity raisings. Their operational needs simply have not grown.

It is natural at this stage to explore the relation between *intra-year* variation in cash holdings and burn rates. Because such variation is unobservable in annual data, Figure 10 presents simulated cash holdings over a 24-month period. I calibrate the values on cash holdings, burn rates, and equity issuance to the average observed values for the negative cash flow firm that issued equity during 2010-2019. The year-end cash balances are largely stable for the firm from a developed economy; however, within a year, cash balances fluctuate widely between 0% and 60% of assets. High burn rates deplete cash reserves rapidly but equity issues replenish them frequently. Conversely,

cash balances of the firm from a developing economy range narrowly within a year between 0% and 30% of assets. Low burn rates slowly deplete cash reserves, and equity issues are infrequently required to replenish them.

In summary, my findings indicate that in recent years, negative cash flows have become a first-order driver of both equity issuances and cash holdings for firms from advanced economies. However, negative cash flows do not play such an important role in the policies of firms from emerging economies.

IV. Causality effect and empirical implications for cash models

First, I formally explore the mechanism through which (i) a country’s intensity of intangible capital contributes to negative cash flows of its firms, and (ii) the erosion in cash flow profitability contributes to firms’ savings. To this end, I propose a 3SLS analysis with instrumental variables.

Table 9 shows the 3SLS results. In the first-stage regression, firms’ intangible investment (II) is instrumented by the International Property Rights Index ($IPRI$), the Global Innovation Index (GII), and GDP per capita at constant prices ($GDPPC$).¹⁴ Because of the multicollinearity between the measures, they are combined through two principal components namely PC(1) and PC(2).¹⁵ In the second-stage regression, the instrumented intangible investment (\widehat{II}) is regressed against firms’ cash flow (OCF). In the third-stage regression, the instrumented cash flow (\widehat{OCF}) is regressed against firms’ cash holdings ($Cash$). By design, II , OCF , and $Cash$ are endogenous variables.

¹⁴The IPRI scores the underlining institutions of a strong property rights regime namely the legal and political environment, physical property rights, and intellectual property rights (www.internationalpropertyrightsindex.org). The GII and its constituents, the Innovation Input Index and Innovation Output Index, are an annual ranking of countries by their capacity for and success in innovation (www.globalinnovationindex.org). GDP per capita is in constant 2010 US\$.

¹⁵PC(1) and PC(2) capture about 89% and 6%, respectively, of the variance in the sample data.

IPRI, *GII*, and *GDPPI* are classified as exogenous variables. Column (1) reports the results returned from the approach in which the regression variables are computed for each country in the sample. I end up with 59 country observations, for which the indices of innovation development are available. Column (2) reports the results returned from the alternative approach in which the regression variables are computed for each country-year. I end up with 1,586 country-year observations. The tests of endogeneity and overidentifying restrictions are reported.

In the first-stage regression, a country's innovation development significantly contributes to the intensity of firms' intangible capital ($PC(1)$ has a coefficient of 0.01, $t = 24.7$ in the country-year regression). In the second-stage regression, intangible capital investment erodes firms' cash flow profitability (\widehat{II} has a coefficient of -0.86, $t = 13.5$). In the third-stage regression, negative OCFs significantly predict firms' savings (\widehat{OCF} has a coefficient of -2.23, $t = 18.0$). The diagnostic tests are satisfactory in all regressions. Therefore, the analysis provides some formal support for the causality relationship proposed in this study: intangible investments in developed economies predict greater negative OCFs, which in turn account for the increase in cash holdings. The opposite relationship holds true for developing economies: low intangible investment intensity is associated with small negative cash flows and small demand for cash.

Second, as shown in Table 5, the relation between cash holdings and cash flow has become increasingly convex over time in major developed economies. Because standard empirical models specify cash holdings as a *linear* function of cash flow, this convexity implies that such models are increasingly misspecified. To address this problem, I propose the following regression equations:

$$Cash_{i,t} = \alpha_{c,j,t} + \beta_1 OCF_{i,t} + \beta_2 Controls_{j,i,t} + \epsilon_{i,t} \quad (1)$$

$$\begin{aligned}
Cash_{i,t} = & \alpha_{c,j,t} + \beta_1 OCF_{i,t} + \beta_2 (OCF_{i,t} * Neg_{i,t}) + \beta_3 Neg_{i,t} + \\
& \beta_4 (HighInt_{i,t} * Neg_{i,t}) + \beta_5 HighInt_{i,t} + \beta_6 Controls_{j,i,t} + \epsilon_{i,t}
\end{aligned}
\tag{2}$$

I introduce the indicator variable *Neg*, which is equal to unity if the firm has a negative operating cash flow (*OCF*) in year *t*, and zero otherwise. Its interaction with cash flow (*OCF * Neg*) determines how firms' propensity to hold cash vary with the sign of cash flow. Also, I introduce an indicator variable for high intangible intensity (*HighInt*) and its interaction with the negative cash flow indicator (*HighInt * Neg*).¹⁶ Table 2 defines the regression variables.

The model specifications control for traditional determinants of cash. Specifically, *Controls* include *Size* to control for the economy of scale; *OCF_vol* to measure the volatility of cash flow; the market-to-book ratio (*MB*) to proxy for future growth opportunities. Also, the model specifications include capital expenditures (*Capex*), leverage (*Debt*), an indicator for dividends (*DivI*), net working capital (*Nwc*), and acquisition spending (*Acq*). The models include country (*c*), industry (*j*), and year (*t*) fixed effects to account for unobserved heterogeneity and time effects. Standard errors are clustered by firm (*i*) and year (*t*). The regression variables are winsorized at the 1% and 99% levels.

Table 10 reports the results. In a standard linear model in Eq.(1), *OCF* carries a negative coefficient in developed economies, whereas it carries a positive coefficient in developing economies. Yet, it is problematic to interpret these coefficients correctly in light of the strong nonlinearity between cash holdings and cash flow. The augmented model in Eq.(2) reveals the importance of including variables that capture the sign of cash flow. The coefficient estimate on *OCF* is significantly positive across all country-specific regressions, while that on *OCF * Neg* – negative. Firms systematically hold

¹⁶It is possible that *Controls* are also affected by the sign of cash flow. To control for this possibility, I run the regressions separately in the subsamples of positive and negative operating cash flows. The unreported results are virtually identical to those reported here.

more cash in response to both positive and negative cash flow realizations. Still, negative OCFs contribute more to the increase in cash holdings in developed economies, while positive OCFs – in developing economies.

The size and significance of the *HighInt * Neg* interaction indicate the impact on cash holdings is strongest among the firms that exhibit both negative OCFs and high intangible intensity. Although negative OCFs and high intangible intensity each have an impact on cash holdings, the impact is strongest when both factors are present. However, consistent with earlier univariate results, this joint influence on cash holding varies in different economies. While firms from developed economies hold more cash when both negative OCFs and intangible intensity are present, those from developing economies hold less cash.

I further note that the predictive power of the augmented model in Eq.2 is higher in the subsample of U.S. firms. Specifically, its R^2 is about 50%, compared to 35% and 30%, respectively, in the subsamples of the other developed and developing economy firms. This difference in the explanatory power is expected because the nonlinearity between cash balances and cash flow is strongest for U.S. firms. The augmented model with the sign of the cash flow variable improves the model fit on the right and the left sides of the cash flow distribution, where large cash flow realizations are otherwise penalized in the prediction of cash holdings if cash flow is linearly specified.

Third, in Figure 11, I detail the effect of functional form misspecification on the regression prediction error. Specifically, the analysis compares the mean prediction error within each cash flow decile in the cross-country panel regression. The comparison is between the standard linear model (Eq.1) and the augmented model (Eq.2). The improvement in the error prediction is evident in the majority of cash flow deciles (7 to 8 deciles) across all sample economies. The improvement is further noted in the tails of the cash flow distribution, which is not surprising due to the strong convex

association between cash balances and cash flow.

Last, Table 11 estimates the contribution of negative cash flow ($OCF * Neg$) and other firm characteristics to the predicted cash holdings (\widehat{Cash}). The first two columns report the OLS coefficients from estimating Eq.2 over the first and the last sample subperiods. The third and fourth columns report the subperiod average values of each regression variable. The predicted contribution to cash holdings, tabulated in the last two columns, is the product of the OLS coefficient and the average value.

In the U.S., the predicted cash holdings have increased sixfold (from 0.07 in the 1970s to 0.38 in the 2010s). Negative OCFs and intangible intensity jointly contribute the most to the predicted cash holdings. In non-U.S. developed economies, the increase in the predicted cash holdings is evident, but not as dramatic as in the U.S. (from 0.20 in the 1990s to 0.29 in the 2010s). Nearly three-quarters of the increase is attributable to negative OCFs and intangible intensity. In contrast, in developing economies, neither the size of negative cash flow nor the intensity of intangibles significantly contributes to the increase in the predicted cash holdings (from 0.07 in the 1990s to 0.12 in the 2010s). They both do not appear to be essential for cash policy.

V. Conclusion

Firms' cash flow, investment, and policies have remarkably changed in the U.S. and other major developed economies but remained largely unchanged in many developing economies. First, the large and still growing fraction of firms in developed economies consists of those with large intangible investments; in turn, this increased intangible intensity causes the size and frequency of negative cash flow to increase. Contrarily, aggregate intangible investment and negative cash flow have remained small in developing economies.

Second, cash holdings have risen significantly more for negative cash flow firms than for the rest of the population. In developed economies, the growth in average cash holdings reflects the immediate liquidity (operational) needs and an expectation of negative cash flow for an uncertain period. In developing economies, no significant increase in average cash holdings has occurred.

Third, negative cash flow firms have become the majority of equity issuers in advanced economies. Although these firms are saving a substantial fraction of equity issuance proceeds, they are burning cash at an unprecedented rate. The patterns suggest that negative cash flow firms need to issue equity frequently. Conversely, negative cash flow firms from developing economies do not necessitate frequent equity raisings. Their liquidity needs have remained small.

Fourth, because of the increased convexity between cash balances and cash flow, it is now necessary to control for the sign of cash flow in cash models. It is primarily nonlinearity on the left side of the cash flow distribution that has increased over time.

In summary, negative operating cash flows induced by intangible investments have altered firms' policies but solely in advanced economies.

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Table 1: **Country classification**

The table reports the IMF's (World Economic Outlook) classification of countries and the number of firm-year observations in the sample. The sample does not include observations for which there are no data on total assets, cash holdings, and cash flow. The sample includes 27 economically developed and 33 developing countries.

| Code | Country | IMF classification | Obs. |
|------|---------------|---------------------|---------|
| USA | U.S. | Advanced/Developed | 182,644 |
| AUS | Australia | Advanced/Developed | 32,133 |
| AUT | Austria | Advanced/Developed | 1,401 |
| BEL | Belgium | Advanced/Developed | 1,951 |
| CAN | Canada | Advanced/Developed | 6,471 |
| CHE | Switzerland | Advanced/Developed | 4,526 |
| DEU | Germany | Advanced/Developed | 12,702 |
| DNK | Denmark | Advanced/Developed | 2,928 |
| ESP | Spain | Advanced/Developed | 2,311 |
| FIN | Finland | Advanced/Developed | 2,974 |
| FRA | France | Advanced/Developed | 12,691 |
| GBR | U.K. | Advanced/Developed | 35,516 |
| GRC | Greece | Advanced/Developed | 3,154 |
| HKG | Hong Kong SAR | Advanced/Developed | 3,462 |
| IRL | Ireland | Advanced/Developed | 2,253 |
| ISR | Israel | Advanced/Developed | 6,676 |
| ITA | Italy | Advanced/Developed | 4,995 |
| JPN | Japan | Advanced/Developed | 60,521 |
| KOR | South Korea | Advanced/Developed | 18,903 |
| NLD | Netherlands | Advanced/Developed | 4,022 |
| NOR | Norway | Advanced/Developed | 3,980 |
| NZL | New Zealand | Advanced/Developed | 2,503 |
| PRT | Portugal | Advanced/Developed | 1,062 |
| SGP | Singapore | Advanced/Developed | 11,682 |
| SVN | Slovenia | Advanced/Developed | 482 |
| SWE | Sweden | Advanced/Developed | 10,428 |
| TWN | Taiwan | Advanced/Developed | 28,533 |
| ARE | U.A.E. | Emerging/Developing | 742 |
| ARG | Argentina | Emerging/Developing | 1,132 |
| BGD | Bangladesh | Emerging/Developing | 1,816 |
| BGR | Bulgaria | Emerging/Developing | 684 |
| BRA | Brazil | Emerging/Developing | 5,474 |
| CHL | Chile | Emerging/Developing | 2,704 |
| CHN | China | Emerging/Developing | 49,079 |
| COL | Colombia | Emerging/Developing | 483 |
| EGY | Egypt | Emerging/Developing | 1,486 |
| HRV | Croatia | Emerging/Developing | 1,230 |
| IDN | Indonesia | Emerging/Developing | 7,210 |
| IND | India | Emerging/Developing | 57,358 |
| JOR | Jordan | Emerging/Developing | 1,866 |
| KEN | Kenya | Emerging/Developing | 510 |
| KWT | Kuwait | Emerging/Developing | 1,185 |
| LKA | Sri Lanka | Emerging/Developing | 2,912 |
| MAR | Morocco | Emerging/Developing | 782 |
| MEX | Mexico | Emerging/Developing | 2,350 |
| MYS | Malaysia | Emerging/Developing | 17,725 |
| NGA | Nigeria | Emerging/Developing | 1,400 |
| OMN | Oman | Emerging/Developing | 1,026 |
| PAK | Pakistan | Emerging/Developing | 5,338 |
| PER | Peru | Emerging/Developing | 1,541 |
| PHL | Philippines | Emerging/Developing | 3,375 |
| POL | Poland | Emerging/Developing | 8,436 |
| ROU | Romania | Emerging/Developing | 1,061 |
| RUS | Russia | Emerging/Developing | 2,603 |
| SAU | Saudi Arabia | Emerging/Developing | 1,830 |
| THA | Thailand | Emerging/Developing | 9,738 |
| TUN | Tunisia | Emerging/Developing | 597 |
| TUR | Turkey | Emerging/Developing | 4,068 |
| VNM | Vietnam | Emerging/Developing | 4,525 |
| ZAF | South Africa | Emerging/Developing | 5,325 |

Table 2: Variable definitions

| Variable | Definition (Compustat mnemonic) |
|----------------|---|
| <i>Cash</i> | Cash holdings (che). |
| <i>OCF</i> | Operating cash flow (oanef). If missing, replaced by $(ibc + dpc + txdc + esubc + sppiv + fopo + fsrco + wcapc + apalch + invch + recch)$. |
| <i>Neg</i> | Indicator that is equal to unity if <i>OCF</i> is negative and zero otherwise. |
| <i>RD</i> | R&D expenses (xrd). |
| <i>SGA</i> | SG&A expenses (xsga + xad). |
| <i>II</i> | Intangible investment is defined as (i) $(xrd + xsga + xad) - (0.25 * at)$ if $(xsga + xad) > (0.25 * at)$ or (ii) xrd if $(xsga + xad) \leq (0.25 * at)$. |
| <i>HighInt</i> | High-intangible intensity indicator that is equal to unity if $(xrd / at) > 0.02$ or $(xsga + xad) / at > 0.25$, and zero otherwise. |
| <i>OCF_vol</i> | Standard deviation of cash flow. Values are estimated based on Fama-French 48 industries annually per country. |
| <i>Size</i> | Natural log of total assets (at). |
| <i>MB</i> | Market value of assets $(cshe * prcf)$ - $ceq + at$ to the book value of assets (at). If missing, replaced by $(mkvalt - ceq + at) / at$. |
| <i>Capex</i> | Capital expenditures (capx). |
| <i>PPE</i> | Property, plant and equipment (ppent). |
| <i>Debt</i> | Long-term debt plus debt in current liabilities (dltt + dlc). |
| <i>NetDebt</i> | Change in total debt $(dltt + dlc)_t - (dltt + dlc)_{t-1}$. |
| <i>NetEq</i> | Sales of stock minus purchases of stock (sstk - prstkc). |
| <i>NetEqI</i> | Firm-initiated equity issuance. Indicator that is equal to unity if $(sstk / at) > 0.03$ and zero otherwise. |
| <i>SalePPE</i> | Sale of property, plant and equipment (sppe). |
| <i>DivI</i> | Indicator that is equal to unity if a firm pays dividends ($dv > 0$) in year t and zero otherwise. |
| <i>Nuc</i> | Net working capital $(act - che - tsca - lct + dlc + prodv)$. |
| <i>Acq</i> | Acquisition spending (aac). |
| <i>Age</i> | A number of years as a public firm in Compustat. |
| <i>InTang</i> | Intangible assets (intan). |

Cash, *OCF*, *RD*, *SGA*, *Capex*, *PPE*, *Debt*, *NetDebt*, *NetEq*, *SalePPE*, *Nuc*, *Acq*, and *InTang* are deflated by total book assets (at).

(continued on next page)

The definition of intangible investment

Intangible investment can be (i) recognized as a component of R&D or SG&A expenses or (ii) capitalized on a balance sheet as an intangible asset if it passes the feasibility test. Both R&D and SG&A expenses are deductions from operating cash flow. Capitalized intangible investments are deductions from investing cash flow.

This paper classifies all R&D expenses (xrd) and SG&A expenses ($xsga + xad$) over 25% of total book assets (at) as intangible investments. Because it is problematic to identify precisely the portion of SG&A expenses that represents an operating cost and that that represents an intangible investment, this paper assumes that the operating cost component is constant over time and equal to 25% of assets. Because there are large increases in SG&A expenses over time and no documented reasons for the increase in operating costs, this paper assumes that the growth in SG&A expenses is primarily due to the growth in intangible investments (Eisfeldt and Papanikolaou, 2013, Falato et al., 2014, Chen et al., 2017, Peters and Taylor, 2017, Cook et al., 2018).

Our measure of intangible investment is rather conservative because it measures only those investments that are expensed and recognized in operating cash flow. Internet Appendices A and B report intangible investments that are capitalized as book intangible assets ($intan$). As documented, intangible assets are significant in the U.S. (about 20% of assets in 2019) and non-U.S. developed economies (about 10%) but less significant in developing economies (only 5%).

Table 3: **Cash flow profitability**

The table reports the mean values of operating cash flow-to-assets by its deciles. The deciles are formed annually. The values are averaged over each decade. The top panel corresponds to U.S. firms, the middle panel – to firms from non-U.S. developed economies, and the bottom panel – to firms from developing economies. Decile 1 (10) denotes the lowest (highest) decile of cash flow. Table 2 defines the variables.

| <i>OCF</i> decile | 1970-79 | 1980-89 | 1990-99 | 2000-09 | 2010-19 |
|-------------------|-------------|-------------|-------------|-------------|---------------|
| 1 | (0.15) | (0.48) | (0.50) | (0.56) | (0.60) |
| 2 | 0.04 | (0.08) | (0.13) | (0.13) | (0.17) |
| 3 | 0.08 | 0.01 | (0.04) | (0.02) | (0.02) |
| 4 | 0.11 | 0.06 | 0.01 | 0.02 | 0.03 |
| 5 | 0.13 | 0.09 | 0.04 | 0.05 | 0.06 |
| 6 | 0.15 | 0.12 | 0.07 | 0.08 | 0.08 |
| 7 | 0.18 | 0.15 | 0.09 | 0.10 | 0.10 |
| 8 | 0.21 | 0.19 | 0.12 | 0.13 | 0.12 |
| 9 | 0.25 | 0.24 | 0.16 | 0.16 | 0.15 |
| 10 | 0.35 | 0.36 | 0.24 | 0.25 | 0.24 |
| Average | 0.14 | 0.07 | 0.01 | 0.00 | (0.01) |

| <i>OCF</i> decile | 1970-79 | 1980-89 | 1990-99 | 2000-09 | 2010-19 |
|-------------------|---------|-------------|-------------|-------------|-------------|
| 1 | - | (0.29) | (0.29) | (0.42) | (0.49) |
| 2 | - | (0.03) | (0.04) | (0.08) | (0.09) |
| 3 | - | 0.03 | 0.01 | (0.01) | (0.02) |
| 4 | - | 0.06 | 0.04 | 0.02 | 0.02 |
| 5 | - | 0.09 | 0.06 | 0.04 | 0.04 |
| 6 | - | 0.11 | 0.08 | 0.06 | 0.06 |
| 7 | - | 0.13 | 0.10 | 0.08 | 0.08 |
| 8 | - | 0.16 | 0.13 | 0.10 | 0.10 |
| 9 | - | 0.21 | 0.17 | 0.14 | 0.13 |
| 10 | - | 0.32 | 0.27 | 0.24 | 0.22 |
| Average | - | 0.08 | 0.05 | 0.02 | 0.00 |

| <i>OCF</i> decile | 1970-79 | 1980-89 | 1990-99 | 2000-09 | 2010-19 |
|-------------------|---------|---------|-------------|-------------|-------------|
| 1 | - | - | (0.17) | (0.17) | (0.18) |
| 2 | - | - | (0.04) | (0.03) | (0.03) |
| 3 | - | - | (0.01) | 0.00 | 0.00 |
| 4 | - | - | 0.01 | 0.02 | 0.02 |
| 5 | - | - | 0.04 | 0.04 | 0.04 |
| 6 | - | - | 0.06 | 0.07 | 0.06 |
| 7 | - | - | 0.08 | 0.09 | 0.08 |
| 8 | - | - | 0.11 | 0.12 | 0.11 |
| 9 | - | - | 0.15 | 0.16 | 0.15 |
| 10 | - | - | 0.26 | 0.27 | 0.25 |
| Average | - | - | 0.05 | 0.06 | 0.05 |

Table 4: **Summary statistics for negative cash flow firms**

The table reports the mean (median) values of selected variables for firms with negative operating cash flow ($OCF < 0$). The top panel corresponds to U.S. firms, the middle panel – to firms from non-U.S. developed economies, and the bottom panel – to firms from developing economies. Table 2 defines the variables.

| | 1970-79 | 1980-89 | 1990-99 | 2000-09 | 2010-19 |
|-----------------|----------------|----------------|----------------|----------------|----------------|
| <i>Cash</i> | 0.08 (0.04) | 0.17 (0.07) | 0.26 (0.13) | 0.37 (0.31) | 0.45 (0.42) |
| <i>RD</i> | 0.02 (0.00) | 0.06 (0.00) | 0.09 (0.01) | 0.14 (0.09) | 0.17 (0.14) |
| <i>SGA</i> | 0.36 (0.30) | 0.41 (0.33) | 0.41 (0.33) | 0.44 (0.35) | 0.42 (0.32) |
| <i>RD + SGA</i> | 0.38 (0.30) | 0.47 (0.33) | 0.50 (0.34) | 0.57 (0.44) | 0.59 (0.46) |
| <i>Age</i> | 5.8 (5.0) | 5.7 (3.0) | 6.2 (4.0) | 9.1 (6.0) | 10.6 (6.0) |
| <i>MB</i> | 1.35 (0.91) | 2.67 (1.39) | 3.06 (1.85) | 2.72 (1.68) | 2.94 (1.94) |
| <i>Debt</i> | 0.39 (0.37) | 0.31 (0.28) | 0.23 (0.16) | 0.19 (0.07) | 0.19 (0.07) |
| <i>Capex</i> | 0.07 (0.04) | 0.08 (0.05) | 0.06 (0.03) | 0.04 (0.02) | 0.03 (0.01) |
| <i>Cash</i> | - | 0.15 (0.07) | 0.21 (0.12) | 0.25 (0.15) | 0.27 (0.17) |
| <i>RD</i> | - | 0.03 (0.00) | 0.03 (0.00) | 0.03 (0.00) | 0.04 (0.00) |
| <i>SGA</i> | - | 0.23 (0.10) | 0.16 (0.03) | 0.24 (0.13) | 0.28 (0.15) |
| <i>RD + SGA</i> | - | 0.26 (0.10) | 0.19 (0.03) | 0.27 (0.13) | 0.32 (0.15) |
| <i>Age</i> | - | 3.5 (2.0) | 3.4 (2.0) | 5.0 (4.0) | 8.9 (8.0) |
| <i>MB</i> | - | 2.18 (1.55) | 2.42 (1.25) | 2.15 (1.23) | 2.50 (1.30) |
| <i>Debt</i> | - | 0.25 (0.19) | 0.22 (0.14) | 0.20 (0.11) | 0.20 (0.10) |
| <i>Capex</i> | - | 0.11 (0.06) | 0.07 (0.04) | 0.06 (0.02) | 0.05 (0.01) |
| <i>Cash</i> | - | - | 0.06 (0.03) | 0.09 (0.04) | 0.12 (0.06) |
| <i>RD</i> | - | - | 0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) |
| <i>SGA</i> | - | - | 0.07 (0.05) | 0.11 (0.07) | 0.12 (0.06) |
| <i>RD + SGA</i> | - | - | 0.08 (0.05) | 0.11 (0.07) | 0.12 (0.06) |
| <i>Age</i> | - | - | 2.4 (2.0) | 4.6 (4.0) | 7.8 (7.0) |
| <i>MB</i> | - | - | 2.01 (1.06) | 2.06 (1.16) | 2.27 (1.21) |
| <i>Debt</i> | - | - 38 | 0.35 (0.34) | 0.30 (0.27) | 0.27 (0.22) |
| <i>Capex</i> | - | - | 0.05 (0.03) | 0.05 (0.03) | 0.04 (0.02) |

Table 5: **Cash holdings, cash flow, and intangible intensity**

The table reports the mean values of cash-to-assets by operating cash flow (*OCF*) deciles for the top three (panel A) and bottom three (panel B) deciles of R&D expenses. The deciles are formed annually. The values are averaged over each decade. The top panel corresponds to U.S. firms, the middle panel – to firms from non-U.S. developed economies, and the bottom panel – to firms from developing economies. Decile 1 (10) denotes the lowest (highest) decile of cash flow. Deciles 1 to 2 have negative operating cash flows, on average, while deciles 3 to 10 – positive operating cash flows, on average. Table 2 defines the variables.

Panel A: Cash holdings for the top three deciles of R&D expenses
(high intangible intensity)

| <i>OCF</i> decile | 1970-79 | 2010-19 | Growth |
|-------------------|---------|---------|--------|
| 1 | 0.08 | 0.67 | 735% |
| 2 | 0.06 | 0.57 | 833% |
| 3 | 0.06 | 0.40 | 578% |
| 4 | 0.07 | 0.35 | 410% |
| 5 | 0.07 | 0.32 | 387% |
| 6 | 0.08 | 0.31 | 302% |
| 7 | 0.08 | 0.33 | 300% |
| 8 | 0.09 | 0.33 | 269% |
| 9 | 0.10 | 0.35 | 247% |
| 10 | 0.13 | 0.41 | 206% |

| <i>OCF</i> decile | 1980-89 | 2010-19 | Growth |
|-------------------|---------|---------|--------|
| 1 | 0.16 | 0.47 | 201% |
| 2 | 0.13 | 0.29 | 119% |
| 3 | 0.13 | 0.22 | 69% |
| 4 | 0.15 | 0.20 | 32% |
| 5 | 0.15 | 0.20 | 33% |
| 6 | 0.14 | 0.19 | 32% |
| 7 | 0.13 | 0.20 | 46% |
| 8 | 0.12 | 0.21 | 66% |
| 9 | 0.16 | 0.23 | 50% |
| 10 | 0.20 | 0.31 | 58% |

| <i>OCF</i> decile | 1990-99 | 2010-19 | Growth |
|-------------------|---------|---------|--------|
| 1 | 0.07 | 0.13 | 94% |
| 2 | 0.06 | 0.12 | 94% |
| 3 | 0.06 | 0.11 | 71% |
| 4 | 0.06 | 0.12 | 107% |
| 5 | 0.07 | 0.13 | 88% |
| 6 | 0.08 | 0.14 | 81% |
| 7 | 0.09 | 0.14 | 67% |
| 8 | 0.09 | 0.15 | 71% |
| 9 | 0.10 | 0.16 | 56% |
| 10 | 0.14 | 0.21 | 45% |

Panel B: Cash holdings for the bottom three deciles of R&D expenses
(low intangible intensity)

| <i>OCF</i> decile | 1970-79 | 2010-19 | Growth |
|-------------------|---------|---------|--------|
| 1 | 0.07 | 0.30 | 298% |
| 2 | 0.07 | 0.17 | 150% |
| 3 | 0.07 | 0.11 | 64% |
| 4 | 0.07 | 0.09 | 24% |
| 5 | 0.08 | 0.09 | 14% |
| 6 | 0.09 | 0.08 | -11% |
| 7 | 0.09 | 0.10 | 7% |
| 8 | 0.10 | 0.10 | -4% |
| 9 | 0.12 | 0.12 | 2% |
| 10 | 0.17 | 0.18 | 6% |

| <i>OCF</i> decile | 1980-89 | 2010-19 | Growth |
|-------------------|---------|---------|--------|
| 1 | 0.22 | 0.38 | 73% |
| 2 | 0.15 | 0.22 | 46% |
| 3 | 0.12 | 0.17 | 41% |
| 4 | 0.11 | 0.15 | 40% |
| 5 | 0.11 | 0.14 | 34% |
| 6 | 0.11 | 0.15 | 36% |
| 7 | 0.11 | 0.15 | 39% |
| 8 | 0.12 | 0.16 | 37% |
| 9 | 0.13 | 0.19 | 49% |
| 10 | 0.18 | 0.25 | 41% |

| <i>OCF</i> decile | 1990-99 | 2010-19 | Growth |
|-------------------|---------|---------|--------|
| 1 | 0.07 | 0.12 | 85% |
| 2 | 0.06 | 0.11 | 76% |
| 3 | 0.06 | 0.09 | 47% |
| 4 | 0.06 | 0.11 | 78% |
| 5 | 0.07 | 0.12 | 64% |
| 6 | 0.08 | 0.12 | 56% |
| 7 | 0.09 | 0.12 | 46% |
| 8 | 0.09 | 0.13 | 52% |
| 9 | 0.10 | 0.15 | 39% |
| 10 | 0.14 | 0.19 | 34% |

Table 6: **Cash holdings in the first year of negative cash flow**

The table reports the median values of cash-to-assets in the first year in which the firm reports negative operating cash flow ($OCF < 0$). The groups are formed based on (i) the persistence of future negative cash flow and (ii) the history of past cash flow. The *Persistent* category consists of firms entering a run of negative cash flows that is at least three years in duration. The *Transitory* category consists of firms that return to positive cash flow the following year. *New Firms* are those that exist less than three years. *Fallen Angels* are firms that reported at least three years of positive cash flow before entering the negative cash flow domain. The top panel corresponds to U.S. firms, the middle panel – to firms from non-U.S. developed economies, and the bottom panel – to firms from developing economies. Table 2 defines the variables.

| | <i>Persistent</i> | | | | <i>Transitory</i> | | | |
|---------|-------------------|-------------|----------------------|-------------|-------------------|-------------|----------------------|-------------|
| | <i>New firms</i> | | <i>Fallen Angels</i> | | <i>New firms</i> | | <i>Fallen Angels</i> | |
| | Obs. | <i>Cash</i> | Obs. | <i>Cash</i> | Obs. | <i>Cash</i> | Obs. | <i>Cash</i> |
| 1970-79 | 115 | 0.06 | 154 | 0.06 | 263 | 0.04 | 496 | 0.04 |
| 1980-89 | 978 | 0.34 | 1,016 | 0.26 | 579 | 0.08 | 865 | 0.05 |
| 1990-99 | 1,327 | 0.57 | 1,330 | 0.54 | 670 | 0.09 | 1,163 | 0.06 |
| 2000-09 | 600 | 0.65 | 760 | 0.49 | 241 | 0.14 | 950 | 0.09 |
| 2010-19 | 546 | 0.75 | 625 | 0.66 | 154 | 0.09 | 479 | 0.08 |

| | <i>Persistent</i> | | | | <i>Transitory</i> | | | |
|---------|-------------------|-------------|----------------------|-------------|-------------------|-------------|----------------------|-------------|
| | <i>New firms</i> | | <i>Fallen Angels</i> | | <i>New firms</i> | | <i>Fallen Angels</i> | |
| | Obs. | <i>Cash</i> | Obs. | <i>Cash</i> | Obs. | <i>Cash</i> | Obs. | <i>Cash</i> |
| 1970-79 | - | - | - | - | - | - | - | - |
| 1980-89 | - | - | - | - | - | - | - | - |
| 1990-99 | 506 | 0.14 | 1,103 | 0.18 | 753 | 0.08 | 1,382 | 0.10 |
| 2000-09 | 1,354 | 0.23 | 2,379 | 0.22 | 1,327 | 0.12 | 3,140 | 0.10 |
| 2010-19 | 721 | 0.27 | 1,601 | 0.22 | 561 | 0.15 | 2,158 | 0.12 |

| | <i>Persistent</i> | | | | <i>Transitory</i> | | | |
|---------|-------------------|-------------|----------------------|-------------|-------------------|-------------|----------------------|-------------|
| | <i>New firms</i> | | <i>Fallen Angels</i> | | <i>New firms</i> | | <i>Fallen Angels</i> | |
| | Obs. | <i>Cash</i> | Obs. | <i>Cash</i> | Obs. | <i>Cash</i> | Obs. | <i>Cash</i> |
| 1970-79 | - | - | - | - | - | - | - | - |
| 1980-89 | - | - | - | - | - | - | - | - |
| 1990-99 | 211 | 0.02 | 371 | 0.02 | 242 | 0.04 | 447 | 0.03 |
| 2000-09 | 386 | 0.03 | 745 | 0.03 | 672 | 0.06 | 1,776 | 0.05 |
| 2010-19 | 466 | 0.02 | 989 | 0.03 | 658 | 0.04 | 2,190 | 0.07 |

Table 7: **External sources of financing**

The table reports the average annual proceeds from equity issues, debt issues, and the sale of fixed (PP&E) assets, and the mean values of cash-to-assets. Firms are ranked by the size of operating cash flow (from below -40% to above 30% of total assets). The top panel corresponds to U.S. firms, the middle panel – to firms from non-U.S. developed economies, and the bottom panel – to firms from developing economies. Table 2 defines the variables.

| <i>OCF</i> bin | Obs. | <u>1970-79</u> | | | | <i>Cash</i> | Obs. | <u>2010-19</u> | | | |
|----------------|--------|----------------|-----------------|-----------------|------|-------------|--------|----------------|-----------------|-----------------|--|
| | | <i>Net Eq</i> | <i>Net Debt</i> | <i>Sale PPE</i> | | | | <i>Net Eq</i> | <i>Net Debt</i> | <i>Sale PPE</i> | |
| >0.3 | 2,261 | 0.05 | 0.00 | 0.01 | 0.16 | 424 | 0.01 | (0.02) | 0.00 | 0.36 | |
| 0.2-0.3 | 5,067 | 0.01 | 0.02 | 0.01 | 0.11 | 1,513 | (0.01) | 0.00 | 0.00 | 0.24 | |
| 0.1-0.2 | 11,315 | 0.00 | 0.02 | 0.01 | 0.08 | 7,891 | 0.00 | 0.01 | 0.00 | 0.17 | |
| 0-0.1 | 6,358 | 0.00 | 0.02 | 0.01 | 0.07 | 10,889 | 0.01 | 0.03 | 0.00 | 0.14 | |
| 0-(0.1) | 1,298 | 0.01 | 0.01 | 0.01 | 0.07 | 2,676 | 0.09 | 0.03 | 0.00 | 0.22 | |
| (0.1)-(0.2) | 448 | 0.01 | 0.01 | 0.01 | 0.07 | 1,190 | 0.22 | 0.02 | 0.00 | 0.41 | |
| (0.2)-(0.3) | 202 | 0.02 | 0.01 | 0.01 | 0.08 | 811 | 0.35 | 0.02 | 0.00 | 0.55 | |
| (0.3)-(0.4) | 129 | 0.04 | (0.00) | 0.01 | 0.09 | 696 | 0.39 | 0.03 | 0.00 | 0.63 | |
| <(0.4) | 281 | 0.06 | (0.05) | 0.01 | 0.10 | 2,179 | 0.51 | 0.02 | 0.00 | 0.65 | |

| <i>OCF</i> bin | Obs. | <u>1980-89</u> | | | | <i>Cash</i> | Obs. | <u>2010-19</u> | | | |
|----------------|------|----------------|-----------------|-----------------|------|-------------|------|----------------|-----------------|-----------------|--|
| | | <i>Net Eq</i> | <i>Net Debt</i> | <i>Sale PPE</i> | | | | <i>Net Eq</i> | <i>Net Debt</i> | <i>Sale PPE</i> | |
| >0.3 | 114 | 0.14 | (0.05) | 0.01 | 0.22 | 1,807 | 0.03 | (0.07) | 0.00 | 0.35 | |
| 0.2-0.3 | 162 | 0.04 | 0.01 | 0.00 | 0.17 | 4,757 | 0.02 | (0.02) | 0.00 | 0.29 | |
| 0.1-0.2 | 593 | 0.03 | 0.01 | 0.00 | 0.12 | 25,242 | 0.01 | (0.01) | 0.00 | 0.21 | |
| 0-0.1 | 538 | 0.06 | 0.03 | 0.01 | 0.14 | 60,507 | 0.01 | 0.01 | 0.00 | 0.17 | |
| 0-(0.1) | 196 | 0.13 | 0.02 | 0.01 | 0.13 | 20,992 | 0.07 | 0.02 | 0.00 | 0.19 | |
| (0.1)-(0.2) | 72 | 0.17 | 0.05 | 0.01 | 0.16 | 6,543 | 0.18 | 0.02 | 0.00 | 0.27 | |
| (0.2)-(0.3) | 31 | 0.22 | (0.02) | 0.01 | 0.12 | 3,204 | 0.27 | 0.01 | 0.00 | 0.36 | |
| (0.3)-(0.4) | 20 | 0.37 | (0.04) | 0.01 | 0.16 | 1,970 | 0.34 | 0.01 | 0.00 | 0.40 | |
| <(0.4) | 40 | 0.50 | 0.08 | 0.01 | 0.23 | 6,387 | 0.50 | 0.02 | 0.00 | 0.47 | |

| <i>OCF</i> bin | Obs. | <u>1990-99</u> | | | | <i>Cash</i> | Obs. | <u>2010-19</u> | | | |
|----------------|-------|----------------|-----------------|-----------------|------|-------------|------|----------------|-----------------|-----------------|--|
| | | <i>Net Eq</i> | <i>Net Debt</i> | <i>Sale PPE</i> | | | | <i>Net Eq</i> | <i>Net Debt</i> | <i>Sale PPE</i> | |
| >0.3 | 382 | 0.02 | (0.07) | 0.00 | 0.18 | 2,489 | 0.01 | (0.08) | 0.00 | 0.24 | |
| 0.2-0.3 | 795 | 0.02 | (0.03) | 0.00 | 0.14 | 5,791 | 0.01 | (0.03) | 0.00 | 0.21 | |
| 0.1-0.2 | 3,239 | 0.01 | 0.00 | 0.00 | 0.10 | 24,520 | 0.02 | (0.01) | 0.00 | 0.16 | |
| 0-0.1 | 6,884 | 0.02 | 0.02 | 0.00 | 0.07 | 54,502 | 0.02 | 0.02 | 0.00 | 0.13 | |
| 0-(0.1) | 3,400 | 0.02 | 0.05 | 0.00 | 0.06 | 21,874 | 0.03 | 0.04 | 0.00 | 0.12 | |
| (0.1)-(0.2) | 715 | 0.06 | 0.10 | 0.00 | 0.06 | 4,090 | 0.06 | 0.07 | 0.00 | 0.12 | |
| (0.2)-(0.3) | 172 | 0.10 | 0.12 | 0.00 | 0.07 | 1,274 | 0.09 | 0.08 | 0.00 | 0.13 | |
| (0.3)-(0.4) | 76 | 0.11 | 0.12 | 0.00 | 0.09 | 532 | 0.13 | 0.07 | 0.00 | 0.15 | |
| <(0.4) | 104 | 0.17 | 0.10 | 0.00 | 0.10 | 1,017 | 0.24 | 0.03 | 0.00 | 0.18 | |

Table 8: **Equity issuance frequency**

The table reports the average number of firm-initiated equity issuances (*NetEqI*) per year by operating cash flow (*OCF*) deciles. The deciles are formed annually. The numbers are averaged over each decade. The top panel corresponds to U.S. firms, the middle panel – to firms from non-U.S. developed economies, and the bottom panel – to firms from developing economies. Decile 1 (10) denotes the lowest (highest) decile of cash flow. Table 2 defines the variables.

| <i>OCF</i> decile | 1970-79 | 1980-89 | 1990-99 | 2000-09 | 2010-19 |
|-------------------|---------|---------|---------|---------|---------|
| 1 | 0.08 | 0.41 | 0.67 | 0.63 | 0.76 |
| 2 | 0.04 | 0.27 | 0.48 | 0.39 | 0.51 |
| 3 | 0.04 | 0.18 | 0.32 | 0.27 | 0.25 |
| 4 | 0.04 | 0.15 | 0.26 | 0.19 | 0.17 |
| 5 | 0.05 | 0.14 | 0.22 | 0.16 | 0.13 |
| 6 | 0.05 | 0.15 | 0.18 | 0.15 | 0.11 |
| 7 | 0.07 | 0.15 | 0.17 | 0.14 | 0.10 |
| 8 | 0.08 | 0.18 | 0.15 | 0.15 | 0.10 |
| 9 | 0.10 | 0.24 | 0.16 | 0.18 | 0.11 |
| 10 | 0.21 | 0.40 | 0.22 | 0.24 | 0.15 |

| <i>OCF</i> decile | 1970-79 | 1980-89 | 1990-99 | 2000-09 | 2010-19 |
|-------------------|---------|---------|---------|---------|---------|
| 1 | - | 0.46 | 0.60 | 0.59 | 0.63 |
| 2 | - | 0.32 | 0.35 | 0.38 | 0.42 |
| 3 | - | 0.24 | 0.22 | 0.21 | 0.22 |
| 4 | - | 0.26 | 0.17 | 0.12 | 0.11 |
| 5 | - | 0.19 | 0.16 | 0.10 | 0.09 |
| 6 | - | 0.24 | 0.15 | 0.09 | 0.08 |
| 7 | - | 0.23 | 0.14 | 0.09 | 0.07 |
| 8 | - | 0.19 | 0.15 | 0.09 | 0.07 |
| 9 | - | 0.21 | 0.13 | 0.09 | 0.07 |
| 10 | - | 0.26 | 0.15 | 0.11 | 0.10 |

| <i>OCF</i> decile | 1970-79 | 1980-89 | 1990-99 | 2000-09 | 2010-19 |
|-------------------|---------|---------|---------|---------|---------|
| 1 | - | - | 0.22 | 0.24 | 0.23 |
| 2 | - | - | 0.13 | 0.14 | 0.14 |
| 3 | - | - | 0.12 | 0.09 | 0.10 |
| 4 | - | - | 0.10 | 0.09 | 0.11 |
| 5 | - | - | 0.10 | 0.08 | 0.10 |
| 6 | - | - | 0.09 | 0.08 | 0.10 |
| 7 | - | - | 0.08 | 0.08 | 0.09 |
| 8 | - | - | 0.10 | 0.07 | 0.09 |
| 9 | - | - | 0.09 | 0.07 | 0.08 |
| 10 | - | - | 0.09 | 0.07 | 0.07 |

Table 9: **Intangible investment, cash flow profitability, and cash holdings**

The table reports the 3SLS regression results. In the first stage, firms' intangible investment (II) is instrumented by the International Property Rights Index ($IPRI$), the Global Innovation Index (GII), and GDP per capita ($GDPPC$). $IPRI$, GII , and $GDPPC$ are combined via two principal components namely PC(1) and PC(2). In the second stage, the instrumented intangible investment (\widehat{II}) is regressed against firms' cash flow (OCF). In the third stage, the instrumented cash flow (\widehat{OCF}) is regressed against firms' cash holdings ($Cash$). II , OCF , and $Cash$ are classified as endogenous variables. $IPRI$, GII , and $GDPPC$ are classified as exogenous variables. Column (1) reports the results returned from the approach in which the regression variables are computed for each country in the sample. Column (2) reports the results returned from the alternative approach in which the regression variables are computed for each country-year in the sample. The diagnostic tests of endogeneity (Wooldridge test) and overidentifying restrictions (Sargan test) are reported. T-statistics are reported in parentheses. Table 2 defines the variables.

| Dep. variable (1 st stage): II | (1) | (2) |
|---|-------------------------|--------------------------|
| PC(1) | 0.01 (6.31) | 0.01 (24.7) |
| PC(2) | -0.01 (-2.00) | 0.01 (1.78) |
| R^2 | 39.0% | 28.0% |
| Dep. variable (2 nd stage): OCF | (1) | (2) |
| \widehat{II} | -1.11 (-4.27) | -0.86 (-13.5) |
| R^2 | 27.3% | 20.5% |
| Wooldridge test (p -value) | 0.11 | 0.00 |
| Sargan test (p -value) | 0.42 | 0.27 |
| Dep. variable (3 rd stage): $Cash$ | (1) | (2) |
| \widehat{OCF} | -1.92 (-5.25) | -2.23 (-18.10) |
| R^2 | 37.8% | 12.7% |
| Obs. | 59 | 1,586 |

Table 10: Determinants of cash holdings

The table reports the regression results returned from the models in Eq.(1) and Eq.(2). The sample of U.S. firms covers the period 1970-2019; the samples of firms from non-U.S. developed and developing economies – 1990-2019. Columns (1) to (4) correspond to U.S. firms, columns (5) to (8) – to firms from non-U.S. developed economies, and columns (9) to (12) – to firms from developing economies. Country (c), industry (j), and year (t) fixed effects are included. T-statistics are reported in parentheses. Standard errors are clustered by firm (i) and year (t). FM denotes the Fama-MacBeth regressions. Table 2 defines the variables.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|----------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-----------------------|-------------------------|-----------------------|-------------------------|
| <i>OCF</i> | -0.04 (-2.60) | 0.14 (5.03) | -0.04 (-2.49) | 0.12 (6.66) | -0.11 (-13.6) | 0.25 (14.9) | -0.11 (-9.59) | 0.20 (9.61) | 0.06 (7.13) | 0.25 (15.5) | 0.05 (2.03) | 0.17 (5.04) |
| <i>OCF * Neg</i> | | -0.16 (-5.34) | | -0.16 (-6.79) | | -0.45 (-19.3) | | -0.36 (-11.1) | | -0.37 (-16.1) | | -0.32 (-3.08) |
| <i>HighInt * Neg</i> | | 0.03 (4.82) | | 0.03 (4.76) | | 0.02 (4.50) | | 0.03 (5.48) | | -0.01 (-4.02) | | -0.01 (-2.09) |
| <i>Neg</i> | | 0.03 (5.71) | | 0.02 (5.36) | | 0.02 (8.58) | | 0.03 (6.68) | | 0.01 (6.09) | | 0.01 (1.94) |
| <i>HighInt</i> | 0.02 (4.30) | 0.01 (2.21) | 0.03 (7.96) | 0.02 (7.11) | 0.01 (7.48) | 0.00 (3.10) | 0.03 (10.7) | 0.02 (11.0) | 0.01 (1.95) | 0.01 (1.54) | 0.00 (0.75) | 0.00 (0.58) |
| <i>OCF_vol</i> | 0.24 (7.43) | 0.23 (7.25) | 0.49 (13.7) | 0.46 (13.3) | 0.06 (4.55) | 0.02 (1.56) | 0.11 (6.20) | 0.07 (4.19) | 0.10 (6.26) | 0.03 (1.97) | 0.10 (3.52) | 0.05 (1.73) |
| <i>Size</i> | -0.01 (-9.36) | -0.01 (-8.21) | -0.01 (-11.2) | -0.01 (-9.27) | -0.01 (-14.9) | -0.01 (-12.9) | 0.00 (0.69) | 0.00 (2.36) | 0.00 (-2.56) | 0.00 (-1.76) | 0.00 (-0.67) | 0.00 (-0.43) |
| <i>MB</i> | 0.01 (12.5) | 0.01 (10.4) | 0.01 (20.5) | 0.01 (19.3) | 0.01 (15.5) | 0.01 (12.7) | 0.01 (23.4) | 0.01 (27.3) | 0.00 (7.23) | 0.00 (6.50) | 0.00 (6.70) | 0.00 (5.80) |
| <i>Capex</i> | -0.43 (-30.8) | -0.44 (-31.1) | -0.49 (-33.5) | -0.51 (-29.7) | -0.31 (-24.9) | -0.34 (-26.2) | -0.33 (-20.5) | -0.36 (-20.0) | -0.19 (-9.32) | -0.21 (-9.40) | -0.15 (-4.83) | -0.17 (-5.10) |
| <i>Debt</i> | -0.29 (-30.7) | -0.29 (-29.7) | -0.27 (-24.9) | -0.26 (-24.6) | -0.29 (-52.0) | -0.29 (-52.6) | -0.29 (-30.8) | -0.29 (-33.0) | -0.20 (-26.1) | -0.20 (-26.7) | -0.16 (-6.94) | -0.16 (-7.02) |
| <i>DivI</i> | -0.03 (-10.1) | -0.03 (-10.4) | -0.03 (-9.96) | -0.03 (-9.86) | 0.00 (-0.27) | -0.01 (-2.29) | -0.02 (-6.50) | -0.02 (-8.53) | 0.03 (13.8) | 0.03 (13.9) | 0.05 (2.76) | 0.05 (2.77) |
| <i>Nwc</i> | -0.38 (-35.3) | -0.37 (-34.4) | -0.33 (-33.3) | -0.32 (-32.7) | -0.23 (-41.4) | -0.22 (-38.1) | -0.20 (-53.8) | -0.19 (-43.4) | -0.13 (-24.4) | -0.13 (-24.9) | -0.12 (-13.2) | -0.12 (-12.3) |
| <i>Acq</i> | -0.04 (-16.4) | -0.04 (-16.3) | -0.04 (-12.3) | -0.04 (-12.4) | -0.03 (-17.1) | -0.03 (-15.5) | -0.05 (-7.03) | -0.04 (-6.67) | -0.01 (-3.53) | -0.01 (-3.12) | -0.01 (-2.68) | -0.01 (-2.30) |
| Clusters | i, t | i, t | i, t | i, t | i, t | i, t | i, t | i, t | i, t | i, t | i, t | i, t |
| Fixed effects | j, t | j, t | j, t | j, t | c, j, t | c, j, t | c, j, t | c, j, t | c, j, t | c, j, t | c, j, t | c, j, t |
| R^2 | 53.2% | 53.7% | 47.7% | 48.5% | 38.0% | 39.3% | 30.0% | 31.6% | 30.5% | 31.6% | 28.7% | 29.0% |
| Obs. | 175,875 | 175,875 | 175,875 | 175,875 | 232,579 | 232,579 | 232,762 | 232,762 | 141,059 | 141,059 | 141,266 | 141,266 |

Table 11: **What drives the growth in cash holdings for negative cash flow firms?**

The table reports the predicted cash holdings (\widehat{Cash}) for the average firm characteristics in the sample of negative cash flow firms ($OCF < 0$). Predicted cash holdings are the product of the OLS coefficients and the mean values of the regression variables. Columns (1) to (6) correspond to U.S. firms, columns (7) to (12) – to firms from non-U.S. developed economies, and columns (13) to (18) – to firms from developing economies. The values for U.S. firms are reported for the 1970s and 2010s; the values for firms from non-U.S. developed and developing economies – 1990s and 2010s. T-statistics are reported in parentheses. Table 2 defines the variables.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) |
|----------------------|-----------------------------|--------------------|-------------------------------|----------------------|------------------------|------------------------------------|-----------------------------|--------------------|-------------------------------|----------------------|------------------------|------------------------------------|-----------------------------|--------------------|-------------------------------|----------------------|------------------------|------------------------------------|
| | OLS coef. 1970s 2010s | OLS coef. 2010s | Mean values 1970s 2010s | Mean values 2010s | 1970s -0.03 0.03 | \widehat{Cash} 1970s 2010s | OLS coef. 1990s 2010s | OLS coef. 2010s | Mean values 1990s 2010s | Mean values 2010s | 1990s -0.01 0.03 | \widehat{Cash} 1990s 2010s | OLS coef. 1990s 2010s | OLS coef. 2010s | Mean values 1990s 2010s | Mean values 2010s | 1990s -0.01 0.02 | \widehat{Cash} 1990s 2010s |
| <i>OCF</i> | 0.19 (10.9) | 0.21 (6.81) | -0.17 (6.81) | -0.30 (6.81) | -0.03 0.03 | -0.06 0.10 | 0.10 (3.60) | 0.32 (23.6) | -0.15 (23.6) | -0.20 (23.6) | -0.01 (23.6) | -0.07 (23.6) | 0.18 (4.80) | 0.27 (14.2) | -0.08 (14.2) | -0.09 (14.2) | -0.01 (14.2) | -0.02 (14.2) |
| <i>OCF * Neg</i> | -0.16 (-7.84) | -0.33 (-8.87) | -0.17 (-8.87) | -0.30 (-8.87) | 0.03 0.01 | 0.10 0.07 | -0.22 (-8.20) | -0.53 (-31.5) | -0.15 (-31.5) | -0.20 (-31.5) | 0.03 0.01 | 0.11 0.01 | -0.22 (-3.54) | -0.40 (-15.3) | -0.08 (-15.3) | -0.09 (-15.3) | 0.02 0.00 | 0.03 0.00 |
| <i>HighInt * Neg</i> | 0.01 (2.68) | 0.08 (5.63) | 0.64 (5.63) | 0.83 (5.63) | 0.01 0.07 | 0.07 0.07 | 0.05 (5.09) | 0.02 (3.43) | 0.30 (3.43) | 0.49 (3.43) | 0.01 0.01 | 0.01 0.01 | 0.00 (-0.13) | -0.02 (-3.74) | 0.06 (-3.74) | 0.16 (-3.74) | 0.00 0.01 | 0.00 0.01 |
| <i>Neg</i> | 0.02 (3.34) | 0.01 (0.58) | 1.00 (0.58) | 1.00 (0.58) | 0.02 0.01 | 0.01 0.01 | 0.01 (3.51) | 0.02 (6.40) | 1.00 (6.40) | 1.00 (6.40) | 0.01 0.01 | 0.02 (6.40) | 0.01 (2.63) | 0.01 (5.20) | 1.00 (5.20) | 1.00 (5.20) | 0.01 0.00 | 0.01 0.00 |
| <i>HighInt</i> | 0.00 (-0.90) | 0.03 (6.05) | 0.64 (6.05) | 0.83 (6.05) | 0.00 0.02 | 0.02 0.02 | 0.00 (0.50) | 0.01 (2.64) | 0.30 (2.64) | 0.49 (2.64) | 0.00 0.00 | 0.00 0.00 | -0.01 (-1.06) | 0.00 (0.77) | 0.06 (0.77) | 0.16 (0.77) | 0.00 0.00 | 0.00 0.01 |
| <i>OCF_vol</i> | 0.00 (0.28) | -0.02 (-0.50) | 0.15 (-0.50) | 0.25 (-0.50) | 0.00 -0.01 | -0.01 -0.02 | 0.04 (1.57) | 0.00 (0.03) | 0.17 (0.03) | 0.21 (0.03) | 0.01 (0.03) | 0.00 (0.03) | 0.02 (0.63) | 0.04 (1.96) | 0.11 (1.96) | 0.12 (1.96) | 0.00 0.00 | 0.01 -0.01 |
| <i>Size</i> | -0.01 (-11.0) | 0.00 (-3.10) | 2.86 (-3.10) | 4.47 (-3.10) | -0.03 0.02 | -0.02 0.04 | 0.00 (-1.88) | -0.01 (-16.3) | 4.59 (-16.3) | 4.97 (-16.3) | 0.01 (-16.3) | -0.06 (-16.3) | 0.00 (0.25) | 0.00 (-2.96) | 6.16 (-2.96) | 7.01 (-2.96) | 0.00 0.00 | -0.01 0.01 |
| <i>MB</i> | 0.01 (6.38) | 0.01 (13.2) | 1.35 (13.2) | 2.94 (13.2) | 0.02 0.04 | 0.04 0.04 | 0.01 (7.06) | 0.01 (12.5) | 2.42 (12.5) | 2.50 (12.5) | 0.01 (12.5) | 0.02 (12.5) | 0.00 (2.49) | 0.00 (6.99) | 2.01 (6.99) | 2.27 (6.99) | 0.00 0.00 | 0.01 0.01 |
| <i>Capex</i> | -0.35 (-18.9) | -0.47 (-14.6) | 0.06 (-14.6) | 0.03 (-14.6) | -0.02 -0.01 | -0.01 -0.04 | -0.33 (-12.9) | -0.38 (-19.4) | 0.07 (-19.4) | 0.05 (-19.4) | -0.02 (-19.4) | -0.02 (-19.4) | -0.16 (-8.72) | -0.26 (-10.0) | 0.05 (-10.0) | 0.03 (-10.0) | -0.01 -0.01 | -0.01 -0.05 |
| <i>Debt</i> | -0.14 (-17.0) | -0.22 (-21.1) | 0.39 (-21.1) | 0.19 (-21.1) | -0.06 0.00 | -0.04 0.00 | -0.22 (-32.1) | -0.30 (-46.3) | 0.22 (-46.3) | 0.20 (-46.3) | -0.05 (-46.3) | -0.06 (-46.3) | -0.11 (-7.15) | -0.20 (-20.8) | 0.35 (-20.8) | 0.27 (-20.8) | -0.04 0.01 | -0.05 0.01 |
| <i>DivI</i> | 0.01 (2.60) | -0.03 (-6.94) | 0.30 (-6.94) | 0.09 (-6.94) | 0.00 0.00 | 0.00 0.00 | -0.02 (-7.97) | 0.00 (0.38) | 0.29 (0.38) | 0.20 (0.38) | -0.01 (0.38) | 0.00 (0.38) | 0.02 (6.00) | 0.03 (12.6) | 0.43 (12.6) | 0.45 (12.6) | 0.01 0.01 | 0.01 0.01 |
| <i>Nwc</i> | -0.25 (-22.5) | -0.33 (-15.8) | 0.28 (-15.8) | 0.00 (-15.8) | -0.07 0.00 | 0.00 0.00 | -0.26 (-24.1) | -0.22 (-34.1) | 0.11 (-34.1) | 0.06 (-34.1) | -0.03 (-34.1) | -0.01 (-34.1) | -0.12 (-12.7) | -0.13 (-25.3) | 0.25 (-25.3) | 0.21 (-25.3) | -0.03 0.00 | -0.03 0.00 |
| <i>Acq</i> | -0.01 (-5.27) | -0.05 (-14.0) | 0.10 (-14.0) | 0.13 (-14.0) | 0.00 -0.01 | -0.01 -0.01 | -0.01 (-1.63) | -0.03 (-17.1) | 0.10 (-17.1) | 0.08 (-17.1) | 0.00 (-17.1) | 0.00 (-17.1) | 0.00 (0.26) | -0.01 (-4.42) | 0.05 (-4.42) | 0.09 (-4.42) | 0.00 0.00 | 0.00 0.00 |
| <i>Const.</i> | 0.21 (29.6) | 0.30 (19.5) | - | - | 0.21 0.30 | 0.30 0.38 | 0.25 (17.6) | 0.35 (47.0) | - | - | 0.25 (47.0) | 0.35 (47.0) | 0.12 (7.50) | 0.18 (25.9) | - | - | 0.12 0.12 | 0.18 0.12 |
| \widehat{Cash} | | | | | 0.07 | 0.38 | | | | | 0.20 | 0.29 | | | | | 0.07 | 0.12 |

Figure 1: **Growth in negative cash flow**

The top chart plots the percentage of negative cash flow firms ($OCF < 0$). The bottom chart plots operating cash flow as a percentage of total assets. The solid black line corresponds to U.S. firms, the dashed black line – to firms from non-U.S. developed economies, and the dotted red line – to firms from developing economies. Table 2 defines the variables.

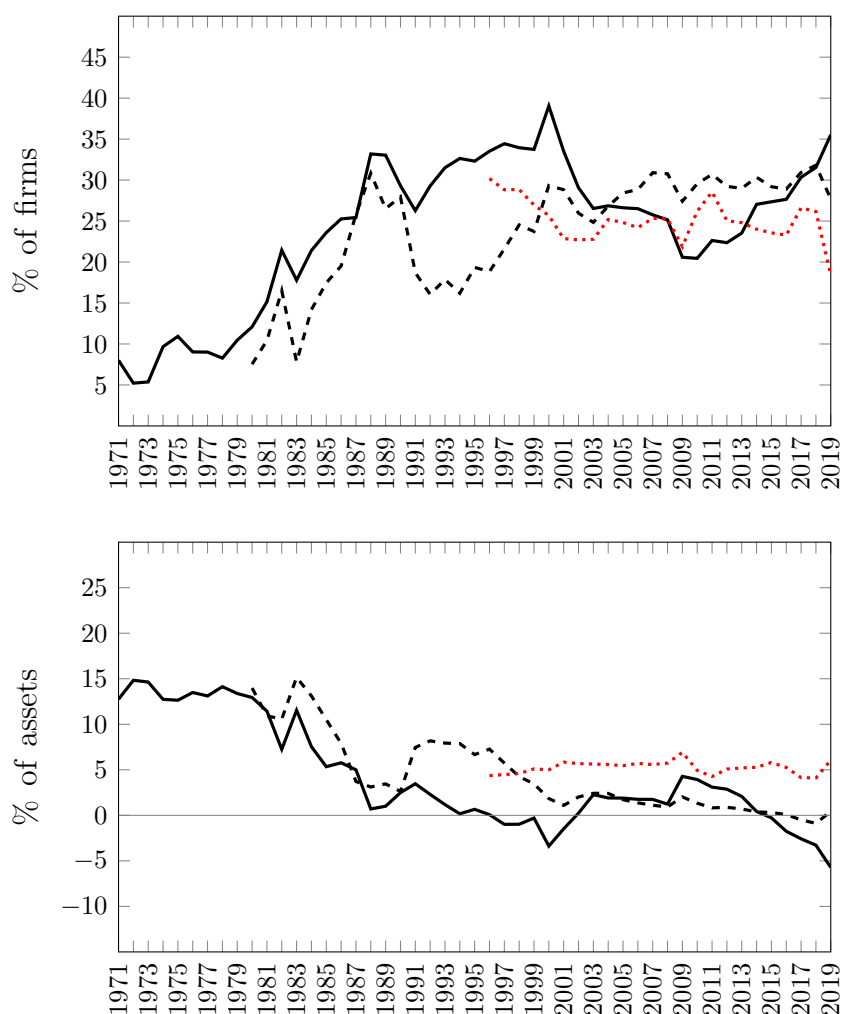


Figure 2: **Persistence of negative cash flow**

The top chart plots the proportion of negative cash flow firms in the current year that report positive operating cash flow ($OCF > 0$) in the following year. The bottom chart plots the average number of consecutive years of negative cash flow for firms that report negative operating cash flow ($OCF < 0$) in the current year. The solid black line corresponds to U.S. firms, the dashed black line – to firms from non-U.S. developed economies, and the dotted red line – to firms from developing economies. Table 2 defines the variables.

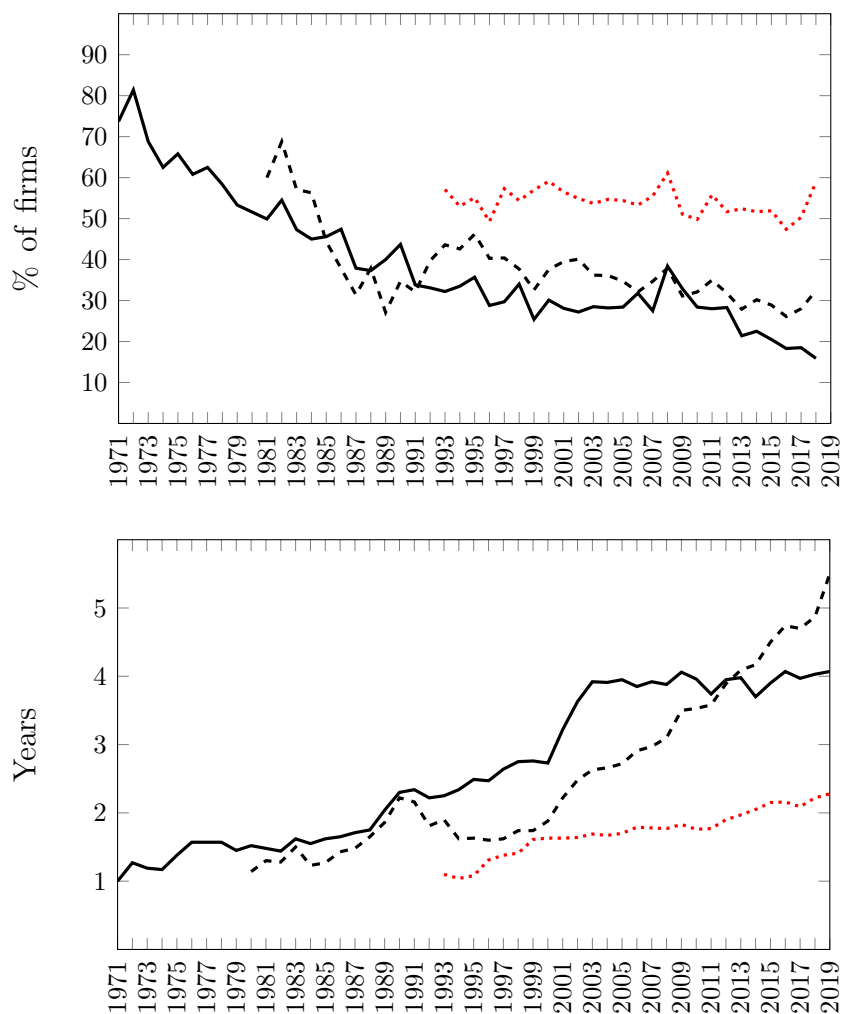


Figure 3: **AR(1) negative cash flow process**

The charts plot the first-order autoregressive $AR(1)$ coefficient on the ratio of operating cash flow to total assets in the subsample of firms that report negative operating cash flow ($OCF < 0$) in the current year. The top chart corresponds to U.S. firms, the middle chart – to firms from non-U.S. developed economies, and the bottom chart – to firms from developing economies. The dashed red lines represent the 95% confidence interval. Table 2 defines the variables.

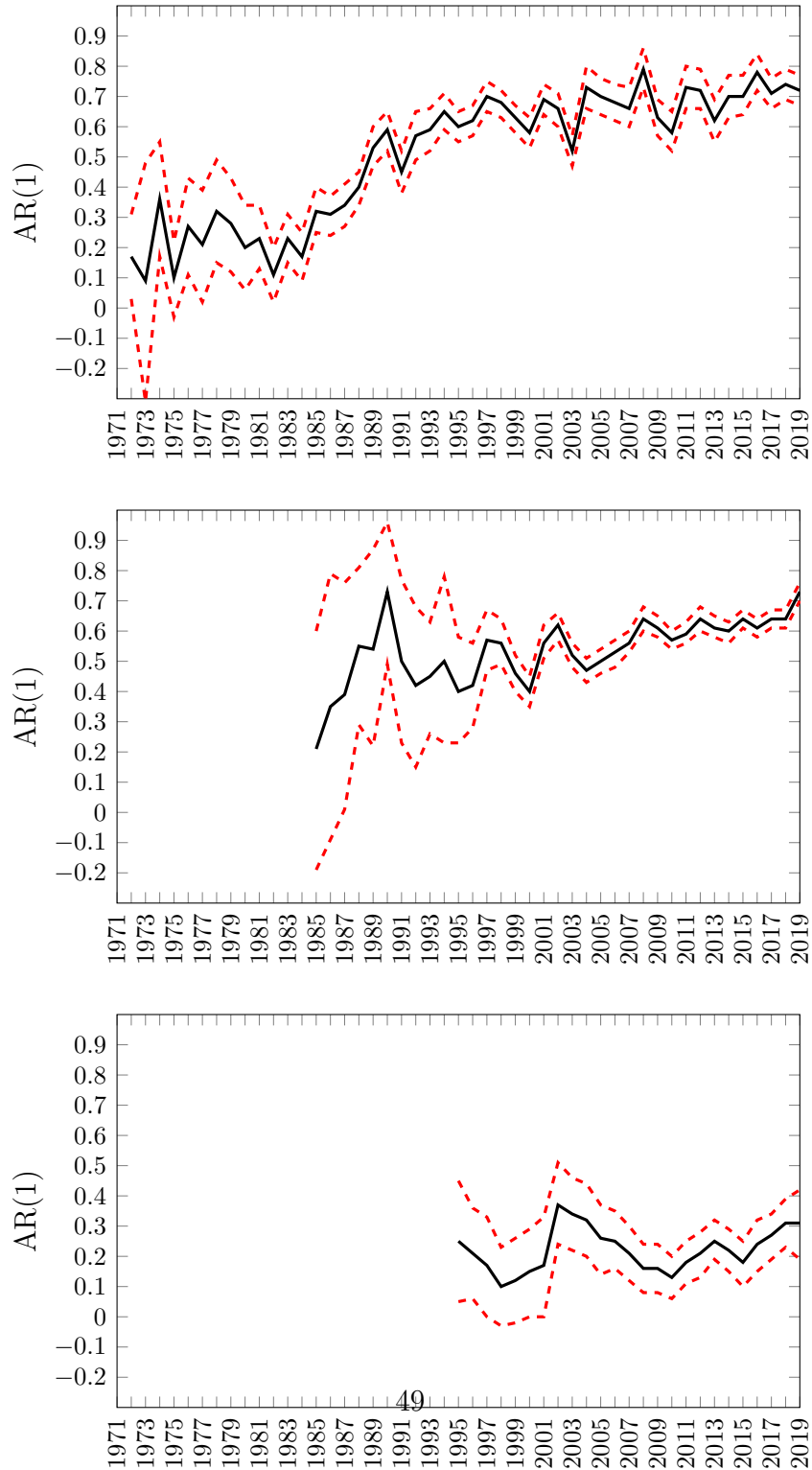


Figure 4: **Distribution of firms by cash flow**

The charts plot the percentage of firm-year observations within each bin of cash flow (*OCF*) in two sample subperiods: (i) 1970-79 and 2010-19 for U.S. firms, (ii) 1980-89 and 2010-19 for firms from non-U.S. developed economies, and (iii) 1990-99 and 2010-19 for firms from developing economies. The top chart corresponds to U.S. firms, the middle chart – to firms from non-U.S. developed economies, and the bottom chart – to firms from developing economies. Table 2 defines the variables.

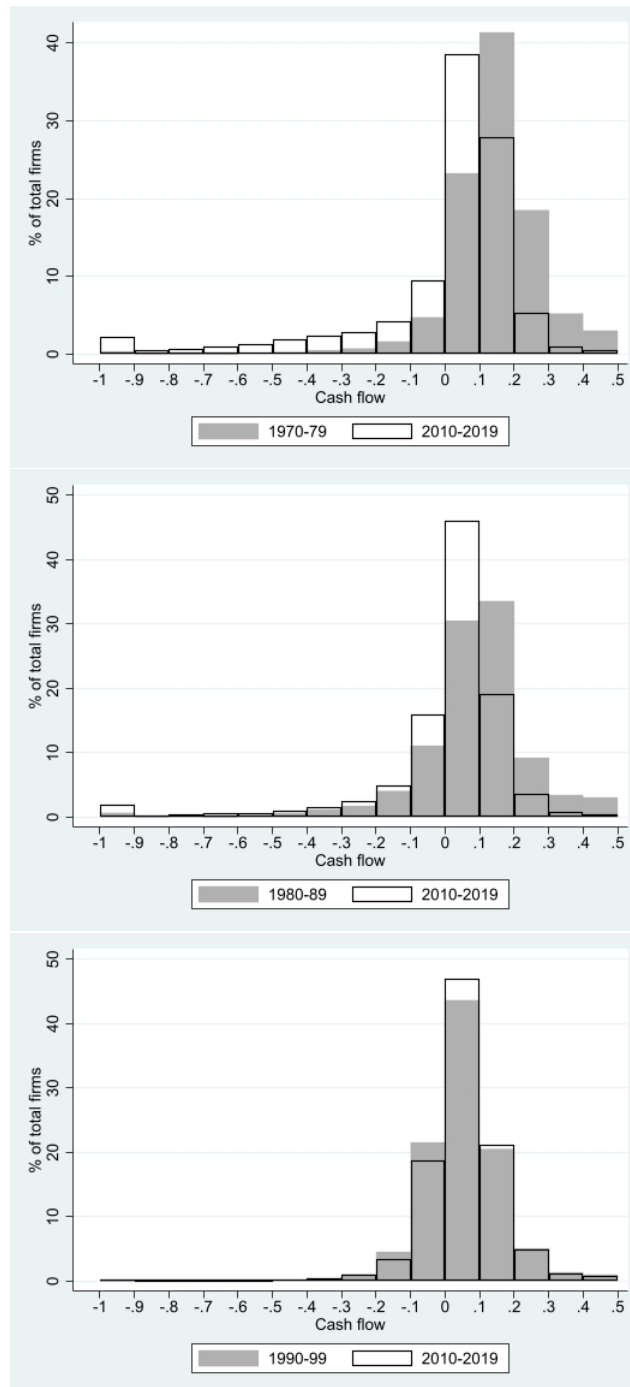
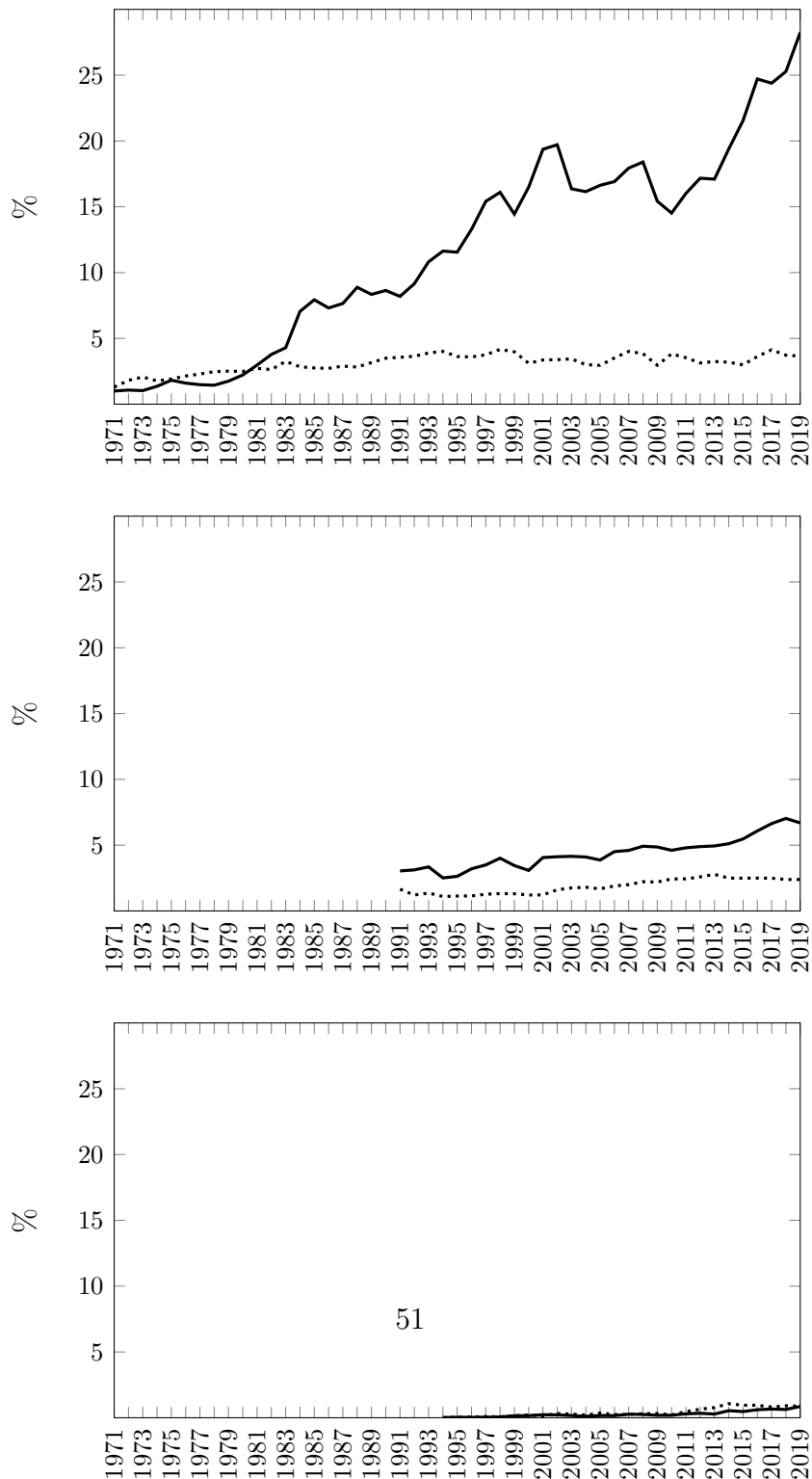


Figure 5: **Intangible investment**

The charts plot the mean values of R&D-to-assets (panel A) and SG&A-to-assets (panel B) for firms in the top two deciles (dashed line) and the bottom two deciles (solid line) of cash flow (*OCF*). SG&A expenses over 25% of assets (horizontal line) are categorised as being intangible investment. The cash flow deciles are formed annually. The top chart corresponds to U.S. firms, the middle chart – to firms from non-U.S. developed economies, and the bottom chart – to firms from developing economies. Table 2 defines the variables.

Panel A: R&D-to-assets



Panel B: SG&A-to-assets

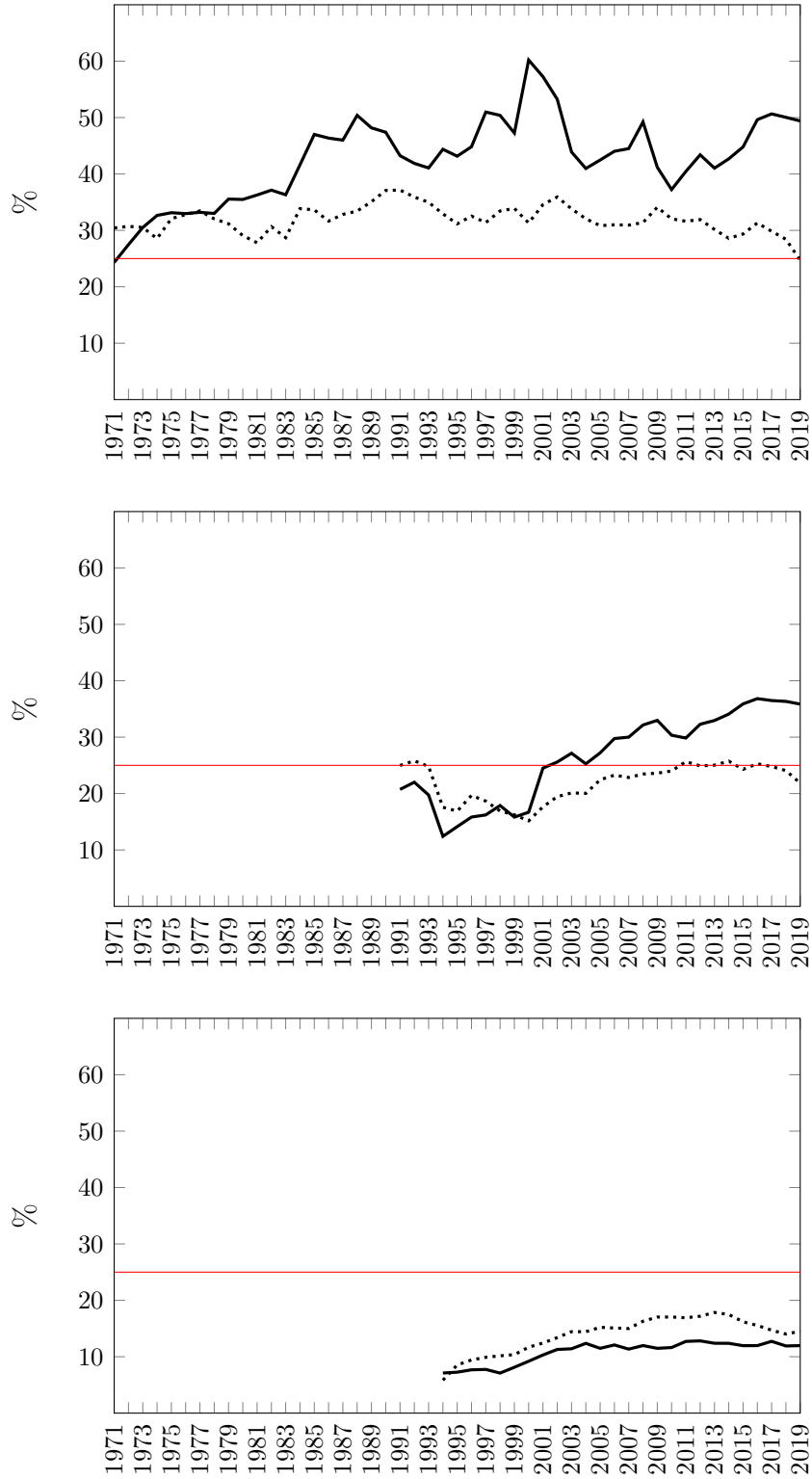


Figure 6: **Intangible investment growth and its effect on cash flow**

The charts plot the percentage of negative cash flow firms. The solid line corresponds to negative operating cash flow ($OCF < 0$), while the dashed line – to negative operating cash flow after adding back R&D expenses and the portion of SG&A expenses that represents intangible investment ($OCF_{adj} < 0$). The top chart corresponds to U.S. firms, the middle chart – to firms from non-U.S. developed economies, and the bottom chart – to firms from developing economies. Table 2 defines the variables.

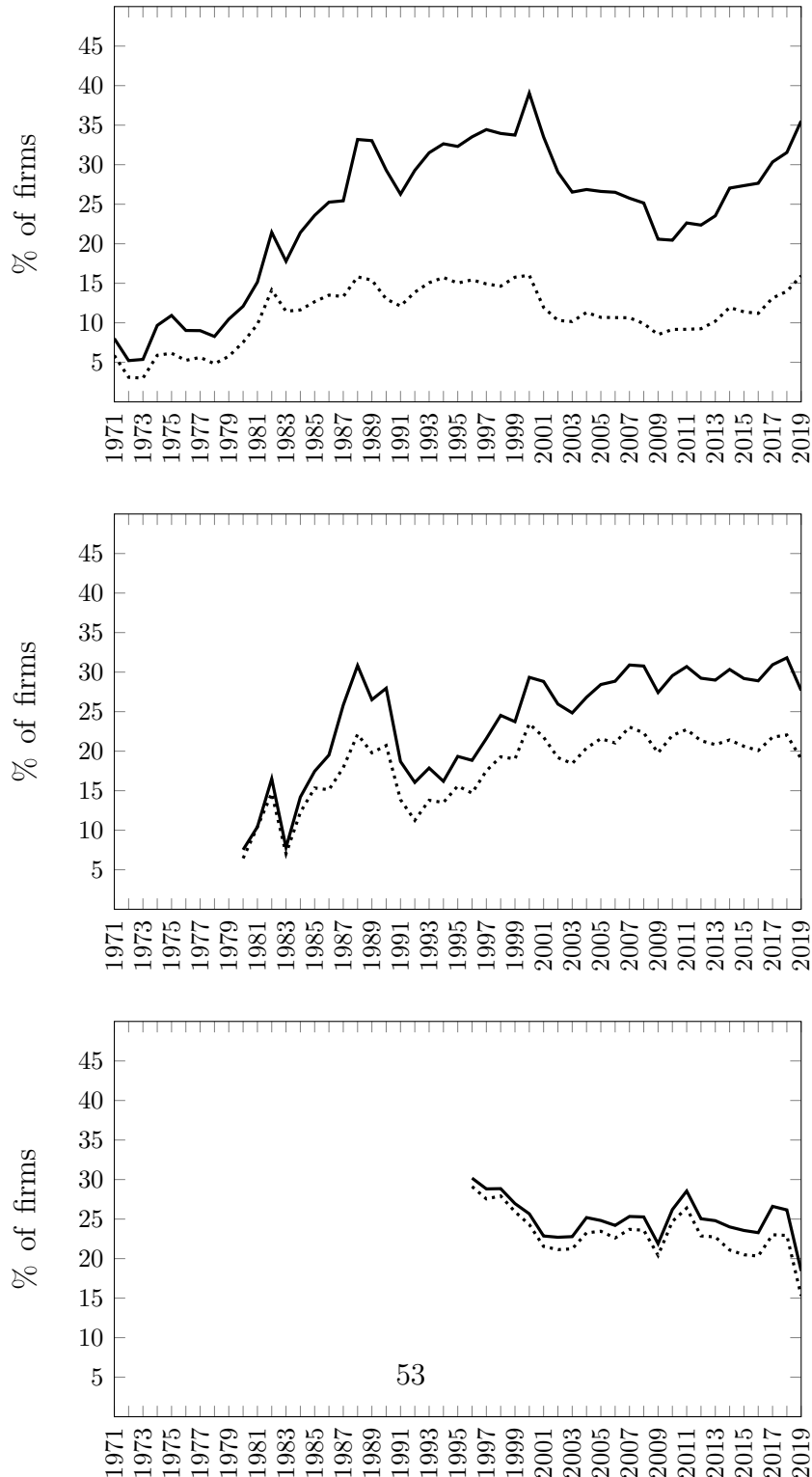


Figure 7: **Cash holdings**

The charts plot the mean values of cash-to-assets in the full sample (solid line) and the subsamples of positive ($OCF > 0$, dotted line) and negative ($OCF < 0$, dashed line) cash flow firms. The top chart corresponds to U.S. firms, the middle chart – to firms from non-U.S. developed economies, and the bottom chart – to firms from developing economies. Table 2 defines the variables.

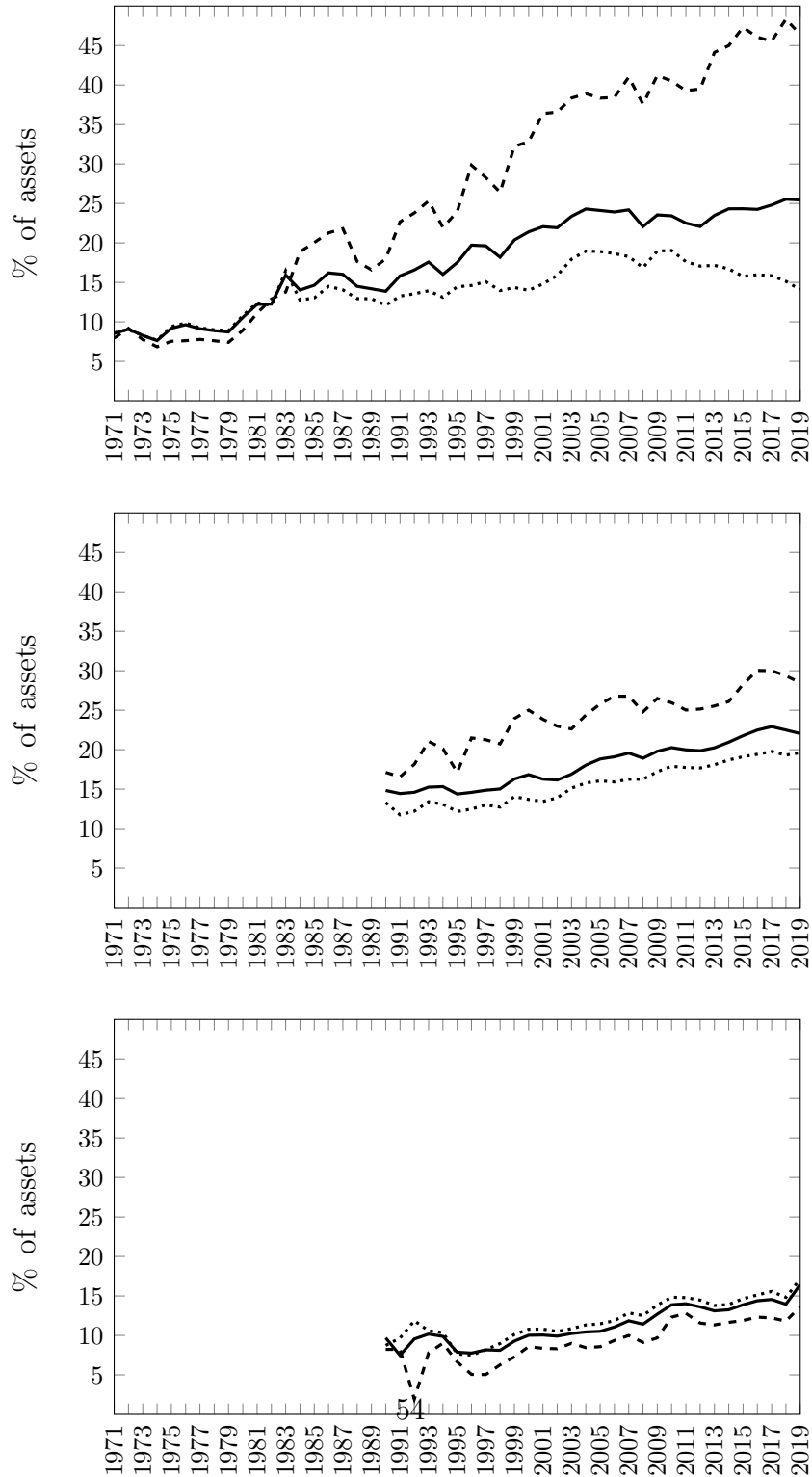


Figure 8: **Cash and cash flow of equity issuers**

The charts plot the mean values of cash-to-assets and operating cash flow-to-assets for firms that initiate an equity issuance in a given year. The solid line corresponds to cash-to-assets, while the dotted line – operating cash flow-to-assets. The top chart corresponds to U.S. firms, the middle chart – to firms from non-U.S. developed economies, and the bottom chart – to firms from developing economies. Table 2 defines the variables.

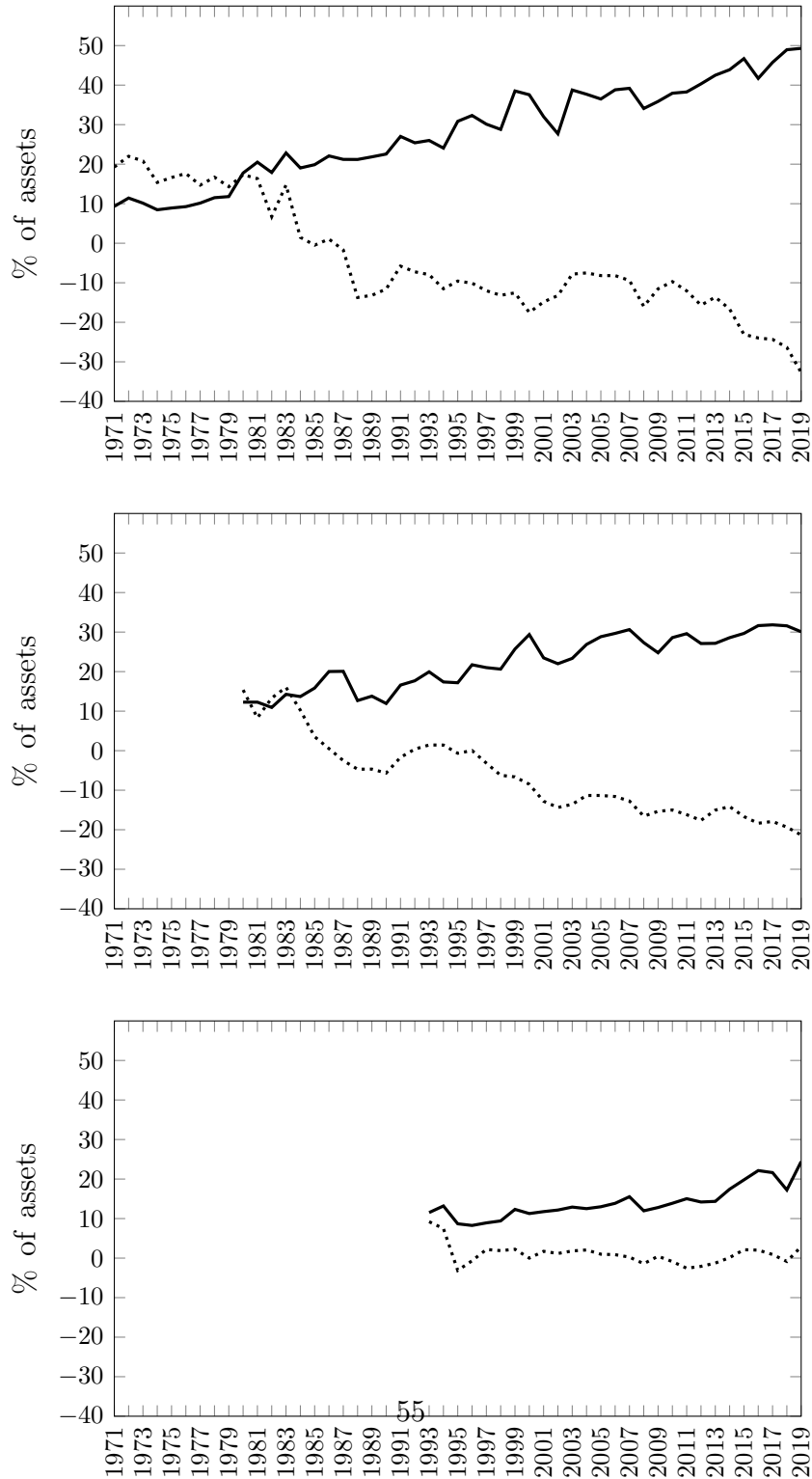


Figure 9: **Cash runaway**

The chart plots the median number of months a negative cash flow firm can continue to operate at its level of cash holdings. This *runaway* measure is calculated as a firm's cash balances (*Cash*) divided by the size of its monthly cash *burn rate*. Monthly cash burn rate is defined as negative free cash flow (*OCF* minus dividends minus capital expenditures) divided by 12. The subsample includes only firms that report negative operating cash flow ($OCF < 0$) in a given year. The solid black line corresponds to U.S. firms, the dashed black line – to firms from non-U.S. developed economies, and the dotted red line – to firms from developing economies. Table 2 defines the variables.

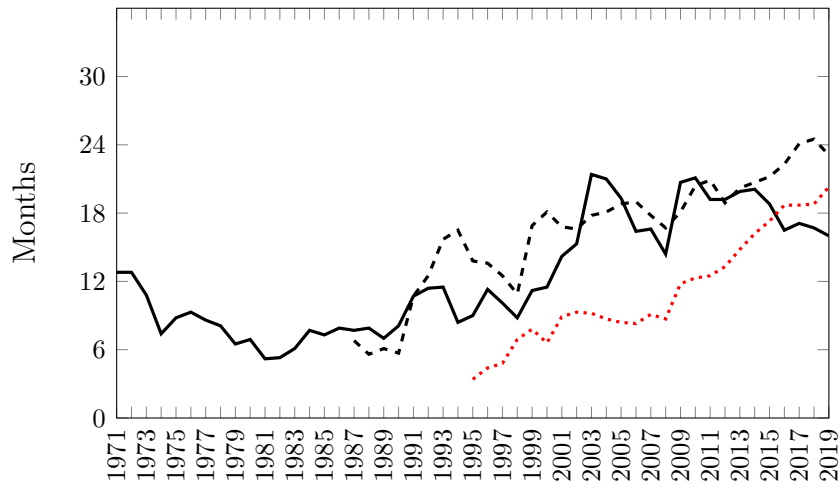


Figure 10: **Simulation of cash holdings of equity issuers with negative cash flow**
 The chart plots stylized values of cash-to-assets over 24 months. Values are calibrated to the observed average values for equity issuers with negative operating cash flow ($OCF < 0$) over the period 2010-2019. The solid black line corresponds to U.S. firms, the dashed black line – to firms from non-U.S. developed economies, and the dotted red line – to firms from developing economies. Table 2 defines the variables.

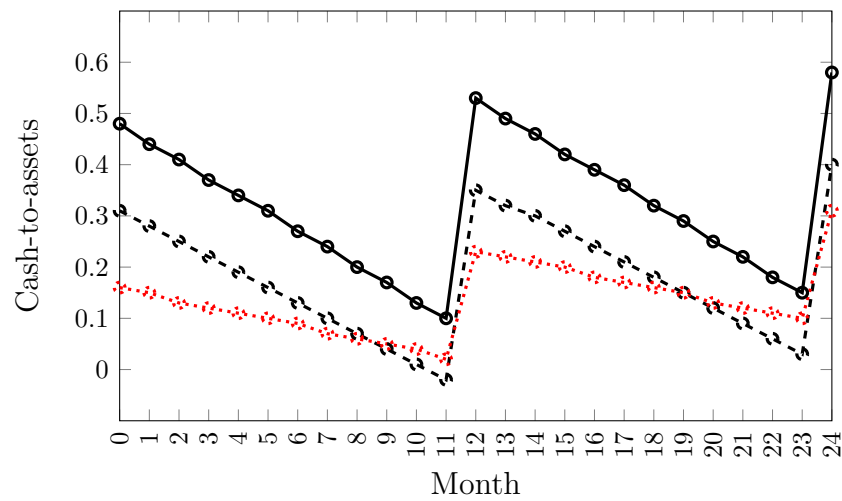
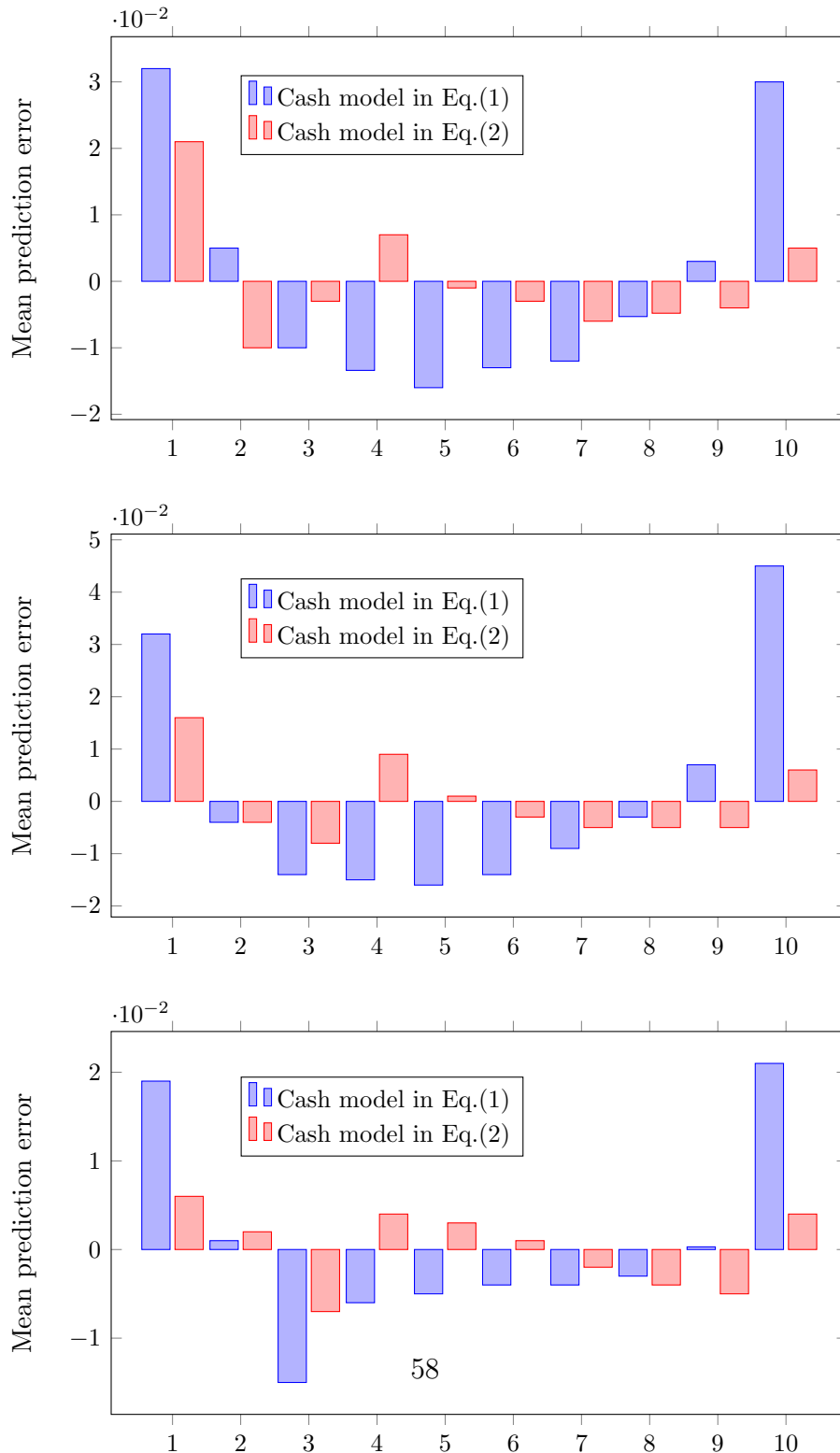


Figure 11: **Prediction errors in cash models**

The charts plot the mean prediction errors from cash models in Eq.1 and Eq.2. The errors are sorted by operating cash flow (*OCF*), where decile 1 (10) is the lowest (highest) decile of cash flow. The deciles are formed annually. The top chart corresponds to U.S. firms, the middle chart – to firms from non-U.S. developed economies, and the bottom chart – to firms from developing economies. Table 2 defines the variables.



Internet Appendix A. The appendix reports the mean values of selected variables by country. The sample includes 27 economically developed (top panel) and 33 developing (bottom panel) countries. Table 1 presents the IMF’s country classification scheme. Table 2 defines the variables.

| Code | Country | <i>Cash</i> | <i>OCF</i> | <i>RD</i> | <i>SGA</i> | <i>PPE</i> | <i>InTang</i> |
|------|--------------------|-------------|-------------|-------------|-------------|-------------|---------------|
| USA | U.S. | 0.18 | 0.04 | 0.04 | 0.32 | 0.29 | 0.10 |
| AUS | Australia | 0.26 | -0.13 | 0.02 | 0.22 | 0.34 | 0.11 |
| AUT | Austria | 0.13 | 0.06 | 0.02 | 0.13 | 0.30 | 0.08 |
| BEL | Belgium | 0.14 | 0.05 | 0.03 | 0.11 | 0.27 | 0.13 |
| CAN | Canada | 0.18 | 0.00 | 0.04 | 0.17 | 0.46 | 0.08 |
| CHE | Switzerland | 0.17 | 0.06 | 0.03 | 0.18 | 0.30 | 0.11 |
| DEU | Germany | 0.16 | 0.04 | 0.02 | 0.16 | 0.22 | 0.12 |
| DNK | Denmark | 0.17 | 0.04 | 0.03 | 0.24 | 0.28 | 0.11 |
| ESP | Spain | 0.10 | 0.07 | 0.01 | 0.09 | 0.31 | 0.12 |
| FIN | Finland | 0.14 | 0.06 | 0.03 | 0.15 | 0.24 | 0.16 |
| FRA | France | 0.16 | 0.04 | 0.02 | 0.15 | 0.17 | 0.16 |
| GBR | U.K. | 0.17 | 0.01 | 0.03 | 0.30 | 0.26 | 0.17 |
| GRC | Greece | 0.09 | 0.04 | 0.00 | 0.14 | 0.35 | 0.05 |
| HKG | Hong Kong SAR | 0.21 | 0.05 | 0.00 | 0.10 | 0.29 | 0.04 |
| IRL | Ireland | 0.18 | 0.03 | 0.03 | 0.19 | 0.28 | 0.20 |
| ISR | Israel | 0.26 | -0.03 | 0.06 | 0.26 | 0.18 | 0.07 |
| ITA | Italy | 0.13 | 0.04 | 0.01 | 0.10 | 0.21 | 0.15 |
| JPN | Japan | 0.19 | 0.05 | 0.01 | 0.23 | 0.28 | 0.02 |
| KOR | South Korea | 0.16 | 0.04 | 0.01 | 0.15 | 0.32 | 0.03 |
| NLD | Netherlands | 0.13 | 0.06 | 0.02 | 0.17 | 0.26 | 0.14 |
| NOR | Norway | 0.19 | 0.01 | 0.02 | 0.10 | 0.31 | 0.12 |
| NZL | New Zealand | 0.12 | 0.01 | 0.02 | 0.16 | 0.33 | 0.14 |
| PRT | Portugal | 0.07 | 0.06 | 0.00 | 0.08 | 0.33 | 0.15 |
| SGP | Singapore | 0.20 | 0.04 | 0.00 | 0.13 | 0.29 | 0.03 |
| SVN | Slovenia | 0.08 | 0.08 | 0.01 | 0.09 | 0.47 | 0.04 |
| SWE | Sweden | 0.20 | -0.06 | 0.03 | 0.32 | 0.15 | 0.18 |
| TWN | Taiwan | 0.22 | 0.06 | 0.03 | 0.11 | 0.29 | 0.02 |
| | Sub-average | 0.16 | 0.03 | 0.02 | 0.16 | 0.29 | 0.10 |
| ARE | U.A.E. | 0.16 | 0.06 | 0.00 | 0.08 | 0.33 | 0.04 |
| ARG | Argentina | 0.08 | 0.08 | 0.00 | 0.18 | 0.37 | 0.04 |
| BGD | Bangladesh | 0.08 | 0.06 | 0.00 | 0.08 | 0.45 | 0.00 |
| BGR | Bulgaria | 0.08 | 0.05 | 0.00 | 0.16 | 0.42 | 0.05 |
| BRA | Brazil | 0.12 | 0.05 | 0.00 | 0.17 | 0.35 | 0.06 |
| CHL | Chile | 0.07 | 0.06 | 0.00 | 0.13 | 0.45 | 0.05 |
| CHN | China | 0.20 | 0.06 | 0.01 | 0.10 | 0.30 | 0.05 |
| COL | Colombia | 0.08 | 0.07 | 0.00 | 0.11 | 0.45 | 0.06 |
| EGY | Egypt | 0.14 | 0.06 | 0.00 | 0.06 | 0.38 | 0.02 |
| HRV | Croatia | 0.08 | 0.05 | 0.00 | 0.09 | 0.54 | 0.02 |
| IDN | Indonesia | 0.11 | 0.06 | 0.00 | 0.13 | 0.40 | 0.02 |
| IND | India | 0.07 | 0.04 | 0.00 | 0.10 | 0.32 | 0.02 |
| JOR | Jordan | 0.09 | 0.05 | 0.00 | 0.07 | 0.39 | 0.02 |
| KEN | Kenya | 0.09 | 0.09 | 0.00 | 0.18 | 0.42 | 0.02 |
| KWT | Kuwait | 0.14 | 0.07 | 0.00 | 0.05 | 0.25 | 0.05 |
| LKA | Sri Lanka | 0.09 | 0.05 | 0.00 | 0.13 | 0.47 | 0.02 |
| MAR | Morocco | 0.10 | 0.10 | 0.00 | 0.13 | 0.26 | 0.04 |
| MEX | Mexico | 0.09 | 0.08 | 0.00 | 0.15 | 0.45 | 0.08 |
| MYS | Malaysia | 0.14 | 0.05 | 0.00 | 0.09 | 0.34 | 0.04 |
| NGA | Nigeria | 0.09 | 0.09 | 0.00 | 0.19 | 0.44 | 0.01 |
| OMN | Oman | 0.13 | 0.09 | 0.00 | 0.10 | 0.44 | 0.02 |
| PAK | Pakistan | 0.07 | 0.06 | 0.00 | 0.09 | 0.46 | 0.01 |
| PER | Peru | 0.07 | 0.09 | 0.00 | 0.12 | 0.50 | 0.05 |
| PHL | Philippines | 0.14 | 0.04 | 0.00 | 0.08 | 0.35 | 0.04 |
| POL | Poland | 0.12 | 0.03 | 0.00 | 0.28 | 0.27 | 0.08 |
| ROU | Romania | 0.07 | 0.04 | 0.00 | 0.11 | 0.50 | 0.01 |
| RUS | Russia | 0.09 | 0.08 | 0.00 | 0.12 | 0.43 | 0.04 |
| SAU | Saudi Arabia | 0.10 | 0.09 | 0.00 | 0.07 | 0.46 | 0.03 |
| THA | Thailand | 0.11 | 0.08 | 0.00 | 0.15 | 0.39 | 0.03 |
| TUN | Tunisia | 0.14 | 0.06 | 0.00 | 0.11 | 0.30 | 0.01 |
| TUR | Turkey | 0.10 | 0.06 | 0.00 | 0.13 | 0.32 | 0.04 |
| VNM | Vietnam | 0.15 | 0.06 | 0.00 | 0.12 | 0.27 | 0.03 |
| ZAF | South Africa | 0.13 | 0.08 | 0.00 | 0.17 | 0.30 | 0.08 |
| | Sub-average | 0.11 | 0.06 | 0.00 | 0.12 | 0.39 | 0.04 |

Internet Appendix B. The appendix plots (i) the ratio of tangible assets (PPE) to total book assets (solid line) and (ii) the ratio of intangible assets ($InTang$) to total book assets (dashed line). The top chart corresponds to U.S. firms, the middle chart – to firms from non-U.S. developed economies, and the bottom chart – to firms from developing economies. Table 2 defines the variables.

