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Abstract

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Keywords: asset tangibility; cash holdings; investments; financial development; economic growth
JEL Classifications: G21, G32, O43

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Abstract

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1. Introduction

The use of collateral is pervasive in corporate borrowing around the world. Berger and Udell (1990) report that about 70% of commercial and industrial loans in the U.S. are secured by collateral. Black, de Meza, and Jeffreys (1996) find that 85% of loans to small businesses in the U.K. are subject to collateral provisions. Using sample firms from 48 countries, Bae and Goyal (2009) show that posting collateral significantly reduces syndicate loan spreads.

Conventionally, tangible assets (e.g., buildings, land, and plants), given their low information asymmetry in valuation and high recovery rates, have served as the primary form of collateral in external financing (e.g., Hart and Moore, 1994; Shleifer and Vishny, 1992; Liberti and Sturgess, 2016). Firms with low asset tangibility generally face costly external financing and are prompted to build up precautionary savings (Bates, Kahle, and Stulz, 2009; Lyandres and Palazzo, 2016). Bernanke and Gertler (1989) and Kiyotaki and Moore (1997) note that the collateral role played by tangibles in determining firms' financial capacity could have important implications for a country's economic growth because corporate investment often relies on asset-based financing. Chaney, Sraer, and Thesmar (2012) indeed find that a representative US firm reduces investment by $0.06 for a one dollar decrease in its real estate value.

Meanwhile, intangible assets (e.g., patents, brands, and employee training) have become an increasingly important component on corporate balance sheets in knowledge-based economies (Lev, 2001; Nakamura, 2003; Syverson 2011; Kogan, Papanikolaou, Seru, and Stoffman, 2017). This shift in asset composition toward intangible components could have important implications on a firm's external borrowing capacity and its liquidity management and investment strategy. Figure 1A shows that, over the past three decades, the secular upward trend of U.S. non-financial and non-utility firms' cash holdings coincides with a substantial decline in asset tangibility. Figure

1B shows that, across countries, the average corporate cash balance is higher in knowledge-based economies (e.g., the U.S. and Israel), where firms generally have lower asset tangibility.

A negative cash-tangibility sensitivity—the increase in cash reserves associated with declining asset tangibility—is potentially costly. As the make-up of corporate assets shifts toward intangibles, growth could be constrained if firms have to forgo investment to preserve cash. This cost could be more detrimental for firms operating in countries with underdeveloped financial markets where credit supply and alternative financing sources are scarce.

Financial development could moderate the dependence of cash and investment policies on asset tangibility and foster firm growth by facilitating the use of intangible assets as collateral and by promoting the adoption of alternative instruments such as covenants to deter borrowers' risk-shifting. For example, Loumioti (2015) finds that, from 1996 to 2005, about a quarter of U.S. originated secured syndicated loans were collateralized by intangibles, and intangible asset collateralization increased significantly near the end of her sample period. The enhanced pledgeability of intangible assets and the accessibility of alternative credit sources lessen the dependence of external financing on tangible assets. However, despite the far-reaching implication for firm growth, little is known about how corporate cash and investment policies respond to declining asset tangibility and what the role of financial development is in affecting this important interaction.

In this paper, we investigate the impact of financial development on the sensitivity of cash holdings to asset tangibility, and examine its implications for firm growth around the world. Using a firm-level dataset covering 45 countries, we find that a high degree of financial development, measured by the ratio of private credit to gross domestic product, lowers cash-asset tangibility sensitivity. Economically, a one-interquartile-range increase in financial development leads to a

reduction in the sensitivity of *63%*. This result suggests that, as financial development broadens sources of corporate financing, it effectively reduces the sensitivity of corporate cash holdings to tangibles and moderates the need to stockpile cash among firms with more intangibles. Our baseline result is further substantiated as we find that the quality of a country's institutional quality directly impinge on cash-tangibility sensitivity.

An important implication of our findings is that financial development, by dampening the impact of tangibles on cash reserves, allows firms with greater intangible assets to reserve less cash and undertake more investment opportunities when they arise. We find confirmatory evidence that a developed financial market disproportionately promotes investment by firms with low tangible capital. Further, using the approach of Rajan and Zingales (1998), we show that industries with fewer tangible assets grow faster in economies with developed financial systems. This finding accentuates the real effect of financial development in relaxing cash-tangibility sensitivity: allowing firms with low stock of tangibles, such as those in high-tech and pharmaceutical sectors, to hoard less cash, invest more, and grow faster.

One concern with our analysis is that financial development could be correlated with other economic forces. As the world's economy evolves, which is partly facilitated by trade liberalization and by the development of information technologies and telecommunications, firms strive to quickly adapt to the rapid changing business environment. As a result, the economic forces that compel financial development might also influence the interplay between asset tangibility and cash holdings. For instance, technological advances could enhance the redeployability of intangible assets and alleviate potential financial constraints due to low asset tangibility, thus affecting corporate cash and investment policies. In addition, the rise of emerging markets, especially China and India, has drastically altered global trade patterns. And the growth of

international trade has promoted financial development and meanwhile constantly shapes corporate policies.

We use several methods to carefully examine the robustness of our findings and to alleviate the concern that the impact of financial development on cash-tangibility sensitivity is confounded with other economic forces. First, we partition the sample based on several important country-level variables (e.g., R&D investment and average income) to delve deeper into the effect of financial development on cash-tangibility sensitivity. Second, in an attempt to absorb the impacts of several forms of omitted variables, our baseline regression specification is augmented to include firm-level and various interactive fixed effects. Third, we conduct an IV analysis to address the potential endogeneity of asset tangibility in determining cash holdings. Last, we consider several alternative measures of financial development to provide a broader assessment of its role on cash-tangibility sensitivity. Our baseline results are robust to a battery of robustness checks.

Our paper is related to the emerging literature on the role of tangible assets in determining a firm's financial policies and investment strategy. Specifically, Gan (2007) examines how a shock to collateral value induced by Japan's land market collapse influences firms' debt capacities. Chaney, Sraer, and Thesmar (2012) provide U.S. evidence that, through a collateral channel, real estate shocks have a significant bearing on firm investments. Benmelech and Bergman (2009) document that debt tranches that are secured by more redeployable collateral exhibit lower credit spreads. Liberti and Mian (2010) shows that financial development reduces the collateralization rate between high- and low-risk borrowers' collateralization rates in bank lending.

We contribute to this line of inquiry. Our study highlights that asset composition and its interaction with financial development play important roles in determining corporate cash holdings and investments. Our sample covers 45 countries, including both emerging and developed

economies. The sizable cross-country variation in the degrees of financial development and asset tangibility allows us to evaluate their interactive effect on corporate cash holdings and investments. Our finding that financial development reduces the sensitivity of a firm's cash and investment policies to its stock of tangibles reveals an important channel through which financial development facilitates firm growth, shedding new light on the role of financial markets in fostering economic growth (Rajan and Zingales, 1998; Levine, 1999; Beck, Levine, and Loayza, 2000; Cull, Senbet, and Sorge, 2005; Durnev, Errunza, and Molchanov, 2009; Aghion, Hemous, and Kharroubi, 2014). In particular, our analysis suggests that financial development could play an important role in facilitating the growth of innovative firms that often have fewer tangible assets.

This study also adds to the growing literature on cash holdings. Bates, Kahle, and Stulz (2009) document that the average cash-to-assets ratio for U.S. industrial firms has more than doubled in the last three decades. Lyandres and Palazzo (2016) find that the increase in average cash holdings concentrates in firms that invest heavily in R&D. Moreover, Falato, Kadyrzhanova, and Sim (2014) argue that the rise in intangibles (e.g., knowledge capital and organizational capabilities) is a key driver of the secular trend of cash holdings. These studies hint the potential association between the rise of U.S. companies' cash pile and their declining tangibility. They further raise important questions: "is this a global phenomenon? And, more importantly, what are the implications for firm growth across countries?" Our study evinces the prevalence of a negative asset tangibility of cash around the globe. It also highlights the importance of country-level institutional quality and its interaction with firm-level asset intangibility in determining corporate cash policy and growth.

The remainder of the paper proceeds as follows. Section 2 outlines empirical specification and describes the data and reports summary statistics. Section 3 presents the results of our empirical analyses. We conclude in Section 4.

2. Empirical Methodology

In this section, we discuss our regression specification and provide information of the data used.[1]

2.1 Regression specification

We conduct a cross-country analysis to study how asset tangibility and financial development determine corporate cash holdings. The baseline econometric model is as follows:

$$Cash_{i,t} = \boldsymbol{\beta_1} Asset\ Tangibility_{i,t} + \boldsymbol{\beta_2}\, Asset\ Tangibility_{i,t} \times Finanical\ Development_{c,t} + \beta_3\, Finanical\ Development_{c,t} + \theta' X_{i,t} + \delta_c + \eta_j + \phi_t + \varepsilon_{i,t}, \quad (1)$$

where i, c, j, and t denote firm, country, industry, and year, respectively. $Cash$ is the natural logarithm of the cash-to-assets ratio (Dittmar, Mahrt-Smith, and Servaes, 2003). Following related literature (e.g., Berger, Ofek, and Swary, 1996; Almeida and Campello, 2007), *Asset Tangibility* is measured as (0.715×receivables + 0.547×inventories + 0.535×fixed capital), deflated by the book value of total assets net of cash.[2]

Financial development is measured using the ratio of private credit to GDP (*Private Credit to GDP*), which is the commonly used proxy of financial development in the literature (e.g., Rajan and Zingales, 1998; Cull, Haber, and Imai, 2011). X is a vector of a constant term and other firm-level control variables that are similar to those used by Dittmar, Mahrt-Smith, and Servaes (2003) and Kalcheva and Lins (2007). We further control for a country's economic development and its interaction with asset tangibility. This is due to the consideration that advances in financial markets

[1] To further motivate our empirical analysis, we use a simple model to illustrate how financial development could affect the asset tangibility sensitivity of cash holdings and investment. This analysis is available at the authors' websites.

[2] Our results remain qualitatively unchanged when we use alternative definitions of the cash ratio, including cash to net assets, cash over sales, and cash to total assets, and when we replace asset tangibility by fixed assets or net tangibility. The latter is calculated as $0.715 \times \text{Receivables} + 0.547 \times \text{Inventories} + 0.535 \times \text{Fixed Capital} -$ total current liabilities (LCT) + total debt in current liabilities (DLC), deflated by book assets net of cash (Berger, Ofek, and Swary, 1996).

tend to be positively related with the level of economic growth. Countries experiencing important changes in their institutional environment could also experience other economic shocks influencing the relationship between cash and tangibility. We use *GDP per capita* to absorb the impact of a country's economic development. Respectively, δ_c and η_j are the country and industry fixed effects, which capture systematic differences in liquidity management across countries and industries. ϕ_t, the year effect, captures common macroeconomic shocks that might affect firms' cash decisions. Detail definitions of variables are presented in the appendix.

The coefficient of *Asset Tangibility* (β_1) indicates the direct effect of tangibility on cash holdings. Given that firms that are rich in tangible capital would have less need to hoard cash, we expect the marginal effect of *Asset Tangibility* on cash holdings to be negative (i.e., $\beta_1 < 0$). We are most interested in the estimate of β_2, the coefficient of the interaction term *Asset Tangibility* $\times$ *Financial Development*. A positive β_2 ($\beta_2 > 0$) would indicate that financial development reduces the negative sensitivity of cash holdings to tangibles.

2.2 Data and summary statistics

We draw firm-level data from the Compustat North America and Compustat Global Fundamentals Annual databases for the period of 1990–2013. Following the sample selection rules described in the appendix yields a comprehensive panel dataset with 294,520 firm-year observations covering 29,422 unique firms from 45 countries.

Table 1 presents country-level medians of key variables used in our analysis. In columns (1) and (2), we observe that Japan, following the U.S., has the second largest number of total firm-year observations and number of unique firms, while Venezuela has the smallest. Column (4) displays wide cross-country variation in cash ratios. For instance, the median cash ratio of firms in Hong Kong is 17.8%, while the ratio is much lower in New Zealand, Pakistan, and Peru—3.1%,

4.0%, and 4.0%, respectively. By contrast, as shown in column (5), the median asset tangibility of Hong Kong firms is relatively higher (42.2%), while the numbers are 47.3%, 52.8% and 50.4% for firms in New Zealand, Pakistan, and Peru, respectively. Thus, the summary statistics hint at a negative relation between cash holdings and asset tangibility in worldwide data.

[Table 1 about here]

The last column of Table 1 reports the country median of private credit to GDP, our main proxy for financial development. The data demonstrate substantial variability in private credit creation. The median value ranges from 302.5% in Japan, 199.9% in the United States, and 162.8% in Switzerland, to values below 30% in Peru, Venezuela, and Argentina.

3. Empirical analysis

3.1 Financial development, asset tangibility, and cash holdings

Table 2 reports the estimation results of equation (1) and its variations. Following Petersen (2009) and Thompson (2011), standard errors are two-way clustered at both the firm and year levels throughout our firm-level empirical analysis to obtain conservative statistical inferences. Columns (1)–(3) report the estimation results of equation (9) without the interaction term. Column (1) shows the estimates using only U.S. firms. The coefficient estimate of *Asset Tangibility* (β_1) is negative and highly significant, which indicates that having large values of tangibles substantially decreases cash holdings. Economically, the estimate suggests that, ceteris paribus, a one-interquartile-range increase in asset tangibility lowers cash balances by 11% on average. Column (2) restricts the sample to non-U.S. firms and the estimate of β_1 remains negative and statistically significant at a 1% level. Column (3) shows the full sample result estimated with both U.S. and non-U.S. firms.[3]

[3] To assess the dollar cost of tangibles, we also estimate a level-level regression in which the cash-assets ratio (Cash/Assets) is regressed against asset tangibility and the full set of controls included in our baseline model (Table 2, column 3). The untabulated results suggest that one dollar's worth of tangible capital lowers cash balance by 76

Taken together and in line with the prediction of Equation (5), the results indicate a negative cash-asset tangibility sensitivity in U.S. firms and around the world.

[Table 2 about here]

Next, we turn to investigate the key issue of the paper: the impact of financial development on cash-tangibility sensitivity. Column (4) reports our baseline estimates of Equation (7) using the full sample. We find that β_2, the coefficient of the interaction of financial development and asset tangibility, is positive and statistically significant. This indicates that the negative relation between tangible assets and cash holdings is weakened in countries with more developed financial markets. In terms of economic significance, ceteris paribus, a one-interquartile-range increase in financial development leads to a 63% reduction in the cash-tangibility sensitivity.[4]

The effects of other control variables are broadly consistent with extant literature. For instance, the coefficient of *Asset tangibility* × *Log of GDP per capita* is negative, suggesting higher collateral value of tangible assets in developed economies and thus lower precautionary cash holdings which could be attributed to enhanced tangibles' redeployability and resalability in countries with better economic development.[5] *Market to book* is positively associated with cash balance, suggesting that firms build up cash reserves to explore greater growth opportunities. Consistent with Opler, Pinkowitz, Stulz, and Williamson (1999) and Bates, Kahle, and Stulz (2009), we also find that cash holdings decrease significantly with firm size (*Log of real assets*) and leverage (*Total book leverage*). These indicate that the precautionary motive for cash savings

cents, a 24% reduction that is subtracted from the liquidation value of tangibles in corporate short-term liquidity management.

[4] For a country with the median level of log(GDP per capita), as $Finanical\ Development$ moves from its 1st quartile (0.496) to its 3rd (1.103), the sensitivity changes from -0.495 $(= -0.749 + 0.513 \times 0.496)$ to -0.183 $(= -0.749 + 0.513 \times 1.103)$, a 63% reduction in magnitude.

[5] In line with this argument, Campello and Giambona (2012) show that the relationship between leverage and tangible assets is stronger when federal funds rate is higher, suggesting enhanced asset redeployability during economic booms.

is softened for large firms, and that cash can be used to reduce leverage. The negative sign of *Cash flow* is in line with the notion that cash flow, by providing an alternative source of liquidity, can be viewed as a cash substitute. Finally, a positive sign of firm R&D expenditure is in line with the notion that corporate innovations often require long-term financing.

To mitigate the concern that our result could be driven by a few developed countries with greater data availability (e.g., the U.S. and Japan), we follow related studies (e.g., Dittmar, Mahrt-Smith, and Servaes, 2003; Khurana, Martin, and Pereira, 2006; Kyröläinen, Tan, and Karjalainen, 2013) and conduct a weighted least squares (WLS) regression. In WLS, each country, despite having different numbers of observations, receives an equal weight in the estimation. As shown in column (5), our key finding reported in column (4) is robust to this weighting scheme.

To summarize, our baseline results show that, despite still being a key determinant, the impact of tangibility on cash holdings is substantially lessened by the development of financial markets.

3.2 The quality of institutions: Creditor rights and accounting standards

A well-functioning financial market is an outcome of high-quality underlying institutions (e.g., La Porta, López-de-Silanes, Shleifer, and Vishny, 1998 hereafter LLSV; Djankov, McLiesh, and Shleifer, 2007; Haselmann, Pistor, and Vig, 2010). Financial development is closely related to creditor protection and the quality of financial disclosures. We employ two indices, *Creditor Rights* and *Accounting Standards*, to directly gauge the quality of a country's financial institutions. The two indices have been widely used in related studies as proxies for the quality of financial institutions (e.g., Rajan and Zingales, 1998; Fisman and Love, 2004; Liberti and Mian, 2010; Fernandes, 2011; Shao, Kwok, and Zhang, 2013).

More specifically, *Creditor Rights*, constructed by LLSV (1998), measures the ease with which creditors secure assets in the event of a borrower's default. *Accounting Standards* is an information disclosure intensity index created by examining and rating companies' 1995 annual reports on their inclusion or omission of 90 accounting items.[6] *Accounting Standards* directly measures the quality of information accessibility. And by construction, the index lacks time variation.

3.2.1 Creditor rights

Strong creditor rights protect lenders from agency costs and facilitate repossession of collateral in default (Bhattacharya and Daouk, 2002; Qian and Strahan, 2007). In particular, Mann (2015), focusing on U.S. firms, shows that elevated creditor rights promote the use of patents, an important form of intangible assets, as collateral to support borrowing and loosen loan covenants. He also finds that patents are more likely to be pledged when it is easier for creditors to seize them in bankruptcy. In our global setting, we thus expect that the benefits of strengthened creditor rights accrue disproportionately to firms with large stock of intangible assets.

[Table 3 about here]

Table 3, column (1), reports regression estimates that evaluate the effect of creditor rights on the relationship between cash holdings and asset tangibility. The positive and significant estimate of the interaction term, *Asset Tangibility* × *Creditor Rights*, indicates that cash-tangibility sensitivity is toned down in countries with an effective institutional environment. The results suggest that stronger creditor rights allow firms with low asset tangibility to adopt a more flexible liquidity management strategy.

[6] These items fall into seven categories: general information, income statements, balance sheets, funds flow statement, accounting standards, stock data, and special items.

In addition, we explore variations of legal enforceability across countries to further gauge the impact of creditor rights on cash-tangibility sensitivity. LLSV (1998) document that legal rules provide greater protection for corporate shareholders and creditors and that the quality of legal enforcement varies considerably across countries. Bae and Goyal (2009) further call attention to the importance of contract enforceability and show that both the existence of strong creditor rights per se and effective legal enforcement are important to bank lending. Motivated by their studies, we postulate that strong legal protection, which ensures creditors' easy repossession of collateral, would promote the development of financial markets. Thus, we expect the impact of *Creditor Rights* on cash-tangibility sensitivity to be more pronounced (i.e., a larger estimate of β_2) in countries with strong legal enforcement.

To capture key aspects of a country's relevant legal environment, we use three proxies: duration of contract enforcement, legal formalism, and enforceability of contracts (see the Appendix for detailed description). We rank countries based on one of three enforcement proxies and partition the sample into strong enforcement versus weak enforcement countries using the annual median of the proxy. Table 3, columns (2)–(7), reports the subsample analysis. Focusing on the coefficient of *Asset Tangibility* × *Creditor Rights*, we consistently find that *Creditor Rights*, a fundamental driver of financial development, significantly weakens the dependence of cash holdings on asset tangibility in countries with stronger enforceability (shown in even numbered columns as compared to the corresponding odd numbered columns). The results suggest that strong credit rights, together with effective legal enforcement, are instrumental in enhancing alternative external financing channels, and consequently reducing the sensitivity of cash holdings to asset tangibility.

3.2.2 Accounting standards

Lenders typically demand sizable tangible assets as collateral to reduce their high risk exposure to opaque borrowers. This is because a borrower's repayment prospects along with other useful information can be obtained by evaluating the quality and nature of its collateral (Picker, 1992). However, financial development, in the form of better accounting and disclosure rules, could decrease banks' dependence on tangibles and allow them to consider intangible collateral or even the provision of unsecured loans.[7]

In Table 4, we explore the effect of *Accounting Standards*, an institutional measure of financial development that appraises a country's corporate disclosure quality, on cash-tangibility sensitivity.[8] Column (1) shows that the coefficient of *Asset Tangibility* × *Accounting Standards* is positive and significant. This suggests that high accounting standards have a significant attenuating impact on the negative link between cash and tangibility. High-quality information accessibility helps alleviate information asymmetry and facilitates the use of alternative instruments in constraining managers from risk shifting, thereby weakening the role of tangible assets as collateral in lending.

We further anticipate that the impact of high accounting standards on cash-tangibility sensitivity is more marked in the presence of a greater degree of information asymmetry between a firm and its outside lenders. We carry out a subsample analysis and report the results in Table 4, columns (2)–(7). Specifically, in every year for a country, we separate firms according to the median of each of the three information asymmetry proxies: 1) firm age, 2) growth opportunities measured by Tobin's *Q*, and 3) R&D intensity calculated as R&D expenditures divided by sales.

[7] Creditors can enhance credit availability by providing unsecured loans through softer lending technologies based on, for instance, borrowers' credit history and reputation, or through the use of more restrictive financial covenants or indentures.

[8] *Accounting Standards*, measured based on companies' 1995 annual reports, is time invariant and therefore completely absorbed by country fixed effects.

Throughout subsamples, we find that the coefficient estimate of *Asset Tangibility* × *Accounting Standards* is of greater magnitude and statistically more significant among firms with a higher level of information asymmetry (i.e., younger, with higher Tobin's *Q* or R&D intensity as shown in even numbered columns). This finding suggests that better accounting standards reduce the cash cost of tangibles, especially for firms with a greater degree of information asymmetry.

[Table 4 about here]

Taken together, the results presented in this subsection attest the main findings in Section 3.1, and show that institutions that promote financial development alleviate the sensitivity of corporate cash policy to asset tangibility.

3.3 The real effects of financial development

We have shown that financial development reduces cash-tangibility sensitivity and benefits firms with more intangible assets by allowing them to reserve less cash and invest more. In this subsection, we examine the real effects of financial development in stimulating the growth of firms with low asset tangibility.

3.3.1 Firm investment

We first explore the link between financial development and firm investment decisions to shed light on the implications of our study for economic growth. Our previous findings show that a developed financial market allows low-tangibility firms to hoard less cash, which could, in turn, enable them to invest more and grow faster. We examine this implication by studying the impact of financial development on asset tangibility sensitivity of investment. The specification of our firm-level investment regression is in line with Faulkender and Petersen (2012) and Harford, Klasa, and Maxwell (2014).

[Table 5 about here]

Table 5, column (1) shows that the coefficient of *Asset Tangibility* is positive and highly significant, suggesting that a firm's investment policy is related to its tangibility level. In column (2), we further include the interaction term, *Asset Tangibility* × *Financial Development* (proxied by *private credit per GDP*), to assess the role of financial development. The coefficient of *Asset Tangibility* × *Financial Development* is negative and statistically significant. This indicates that financial development reduces the impact of asset tangibility on firm investment decisions. As a result, firms with low asset tangibility can invest more in better developed financial markets. Similar to the WLS regression conducted in our baseline analysis (Table 2, column 5), column 3 provides confirmatory evidence when each country, despite having different number of observations, is assigned an equal weight in the estimation. The firm-level investment analysis shows that financial development enables firms with fewer tangible assets to invest more by reducing cash-tangibility sensitivity. Our finding is consistent with Love (2003) who documents that financial development reduces financing constraint and thus promotes an efficient capital allocation.

3.3.2 Industrial growth

Our analysis implies that financial development, by expanding the scope of acceptable collateral and opening up alternative credit sources, would disproportionately benefit industries with low asset tangibility. To shed light on the differential impact of financial development on the growth of sectors with different asset tangibility ratios, we estimate an industry-level regression model. Following Manova (2008), Maskus, Neumann, and Seidel (2012), and Hsu, Tian, and Xu (2014), the model is specified as follows:

$$
\begin{aligned}
&Industry\ growth_{i,c,t}\ \left(or\ R\&D\ intensity\ growth_{i,c,t}\right) \\
&\quad = \beta_0 + \beta_1 Initial\ Share_{i,c}\left(or\ Initial\ R\&D\ Share_{i,c}\right) \\
&\quad + \beta_2 Dependence_i \times Finanical\ Development_{c,t} \\
&\quad + \boldsymbol{\beta_3} Asset\ Tangibility_i \times Finanical\ Development_{c,t} \\
&\quad + \beta_4 Finanical\ Development_{c,t} + \beta_5 Dependence_i \\
&\quad \times log(GDP\ per\ capita)_{c,t} + \beta_6 Asset\ Tangibility_i \\
&\quad \times log(GDP\ per\ capita)_{c,t} + \beta_7\ log(GDP\ per\ capita)_{c,t} + \eta_i + \eta_c \\
&\quad + \eta_t + \varepsilon_{i,c,t},
\end{aligned}
\tag{2}
$$

where the dependent variable measures industry or R&D intensity growth rate (annual real value-added). The subscripts *i*, *c*, and *t* indicate industry, country, and year, respectively. Specifically, $Industry\ growth$ is the annual real value-added growth rate. $R\&D\ intensity\ growth$, obtained from OECD data, is the growth rate of industry-level R&D expenditures as a share of value added in each country. $Initial\ Share$ denotes the industry's initial share of total value-added.[9] Similarly, $Initial\ R\&D\ Share$ is the industry's initial share of total R&D value-added.[10] Rajan and Zingales (1998) show that well-developed financial markets lead to higher growth in industries that rely more on external finance. Therefore, to control for external financing dependence, we include $Dependence$, which measures an industry's dependence on external finance and is calculated as the fraction of capital expenditures not financed by internal funds. $Asset\ Tangibility$ is the industry-level asset tangibility (Berger, Ofek, and Swary, 1996; Almeida and Campello, 2007). η_i, η_c, and η_t denote the dummies for industry *i*, country *c*, and year *t*, respectively. The direct effects

[9] The value-added data are obtained from the UNIDO Industrial Statistics Database (INDSTAT4) at the 2-digit level of the International Standard Industrial Classification of All Economic Activities (ISIC) Revision 3 pertaining to the manufacturing sector.

[10] We obtain industry-level R&D expenditures (ISIC Rev. 3) from the OECD STAN database for industrial analysis.

of $Dependence$ and $Asset\ Tangibility$ are absorbed by industry fixed effects. Furthermore, because financial development tends to be positively correlated with economic development, we include the natural logarithm of GDP per capita as a control for economic development and interact it with *Asset Tangibility* and *Dependence* to capture other aspects of a country's economic activities (Liberti and Mian, 2010; Mitton, 2012). Our sample covers the period of 1990–2010 and includes 22 ISIC industries at the two-digit level.

Consistent with Rajan and Zingales (1998), a positive β_2 ($\beta_2 > 0$) would indicate that a better-developed financial market leads to higher growth in industries that rely more on external finance. The focal point of our analyses in this subsection centers on β_3, the coefficient of *Asset Tangibility* × *Financial Development*. Specifically, our rationale suggests that the coefficient is less than zero ($\beta_3 < 0$) – ceteris paribus, in economies with better-developed financial systems, sectors with larger proportions of intangible assets (i.e., smaller values of *Asset Tangibility*) would enjoy higher growth.

The regression results are reported in Table 6. The standard errors are clustered by country to allow for correlations among industries in the same country. Column (1) confirms the finding documented by Rajan and Zingales (1998): as indicated by the positive and significant interaction term, *Dependence* × *Financial Development*, industrial sectors that rely more on external finance grow faster in countries with stronger financial markets.

Further, the result indicates that β_3, the coefficient of the interaction term *Asset Tangibility* × *Financial Development*, is negative and highly significant. It implies that industries with less tangible assets, and thus higher levels of intangibles, grow faster and benefit from financial

development to a greater extent.[11] In column 2, where we turn to R&D intensity growth, β_3 remains negative and statistically significant, indicating that financial development fosters R&D activities in intangible-rich industries.

[Table 6 about here]

In sum, we provide evidence that firms operating in sectors with low asset tangibility benefit more from financial development. These results corroborate our earlier findings that financial development relaxes the liquidity constraints of young and R&D intensive firms that often have limited collateralizable hard assets, and hence stimulates investment and growth.

3.4 Robustness checks

In this subsection, we conduct additional analyses to alleviate the omitted variables concern and examine the robustness of our finding regarding the role of financial development in corporate cash management.

3.4.1 Country heterogeneity

Countries are intrinsically different in many aspects, which, in addition to financial development, may also influence the relationship between tangibility and cash holdings. In previous analyses, we include country-level fixed effects to absorb country-specific unobserved heterogeneity. In this section, to examine the robustness of our findings, we partition the full sample based on a few key macroeconomic variables that tend to strongly affect corporate financial decisions and examine the robustness of our finding across these subsamples. In particular, we focus on 1) *R&D per GDP* defined as total domestic intramural R&D expenditure as a percentage of a country's GDP; and 2) national average income proxied by *GDP per capita*. The former is widely used to assess a

[11] In untabulated results, we provide further evidence that firms operating in industries that depend more heavily on external financing or have more intangible assets also perform better in economies with developed financial systems. Firm performance is measured by return on assets and return on sales.

country's relative capacity of investment in generating new knowledge (e.g., Feenstra, Inklaar, and Timmer, 2015); and the latter reflects the degree of economic development. For each variable, we split the sample based on the corresponding annual median and re-estimate our baseline specification (Eq.1) in each subsample. The estimates are reported in Table 7.

[Table 7 about here]

The coefficient of the interaction term *Asset Tangibility* × *Financial Development* (β_2, Eq. 1) remains positive and statistically significant across subsamples. To the extent that these subgroups of countries may differ in many aspects of economic and financial environments, our results highlight the robustness of financial development in reducing cash-tangibility sensitivity across countries. Moreover, β_2 has a larger magnitude and greater significance level in high-tech and high-income countries (shown in Columns 1 and 3, respectively). This further corroborates a strengthened role of financial development in knowledge-based economies, where firms often have lower asset tangibility.[12] In addition, the coefficient of *Asset Tangibility* is also of a smaller magnitude in low-tech and emerging markets (Columns 2 and 4, respectively), which suggests that, ceteris paribus, the collateral value of tangible assets is heavily discounted in less developed economies.

3.4.2 Alternative model specifications

Throughout our analysis we control for a full set of country, industry, and year fixed effects to absorb various time-invariant omitted variables. We now consider several different regression specifications to further mitigate the endogeneity issue. The results are presented in Table 8.

[Table 8 about here]

[12] In untabulated results, we obtain similar findings when partitioning based on *TFP* (total factor productivity), which is considered as a key driver of economic growth and an economy's long-term technological competitiveness. More specifically, *TFP* is the portion of output not explained by traditionally measured inputs of labor and capital used in production. The data is obtained from Penn World Table (version 9.0) database.

In Columns 1 and 2, the baseline model is augmented to include multiple interactive fixed effects. Column 1 tests the robustness of our finding by having country×industry fixed effects. This factors out omitted time-invariant characteristics that are specific to an industry in a particular country (e.g., country-industry shocks). Column 2 includes country×year and industry×year fixed effects to explicitly account for time-varying country and industry factors that may affect cash-tangibility sensitivity. Column 3 uses firm-level fixed effects to absorb time-invariant heterogeneity at the firm level. Column 4 performs a changes regression where we regress change of cash holdings on changes of all control variables specified in Equation (1). This practice helps to control for omitted variables that evolve only slowly over time. Our key finding (i.e., $\beta_2 > 0$) is fully retained across all four specifications.

3.4.3 An instrumental variable analysis

Here we conduct an instrumental variable analysis to further alleviate the concern that both asset tangibility and financial development could be endogenous in determining cash holdings. Following Liberti and Mian (2010), we instrument *Private credit to GDP* using *Legal Origin* (LLSV, 1998), *Creditor Rights*, and *Information Sharing*. The three instruments capture different country-level aspects of the development of financial systems.

Our instruments for asset tangibility are motivated by the rationale that a firm's asset tangibility is correlated with its manufacture structure (the use of machinery and equipment) and labor configuration. Following Schlingemann, Stulz, and Walkling (2002) and Campello and Giambona (2013), the first instrument for asset tangibility, *IndustryResale*, is a measure that proxies the liquidity of the market for second-hand machinery and equipment within the industry where the firm operates. In an industry for a given year, it is calculated as the ratio of the median of firm-level sales of PP&E to that of total PP&E and capital expenditures. The higher the ratio,

the more active the supply and demand conditions of the second-hand market are. In a liquid secondary market, a firm can acquire used equipment and integrate it into its production process at a lower cost (Gavazza, 2011); meanwhile, the firm incurs a smaller cost of carrying those assets on its balance sheets (Almeida and Campello, 2007). Therefore, a firm's asset tangibility should be related to the liquidity of machinery and equipment within the industry.

The second instrument, denoted as *IndustryLabor*, is defined as the industry-year median ratio of the number of employees scaled by total assets. *IndustryLabor* is used by Garmaise (2008) and Campello and Giambona (2013) to instrument firm tangibility. *IndustryLabor* measures the typical technology level in an industry (Williams, 1995; MacKay and Phillips, 2005), and thus is related to the use of tangible assets in corporate production.

The validity of the IVs is closely examined. For a variable to be qualified as a valid instrument, it must be both relevant (highly correlated with the endogenous explanatory variable) and exogenous (uncorrelated with the regression residuals). Instrument relevance is confirmed by first-stage regressions (untabulated for brevity): *Legal Origin*, *Creditor Rights*, and *Information Sharing* are significantly related to financial development; and *IndustryResale* and *IndustryLabor*, bearing the expected signs are statistically significantly related to asset tangibility. Instrument relevance is further established by the Angrist-Pischke's weak identification test. We also conduct Hansen's *J* overidentification test, which has a joint null hypothesis of proper IVs (relevance and exogeneity). The validity of IVs is substantiated by the fact that we cannot reject the null hypothesis at a conventional level of significance.

[Table 9 about here]

The results of the IV regression and related IV validity tests are reported in Table 9. We find that our baseline regression results (Table 2, column 4) are fully retained. After controlling for

potential endogeneity, the diminishing effect of financial development on cash-tangibility sensitivity remains highly significant as the coefficient of $Asset\ Tangibility \times Private\ credit\ per\ GDP$ (column 1) remains positive and highly significant.

Table 9, columns (2) and (3) revisit the role of financial institutions (presented in Table 3, column 1 and Table 4, column 1). We continue to instrument asset tangibility with *IndustryResale* and *IndustryLabor*, and find confirmatory evidence that high intuitional quality, as reflected in creditor rights and accounting standards, eases the reliance of cash on tangibles.

To summarize, after accounting for potential endogeneity, our previous finding that the improvement of a country's financial market weakens the linkage between cash holdings and asset tangibility is fully retained.

3.4.4 Alternative measures of financial development

We employ three alternative measures of financial development to assess the robustness of our key results. First, following Khurana, Martin, and Pereira (2006), we construct an index (*FININT*) that equals the sum of standardized indices of a) the ratio of liquid liabilities to GDP and b) the total amount of credit from deposit money banks and other financial institutions going to the private sector over GDP.[13] *FININT* aims to quantify the overall level of financial intermediary development. Second, we use *Financial Disclosure* as an alternative institutional measure of financial development.. The variable assesses the overall quality of a country's corporate reporting environment and provides an average ranking of the prevalence of disclosures concerning various areas of corporate operations.[14] These disclosures are proprietary in nature and useful for creditors

[13] The two components used to construct *FININT* are provided by Beck, Demirgüç-Kunt, and Levine (2010). Please refer to the appendix for variable definitions.

[14] Those areas include research and development expenses, capital expenditures, product and geographic segment data, subsidiary information, and accounting methods and policies. *Financial disclosure* is measured based on the data collected by the Center for Financial Analysis and Research (CIFAR) in 1995. *Financial Disclosure* is not introduced additively because it is time invariant and therefore fully absorbed by country fixed effects.

in evaluating borrower risks and tailoring loan contracts. The third proxy of financial development is the inverse of the banks' overhead costs as a share of the total bank assets (Beck, Demirgüç-Kunt, and Levine, 2010). This measure is denoted as *Inverse of Overhead Costs*.

With each alternative measure of financial development, we re-estimate the baseline specification (Table 2, column 4) and report the results in Table 10. We find that the coefficients of *Asset Tangibility* × *FININT* (column 1), *Asset Tangibility* × *Financial Disclosure* (column 2), and *Asset Tangibility* × *Inverse of Overhead Costs* (column 3) are all positive and statistically significant. This suggests that the development of financial intermediaries and better financial disclosures contribute greatly to ease financing constraints due to limited availability of tangible collateral.

Columns (4)–(6) report the results obtained using the WLS regression. The weight is set to the reciprocal of the number of a country's observations so that countries receive equal weight in the estimation. Correspondingly, the results are similar to those reported in columns (1)–(3).

[Table 10 about here]

Collectively, the additional analyses carried out in this subsection underline the robustness of our finding that financial development reduces the impact of tangibles on corporate cash policy.

4. Conclusion

In the presence of contracting frictions and limited enforceability, tangible assets are conventionally demanded by external capital providers as collateral against borrowing. The decline of tangible capital on corporate balance sheets in recent decades could limit firms' debt capacity and compel cash hoarding. Stiff cash policy is costly as excess cash reserve is often accumulated at the expense of forgoing investment opportunities. Therefore, the cash cost of tangibility has significant implications on corporate policies and country-level economic growth.

In light of the rising importance of intangible capital in corporate asset portfolio, it is of great importance to understand how the development of a country's financial system shapes corporate cash reserves and investment decisions through the channel of tangible assets.

Using data covering 45 countries from 1990 to 2013, we find strong evidence that financial development reduces the sensitivity of cash holdings to asset tangibility. Our findings also highlight that institutions, which enhance financial development in terms of better creditor rights and transparency, alleviate cash-tangibility sensitivity. Furthermore, we show that financial development promotes investment made by firms with fewer tangible assets, and allows low-tangibility industries to grow faster. Our results further the understanding of the determinants of cash holdings by showing that country-level factors (e.g., financial development and institutional quality) could interact with firm-specific characteristics in shaping corporate cash policy.

Large asset tangibility sensitivities of cash holdings and investment are a sign of imperfections in a country's financial market because, in a frictionless market, a firm's investment decision should only be based on future expected cash flows and cash holdings become irrelevant. It has long been recognized that financial development reduces financing frictions and promotes economic growth (e.g, King and Levine, 1993; Levine, 1997). Our analysis highlights an important mechanism through which financial development facilitates economic growth–limiting the reliance of corporate financial and investment policies on the stock of tangible assets.

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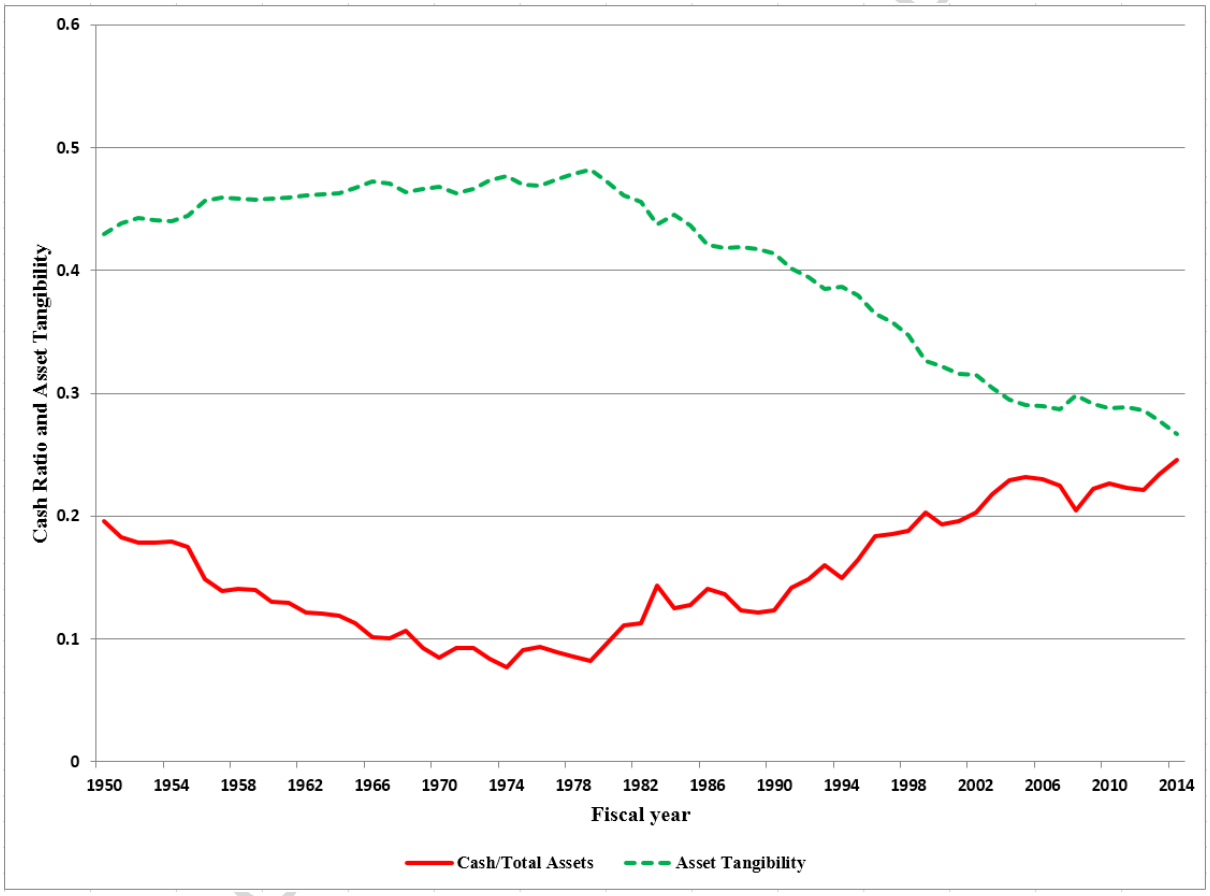
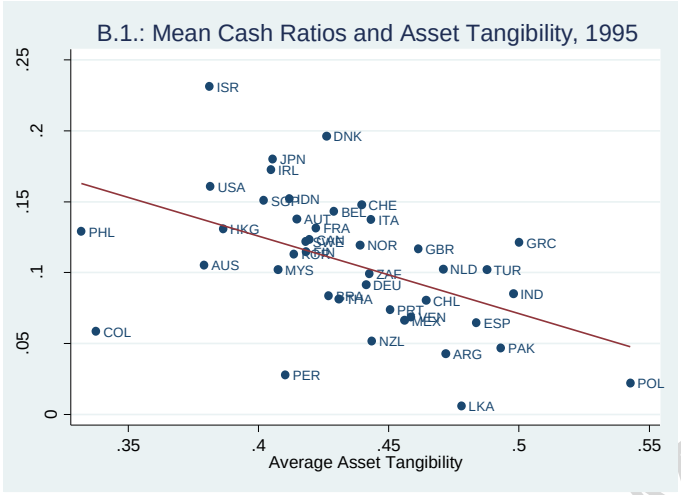
Figure 1. The negative cash-tangibility sensitivity

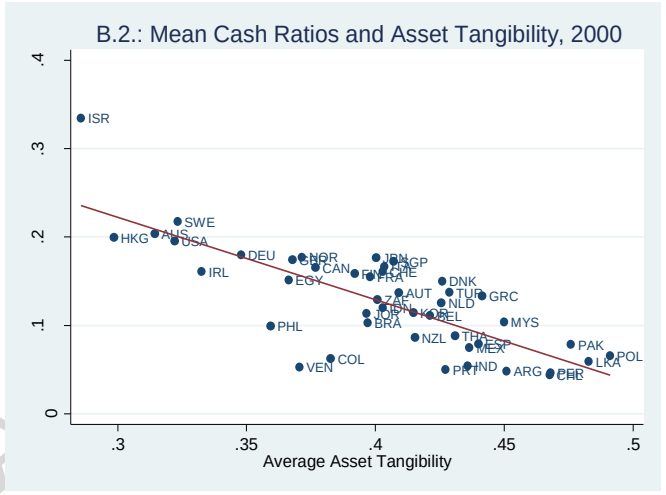
The sample covers fiscal years 1950-2014. We require Compustat firm-year observations to have positive cash holdings, positive total assets, positive sales, and non-missing values of fixed assets. Financial firms (SIC code 6000-6999) and utility firms (4900-4999) are excluded, leaving an unbalanced panel of 230,261 observations for 18,462 unique firms. *Cash Ratio* is measured as the ratio of cash and marketable securities to the book value of total assets. As in Berger, Ofek, and Swary (1996), *Asset Tangibility* is defined as the ratio of (0.715×Receivables + 0.547×Inventories + 0.535× Fixed Capital) to the book value of total assets. All continuous variables are winsorized at the 1% and 99% levels. See the Appendix for detailed variable definitions.

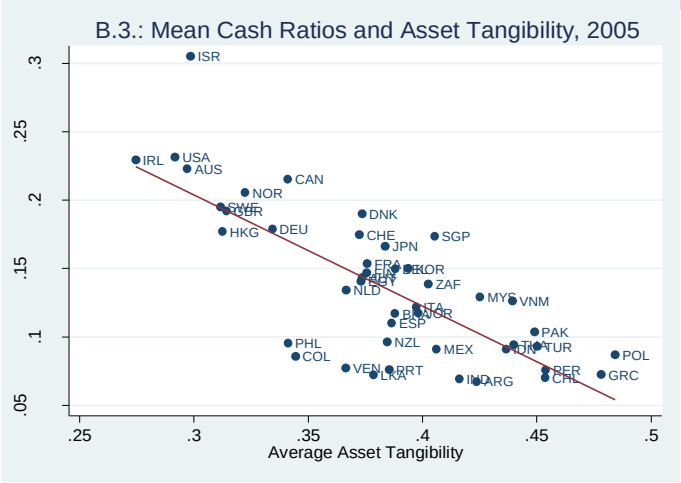
Panel A. Average cash-to-asset ratio and asset tangibility (1950-2014; U.S. firms only)



Panel B. The relation between the average cash-to-asset ratio and asset tangibility around the world
Panel B provides scatter plots of the annual mean of the cash-to-assets ratio against that of asset tangibility for fiscal years 1995, 2000, 2005 and 2010.







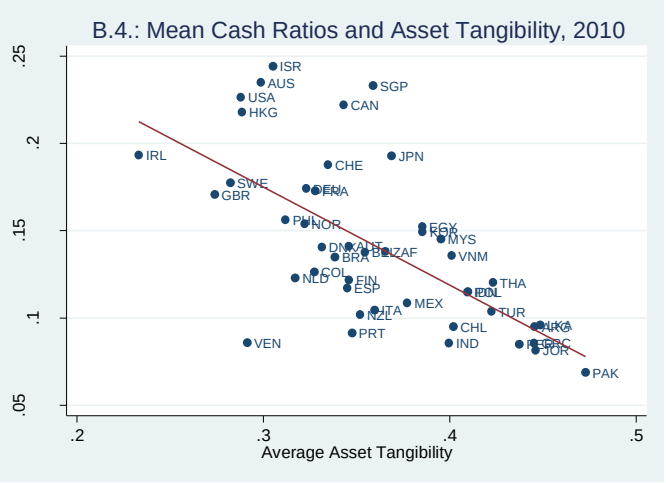


Table 1. Summary statistics

This table presents descriptive statistics including country-level medians of key variables. The firm-level data for 45 countries are drawn from the Compustat North America and Compustat Global Fundamentals Annual databases for the period 1990-2013. *Cash/Net Assets* is the ratio of cash plus marketable securities (CHE) divided by assets. Assets are calculated as the book value of total assets (AT) net of cash (CHE). Following Berger et al. (1996), *Asset Tangibility* is defined as 0.715×receivables (RECT) + 0.547×inventories (INVT) + 0.535×fixed capital (PPENT), deflated by book value of total assets (AT) net of cash (CHE). *Private Credit/GDP* is the domestic credit provided to the private sector as a percentage of GDP. The definitions of all variables are provided in the Appendix.

Country	No. of firm-years (1)	No. of unique firms (2)	Average no. of firms per year (3)	Cash/ net assets (%) (4)	Asset tangibility (%) (5)	Private credit/ GDP (%) (6)
Argentina	480	53	25	5.9	50.7	28.8
Australia	11,815	1,464	473	10.4	45.1	96.3
Austria	1,175	109	51	9.5	47.3	123.2
Belgium	1,454	129	58	8.6	48.7	113.5
Brazil	2,356	283	118	11.4	45.6	86.5
Canada	9,133	1,236	304	7.9	49.5	116.0
Chile	1,143	118	60	5.0	49.0	79.1
Colombia	221	26	13	5.9	36.1	41.1
Denmark	1,807	161	46	9.3	50.8	149.9
Egypt	486	83	29	12.5	50.2	83.9
Finland	1,895	145	68	9.0	46.0	76.7
France	8,848	821	268	11.3	46.6	102.2
Germany	9,343	820	275	9.7	45.4	127.2
Greece	2,285	226	120	5.2	52.8	91.9
Hong Kong, China	1,837	135	73	17.8	42.2	141.1
India	12,294	1,698	559	4.1	49.1	54.3
Indonesia	3,587	323	156	8.0	49.9	47.1
Ireland	903	83	38	11.0	48.4	105.6
Israel	1,446	225	85	19.9	47.3	78.0
Italy	3,036	277	117	8.3	48.7	96.3
Japan	42,332	3,534	1,693	15.9	48.2	302.5
Jordan	323	69	19	4.3	50.2	90.0
Korea, Rep.	9,391	1,240	348	12.3	47.3	123.4
Malaysia	11,127	932	397	9.2	51.9	127.8

Mexico	1,340	114	58	6.7	48.0	36.1
Netherlands	2,458	210	107	6.9	48.7	144.3
New Zealand	870	107	44	3.1	47.3	109.6
Norway	1,195	149	36	13.5	48.7	68.2
Pakistan	1,949	197	89	4.0	52.8	47.8
Peru	638	66	32	4.0	50.4	19.0
Philippines	1,305	129	59	7.7	44.1	51.4
Poland	2,593	332	74	6.0	51.6	37.2
Portugal	749	67	36	3.9	43.6	135.6
Singapore	6,941	642	267	16.9	51.7	72.6
South Africa	3,028	302	132	10.7	50.1	159.9
Spain	1,821	160	40	6.6	48.8	118.2
Sri Lanka	964	134	48	4.6	52.5	40.8
Sweden	4,035	414	139	10.7	42.7	116.4
Switzerland	3,101	238	129	13.4	49.3	162.8
Thailand	5,557	465	232	6.1	51.0	131.2
Turkey	1,531	173	55	7.3	51.4	42.1
United Kingdom	20,625	2,072	458	9.4	48.5	133.0
United States	93,859	9,017	3,754	10.6	44.9	199.9
Venezuela	153	16	9	6.0	49.5	20.1
Vietnam	1,091	228	136	9.8	48.3	48.0

Table 2. Baseline results: Financial development and cash-tangibility sensitivity

This table explores how the sensitivity of cash holdings to asset tangibility varies with financial development. The dependent variable is the natural logarithm of the ratio of cash and equivalents divided by total assets net of cash. Columns (1) through (4) report OLS estimates. Columns (1) and (2) show regression estimates using only U.S. and non-U.S. firms, respectively. The remaining columns report results using the full sample. Column (5) presents the weighted least squares (WLS) estimates. The weight is the inverse of the number of observations for a country so that each country receives the equal weight in the estimation. Values of *t*-statistics, reported in parentheses, are based on standard errors that are robust to heteroscedasticity and are firm-year two-way clustered. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable: Ln(Cash/Assets)	(1) U.S. OLS	(2) Non-U.S. OLS	(3) Full OLS	(4) Full OLS	(5) Full WLS
Asset tangibility	-0.337***	-0.265***	-0.260***	-0.749***	-0.732***
	(-2.74)	(-2.62)	(-3.30)	(-5.42)	(-13.35)
Asset tangibility × Private credit per GDP				0.513***	0.479***
				(3.18)	(9.12)
Private credit per GDP				-0.124	-0.141***
				(-1.01)	(-5.32)
Asset tangibility × Log of GDP per capita				-0.346***	-0.346***
				(-3.53)	(-8.65)
Log of GDP per capita				0.128	0.181***
				(0.81)	(3.97)
Market to book	0.171***	0.123***	0.148***	0.148***	0.141***
	(24.03)	(21.49)	(31.63)	(32.06)	(67.39)
Log of real assets	-0.150***	-0.086***	-0.102***	-0.103***	-0.097***
	(-13.95)	(-10.98)	(-16.61)	(-17.14)	(-61.66)
Cash flow	-0.332***	-0.376***	-0.410***	-0.409***	-0.412***
	(-8.65)	(-5.88)	(-10.55)	(-10.44)	(-29.60)
Total capital expenditures	2.505***	1.660***	1.938***	1.953***	1.890***
	(13.95)	(15.21)	(21.08)	(21.34)	(47.08)
Total book leverage	-1.487***	-1.387***	-1.443***	-1.451***	-1.451***
	(-18.11)	(-26.44)	(-39.41)	(-40.91)	(-105.75)
R&D expenditures	0.482***	0.632***	0.584***	0.576***	0.595***
	(14.34)	(17.25)	(21.97)	(21.98)	(45.48)
Constant	-2.211***	-2.618***	-2.630***	-2.432***	-2.390***
	(-7.89)	(-13.86)	(-13.32)	(-7.77)	(-25.37)
Country fixed effects	No	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Number of observations	93,859	200,661	294,520	294,520	294,520
Adj. R^2	0.39	0.26	0.30	0.30	0.29

Table 3. The quality of institutions: Creditor rights and legal enforcement

This table examines the effect of creditor rights, an institutional measure of financial development, on the cash-tangibility sensitivity, and whether this effect varies with the enforceability of contracts (Bae and Goyal, 2009). *Creditor Rights* ranges from zero to four and measures the ease with which creditors repossess a bankrupt firm's assets. The degree of legal enforcement of creditor rights is measured by three proxies: *Duration of Enforcement*, *Legal Formalism*, and *Enforceability of Contracts*. Short enforcement time, low legal formalism, and high enforceability of contracts reflect a high degree of legal enforcement. Specifically, *Duration of Enforcement* is the number of days it takes to resolve a dispute and eventually enforces a basic business contract. *Legal Formalism* is a check-based index that measures substantive and procedural statutory intervention in judicial cases at lower-level civil trial courts. A higher score of the index implies that the court system is slower (more bureaucracy) and less efficient. The index measures how efficiently the courts in the borrower's country enforce contracts. Court efficiency matters because the ability of lenders to enforce (or to threaten to enforce) specific clauses of a loan contract (e.g., covenants) and to seize collateral depends on the costs of resorting to the legal system. *Enforceability of Contracts* is an index ranging from zero to ten with higher scores indicating higher enforceability. It represents the relative degree to which contractual agreements are honored and complications due to language and mentality differences. Values of *t*-statistics, reported in parentheses, are based on standard errors that are robust to heteroscedasticity and are firm-year two-way clustered. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Partition by legal enforcement proxy		Duration of enforcement		Legal formalism		Enforceability of contracts	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable: Ln(Cash/Assets)	Full sample	Short	Long	Low	High	High	Low
Asset tangibility	-0.550***	-0.916***	-0.082	-0.949***	0.159	-0.750***	-0.542**
	(-4.67)	(-6.42)	(-0.32)	(-5.89)	(0.74)	(-3.73)	(-2.39)
Asset tangibility × Creditor rights	0.129**	0.236***	-0.101	0.392***	-0.496	0.293***	-0.014
	(2.13)	(3.62)	(-0.75)	(5.48)	(-1.30)	(3.72)	(-0.17)
Creditor rights	-0.283***	-0.414***	0.008	0.195***	0.299***	-0.611***	0.014
	(-3.37)	(-6.03)	(0.07)	(4.22)	(2.76)	(-6.62)	(0.13)
Asset tangibility × Log of GDP per capita	-0.277***	0.664***	-0.437***	0.359*	-0.450***	0.909*	-0.371***
	(-2.73)	(2.78)	(-3.10)	(1.66)	(-3.09)	(1.68)	(-2.77)
Log of GDP per capita	0.191	-0.005	0.523***	0.015	0.201	-2.130***	0.526***
	(1.15)	(-0.02)	(3.14)	(0.06)	(1.11)	(-3.02)	(3.00)
Market to book	0.148***	0.173***	0.092***	0.176***	0.090***	0.176***	0.097***
	(31.68)	(30.83)	(12.13)	(29.98)	(12.42)	(30.64)	(12.49)
Log of real assets	-0.103***	-0.123***	-0.019	-0.127***	-0.078***	-0.113***	-0.098***
	(-16.89)	(-20.91)	(-1.53)	(-19.28)	(-9.87)	(-14.70)	(-13.53)
Cash flow	-0.411***	-0.446***	0.031	-0.471***	0.304**	-0.464***	-0.052
	(-10.54)	(-12.12)	(0.30)	(-14.01)	(2.23)	(-11.49)	(-1.00)

Total capital expenditures	1.944***	1.995***	1.505***	2.042***	1.427***	2.154***	1.806***
	(21.20)	(17.33)	(10.04)	(16.00)	(11.62)	(14.23)	(19.47)
Total book leverage	-1.446***	-1.405***	-1.565***	-1.588***	-1.182***	-1.535***	-1.326***
	(-39.66)	(-32.05)	(-21.00)	(-29.14)	(-17.94)	(-23.14)	(-19.41)
R&D expenditures	0.577***	0.491***	0.999***	0.433***	1.003***	0.452***	0.729***
	(22.01)	(16.73)	(12.76)	(14.37)	(13.16)	(15.22)	(15.94)
Constant	-2.167***	-1.302***	-2.756***	-2.713***	-2.430***	-0.695**	-1.906***
	(-5.50)	(-3.22)	(-6.85)	(-15.26)	(-5.73)	(-2.23)	(-4.79)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	294,520	218,996	75,524	162,573	131,947	144,924	145,602
Adj. R^2	0.30	0.33	0.21	0.34	0.28	0.34	0.27

Table 4. The quality of institutions: Accounting standards and information asymmetry

This table studies the effect of accounting standards, another institutional measure of financial development, on cash-tangibility sensitivity, and whether the effect varies with the degree of information asymmetry. *Accounting Standards* is an information disclosure intensity index created by examining and rating companies' 1995 annual reports on their inclusion or omission of 90 accounting items. These items fall into seven categories: general information, income statements, balance sheets, funds flow statement, accounting standards, stock data, and special items. *Accounting Standards* reflects the quality of information available to creditors and the costs of lender monitoring and screening. High accounting standards help alleviate information asymmetry, and therefore promote lending and weakens the need of posting tangible assets as collateral. The degree of information asymmetry is measured by three proxies: firm age, growth opportunities proxied by Tobin's *Q*, and R&D intensity measured by R&D expenditures divided by sales. Young, growth, or high R&D intensity firms usually exhibit a high degree of information asymmetry. The sample is partitioned according to the annual median value of an information asymmetry proxy in a country. Values of *t*-statistics, reported in parentheses, are based on standard errors that are robust to heteroscedasticity and are firm-year two-way clustered. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Partition by information asymmetry proxy		Firm age		Tobin's *Q*		R&D intensity	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable: Ln(Cash/Assets)	Full sample	Young	Mature	High	Low	High	Low
Asset tangibility	-4.488***	-5.954***	-2.566**	-5.127***	-3.644***	-7.995***	-2.895***
	(-5.12)	(-5.87)	(-2.19)	(-5.15)	(-3.44)	(-7.19)	(-3.02)
Asset tangibility × Accounting standards	5.537***	7.779***	2.696*	6.685***	4.215***	10.929***	3.288**
	(4.70)	(5.75)	(1.74)	(5.02)	(3.03)	(7.41)	(2.57)
Asset tangibility × Log of GDP per capita	-0.642***	-0.688***	-0.606***	-0.263*	-0.830***	-0.904***	-0.556***
	(-5.22)	(-4.49)	(-3.82)	(-1.76)	(-5.21)	(-4.72)	(-4.10)
Log of GDP per capita	0.515***	0.571***	0.643***	0.360**	0.606***	0.131***	0.148***
	(3.24)	(3.27)	(3.45)	(2.42)	(2.99)	(19.70)	(24.69)
Market to book	0.154***	0.144***	0.160***	0.111***	0.278***	-0.101***	-0.115***
	(31.47)	(22.32)	(24.32)	(23.62)	(5.00)	(-15.08)	(-16.17)
Log of real assets	-0.104***	-0.124***	-0.097***	-0.125***	-0.085***	-0.430***	-0.355***
	(-17.02)	(-12.75)	(-12.20)	(-19.14)	(-11.68)	(-13.79)	(-5.76)
Cash flow	-0.429***	-0.483***	-0.178***	-0.263***	-0.942***	2.650***	1.713***
	(-11.38)	(-11.94)	(-3.56)	(-9.06)	(-16.11)	(13.83)	(15.80)
Total capital expenditures	1.909***	1.989***	1.695***	1.651***	1.871***	-1.285***	-1.448***
	(19.97)	(16.83)	(14.04)	(15.90)	(14.85)	(-19.47)	(-35.74)
Total book leverage	-1.462***	-1.482***	-1.405***	-1.315***	-1.660***	0.432***	7.363
	(-39.58)	(-31.72)	(-28.03)	(-31.11)	(-35.77)	(16.71)	(1.30)
R&D expenditures	0.563***	0.513***	0.706***	0.550***	0.660***	-2.316***	-1.718***

	(21.56)	(17.81)	(15.12)	(21.48)	(14.45)	(-5.17)	(-5.41)
Constant	-2.088***	-1.808***	-1.853***	-1.986***	-2.088***	-2.795***	-2.340***
	(-6.28)	(-4.33)	(-4.84)	(-6.30)	(-5.11)	(-7.99)	(-10.85)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	284,685	134,049	150,636	142,730	141,955	102,357	182,328
Adj. R^2	0.31	0.35	0.26	0.33	0.25	0.40	0.22

Table 5. Firm investment, asset tangibility, and financial development

This table tests whether the impact of asset tangibility in corporate investment declines in better developed financial systems. Dependent variable is *Investment*, which is defined as the sum of capital expenditures (CAPX) and research and development (XRD) and advertising expenses (XAD), divided by the book value of total assets (AT). Similar to Faulkender and Petersen (2012) and Harford, Klasa, and Maxwell (2014), the independent variables include market-to-book assets, the natural logarithm of real assets, leverage, and pre-investment earnings [defined as earnings before interest, taxes, depreciation, and amortization (EBITDA) plus research and development (XRD) and advertising expenses (XAD), scaled by book assets (AT)]. All regressions contain country, industry, and year fixed effects. Values of *t*-statistics, reported in parentheses, are based on standard errors that are robust to heteroscedasticity and are firm-year two-way clustered. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable: Investment	(1) OLS	(2) OLS	(3) WLS
Asset tangibility	0.029***	0.093*	0.085***
	(8.08)	(1.82)	(3.11)
Asset tangibility × Private credit per GDP		-0.020**	-0.022***
		(-2.11)	(-4.10)
Private credit per GDP		0.005	0.006**
		(1.15)	(2.44)
Asset tangibility × Log of GDP per capita		-0.004	-0.003
		(-0.77)	(-1.12)
Log of GDP per capita		0.012	0.009***
		(1.24)	(3.11)
Market to book	0.004***	0.004***	0.005***
	(13.99)	(13.43)	(26.84)
Log of real assets	0.000	0.000	0.001***
	(0.57)	(1.05)	(7.12)
Total book leverage	-0.026***	-0.026***	-0.024***
	(-12.06)	(-11.65)	(-21.68)
Pre-investment earnings	-0.036***	-0.036***	-0.035***
	(-5.82)	(-5.34)	(-13.50)
Constant	0.028***	0.032*	0.034***
	(3.35)	(1.90)	(5.08)
Country fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Number of observations	171,140	171,140	171,140
Adj. R^2	0.19	0.19	0.21

Table 6. Industry growth, asset tangibility, and financial development

This table examines whether industries with less tangible assets grow faster in economies with better developed financial systems. Following Manova (2008), Maskus, Neumann, and Seidel (2012), and Hsu, Tian, and Xu (2014), we estimate an industry-level regression model specified as follows:

$$\begin{aligned} &Industry\ growth_{i,c,t}\ \left(or\ R\&D\ intensity\ growth_{i,c,t}\right) \\ &\quad = \beta_0 + \beta_1 Initial\ Share_{i,c}\left(or\ Initial\ R\&D\ Share_{i,c}\right) + \beta_2 Dependence_i \\ &\quad \times Finanical\ Development_{c,t} + \boldsymbol{\beta_3} Asset\ Tangibility_i \times Finanical\ Development_{c,t} \\ &\quad + \beta_4 Finanical\ Development_{c,t} + \beta_5 Dependence_i \times log(GDP\ per\ capita)_{c,t} \\ &\quad + \beta_6 Asset\ Tangibility_i \times log(GDP\ per\ capita)_{c,t} + \beta_7\, log(GDP\ per\ capita)_{c,t} + \eta_i \\ &\quad + \eta_c + \eta_t + \varepsilon_{i,c,t}, \end{aligned}$$

where the dependent variable, $Industry\ growth_{i,c,t}$, is the annual real value-added growth rate in industry *i*, country *c*, and year *t*. $Initial\ Share$ denotes an industry's initial share of total value-added. $R\&D\ intensity\ growth$ is the growth of industry-level R&D expenditures as a share of value added in a country. $Initial\ R\&D\ Share$ denotes an industry's initial share of total R&D value-added in the manufacturing sector. $Dependence$ measures an industry's external finance dependence, and is calculated as the fraction of capital expenditures not financed with internal funds (Rajan and Zingales, 1998). $Asset\ Tangibility$ is industry-level asset tangibility (Berger, Ofek, and Swary, 1996). Other variables are the same as in equation (10). η_i, η_c and η_t are dummies for industry *i*, country *c* and year *t*, respectively. Our sample spans 1990-2010 and includes 22 two-digit ISIC industries. Values of *t*-statistics, reported in parentheses, are based on standard errors that are robust to heteroscedasticity and clustered by country. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)
Dependent variable:	Industry growth	R&D intensity growth
Initial share	-0.242***	
	(-3.67)	
Initial R&D share		-0.394***
		(-3.08)
Dependence × Private credit per GDP	0.011**	0.101*
	(2.04)	(2.10)
Asset tangibility × Private credit per GDP	-0.251**	-0.771**
	(-2.42)	(-2.52)
Private credit per GDP	0.261***	0.545**
	(4.79)	(2.24)
Dependence × Log of GDP per capita	-0.000	-0.100**
	(-0.08)	(-2.37)
Asset tangibility × Log of GDP per capita	-0.068	0.906***
	(-0.79)	(3.23)
Log of GDP per capita	0.235**	-1.087***
	(2.03)	(-3.65)
Constant	-1.827*	5.249***
	(-1.88)	(3.43)
Country fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Number of observations	14,125	2,836
Adj. R^2	0.07	0.03

Table 7. Robustness checks: country heterogeneity

This table reports regression evidence on the effect of country-level technological development and economic development on cash-tangibility sensitivity. R&D per GDP is total domestic intramural expenditure on R&D as a percentage of the GDP. R&D covers basic research, applied research, and experimental development. GDP per capita measures a country's level of economic development. The sample is partitioned according to the annual sample median value of a technological (economic) development proxy. Values of *t*-statistics, reported in parentheses, are based on standard errors that are robust to heteroscedasticity and are firm-year two-way clustered. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Partition by country-level characteristics	R&D per GDP		GDP per capita	
	(1)	(2)	(3)	(4)
Dependent variable: Ln(Cash/Assets)	High	Low	High	Low
Asset tangibility	-1.253***	-0.299	-0.979***	-0.401
	(-4.41)	(-1.14)	(-4.79)	(-1.40)
Asset tangibility × Private credit per GDP	0.695**	0.250**	0.884***	0.474*
	(2.30)	(2.25)	(5.71)	(1.94)
Private credit per GDP	0.015	-0.015	-0.779***	0.454***
	(0.07)	(-0.15)	(-7.90)	(3.59)
Asset tangibility × Log of GDP per capita	1.620***	-0.238*	0.494	-0.534***
	(2.59)	(-1.82)	(1.16)	(-3.79)
Log of GDP per capita	-1.728***	0.382***	0.360	0.246
	(-2.98)	(3.14)	(1.09)	(1.55)
Market to book	0.166***	0.121***	0.171***	0.117***
	(29.00)	(18.64)	(27.83)	(12.20)
Log of real assets	-0.136***	-0.049***	-0.131***	-0.081***
	(-21.70)	(-5.70)	(-16.53)	(-8.76)
Cash flow	-0.344***	-0.471***	-0.460***	-0.012
	(-8.64)	(-7.93)	(-12.87)	(-0.08)
Total capital expenditures	2.155***	1.767***	2.171***	1.626***
	(14.14)	(14.76)	(14.25)	(12.67)
Total book leverage	-1.373***	-1.586***	-1.508***	-1.364***
	(-24.91)	(-26.09)	(-26.52)	(-25.08)
R&D expenditures	0.547***	0.606***	0.435***	0.977***
	(18.69)	(15.36)	(14.74)	(11.41)
Constant	-2.193***	-2.535***	-0.569**	-2.488***
	(-4.78)	(-9.01)	(-2.07)	(-7.84)
Country fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Number of observations	167,209	127,311	145,449	149,071
Adj. R^2	0.36	0.23	0.35	0.26

Table 8. Robustness checks: alternative model specifications

This table explores how the sensitivity of cash holdings to asset tangibility varies with financial development. The dependent variable is the natural logarithm of the ratio of cash and equivalents divided by total assets net of cash. Columns (1) and (2) report pooled OLS estimates with different fixed effects and robust standard errors corrected for firm-year clustering. Column (3) reports firm fixed effects regression results with robust standard errors corrected for firm-level clustering. Column (4) presents estimates of regression of changes in cash holdings on changes of control variables with country, industry, and year dummies and robust standard errors corrected for firm-level clustering. Robust *t*-statistics are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Interactive FE		Firm-level FE	Change on changes
Dependent variable: Ln(Cash/Assets)	(1)	(2)	(3)	(4)
Asset tangibility	-0.566***	-0.487***	-0.240**	-0.186***
	(-4.41)	(-3.70)	(-2.07)	(-4.31)
Asset tangibility × Private credit per GDP	0.408***	0.231**	0.685***	0.133***
	(3.43)	(2.36)	(6.01)	(3.44)
Private credit per GDP	-0.116*	-0.205*	-0.159***	0.007
	(-1.96)	(-1.68)	(-2.73)	(1.17)
Asset tangibility × Log of GDP per capita	-0.199**	-0.123*	-0.153*	-0.127***
	(-2.15)	(-1.71)	(-1.79)	(-5.07)
Log of GDP per capita	-0.024	-0.717	0.615***	-0.278***
	(-0.27)	(-1.39)	(7.26)	(-12.49)
Market to book	0.131***	0.146***	0.029***	0.057***
	(33.48)	(34.88)	(9.78)	(52.98)
Log of real assets	-0.093***	-0.100***	-0.326***	-0.346***
	(-22.45)	(-24.26)	(-39.08)	(-26.48)
Cash flow	-0.264***	-0.261***	0.004	-0.305***
	(-10.47)	(-10.11)	(0.20)	(-19.80)
Total capital expenditures	0.918***	0.909***	-0.136***	-0.049
	(12.93)	(12.43)	(-2.82)	(-1.61)
Total book leverage	-1.375***	-1.437***	-0.376***	-0.444***
	(-44.61)	(-46.38)	(-13.90)	(-26.08)
R&D expenditures	0.592***	0.662***	0.166***	0.382***
	(23.59)	(26.50)	(7.82)	(10.39)
Constant	-2.547***	-3.232***	-0.409***	-0.313***
	(-18.89)	(-3.81)	(-5.12)	(-7.08)
Country fixed effects	Subsumed	Subsumed	Subsumed	Yes
Industry fixed effects	Subsumed	Subsumed	Subsumed	Yes
Year fixed effects	Yes	Subsumed	Yes	Yes
Country × industry fixed effects	Yes	No	No	No
Country × year fixed effects	No	Yes	No	No
Industry × year fixed effects	No	Yes	No	No
Firm fixed effects	No	No	Yes	No
Number of observations	294,520	294,520	294,520	258,061
Adj. R^2	0.34	0.32	0.12	0.11

Table 9. Robustness checks: an instrumental variables analysis

This table reports estimates of instrumental variable (IV) regressions. *Legal Origin* (LLSV, 1998), *Creditor Rights*, and *Information Sharing* are instruments for *Private Credit to GDP*. *IndustryResale* and *IndustryLabor* are used as instruments for *Asset Tangibility*. *IndustryResale* is calculated as the industry-year median ratio of sales of PP&E to the sum of sales of PP&E and capital expenditures. *IndustryLabor*, is defined as the industry-year median ratio of the number of employees scaled by total assets. Values of *t*-statistics, reported in parentheses, are based on standard errors that are robust to heteroscedasticity and are firm-year two-way clustered. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable: Ln(Cash/Assets)	(1) IV	(2) IV	(3) IV
Asset tangibility	-0.698***	-0.560***	-3.598***
	(-3.70)	(-4.64)	(-4.68)
Asset tangibility × Private credit per GDP	0.447**		
	(2.01)		
Private credit per GDP	-0.192		
	(-0.38)		
Asset tangibility × Creditor rights		0.173***	
		(2.64)	
Creditor rights		-0.481***	
		(-4.81)	
Asset tangibility × Accounting standards			4.507***
			(4.59)
Asset tangibility × Log of GDP per capita	-0.349***	-0.218	-0.232
	(-3.52)	(-0.80)	(-0.88)
Log of GDP per capita	0.217	0.005	0.227
	(1.25)	(0.02)	(0.89)
Market to book	0.148***	0.159***	0.165***
	(18.63)	(31.55)	(28.43)
Log of real assets	-0.103***	-0.108***	-0.120***
	(-17.02)	(-17.78)	(-17.28)
Cash flow	-0.411***	-0.438***	-0.422***
	(-10.29)	(-11.79)	(-12.13)
Total capital expenditures	1.952***	1.977***	1.969***
	(20.32)	(20.51)	(18.68)
Total book leverage	-1.446***	-1.487***	-1.511***
	(-40.61)	(-34.18)	(-31.79)
R&D expenditures	0.576***	0.534***	0.530***
	(22.77)	(20.58)	(20.41)
Constant	-2.341***	-1.572***	-1.752***
	(-4.84)	(-3.68)	(-4.15)
Country fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Angrist-Pischke χ^2-statistic *p*-value (underidentification)	0.000	0.000	0.000
Angrist-Pischke *F*-statistic *p*-value (weak identification)	0.000	0.000	0.000
Hansen *J*-statistic *p*-value (overidentification)	0.202	0.146	0.313
Number of observations	253,747	253,747	246,961

Adj. R^2	0.30	0.32	0.34

Table 10. Robustness checks: alternative measures of financial development

This table assesses the robustness of our key finding: financial development reduces the sensitivity of cash holdings to asset tangibility. We employ three alternative measures of financial development. Following Khurana, Martin, and Pereira (2006), we construct an index (*FININT*) that equals the sum of standardized indices of a) the ratio of liquid liabilities to the GDP and b) the total amount of credit by deposit money banks and other financial institutions going to the private sector over the GDP. *FININT* aims to quantify the overall level of financial intermediary development. *Financial Disclosure*, an alternative institutional measure of financial development, captures the quality of a company's financial information available to outside investors. The variable represents an average ranking of the prevalence of disclosures concerning various areas of corporate operations. These disclosures are proprietary in nature and useful to creditors to evaluate borrower risks and tailor loan contracts. *Inverse of Overhead Costs* is the inverse of the banks' overhead costs as a share of the total bank assets in 2011 taken from Beck, Demirgüç-Kunt, and Levine (2010). Values of *t*-statistics, reported in parentheses, are based on standard errors that are robust to heteroscedasticity and are firm-year two-way clustered. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable: Ln(Cash/Assets)	(1) OLS	(2) OLS	(3) OLS	(4) WLS	(5) WLS	(6) WLS
Asset tangibility	-0.326***	-1.810***	-0.585***	-0.314***	-1.744***	-0.591***
	(-3.57)	(-3.56)	(-5.05)	(-11.56)	(-8.92)	(-12.73)
Asset tangibility × FININT	0.153***			0.154***		
	(3.69)			(10.87)		
FININT	-0.136***			-0.136***		
	(-3.52)			(-13.42)		
Asset tangibility × Financial disclosure		1.654***			1.588***	
		(2.88)			(7.55)	
Asset tangibility × Inverse of overhead costs			0.387**			0.390***
			(2.54)			(7.84)
Inverse of overhead costs			-0.021			-0.031
			(-0.17)			(-0.75)
Asset tangibility × Log of GDP per Capita	-0.238**	-0.454***	-0.323***	-0.211***	-0.441***	-0.321***
	(-2.16)	(-4.29)	(-3.26)	(-4.73)	(-9.87)	(-8.02)
Log of GDP per Capita	0.384*	0.399**	0.203	0.392***	0.413***	0.224***
	(1.86)	(2.56)	(1.21)	(7.59)	(9.00)	(5.08)
Market to book	0.151***	0.154***	0.148***	0.145***	0.148***	0.142***
	(30.29)	(31.51)	(31.69)	(64.41)	(68.44)	(67.36)
Log of real assets	-0.106***	-0.104***	-0.103***	-0.099***	-0.097***	-0.096***
	(-16.50)	(-16.98)	(-16.99)	(-59.44)	(-61.52)	(-61.54)
Cash flow	-0.420***	-0.425***	-0.410***	-0.427***	-0.434***	-0.413***

	(-10.63)	(-11.17)	(-10.48)	(-29.58)	(-31.10)	(-29.65)
Total capital expenditures	1.943***	1.927***	1.953***	1.872***	1.858***	1.893***
	(20.38)	(20.26)	(21.64)	(44.22)	(45.39)	(47.13)
Total book leverage	-1.458***	-1.462***	-1.445***	-1.456***	-1.467***	-1.447***
	(-39.14)	(-39.46)	(-39.62)	(-99.72)	(-105.34)	(-105.56)
R&D expenditures	0.574***	0.563***	0.576***	0.589***	0.580***	0.595***
	(21.25)	(21.56)	(22.00)	(43.09)	(44.16)	(45.39)
Constant	-1.879***	-2.178***	-2.407***	-1.884***	-2.193***	-2.402***
	(-4.16)	(-6.60)	(-6.94)	(-18.38)	(-23.33)	(-25.21)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	261,946	285,323	294,520	261,946	285,323	294,520
Adj. R^2	0.31	0.31	0.30	0.29	0.30	0.29

Appendix: Sample selection and variable definitions

The following sets of firms are removed from the sample: 1) financial firms (SIC code 6000-6999) and utility firms (SIC codes 4900-4999); 2) firms for which cash and equivalents, asset tangibility, or total assets are missing; and 3) all firm-year observations with negative cash holdings, total assets or sales revenue, cash less than total assets, or book value of total assets less than $5 million (inflation-adjusted in 2006 U.S. dollars), and 4) missing other explanatory variables. The panel contains 294,520 firm-year observations covering 29,422 unique firms from 45 countries.

The table below details the definition of variables used in the study.

Country-level variables	
Private credit per GDP	The domestic credit provided to the private sector as a percent of GDP from 1990 to 2013. Data source: World Bank's World Development Indicators (WDI) database.
Creditor rights	An index aggregating four powers of secured lenders in bankruptcy. A score of one is added to the index when a country's laws and regulations provide each of these powers to secured creditors to arrive at the aggregate creditor rights index: (1) whether there are restrictions imposed, such as creditors' consent, when a debtor files for reorganization (restrictions on reorganization); (2) whether secured creditors have the ability to seize collateral after the petition for reorganization is approved (no automatic stay or asset freeze); (3) whether secured creditors are ranked first in the distribution of proceeds of liquidating a bankrupt firm as opposed to other creditors such as employees or government (secured creditor paid first); and (4) whether an administrator, rather than the incumbent management, is in control of property pending and responsible for running the business during the reorganization (no management stay). The aggregate creditor rights index ranges from zero to four, with higher values indicating stronger creditor rights. The index measures the ease with which creditors can secure the assets in the event of bankruptcy, and ranges between zero and four as of 2002. Data source: LLSV (1998), and Djankov, McLeish, and Shleifer (2007).
Accounting standards	A disclosure intensity index created by examining and rating companies' 1995 annual reports on their inclusion or omission of 90 items. These items fall into seven categories: general information, income statements, balance sheets, funds flow statement, accounting standards, stock data, and special items. A minimum of 3 companies in each country were studied. Data source: International Accounting and Auditing Trends, Center for Financial Analysis and Research (CIFAR). The variable is divided by 100, and is bounded between 0 and 1.
Duration of enforcement	The number of days it takes to resolve a dispute counted from the moment the plaintiff files the lawsuit in court until payment is made. This includes both the days when actions take place and the waiting periods between. Data source: World Bank's World Development Indicators (WDI) database.
Legal formalism	An index of formalism in check collection. Based on extensive surveys of lawyers and judges, DLLS (2003) construct measures on how courts handle two types of cases: collection of a bounced check and eviction of a (non-paying) tenant. A higher score in either category implies that the court system is slower (more bureaucracy) and less efficient. Although these measures are highly positively correlated across countries, I use the check-based formalism index because the process of collecting a check boils down to enforcement of a financial contract. The index measures substantive and procedural statutory intervention in judicial cases at lower-level civil trial courts, and equals the sum of the following

	categories (each takes on the value of one or zero): (1) professionals vs. laymen; (2) written vs. oral elements; (3) legal justification; (4) statutory regulation of evidence; (5) control of superior review; (6) engagement formalities; and (7) independent procedural actions. The index measures legal enforcement costs DLLS (2003). The more legal formalism, the higher enforcement costs in the courts. Data source: Survey of Lex Mundi/Lex Africa association of law firms.
Enforceability of contracts	An index ranging from zero to ten with higher scores indicating higher enforceability representing "The relative degree to which contractual agreements are honored and complications presented by language and mentality differences." Exact definition in Knack and Keefer (1995). Data source: Business Environmental Risk Intelligence; DLLS (2003).
Log(GDP per capita)	The natural logarithm of country real gross domestic product per capita in constant 2011 international dollars, PPP adjusted, for the years 1990-2013. To ease interpretation, we subtract the median from *log(GDP per capita)*. Data source: World Bank's World Development Indicators (WDI) database.
FININT	The financial intermediary development index that equals the sum of (standardized indices of) the ratio of liquid liabilities to the GDP and the total amount of credit by deposit money banks and other financial institutions going to the private sector over the GDP, from 1990 to 2011, following Khurana, Martin, and Pereira (2006). Liquid liabilities of the financial system measured by currency plus demand and interest-bearing liabilities of banks and non-bank financial intermediaries, divided by GDP. It is a measure of financial depth. Data source: Authors' calculations using data from Beck, Demirgüç-Kunt, and Levine (2010).
Financial disclosure	Average ranking of the prevalence of disclosures concerning research and development (R&D) expenses, capital expenditures, product and geographic segment data, subsidiary information, and accounting methods and policies. These disclosures are proprietary in nature and useful to creditors for evaluating borrowing firms' risks and creating loan contracts. Data source: Bushman, Piotroski, and Smith (2004) using data contained in CIFAR.
Inverse of overhead costs	The inverse of the banks' overhead costs as a share of the total bank assets in 2011. Data source: Beck, Demirgüç-Kunt, and Levine (2010).
Information sharing	A time-varying indicator variable equals one if either a public registry or a private bureau operates in the country, zero otherwise. Information sharing among creditors about clients' past (and possible subsequent) indebtedness helps alleviate the costs of information asymmetries, and therefore facilitate lending decisions and promote more lending. Data source: Djankov, McLiesh, and Shleifer (2007).
R&D per GDP	Total domestic intramural expenditure on R&D during a given period as a percentage of the GDP. R&D covers basic research, applied research, and experimental development. Data source: World Bank's World Development Indicators (WDI) database.
Firm-level variables	
Ln(cash/assets)	The natural logarithm of the ratio of cash plus marketable securities (CHE) divided by assets. Assets are the book value of total assets (AT) net of cash (CHE).
Asset tangibility	Following Berger et al. (1996), asset tangibility is defined as 0.715×receivables (RECT) + 0.547×inventories (INVT) + 0.535×fixed capital (PPENT), deflated by book value of total assets (AT) net of cash (CHE).
Market-to-book	The ratio of market value of assets to book value of total assets (AT) net of cash (CHE). The market value of assets is equal to the market value of common equity

	(fiscal year end price (PRCC_F) times shares outstanding (CSHO), plus total assets (AT) minus book value of common equity (CEQ). Market value of equity for firms in Compustat Global database is calculated using December closing price (PRCCD) multiplied by the total number of common shares outstanding for the issue (CSHOC). If the current figure for common shares outstanding as of the company's fiscal year-end is missing, the previous year's value is used.
Log of real assets	The natural logarithm of book value of total assets (AT) net of cash (CHE) in millions of 2006 U.S. dollars.
Cash flow	Cash flow is defined as operating income before depreciation (OIBDP), less interest and related expense (XINT), income taxes (TXT), and dividends (DVC), divided by book value of total assets (AT) net of cash (CHE) over year *t*.
Total capital expenditures	The ratio of capital expenditures (CAPX) to the book value of total assets (AT) net of cash (CHE). The capital expenditure from the statement of cash flows is often missing. Following Dittmar and Mahrt-Smith (2007), I impute any missing CAPX from the change in net fixed assets plus depreciation and amortization over the year. CAPX is replaced by zero if it is negative.
Total book leverage	The ratio of long-term debt (DLTT) plus debt in current liabilities (DLC) to total assets (AT) net of cash (CHE).
R&D expenditures	The ratio of R&D expenditure (XRD) to sales (SALE). If R&D expenditure is missing, I follow the tradition to set the missing value to zero, over year *t*.

Industry-level variables

Industry growth	The annual real value-added growth rate for each two-digit level ISIC industry in each country and year. Data source: Authors' calculations using data from UNIDO Industrial Statistics Database (INDSTAT4) Revision 3.
Initial share	The two-digit level ISIC industry's initial share of total value-added in each country's manufacturing sectors. Data source: Authors' calculations using data from UNIDO Industrial Statistics Database (INDSTAT4) Revision 3.
R&D intensity growth	The annual growth of industry-level R&D expenditures as a share of value added in each country. Data source: Authors' calculations using data from OECD STAN database.
Initial R&D share	Industry's initial share of total R&D value-added in manufacturing sectors in each country. Data source: Authors' calculations using data from OECD STAN database.
Dependence	External finance dependence, which is calculated as the fraction of capital expenditures not financed by cash flow from operations for U.S. firms in each two-digit level ISIC industry between 1990-2010, similar to Rajan and Zingales (1998). Data source: Authors' calculations using data from Compustat North America database.

Highlights

- Rising intangible assets could lower borrowing capacity and hence hinder growth if firms must preserve cash and forgo investment opportunities.
- Financial development lowers the sensitivity of cash holdings to tangible assets and promotes firm growth.
- Sectors with a smaller proportion of tangible assets grow faster in countries with more developed financial markets.
- The study suggests that financial development facilitates firm growth through an important asset tangibility channel.