Cash Cost of Tangibles and Financial Development

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Abstract

We show that financial development promotes firm growth by lowering the cash cost of tangibles. The cash cost of tangibles is defined as the increase in cash hoarding due to lowered borrowing capacity caused by the decrease in asset tangibility. The effect of financial development in lowering the cash cost of tangibles is stronger for younger, smaller and R&D intensive firms and firms operating in economies with better legal enforcement of creditors' rights. We also show that sectors with a smaller proportion of tangible assets grow faster in countries with more developed financial markets. Our analysis uncovers an important channel through which financial development affects firm financing policies, investment, and growth.

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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 all commercial and industrial loans in the U.S. are secured by collateral. Black, deMeza, 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. These findings are consistent with theoretical models showing that the availability of collateral facilitates credit extension by mitigating moral hazard and adverse selection (e.g., Stiglitz and Weiss, 1981; Wette, 1983).

Conventionally, tangible assets, given their low information asymmetry in valuation and high recovery rates, have served as the primary source of collateral in external financing (e.g., Hart and Moore, 1994; Shleifer and Vishny, 1992). Intangible assets (e.g., R&D, brand enhancement, and employee training) however have become an increasingly important component on corporate balance sheets in knowledge-based economies (Lev, 2001; Nakamura, 2003). The declining asset tangibility could lower the pledgeability of a firm's assets, thus reducing its external financing capacity and intensifying the need for cash hoarding. Figure 1A shows that, over the past three decades, the secular upward trend of cash holdings of U.S. firms coincides with a substantial decline in their asset tangibility. Figure 1B further shows that, across countries, the average corporate cash balance is greater in knowledge-based economies that generally have lower asset tangibility (e.g., USA and Israel). These figures depict a strong negative association between cash holdings and asset tangibility over time and across countries.

The shift in the make-up of corporate assets toward intangibles could constrain firm growth if they have to forgo investment opportunities in order to preserve cash. This tangibility constraint could be even tighter for innovative firms that often have a significant proportion of intangible capital and for those operating in countries with less developed financial markets where alternative financing sources are scarce. Despite the importance of such a constraint in affecting firm growth, little is known about the impact of financial development on the reliance of cash policy on tangibles, and its implication on firm growth around the globe.

In this paper, we explore how the level of financial development affects the asset tangibility sensitivity of cash, i.e., the firm's cash stockpiling in response to the decrease in its asset tangibility. As hoarding cash to cope with external financing constraints is associated with opportunity costs of forgoing investment and potentially aggravates agency costs, we term this sensitivity as the *cash cost of tangibles* (hereafter *CCT*).

Financial development could facilitate the use of intangible assets as collateral or the adoption of alternative instruments such as covenants to deter borrowers' risk-shifting. Loumioti (2014) finds that, from 1996 to 2005, about a quarter of U.S. originated secured syndicated loans have been collateralized by intangibles and the collateralization of intangibles has significantly increased near the end of the period. Liberti and Mian (2010) show that financial development allows banks to use alternative instruments in lending and lowers collateralization rates. The enhanced pledgeability of intangible assets and accessibility of alternative credit sources lessen the dependence of external financing on tangible assets and could consequently reduce *CCT*.

We find that a high degree of financial development, measured by the ratio of private credit to gross domestic product, lowers *CCT*. Economically, a one-interquartile-range increase in financial development leads to a reduction of nearly one half, or 48% in the cash-asset tangibility sensitivity. The result suggests that, as financial development broadens sources of corporate financing, it effectively reduces the reliance of corporate cash holdings on tangibles and moderates the need to stockpile cash for firms with more intangibles.

The development of a country's financial markets reflects its overall institutional quality. We thus expect the quality of institutions to directly impinge on *CCT*. Recent studies introduce two leading measures of a country's institutional characteristics that are key to financial development. The first is a creditor rights index that measures the ease with which creditors secure assets in the event of bankruptcy (Djankov, McLiesh, and Shleifer, 2007; Haselmann, Pistor, and Vig, 2010). Using this measure, we find that stronger creditor rights weaken the impact of asset tangibility on cash policy. Further analysis shows that the attenuating effect of creditor rights protection is more pronounced in countries with stronger legal environment. The second measure of institutional quality is an accounting standards index that appraises the availability and quality of corporate disclosures and other accounting information (Sengupta, 1998; Francis, Khurana, and Pereira, 2005). Our result reveals that higher accounting standards lower the cash-tangibility sensitivity. Moreover, we show that young, high-growth, and R&D-intensive firms, which are likely to suffer the most from information asymmetry in external financing, benefit more from improved accounting standards. Our findings highlight the importance of strong institutions for financial development and its importance in reducing *CCT*.

A direct implication of our findings is that financial development, by reducing the impact of tangibles on cash reserves, allows firms with greater intangible assets (less tangibles as collateral) to reserve less cash and undertake investment opportunities when they arise. We find confirmatory evidence that a developed financial market promotes growth-enhancing forms of capital flows by allowing firms with low tangible capital to invest more. Furthermore, using the framework of Rajan and Zingales (1998), we show that industries with lower tangible assets grow faster in economies with developed financial systems. This finding accentuates the real effect of financial development in relaxing *CCT*: allowing industries with less tangible assets, such as high-tech and pharmaceutical sectors, to hoard less cash, invest more, and grow faster.

This study is the first to analyze how financial development affects the relationship between cash, asset tangibility, and firm growth. Our paper is closely related to the recent work by Liberti and Mian (2010). They study how financial development affects the collateral spread of bank loans, which is defined as the difference in collateralization rates between high- and low-risk borrowers. They find that the spread declines rapidly with improvements in financial development, thus reducing the amount of collateral pledged by risky firms to access credit. Quite differently, our study focuses on the impact of financial development on internal cash holdings through the collateral channel. In addition, comparing with their data that contain 15 emerging economies, our sample covers 45 countries, including both emerging and developed economies. The large cross-country variation in levels of financial development allows us to identify its interaction with firm-level asset tangibility and to evaluate its differential impact across countries. Our finding that financial development affects corporate cash policy through the collateral channel

reveals an important dimension in which financial development facilitates economic growth. Moreover, our finding that industries with lower asset tangibility grow faster in countries with developed financial markets also adds to the literature that investigates the key role of financial development in economic growth (Rajan and Zingales, 1998; Levine, 1999; Beck, Levine, and Loayza, 2000; Durnev, Errunza, and Molchanov, 2009; Aghion, Hemous, and Kharroubi, 2014).

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

2. Data and summary statistics

In this section, we describe the data used in our analysis and the construction of key variables. The appendix details sample selection and variable definitions.

2.1 Key variables

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.

In this study the dependent variable, cash holdings, is the natural logarithm of 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.[1]

[1] 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

Financial development is measured using the ratio of private credit to GDP (*Private Credit to GDP*), which is the most commonly used proxy of financial development in the literature (e.g., Rajan and Zingales, 1998; Cull, Haber, and Imai, 2011). We use two indices, namely *Creditor Rights* and *Accounting Standards*, to gauge the quality of a country's financial institutions. Because advances in financial markets (institutional variables) tend to be positively correlated with the level of economic development, we use *GDP per capita* to control for the impact of a country's economic development. The variable construction is presented in the appendix.

2.2 Summary statistics

Table 1 presents country-level medians of key variables employed in our analysis. In columns (2) and (3), we observe that Japan behind the U.S. has the second largest total firm-year observations and number of unique firms, while Venezuela has the smallest. Column (5) displays a wide 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. In contrast, as shown in column (6), the median asset tangibility of Hong Kong firms is relatively higher (42.2%), whereas the share of tangibles assets is 47.3%, 52.8% and 50.4% for firms in New Zealand, Pakistan, and Peru, respectively. Thus, the summary statistics hint a negative relation between cash holdings and asset tangibility in worldwide data.

[Table 1 about here]

assets or net tangibility, which is calculated as $[0.715 \times \text{Receivables} + 0.547 \times \text{Inventories} + 0.535 \times \text{Fixed Capital} - \text{total current liabilities (LCT)} + \text{total debt in current liabilities (DLC)}$, deflated by book assets net of cash (Berger, Ofek, and Swary, 1996).

The last two columns of Table 1 report the country median of private credit to GDP and real per capita GDP. The data reveal substantial variability in private credit creation (financial development) and the wealth of nations (economic development). The median private credit over the sample period 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. Similarly, as our sample covers both developing and developed countries, the median gross national income level per capita varies from well above $50,000 to as low as about $3,000 per annum.

3. Empirical results

This section examines the impact of financial development on *CCT* and its implication for firm growth across countries.

3.1 Baseline results: financial development, asset tangibility, and cash holdings

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:

$$\begin{aligned} Cash_{i,t} = {} & \boldsymbol{\beta_1} Asset\ Tangibility_{i,t} + \boldsymbol{\beta_2}\, Asset\ Tangibility_{i,t} \\ & \times Finanical\ Development_{c,t} + \beta_3\, Asset\ Tangibility_{i,t} \\ & \times log(GDP\ per\ capita)_{c,t} + \theta' X_{i,t} + \delta_c + \eta_j + \phi_t + \varepsilon_{i,t}, \end{aligned} \tag{1}$$

where i, c, j and t denote firm, country, industry and year, respectively. All variables are defined as in Section 2.1 and the Appendix. *Financial Development*, measured by *Private credit to GDP*, captures the size of financial sector's primary activity (i.e., loan provisions) relative to the economic output. As in Liberti and Mian (2010), we include the natural logarithm of income per capita [*log(GDP per capita*)] as a control for economic

development and interact it with *Asset Tangibility* to capture other aspects of a country's economic activities other than its financial development.[2] 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). Respectively, δ_c and η_j are the country and industry fixed effects, which absorb systematic differences in liquidity management across countries and industries. ϕ_t, the year effect, captures common macroeconomic shocks that might affect firms' cash decisions.

The coefficient on *Asset Tangibility* (β_1) indicates the direct effect of tangibility on cash holdings. Given that conventionally tangibles are used primarily as collateral to raise debt financing, firms that are rich in tangible capital would have less need to hoard cash. Therefore, 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* × *Financial Development*. A positive β_2 ($\beta_2 > 0$) would indicate that financial development reduces the sensitivity of corporate cash holdings to tangibles; whereas a negative β_2 would suggest that financial development strengthens the importance of tangible assets in external financing and increases the sensitivity of cash policy to asset tangibility.

[Table 2 about here]

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

[2] To ease interpretation, we subtract the median from log($GDP\ per\ capita$), so that the marginal effect of $Asset\ Tangibility$ is evaluated at the sample median per capita income level.

firm and year levels throughout our empirical analysis to obtain conservative statistical inference.[3] Columns (1)-(3) report the estimation results of equation (1) without the two interaction terms. Column (1) shows the estimates using only U.S. firms. We observe that the coefficient estimate of *Asset Tangibility* (β_1) is negative and highly significant, which indicates that having high 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 8% on average.[4] This result is consistent with the finding in Falato et al. (2014) who also find a negative relationship between cash holdings and asset tangibility for U.S. firms. Column (2) restricts to non-U.S. firms and, again, 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. Taken together, the results indicate the existence of a significant *CCT* in U.S. firms and around the world.

Next, we turn to investigate the key issue of the paper: the impact of financial development on *CCT*. Column (4) reports our baseline estimates of equation (1) with our full sample. We find that β_2, the coefficient on the interaction of financial development with asset tangibility, is positive and statistically significant. This indicates that the relation between tangible assets and cash holdings is weakened in countries with developed financial markets. In terms of economic significance, ceteris paribus, a one-interquartile-

[3] Following Bates, Kahle, and Stulz (2009), we use the double-clustered standard errors suggested by Petersen (2009), Moulton (1986) and Thompson (2011) to account for serial correlations of unobserved time and firm effects.

[4] To assess the dollar cost of tangibles, we also estimate a level-level regression in which the cash-assets ratio (Cash/Assets) is regressed on 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 balances by 76 cents, a 24% haircut that is subtracted from the liquidation value of tangibles in corporate short-term liquidity management.

range increase in financial development leads to a 48% reduction in the cash-tangibility sensitivity.[5]

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

In our study, the potential reverse causality is less of a concern as it is unlikely that an individual firm's cash holdings would affect a country's financial development. Nevertheless, we conduct an instrumental variable (IV) analysis to tackle the potential endogeneity issue. Following Liberti and Mian (2010), we instrument *Private credit to GDP* using *Legal Origin* (La Porta, López-de-Silanes, Shleifer, and Vishny, 1998, hereafter LLSV), *Creditor Rights*, and *Information Sharing*. The three instruments capture different country-level aspects that facilitate the development of its financial systems. As shown in Column (6), β_2 remains positive and statistically significant. The Angrist-Pischke *F*-statistic of a joint test on whether the three IVs are significant (*p*-value=0.00), which strongly indicates the relevance of the three IVs. Hansen's *J* test (*p*-value=0.48) confirms the instrument relevance and exogeneity.

[5] The cash-tangibility sensitivity is equal to $\beta_1 + \beta_2 \times Finanical\ Development + \beta_3 \times log(GDP\ per\ capita)$. For a country with the median level of $log(GDP\ per\ capita)$, as $Finanical\ Development$ moves from its 1st quartile (0.496) to the 3rd (1.103), the sensitivity changes from -0.408 $(= -0.567 + 0.320 \times 0.496)$ to -0.214 $(= -0.567 + 0.320 \times 1.103)$, a 48% reduction in magnitude.

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 financial institutions: creditor rights and accounting standards

A well-functioning financial market is an outcome of the high-quality underlying institutions (e.g., LLSV, 1998, 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, namely *Creditor Rights* and *Accounting Standards*, to directly gauge the quality of a country's financial institutions. These 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).

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.

3.2.1 Creditor rights and legal enforcement

Strong creditor rights and contract enforceability protect lenders from agency costs and facilitate repossessing collateral in default (Bhattacharya and Daouk, 2002, 2005; 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,

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

as collateral to support and loosen loan covenants. He also finds that patents are more likely to be pledged when it is easier to seize them as collateral 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 the 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 the cash-tangibility sensitivity is toned down in countries with an effective institutional environment. The results suggest that higher creditor rights facilitate the borrowing through intangible collateral, reducing the sensitivity of cash holdings to tangible assets.

In addition, we explore variations of legal enforceability across countries to further gauge the impact of creditor rights on the cash-tangibility sensitivity. LLSV (1998) document that the legal rules providing the protection of corporate shareholders and creditors and that the quality of their 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 the effective legal enforcement are important to bank lending. Motivated by their studies, we postulate that strong legal protection that better ensures creditors to repossess collateral would strongly facilitate the development of financial markets. Thus, we expect the impact of *Creditor Rights* on the 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, namely, the duration of contract enforcement, legal formalism, and enforceability of contracts (See the Appendix for detailed description). We rank countries based on one of the enforcement proxies and partition the sample using the annual median of the proxy. This split-sample analysis aims to differentiate the effect of legal enforcement and its results are presented in Table 3, columns (2)-(7).

Focusing on the coefficient of *Asset Tangibility* × *Creditor Rights*, we consistently find that *Creditor Rights*, a fundamental driver of financial development, significantly weakens the underpinnings of cash on asset tangibility in countries with stronger enforceability (shown in odd numbered columns as compared with corresponding even numbered columns).

3.2.2 Accounting standards and information asymmetry

Lenders typically demand sizable tangible assets as collateral to reduce their high risk exposure to opaque firms as 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 sector 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 providing unsecured loans.[7]

In Table 4, we explore the effect of *Accounting Standards*, an institution-level measure of financial development that appraises a country's corporate disclosure quality, on the cash-tangibility sensitivity. Column (1) shows that the coefficient on *Asset*

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

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. The finding suggests that a high quality of information accessibility helps alleviate the costs of information asymmetries and facilitate 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 the cash-tangibility sensitivity would be 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.

Throughout all subsamples, we find that the coefficient estimate of *Asset Tangibility* × *Accounting Standards* is of greater magnitudes 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; shown in even numbered columns). This finding suggests that better accounting standards reduce *CCT*, especially for firms facing greater asymmetric information.

[Table 4 about here]

Taken together, the results presented in this subsection broadly confirm our main findings in Section 3.1, and show that institutions that promote financial development, in terms of better creditor rights and accounting standards, alleviate *CCT*.

3.3 The real effects of financial development: firm investment and industry growth

Financial development benefits firms through enhancing their access to external financing by reducing *CCT* and facilitating a diverse array of, including intangible asset-based, borrowing. In this subsection, we examine the real effects of financial development in promoting growth-enhancing forms of capital flows and fostering economic growth.

3.3.1 Firm investment

We first explore the link between financial development and firm investment decisions to shed light on the understanding of economic development and growth. Our pervious findings show that a developed financial market loosens the collateral constraint and allows a more flexible liquidity management for low-tangibility firms, which are often in an early stage of growth with significant R&D spending. We examine a direct implication of our results by studying the impact of financial development on low-tangibility firms' investment decisions. 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]

As shown in Column (1), Table 5, the coefficient of *Asset Tangibility* × *Financial Development* (proxied by *private credit per GDP*) is negative and significant. This suggests that, ceteris paribus, firms operating in low-tangibility industries invest more than those residing in high-tangibility industries because the former benefits more from financial development. Similarly to the IV analysis conducted in our baseline regressions (reported in Table 2, Column 6), we instrument *Financial Development* using the same set of instruments (*Legal Origin*, *Creditor Rights*, and *Information Sharing*) and find

confirmatory evidence (reported in Column 2). Therefore, we find that financial development, by reducing *CCT*, permits low-tangibility firms to shift low-productivity cash reserves to investment.

Furthermore, the results of our subsample analyses (reported in Columns (3)-(6)) indicate that the beneficial effect of financial development is greater for firms that are more likely to be financially constrained (e.g., younger (Column 2) and smaller (Column 4) firms).

To sum, our result hints that financial development could potentially alleviate underinvestment issues for firms operating in low-tangibility industries. Our finding is also consistent with Love (2003) who documents that financial development reduces financing constraints that would otherwise distort efficient capital allocation.

3.3.2 Industrial growth

Rajan and Zingales (1998) show that well-developed financial markets lead to higher growth in industries that rely more on external finance. In the same vein of their seminal work, we argue that financial development, which expands the scope of acceptable collateral and opens up alternative credit sources, would disproportionately benefit industry sectors with low asset tangibility. We thus adopt the framework of Rajan and Zingales (1998) and Braun and Larrain (2005) to study the differential impact of financial market development on the growth rate of sectors with low versus high tangibility ratios. The industry-level regression model we estimate is as follows:

$$Industry\ growth_{i,c,t} = \beta_0 + \beta_1 Initial\ Share_{i,c} + \beta_2 Dependence_i \times Finanical\ Development_{c,t} + \beta_3 Dependence_i \times log(GDP\ per\ capita)_{c,t} + \quad (2)$$

$$\boldsymbol{\beta_4} Asset\ Tangibility_i \times Finanical\ Development_{c,t} +$$

$$\beta_5 Asset\ Tangibility_{i,t} \times log(GDP\ per\ capita)_{c,t} + \eta_i + \eta_c + \eta_t + \varepsilon_{i,c,t},$$

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*. $Initial\ Share_{i,c}$ denotes the industry *i*'s initial share of total value-added in manufacturing in country *c*.[8] $Dependence_i$ 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). $Asset\ Tangibility_i$ denotes asset tangibility of industry *i* (Berger, Ofek, and Swary, 1996). η_i, η_c and η_t denotes the dummies for industry *i*, country *c* and year *t*, respectively. 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 the analyses in this subsection centers on β_4, the coefficient of *Asset Tangibility* × *Financial Development*. Specifically, our rationale suggests that the coefficient is less than zero ($\beta_4 < 0$) – 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 firms in the same country. Column (1) confirms the finding documented by Rajan and Zingales (1998): as indicated by the positive and

[8] The value-added data are obtained from the UNIDO Industrial Statistics Database (INDSTAT4) at the 3- and 4-digit levels of the International Standard Industrial Classification of All Economic Activities (ISIC) Revision 3 pertaining to the manufacturing sector.

significant interaction term, *Dependence* × *Financial Development*, industrial sectors that are relatively more in need of external finance grow faster in countries with stronger financial markets.

Turn to the main issue of this subsection, Column (2) indicates that, β_4, the coefficient on the interaction term *Asset Tangibility* × *Financial Development*, is negative and highly significant. It implies that industries with less tangible assets, thus higher levels of intangibles, grow faster and benefit from financial development to a greater extent. [9] β_4 remains negative and statistically significant in Column (3) where we adopt the same set of instruments (*Legal Origin*, *Creditor Rights*, and *Information Sharing*) for *Financial Development* as in our baseline analysis (reported in Table 2, Column 6).[10]

[Table 6 about here]

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

3.4 Additional robustness checks

In this subsection, we conduct additional analyses to examine the robustness of our result regarding the role of financial development in corporate short-term liquidity management.

[9] 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 or return on sales.

[10] The Angrist-Pischke *F*-statistic of a joint test on whether the three IVs are significant (*p*-value=0.00), which strongly indicates the relevance of the three IVs. Hansen's *J* test (*p*-value= 0.55) confirms the instrument relevance and exogeneity in our analysis of industry growth.

3.4.1 An instrumental analysis of asset tangibility

While throughout our analysis we control for a full set of country, industry, and year fixed effects to absorb various time-invariant omitted variables, here we conduct an instrumental variable regression to further alleviate the endogeneity concern of asset tangibility in determining cash holdings.[11]

Our instruments for asset tangibility are motivated by the rationale that a firm's asset tangibility is correlated with its manufacture structure (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. It is calculated as the industry-year median ratio of firm-level sales of PP&E to those of PP&E and capital expenditures. The higher the ratio, the more active the supply and demand conditions of the second-hand market are. Given a liquid secondary market, a firm can acquire used equipment and integrate it into its production process at a lower cost (Gavazza, 2011), and meanwhile the firm incurs a smaller cost carrying those assets in its balance sheets (Almeida and Campello, 2007). Therefore, a firm's asset tangibility should be closely related to the liquidity of machinery and equipment within the industry. Nonetheless, *IndustryResale*, the industry median value, is unlikely to directly affect an individual firm's cash reserves.

The second instrument, denoted as *IndustryLabo*r, is defined as the industry-year median ratio of the number of employees scaled by total assets. *IndustryLabo*r has been employed by Garmaise (2008) and Campello and Giambona (2013) to instrument firm

[11] Similar to Table 2, legal origin (LLSV, 1998; Djankov, McLiesh, and Shleifer, 2007), creditor rights, and information sharing are adopted as instruments for private credit to GDP, following Liberti and Mian (2010).

tangibility. Its economic justification stems from the fact that manufacture structure (machinery and equipment) and labor configuration tend to move together (MacKay and Phillips, 2005; Garmaise 2008). Simply put, a larger value of *IndustryLabo*r suggests that a firm could be in a high demand for machinery and equipment. Therefore, the firm's asset tangibility is positively related to its level of labor intensity. Again, there is no obvious reasons to suspect that the level of an industry median labor input directly influences an individual firm's cash holdings.

[Table 7 about here]

The validity of the IVs is closely examined. In order 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). The instrument relevance is confirmed by first-stage regressions (untabulated for brevity): both *IndustryResale* and *IndustryLabor*, bearing expected signs, are statistically significantly related to asset tangibility, and 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 valid 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.

The results of the instrumental variables (IV) regression are reported in Table 7. 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 the cash-tangibility sensitivity remains highly significant as the coefficient of $Asset\ Tangibility \times Private\ credit\ per\ GDP$ (column 1) remains positive and highly

significant. Columns (2) and (3) provide further confirmatory evidence that creditor rights and accounting standards ease the reliance of cash on tangibles.

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

3.4.2 Alternative measures of financial development

In this subsection, we employ alternative measures of financial development to verify our key results presented thus far. First, following Khurana, Martin, and Pereira (2006), we construct an index (*FININT*) that equals the sum 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.[12] *FININT* aims to quantify the overall level of the financial intermediary development. Second, we use *Financial Disclosure* as an alternative institutional measure of financial development. It 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.[13] These disclosures are proprietary in nature and useful to creditors for evaluating borrower risks and tailoring loan contracts.

We re-estimate the baseline specification (Table 2, column 4) and report the results in Table 8. We find that the coefficient of *Asset Tangibility* × *FININT* (column 1) and *Asset Tangibility* × *Financial Disclosure* (column 2) is positive and statistically significant. This

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

[13] Those areas include research and development expenses, capital expenditures, product and geographic segment data, subsidiary information, and accounting methods and policies.

suggests that the development of financial intermediaries and better financial disclosures contribute greatly to ease financing constraints due to limited tangible collaterals. Columns (3) and (4) show the results obtained using the weighted least squares (WLS) regression. The weight is set to the reciprocal of the number of a country's observations so that each country receives equal weight in the estimation. The results are similar to those reported in columns (1) and (2).

[Table 8 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, external capital providers generally demand firms to post tangible assets as collateral against lending. The decline in tangible capital could limit a firm's debt capacity and presses for cash hoarding, which is costly as accumulating excess cash reserves could be at the expense of forgoing investments and aggravating agency problems.

We investigate how financial development affects the reliance of cash holdings on asset tangibility, which we term it as the cash cost of tangibles. Given the rise of intangibles and knowledge-based capital in corporate asset portfolios and the consequently shrinking debt capacity, it is of great importance to examine how the development of a country's financial system shapes corporate cash and other real decisions through this collateral channel.

Using data covering 45 countries from 1990 to 2013, we find strong evidence that financial development, which broadens pledgeability of intangible assets and expands alternative financing sources, reduces cash cost of tangibles and promotes growth-enhancing forms of capital flows. Our findings also highlight that institutions, which enhance financial development in terms of better creditor rights and accounting standards, alleviate the cash-tangibility sensitivity. Furthermore, our result suggests that financial development could potentially mitigate underinvestment issues for firms operating in low-tangibility industries and eventually promote the growth of those industries.

In sum, this paper uncovers an important channel through which the institutional environment shapes corporate financial policies. We provide cross-country firm-level evidence that financial development contributes to economic growth by lessening the reliance of cash holdings on tangibles and by promoting the investment and growth of low-tangibility firms.

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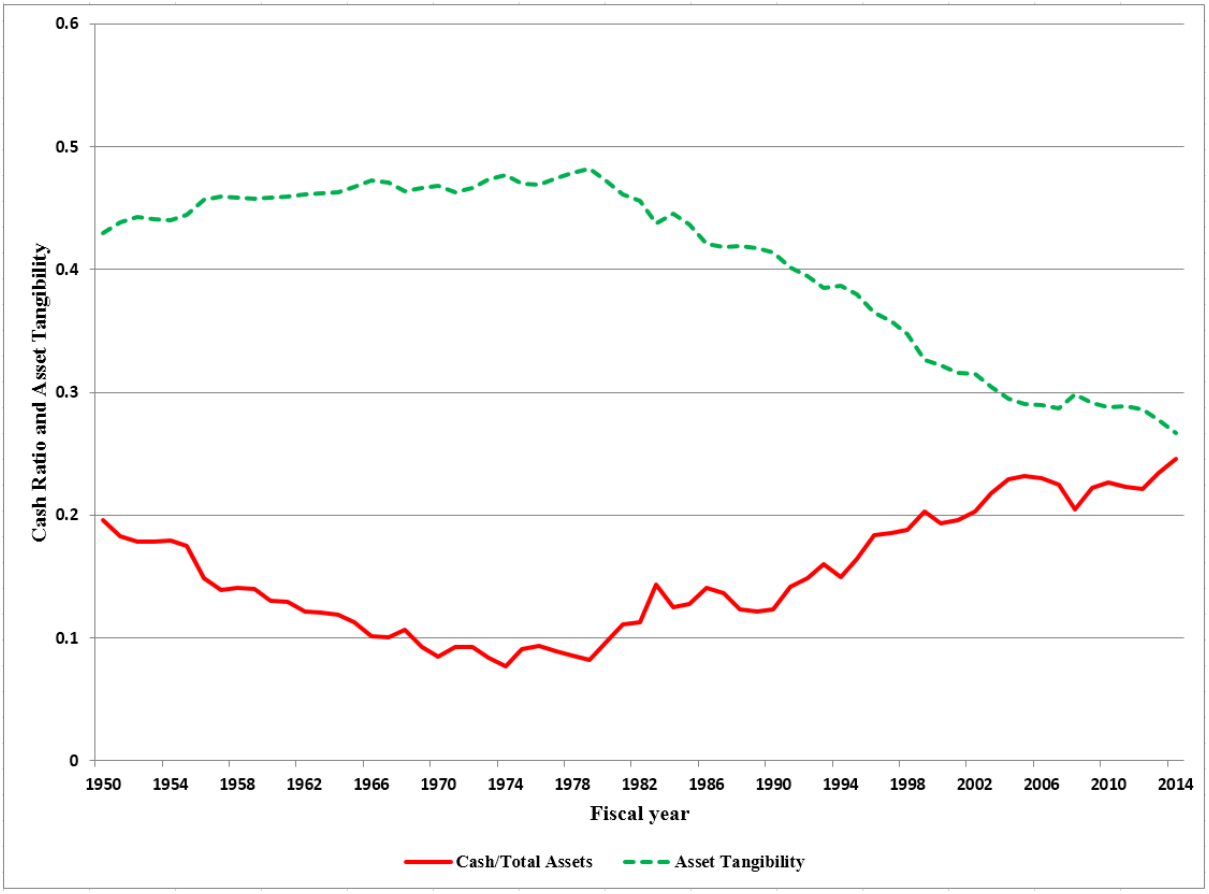
Figure 1. The negative cash-tangibility sensitivity

The sample includes all Compustat firm-year observations over fiscal years 1950-2014 with positive cash holdings, total assets and sales revenue, non-missing values for fixed assets, values for cash less than total assets, and values for the book value of total assets greater than $5 million in 2006 US dollars for both active and inactive firms incorporated and traded in the United States. Financial firms (SIC code 6000-6999), utilities firms (SIC codes 4900-4999), firms missing the 48 Fama-French industry dummies constructed by using the firm's four-digit SIC industry code, 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. According to 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 ratios are winsorized at the 1% and 99% levels. See the Appendix for detailed variable definitions.

Panel A. Annual mean cash ratios and asset tangibility from 1950 to 2014 in the U.S.



Panel B. Annual mean cash ratios and asset tangibility across countries

Panel B depicts, for a sample of countries, a scatter plot of annual mean cash-to-assets ratio against average asset tangibility for fiscal years 1995, 2000, 2005 and 2010.

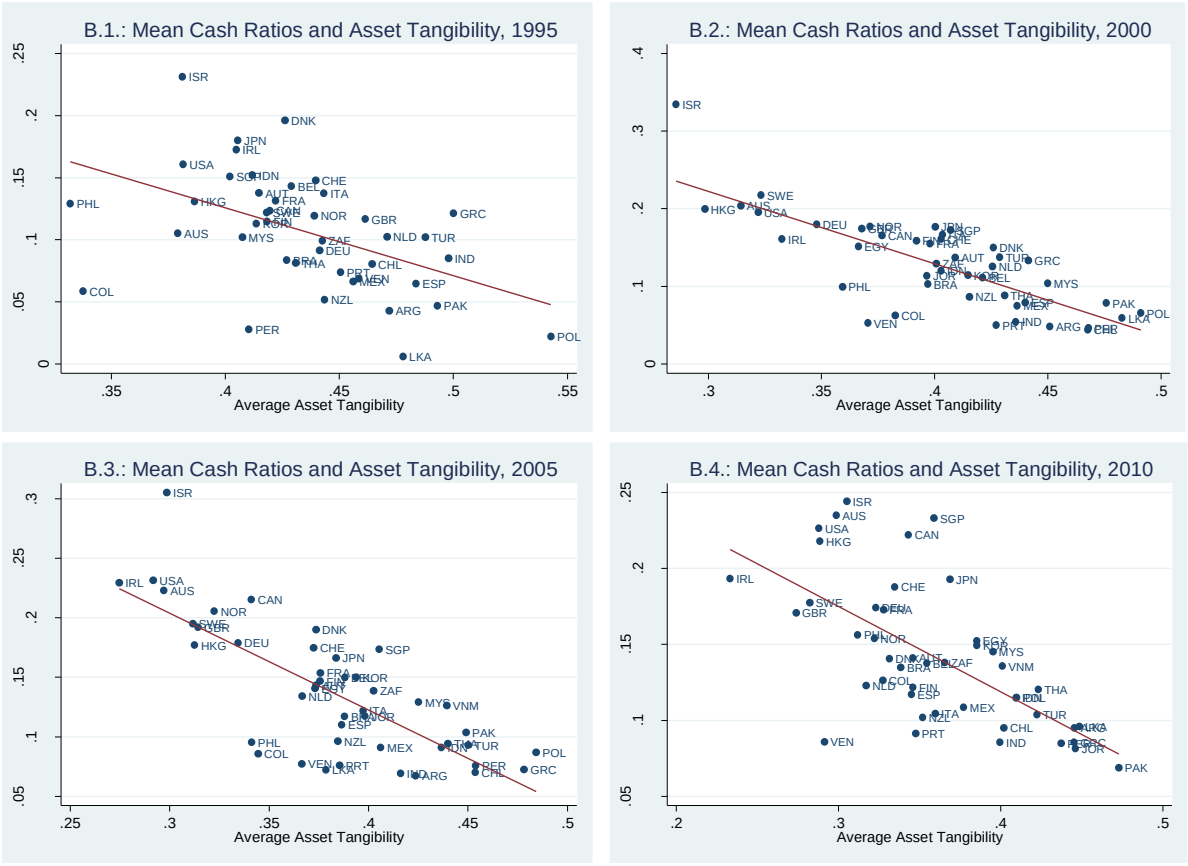


Table 1. Summary Statistics

This table presents descriptive statistics including country-level medians of key firm-specific characteristics. 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 percent of GDP. *Real GDP Per Capita* is a country real gross domestic product per capita in constant 2011 international dollars, PPP adjusted. Both country-level variables are extracted from the World Bank's World Development Indicators (WDI) database. The definitions of all variables are provided in Appendix.

Country	No. of firm-years	No. of unique firms	Mean no. of firms per year	Cash/ net assets (%)	Asset tangibility (%)	Private credit/ GDP (%)	Real GDP per capita (2011 international $)
Argentina	480	53	25	5.9	50.7	28.8	10,011
Australia	11,815	1,464	473	10.4	45.1	96.3	35,913
Austria	1,175	109	51	9.5	47.3	123.2	39,145
Belgium	1,454	129	58	8.6	48.7	113.5	37,828
Brazil	2,356	283	118	11.4	45.6	86.5	11,070
Canada	9,133	1,236	304	7.9	49.5	116.0	37,861
Chile	1,143	118	60	5.0	49.0	79.1	15,009
Colombia	221	26	13	5.9	36.1	41.1	8,692
Denmark	1,807	161	46	9.3	50.8	149.9	41,916
Egypt	486	83	29	12.5	50.2	83.9	7,988
Finland	1,895	145	68	9.0	46.0	76.7	35,580
France	8,848	821	268	11.3	46.6	102.2	35,265
Germany	9,343	820	275	9.7	45.4	127.2	37,312
Greece	2,285	226	120	5.2	52.8	91.9	25,010
Hong Kong, China	1,837	135	73	17.8	42.2	141.1	34,201
India	12,294	1,698	559	4.1	49.1	54.3	2,656
Indonesia	3,587	323	156	8.0	49.9	47.1	6,077
Ireland	903	83	38	11.0	48.4	105.6	43,273
Israel	1,446	225	85	19.9	47.3	78.0	24,908
Italy	3,036	277	117	8.3	48.7	96.3	35,126
Japan	42,332	3,534	1,693	15.9	48.2	302.5	32,319
Jordan	323	69	19	4.3	50.2	90.0	8,031
Korea, Rep.	9,391	1,240	348	12.3	47.3	123.4	22,272
Malaysia	11,127	932	397	9.2	51.9	127.8	15,849

Mexico	1,340	114	58	6.7	48.0	36.1	14,340
Netherlands	2,458	210	107	6.9	48.7	144.3	41,809
New Zealand	870	107	44	3.1	47.3	109.6	28,702
Norway	1,195	149	36	13.5	48.7	68.2	59,232
Pakistan	1,949	197	89	4.0	52.8	47.8	3,385
Peru	638	66	32	4.0	50.4	19.0	6,622
Philippines	1,305	129	59	7.7	44.1	51.4	4,307
Poland	2,593	332	74	6.0	51.6	37.2	14,842
Portugal	749	67	36	3.9	43.6	135.6	26,146
Singapore	6,941	642	267	16.9	51.7	72.6	51,378
South Africa	3,028	302	132	10.7	50.1	159.9	10,289
Spain	1,821	160	40	6.6	48.8	118.2	31,585
Sri Lanka	964	134	48	4.6	52.5	40.8	5,030
Sweden	4,035	414	139	10.7	42.7	116.4	37,616
Switzerland	3,101	238	129	13.4	49.3	162.8	49,130
Thailand	5,557	465	232	6.1	51.0	131.2	9,571
Turkey	1,531	173	55	7.3	51.4	42.1	13,016
United Kingdom	20,625	2,072	458	9.4	48.5	133.0	33,618
United States	93,859	9,017	3,754	10.6	44.9	199.9	46,177
Venezuela	153	16	9	6.0	49.5	20.1	15,497
Vietnam	1,091	228	136	9.8	48.3	48.0	2,849

Table 2. Baseline results: financial development and the cash cost of tangibles

This table explores how the cash holding sensitivities 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. firms 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 weights are the inverse of the number of observations for each country so that each country receives an equal weight in the estimation. Column (6) reports instrumental variables (IV) estimates using Legal Origin (LLSV, 1998), Creditor Rights, and Information Sharing as instruments for Private Credit to GDP, following Liberti and Mian (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 level at 1%, 5%, and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	U.S.	Non-U.S.	Full	Full	Full	Full
Dependent variable: Ln(Cash/Assets)	OLS	OLS	OLS	OLS	WLS	IV
Asset tangibility	-0.337***	-0.265***	-0.260***	-0.567***	-0.505***	-0.737***
	(-2.74)	(-2.62)	(-3.30)	(-5.00)	(-15.36)	(-5.09)
Asset tangibility × Private credit per GDP				**0.320*** **	**0.255*** **	**0.518*** **
				(3.35)	**(10.79)**	**(3.41)**
Asset tangibility × Log of GDP per capita				-0.300***	-0.272***	-0.332***
				(-3.61)	(-7.40)	(-4.08)
Market to book	0.171***	0.123***	0.148***	0.149***	0.142***	0.149***
	(24.03)	(21.48)	(31.63)	(32.06)	(67.50)	(38.77)
Log of real assets	-0.150***	-0.086***	-0.102***	-0.103***	-0.096***	-0.103***
	(-13.95)	(-10.98)	(-16.61)	(-16.43)	(-61.42)	(-26.41)
Cash flow	-0.332***	-0.376***	-0.410***	-0.410***	-0.413***	-0.409***
	(-8.65)	(-5.89)	(-10.56)	(-10.59)	(-29.69)	(-18.17)
Total capital expenditures	2.505***	1.660***	1.938***	1.953***	1.892***	1.958***
	(13.95)	(15.20)	(21.09)	(21.22)	(47.12)	(28.56)
Total book leverage	-1.487***	-1.387***	-1.443***	-1.452***	-1.452***	-1.456***
	(-18.11)	(-26.45)	(-39.41)	(-40.84)	(-105.86)	(-49.73)
R&D expenditures	0.482***	0.632***	0.584***	0.578***	0.597***	0.576***
	(14.34)	(17.25)	(21.98)	(21.77)	(45.58)	(25.63)
Constant	-2.211***	-2.618***	-2.630***	-2.679***	-2.716***	-2.619***
	(-7.89)	(-13.87)	(-13.32)	(-13.28)	(-37.33)	(-14.76)
Country fixed effects	No	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	93,859	200,661	294,520	294,520	294,520	294,520
Adj. R^2	0.39	0.26	0.30	0.30	0.29	0.30

Table 3. The quality of institutions: creditor rights and the legal enforcement of creditors' rights

This table examines the effect of creditor rights, as an institutional measure of financial development, on the cash cost of tangibles, and whether this effect varies with the differences in laws and enforceability of contracts (Bae and Goyal, 2009). *Creditor Rights* ranges from zero to four and measures the ease with which creditors can 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 of 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 resort 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 presented by language and mentality differences. The standard errors are robust to heteroscedasticity and two-way clustered at the firm and year level. ***, **, and * indicate significance level at 1%, 5%, and 10%, 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	-0.543***	-0.915***	0.011	-0.950***	0.207	-0.491**	-0.366
	(-4.64)	(-6.21)	(0.04)	(-5.87)	(1.00)	(-2.44)	(-1.63)
Asset tangibility × Creditor rights	**0.131****	**0.236*****	-0.078	**0.392*****	-0.501***	**0.226*****	-0.053
	(2.16)	**(3.57)**	(-0.59)	**(5.36)**	(-5.32)	**(2.75)**	(-0.62)
Asset tangibility × Log of GDP per capita	-0.225***	0.660***	-0.295**	0.365**	-0.386***	-0.038	-0.200*
	(-2.74)	(3.03)	(-2.35)	(1.96)	(-3.36)	(-0.08)	(-1.66)
Market to book	0.149***	0.173***	0.092***	0.176***	0.090***	0.176***	0.098***
	(31.64)	(30.86)	(12.41)	(29.97)	(12.66)	(30.83)	(12.79)
Log of real assets	-0.103***	-0.123***	-0.018	-0.127***	-0.078***	-0.113***	-0.098***
	(-16.93)	(-20.92)	(-1.45)	(-19.44)	(-9.89)	(-14.72)	(-13.38)
Cash flow	-0.411***	-0.446***	0.031	-0.471***	0.304**	-0.466***	-0.049
	(-10.53)	(-12.12)	(0.30)	(-13.98)	(2.22)	(-11.56)	(-0.95)
Total capital expenditures	1.945***	1.995***	1.517***	2.042***	1.434***	2.148***	1.815***
	(21.05)	(17.33)	(10.13)	(16.05)	(11.73)	(14.22)	(19.93)
Total book leverage	-1.446***	-1.405***	-1.571***	-1.588***	-1.183***	-1.533***	-1.326***
	(-39.71)	(-32.11)	(-21.18)	(-29.11)	(-18.03)	(-23.25)	(-19.46)

R&D expenditures	0.578***	0.491***	1.005***	0.433***	1.005***	0.450***	0.732***
	(21.92)	(16.58)	(13.00)	(14.37)	(13.18)	(15.14)	(15.96)
Constant	-2.696***	-1.248***	-3.487***	-3.539***	-2.396***	-1.573***	-2.631***
	(-13.51)	(-3.63)	(-16.03)	(-15.39)	(-10.89)	(-6.58)	(-13.33)
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, as an institutional measure of financial development, on the cash cost of tangibles, and whether the effect varies with a firm's 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 monitoring and screening. High accounting standards helps alleviate the costs of information asymmetries, and therefore promotes more lending and weakens the role of tangible assets as collateral in debt financing. 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. The sample is partitioned according to the median value in each country and in each year. Young, growth, or high R&D intensity firms usually exhibit a high degree of information asymmetry. The standard errors are robust to heteroscedasticity and two-way clustered by firm and year. ***, **, and * indicate significance level at 1%, 5%, and 10%, 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	-3.778***	-5.348***	-1.500	-4.614***	-2.824***	-7.190***	-2.056**
	(-4.32)	(-5.30)	(-1.31)	(-4.65)	(-2.75)	(-6.37)	(-2.21)
Asset tangibility × Accounting standards	**4.627*** **	**6.992*** **	1.342	**6.024*** **	3.169**	**9.862*** **	2.228*
	(3.92)	**(5.19)**	(0.88)	**(4.54)**	(2.32)	**(6.49)**	(1.79)
Asset tangibility × Log of GDP per capita	-0.458***	-0.518***	-0.352**	-0.126	-0.625***	-0.676***	-0.346***
	(-4.01)	(-3.63)	(-2.45)	(-0.89)	(-4.55)	(-4.11)	(-2.80)
Market to book	0.154***	0.144***	0.160***	0.111***	0.282***	0.131***	0.148***
	(31.38)	(22.31)	(24.29)	(23.44)	(5.01)	(19.51)	(24.60)
Log of real assets	-0.104***	-0.124***	-0.096***	-0.125***	-0.085***	-0.101***	-0.115***
	(-17.05)	(-12.71)	(-12.21)	(-19.17)	(-11.67)	(-15.18)	(-16.25)
Cash flow	-0.429***	-0.483***	-0.178***	-0.263***	-0.943***	-0.430***	-0.357***
	(-11.35)	(-11.94)	(-3.55)	(-9.09)	(-15.99)	(-13.81)	(-5.77)
Total capital expenditures	1.914***	1.993***	1.700***	1.653***	1.878***	2.645***	1.721***
	(19.67)	(16.70)	(13.88)	(15.80)	(14.71)	(13.76)	(15.74)
Total book leverage	-1.462***	-1.483***	-1.403***	-1.317***	-1.657***	-1.283***	-1.449***
	(-39.64)	(-31.74)	(-28.00)	(-31.20)	(-35.66)	(-19.54)	(-35.98)
R&D expenditures	0.564***	0.515***	0.708***	0.551***	0.662***	0.434***	7.985
	(21.46)	(17.73)	(15.16)	(21.47)	(14.41)	(16.64)	(1.36)
Constant	-2.752***	-2.548***	-2.685***	-2.446***	-2.879***	-3.150***	-2.489***
	(-12.93)	(-7.87)	(-10.63)	(-9.82)	(-12.03)	(-8.68)	(-11.12)

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, industry asset tangibility, and financial development

This table presents the results from ordinary least squares and instrumental variables (IV) regressions which test whether firms that operate in industries that have high tangible assets invest less than those operate in industries with less tangible assets in economies with 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). Independent variables include market-to-book assets, the natural logarithm of the real assets, leverage, and pre-investment earnings which is defined as earnings before interest, taxes, depreciation, and amortization (EBITDA) plus research and development (XRD) and advertising expenses (XAD), scaled by book assets (AT), similar to Faulkender and Petersen (2012) and Harford, Klasa, and Maxwell (2014). *Asset Tangibility* denotes asset tangibility for each industry (Berger, Ofek, and Swary, 1996). The degree of financial constraint is captured by two proxies: firm age and firm size. The sample is partitioned according to the median value in each country and in each year. All regressions contain country, industry, and year fixed effects. Industry dummies are defined according to the Fama and French (1997) 48-industry classification. Values of *t*-statistics based on standard errors of the coefficients robust to heteroscedasticity are reported in parentheses. The standard errors are clustered by firm and by year. Significance at the 1%, 5%, and 10% levels is represented by ***, **, and *, respectively.

Partition by financial constraint proxy			Firm age		Firm size	
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable: Investment	Full sample	IV	Young	Mature	Small	Large
Asset tangibility × Private credit per GDP	**-0.020*** **	**-0.060*** **	**-0.034*** **	-0.021***	**-0.032*** **	-0.015***
	(-3.41)	**(-3.31)**	**(-3.78)**	(-4.00)	**(-3.11)**	(-2.67)
Asset tangibility × Log of GDP per capita	0.002***	0.006***	0.003**	0.003***	0.002	0.003***
	(2.89)	(3.29)	(2.37)	(2.95)	(1.44)	(3.15)
Market to book	0.004***	0.004***	0.004***	0.004***	0.004***	0.004***
	(12.79)	(14.58)	(8.95)	(10.61)	(9.56)	(9.13)
Log of real assets	0.000	0.000	0.001	-0.000	0.002***	-0.003***
	(0.38)	(0.72)	(1.35)	(-0.32)	(2.96)	(-5.96)
Total book leverage	-0.022***	-0.022***	-0.024***	-0.021***	-0.029***	-0.013***
	(-9.07)	(-10.49)	(-7.67)	(-6.62)	(-10.19)	(-3.96)
Pre-investment earnings	-0.032***	-0.033***	-0.033***	-0.029***	-0.044***	0.020
	(-4.81)	(-7.65)	(-4.64)	(-3.15)	(-6.62)	(1.46)
Constant	0.045***	0.033***	0.033**	0.045***	0.002	0.062***
	(4.70)	(3.28)	(2.30)	(4.53)	(0.18)	(5.14)
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	166,229	166,229	78,255	87,974	78,098	88,131
Adj. R^2	0.19	0.19	0.21	0.19	0.21	0.20

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

This table tests whether industries with less tangible assets grow faster than industries with more tangible assets in economies with better developed financial systems. Similar to Rajan and Zingales (1998) and Braun and Larrain (2005), the industry-level regression model we estimate is as follows:

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

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*. $Initial\ Share_{i,c}$ denotes the industry *i*'s initial share of total value-added in manufacturing in country *c*. $Dependence_i$ 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). $Asset\ Tangibility_i$ denotes asset tangibility for industry *i* (Berger, Ofek, and Swary, 1996). Other variables are defined as in Eq. (1). η_i, η_c and η_t denotes the dummies for industry *i*, country *c* and year *t*, respectively. Our sample includes 22 ISIC industries at the two-digit level. The sample period is 1990-2010. The value-added data are obtained from the UNIDO Industrial Statistics Database (INDSTAT4) at the 3- and 4-digit level of the International Standard Industrial Classification of All Economic Activities (ISIC) Revision 3 pertaining to manufacturing sectors. Instrumental variables (IV) estimates use Legal Origin (LLSV, 1998), Creditor Rights, and Information Sharing as instruments for Private Credit to GDP, following Liberti and Mian (2010). The standard errors are robust to heteroscedasticity and clustered by country. ***, **, and * indicate significance level at 1%, 5%, and 10%, respectively.

Dependent variable: Industry growth	(1) OLS	(2) OLS	(3) IV
Initial share	-0.246***	-0.262***	-0.226***
	(-3.92)	(-3.97)	(-2.67)
Asset tangibility × Private credit per GDP		**-0.268*** **	**-1.127** **
		(-3.08)	**(-2.14)**
Asset tangibility × Log of GDP per capita		0.248*	0.438***
		(1.99)	(2.87)
Dependence × Private credit per GDP	0.021**	0.009*	0.102**
	(2.35)	(1.88)	(2.46)
Dependence × Log of GDP per capita	-0.014***	-0.014**	-0.043***
	(-2.92)	(-2.25)	(-3.00)
Constant	-0.138*	-1.074*	-2.000***
	(-1.78)	(-1.92)	(-3.57)
Country fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Number of observations	14,125	14,125	14,125
Adj. R^2	0.07	0.07	0.07

Table 7. Robustness check: **instrumental variables analysis of asset tangibility**

This table reports estimates of instrumental variables (IV) regressions. As in Liberti and Mian (2010), *Legal Origin* (LLSV, 1998), *Creditor Rights*, and *Information Sharing* are adopted as instruments for Private Credit to GDP. Following Schlingemann, Stulz, and Walkling (2002) and Campello and Giambona (2013), *IndustryResale* and *IndustryLabor* are used as instruments for *Asset tangibility*. The first instrument, *IndustryResale*, is a proxy for the liquidity of machinery and equipment in the industry where a firm operates. It is calculated as the industry-year median ratio of sales of PP&E to the sum of sales of PP&E and capital expenditures. The second instrument, *IndustryLabor*, used by Garmaise (2008) and Campello and Giambona (2013), is defined as the industry-year median ratio of the number of employees scaled by total assets. The standard errors are robust to heteroscedasticity and clustered by firm and year. ***, **, and * indicate significance level at 1%, 5%, and 10%, respectively.

Dependent variable: Ln(Cash/Assets)	(1) IV	(2) IV	(3) IV
Asset tangibility	-6.608***	-8.452***	-18.47***
	(-7.90)	(-8.46)	(-7.71)
Asset tangibility × Private credit per GDP	**3.974*** **		
	(8.63)		
Asset tangibility × Creditor rights		**0.899*** **	
		(7.35)	
Asset tangibility × Accounting standards			**14.87*** **
			(5.52)
Asset tangibility × Log of GDP per capita	0.335	1.241***	0.954***
	(1.37)	(4.71)	(3.56)
Market to book	0.150***	0.144***	0.150***
	(34.43)	(30.56)	(30.32)
Log of real assets	-0.155***	-0.195***	-0.196***
	(-13.81)	(-16.44)	(-16.01)
Cash flow	-0.330***	-0.273***	-0.286***
	(-11.16)	(-8.39)	(-8.71)
Total capital expenditures	3.088***	4.202***	4.320***
	(9.66)	(12.67)	(12.34)
Total book leverage	-1.547***	-1.523***	-1.527***
	(-48.37)	(-44.41)	(-43.31)
R&D expenditures	0.399***	0.259***	0.248***
	(8.72)	(5.17)	(4.79)
Constant	1.298**	2.895***	3.056***
	(1.96)	(3.84)	(3.90)
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)	0.143	0.708	0.968
Number of observations	253,755	253,755	246,951
Adj. R^2	0.24	0.11	0.09

Table 8. Robustness check: alternative measures of financial development

This table employs alternative measures of financial development to assess the robustness of our key finding: financial development reduces the reliance of cash holdings on asset tangibility. First, following Khurana, Martin, and Pereira (2006), we construct an index (*FININT*) that equals the sum 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 the financial intermediary development. Second, we use *Financial Disclosure* as an alternative institutional measure of financial development. It 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 for evaluating borrower risks and tailoring loan contracts. The standard errors are robust to heteroscedasticity and clustered by firm and year. ***, **, and * indicate significance level at 1%, 5%, and 10%, respectively.

Dependent variable: Ln(Cash/Assets)	(1) OLS	(2) OLS	(3) WLS	(4) WLS
Asset tangibility	-0.324***	-1.612***	-0.307***	-1.506***
	(-4.27)	(-3.23)	(-11.27)	(-7.79)
Asset tangibility × FININT	**0.130*** **		**0.111*** **	
	(3.23)		**(12.13)**	
Asset tangibility × Financial disclosure		**1.456** **		**1.355*** **
		(2.57)		**(6.51)**
Asset tangibility × Log of GDP per Capita	-0.407***	-0.332***	-0.370***	-0.310***
	(-4.28)	(-3.57)	(-8.91)	(-7.65)
Market to book	0.151***	0.155***	0.145***	0.148***
	(30.32)	(31.40)	(64.13)	(68.46)
Log of real assets	-0.108***	-0.104***	-0.101***	-0.097***
	(-17.25)	(-17.01)	(-60.47)	(-61.36)
Cash flow	-0.414***	-0.426***	-0.422***	-0.434***
	(-10.48)	(-11.15)	(-29.16)	(-31.11)
Total capital expenditures	1.966***	1.929***	1.893***	1.862***
	(20.32)	(19.99)	(44.58)	(45.49)
Total book leverage	-1.459***	-1.462***	-1.455***	-1.467***
	(-38.95)	(-39.53)	(-99.49)	(-105.35)
R&D expenditures	0.571***	0.565***	0.587***	0.581***
	(20.87)	(21.45)	(42.96)	(44.27)
Constant	-2.484***	-2.702***	-2.540***	-2.739***
	(-11.11)	(-12.98)	(-32.90)	(-36.31)
Country fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Number of observations	259,485	285,323	259,485	285,323
Adj. R^2	0.31	0.31	0.29	0.30

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, values for cash less than total assets, and values for the book value of total assets less than $5 million (inflation-adjusted in 2006 U.S. dollars). Finally, other missing explanatory values reduce the panel to 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.
Ln(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. 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).
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).
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: 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.
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).

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).
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*.
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.

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*.
Dividend dummy	A dummy variable equal to one in years in which a firm pays a common dividend (DVC). Otherwise, the dummy equals zero.

Industry-level variables

Industry growth	The annual real value-added growth rate for each three-digit level ISIC industry in each country and year. Authors' calculations using data from UNIDO Industrial Statistics Database (INDSTAT4) Revision 3.
Initial share	The three-digit level ISIC industry's initial share of total value-added in manufacturing in each country. Authors' calculations using data from UNIDO Industrial Statistics Database (INDSTAT4) Revision 3.
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 three-digit level ISIC industry between 1990-2010, similar to Rajan and Zingales (1998). Authors' calculations using data from Compustat North America database.