

INTANGIBLE CAPITAL & CORPORATE CASH HOLDINGS

INTERNATIONAL EVIDENCE

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Bachelor Thesis

Stockholm School of Economics

2026



Intangible Capital & Corporate Cash Holdings: International Evidence

Abstract:

Corporate cash holdings have risen over the past four decades, alongside firms' growing reliance on intangible capital. Because intangible capital is hard to pledge as collateral, this reliance lowers debt capacity and raises the demand for precautionary cash. We ask whether this intangible-collateral channel, originally documented for the United States, accounts for cash holdings internationally. We quantify its contribution by calibrating a dynamic structural model country by country across four advanced and four emerging economies. In the advanced economies, the channel accounts for an average of 55% of the increase in cash holdings. In the emerging economies, the evidence is weaker and does not support the same conclusion. Across countries, differences in intangible capital account for roughly half of the dispersion in cash levels, a contribution comparable to all other country-specific parameters combined. The evidence points to intangible capital being a central driver of corporate cash holdings across advanced economies.

Keywords:

Intangible capital, Corporate cash holdings, Asset tangibility, Precautionary savings, Dynamic structural model, International

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Acknowledgements:

We would like to express our gratitude to our tutor, Mehran Ebrahimian, and to Morteza Aghajanzadeh for their guidance and support throughout writing the thesis.

Bachelor Thesis

Bachelor Program in Business and Economics

Stockholm School of Economics

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CORPORATE CASH HOLDINGS HAVE RISEN over the past four decades. In the U.S., corporate cash holdings doubled between 1980 and 2006 (Bates, Kahle, and Stulz, 2009). Internationally, a similar upward trend in cash holdings is observed, especially in advanced economies (Pinkowitz, Stulz, and Williamson, 2016). Falato, Kadyrzhanova, Sim, and Steri (2022) trace the U.S. rise to the changing composition of corporate capital. As firms invest more in intangible capital, a smaller share of their productive assets can be pledged as collateral for debt. Lower debt capacity raises the value of internal cash, leading intangible-intensive firms to hold larger precautionary cash balances. Their structural model, calibrated to U.S. data, attributes 75% of the secular rise in U.S. cash holdings to this intangible-collateral channel. Whether this mechanism is a general feature of corporate financing or instead reflects the U.S. financial environment remains untested.

The mechanism rests on a distinction between productive capital and pledgeable capital. Tangible capital and intangible capital are both productive, but they differ in collateral value. Tangible capital can be pledged to lenders and recovered in default; intangible capital is harder to seize, verify, and redeploy. A shift from tangible to intangible capital therefore reduces the collateral available to support debt financing. Firms respond by holding more cash to finance investment and insure against adverse shocks. This channel predicts that cash holdings should rise where intangible capital is both large and increasing.

A test of the intangible-collateral channel is strengthened with an international panel. Real interest rates, tax systems, equity-market depth, and profitability volatility differ substantially across economies and affect cash holdings through channels distinct from the intangible-collateral mechanism. In a single-country time series, these forces evolve alongside intangible capital, making it difficult to assess whether the channel is a general feature of corporate financing or a product of a particular institutional environment. An international panel provides variation in both intangible-capital intensity and country-level financing conditions, allowing us to separate the intangible-collateral mechanism from other determinants of cash holdings. We ask:

Does the intangible-collateral channel explain corporate cash holdings internationally?

(i) Does the channel account for the rise in cash holdings within each country?

(ii) How much of the cross-country variation in cash levels is attributable to differences in intangible-capital intensity?

Our panel covers four advanced economies (United States, United Kingdom, Japan, Taiwan) and four emerging economies (Brazil, India, Indonesia, Thailand) from 1987 to 2024. We construct intangible-capital stocks for each country and take the intangible-collateral mechanism of Falato et al. (2022) to international data by recalibrating their dynamic structural model country by country. The strength of the channel is governed by the asset-tangibility parameter θ , which we calibrate to each country's own data. The other country-specific parameters also take country-specific values. We then run two counterfactuals. The time-series counterfactual asks how much of each country's within-country rise in cash is explained by the change in θ . The cross-sectional counterfactual asks how much of the cross-country dispersion in Late period cash is explained by cross-country differences in θ .

We document two main findings. In the time-series counterfactual, the intangible-collateral channel is economically important in the four advanced economies in our panel, accounting for an average of 55% of the model-implied increase in cash holdings: 40% in the United States, 73% in the United Kingdom, 63% in Japan, and 43% in Taiwan. In the cross-section, cross-country differences in θ account for 52% of the cross-country variance in cash, a contribution comparable to that of all other country-specific parameters combined. The channel operates with reduced strength in the two emerging economies that pass the calibration (Thailand and India), where intangible-capital intensity is low relative to the advanced economies and changes little over time. The results indicate that the intangible-collateral mechanism is most relevant where intangible capital is both economically large and increasing.

We initially document the stylised facts that motivate the structural exercise. Firms with more intangible capital hold more cash within every country in our panel. Pairwise firm-level correlations between cash and intangible-capital intensity range from 0.42 to 0.59 in the four advanced economies and from 0.16 to 0.24 in the four emerging economies. Country-by-country panel regressions of the cash ratio on intangible capital, with firm and year fixed effects and standard cash-determinant controls, return positive coefficients on intangible capital in all eight countries, each significant at the 1% level. These reduced-form patterns establish an association, but they do not quantify the contribution of intangible capital to either within-country cash growth or cross-country cash dispersion. Nor can they separate the intangible-capital channel from taxes, real interest rates, profitability volatility, and equity-market frictions, all of which vary across our sample. We treat the patterns as stylised facts rather than as the analysis itself.

We therefore turn to the structural model. Recalibrated country by country, the model matches Late period cash holdings to within two percentage points in six of the eight countries. Brazil and Indonesia fall outside this threshold, so we report their calibration outcomes separately and exclude them from the counterfactual decompositions. We then conduct the two complementary counterfactuals on the six calibrated countries. The time-series counterfactual reverses the observed change in intangible-capital intensity while holding all other parameters at their Late period values, isolating the contribution of intangible capital to the within-country rise in cash. The cross-sectional counterfactual removes cross-country differences in intangible-capital intensity, isolating the contribution of intangible capital to the dispersion in cash levels. These exercises generate the 55% advanced-economy time-series share and the 52% cross-country variance share reported above.

These estimates should be interpreted as model-based decompositions, not as precise point estimates. The calibrated counterfactual panel contains only six countries, so the 52% cross-country variance share is sensitive to the large differences between the advanced and emerging economies in the sample. The emerging-economy evidence also limits external validity. Brazil and Indonesia do not satisfy our calibration criterion, while India and Thailand calibrate but exhibit small or negative intangible-capital contributions. Thus, the model travels well to advanced economies, but less cleanly to emerging economies. A further measurement limitation is that equity-issuance frictions outside the United States are identified using an accounting-based proxy rather than transaction-level issuance data. We therefore view the results as evidence that the intangible-collateral mechanism is quantitatively important in advanced economies, rather than as precise estimates of universal effect sizes.

Our paper relates to three literatures. The first establishes intangible capital as an economically meaningful firm asset that does not appear on the balance sheet. Corrado, Hulten, and Sichel (2009) document the magnitude and growing importance of intangible investment in the United States. Peters and Taylor (2017) find that intangible capital is an important part of firms' capital and that it can improve the performance of measures such as Tobin's q . This literature confirms that intangible capital is a real and significant phenomenon which can be proxied by relatively simple accounting methods, thus justifying its inclusion in this paper.

The second literature studies the determinants of cash holdings and the secular rise in corporate cash documented for the United States by Bates, Kahle, and Stulz (2009) and across other advanced economies by Pinkowitz, Stulz, and Williamson (2016). The literature offers several explanations for the rise in cash. Bates et al. (2009) attribute it to higher cash-flow risk and lower working capital. Bates, Chang, and Chi (2018) suggest that capital market frictions can explain why firms look to hold more cash. We incorporate these forces in our structural exercise as separately calibrated country-specific parameters and quantify the contribution of intangible capital relative to them.

The third literature studies collateral, pledgeability, and debt capacity. Shleifer and Vishny (1992), Hart and Moore (1994), and Kiyotaki and Moore (1997) show that lenders restrict how much they lend when the borrower's assets cannot be reliably pledged as collateral, which limits firms' debt capacity. Rampini and Viswanathan (2013) extend this work by modelling tangible capital as pledgeable while intangible capital is not. Almeida, Campello, and Weisbach (2004) formalise the precautionary motive that drives financially constrained firms to hold cash, the same motive that intangible-intensive firms face in our setting because the value of their internal liquidity rises when collateral capacity falls.

Falato et al. (2022) bring these three literatures together. They build a model for the United States that incorporates pledgeability, rising intangible capital, and the secular rise in cash, and show that the resulting intangible-collateral channel accounts for about 75% of the rise in U.S. cash holdings. We take their structural framework to international data and quantify the channel both within and across countries.

We extend Falato et al. (2022) in three ways. First, we take their structural model outside the United States by recalibrating it country by country in seven additional economies. This allows us to test whether the intangible-collateral channel operates beyond the U.S. institutional environment. We find that it is quantitatively important in all four advanced economies in our panel. Second, we use the international setting to decompose not only the within-country rise in cash holdings, but also the cross-country dispersion in cash levels. This variance decomposition is not available in a single-country setting and shows that differences in intangible-capital intensity account for a large share of cross-country cash dispersion. Third, we identify an important boundary to the mechanism. The channel is weaker in the two emerging economies that pass the calibration, where intangible capital is low and changes little over time, and where the model does not fit cash holdings as consistently as it does in the advanced economies.

The remainder of the paper proceeds as follows. Section I constructs the international panel and the firm-level intangible-capital measure. Section II documents the reduced-form patterns. Section III sets out the structural model. Section IV calibrates the model country by country and assesses the model fit. Section V presents the within-country and cross-country counterfactuals. Section VI concludes.

I. Data and Intangible Capital Construction

A. Data and Sample

We draw accounting data from Compustat North America for the United States and from Compustat Global for the seven other countries in our sample: the United Kingdom, Japan, Taiwan, Brazil, India, Indonesia, and Thailand. The country set is chosen to satisfy two requirements. First, the panel must contain both advanced and emerging economies across several regions, generating variation in intangible-capital intensity, real interest rates, tax rates, and equity-issuance frictions. Second, each country must have sufficient Compustat coverage to construct firm-level intangible capital and the moments used in the calibration. The United States, United Kingdom, Japan, and Taiwan form the advanced-economy group, where intangible capital is relatively high. Brazil, India, Indonesia, and Thailand extend the sample to emerging economies with less intangible capital and different financing environments.

We retain a country only if it satisfies a set of coverage criteria. Because selling, general, and administrative expenses (SG&A) are the main input to organisational capital, we require SG&A coverage for at least 75% of firm-years; average coverage in the retained sample is 89%. Research and development (R&D), the input to knowledge capital, is more unevenly reported. Taiwan reports R&D for 79% of firm-years, whereas Thailand reports R&D for only 3%. This creates a measurement concern but excluding firms with missing R&D would bias the sample toward innovative firms and overstate intangible intensity. We therefore retain R&D in the construction and set missing R&D to zero, so that non-reporting firms do not mechanically increase measured intangible capital. We further require each retained country to have more than 100 unique firms in every sample year, stable dominant reporting currency, and sufficient coverage of the accounting items used in the calibration. Among countries satisfying these criteria, we prioritise those with the longest available time series. Annual R&D and SG&A coverage rates are reported in Appendix A.

Following Falato et al. (2022) we exclude financial firms (SIC 6000–6999), utilities (SIC 4900–4999), and firm-year observations with non-positive total assets or sales. For duplicate firm-year entries, we retain the observation with the largest total assets. We also require each firm to have at least three consecutive years of observations, the minimum needed to estimate within-firm profit variance. To ensure that the accounting data correspond to the country being calibrated, we require firms to be incorporated in the target country and to report in the target country’s currency. We drop observations with debt exceeding total assets and floor negative gross leverage at zero, because the model’s leverage state is bounded between zero and one.

Consistent with Falato et al. (2022), we split each country’s sample into an Early and a Late period. The Early period runs from the country’s first year of adequate coverage through 2006, and the Late period runs from 2009 through 2024. Our 1987 to 2024 sample differs from the 1970 to 2010 U.S. sample in Falato et al. (2022) for two reasons. First, Compustat Global coverage is sparse before the late 1980s for most non-U.S. countries. Second, extending the sample through 2024 allows us to assess whether the mechanism continues to operate outside the original U.S. setting. We exclude 2007 and 2008 to keep the global financial crisis out of both periods.¹ After applying these filters, 223,625 firm-year observations remain across 27,995 unique firms (Table I). Sample sizes vary substantially across countries, from roughly 2,500 firm-years in Brazil to nearly 143,000 in the United States. Because the model is calibrated separately by country, larger samples do not mechanically receive greater weight in the structural estimates.

¹ We use a shorter buffer period than Falato et al. (2022) because our effective sample period is shorter.

Table I
Sample Composition by Country and Period

This table reports firm-year observations and unique firms by country for the full sample, the Early period, and the Late period. The Early period runs from each country’s first year of adequate coverage through 2006; the Late period runs from 2009 through 2024. The years 2007 and 2008 are excluded, so Early and Late counts do not sum to full-sample counts. Data are from Compustat North America for the United States and Compustat Global for all other countries.

| Country | Early Period | Late Period | Full | | Early | | Late | |
|--------------|--------------|-------------|----------------|---------------|----------------|---------------|---------------|---------------|
| | | | Firm-Years | Firms | Firm-Years | Firms | Firm-Years | Firms |
| U.S. | 1987-2006 | 2009-2024 | 142,844 | 14,773 | 90,272 | 11,783 | 45,508 | 6,033 |
| U.K. | 1988-2006 | 2009-2024 | 19,204 | 2,448 | 12,276 | 1,975 | 5,817 | 1,069 |
| Japan | 1987-2006 | 2009-2024 | 17,999 | 3,713 | 6,190 | 2,179 | 10,679 | 2,457 |
| Brazil | 1997-2006 | 2009-2024 | 2,557 | 372 | 1,233 | 230 | 1,203 | 239 |
| India | 1995-2006 | 2009-2024 | 14,293 | 3,083 | 5,111 | 1,708 | 7,802 | 2,380 |
| Indonesia | 1994-2006 | 2009-2024 | 3,059 | 650 | 1,810 | 262 | 1,125 | 481 |
| Thailand | 1994-2006 | 2009-2024 | 4,580 | 760 | 2,463 | 406 | 1,955 | 562 |
| Taiwan | 1997-2006 | 2009-2024 | 19,089 | 2,196 | 6,089 | 1,257 | 10,600 | 2,080 |
| Total | | | 223,625 | 27,995 | 125,444 | 19,800 | 84,689 | 15,301 |

B. Intangible Capital Construction

Intangible capital consists of the stock of non-physical productive assets a firm builds through investment in research, organisational processes, brand value, distribution networks, and firm-specific human capital. Because internally generated intangible capital is generally *expensed rather than recorded* as an asset, we construct intangible-capital stocks from investment flows using the perpetual inventory method. The method treats intangible expenditures as investment, accumulates them into a stock, and depreciates the existing stock each year.

Following Falato et al. (2022), we construct intangible capital from two components: knowledge capital, built from R&D, and organisational capital, built from SG&A.² We define total intangible capital, IK_t , as the sum of knowledge capital, KC_t , and organisational capital, OC_t :

$$IK_t = KC_t + OC_t. \quad (1)$$

Knowledge capital is the perpetual-inventory stock of R&D. Following Falato et al. (2022), we capitalise R&D fully and depreciate the stock at 15% per year:

$$KC_t = (1 - \delta_{KC}) \times KC_{t-1} + xrd_t, \quad \delta_{KC} = 0.15. \quad (2)$$

Organisational capital is the perpetual-inventory stock of capitalised SG&A. Following Falato et al. (2022) we capitalise 20% of SG&A and depreciate the resulting stock at 20% per year.³ Because Compustat SG&A generally includes R&D, using raw SG&A in Equation (3) would double-count R&D expenditure. Following Peters and Taylor (2017) we therefore subtract R&D from SG&A before capitalisation when R&D is reported and does not exceed SG&A. Throughout, sga_t denotes SG&A net of R&D where applicable.

$$OC_t = (1 - \delta_{OC}) \times OC_{t-1} + \gamma_S \times sga_t, \quad \gamma_S = 0.20, \quad \delta_{OC} = 0.20. \quad (3)$$

² We follow Falato et al. (2022) in excluding the Compustat item “Intangibles,” which combines acquired intangibles, goodwill, and acquisition-related accounting items. Unlike Falato et al. (2022), we omit information-technology capital because their measure relies on U.S.-specific BEA industry-level investment data with no comparable cross-country source. Falato et al. (2022, footnote 8) report that excluding information-technology capital leaves their main results largely unchanged.

³ The 20% capitalisation rate assumes that one fifth of SG&A represents investment in long-lived organisational capability, with the remaining four fifths treated as a current-period operating expense.

For firms observed at the start of the sample, setting the initial intangible stock to zero would understate intangible capital. Following Peters and Taylor (2017), we initialise knowledge and organisational capital using the steady-state perpetual-inventory formula:

$$KC_0 = xrd_0 \times \frac{1+g}{g+\delta_{KC}}. \quad (4)$$

$$OC_0 = \gamma_S \times sga_0 \times \frac{1+g}{g+\delta_{OC}}. \quad (5)$$

where the pre-sample growth rate is $g = 0.10$. The stocks then evolve according to Equations (2) and (3).

C. Variable Definitions

The empirical analysis uses two main firm-year ratios. The cash ratio is cash and short-term investments scaled by total assets. The intangible-capital ratio is intangible capital scaled by total assets net of cash:

$$Cash\ Ratio_{it} = \frac{che_{it}}{at_{it}}. \quad (6)$$

$$IK\ Ratio_{it} = \frac{ik_{it}}{at_{it} - che_{it}}. \quad (7)$$

Both ratios follow the definitions of Falato et al. (2022). Appendix B reports the Compustat item definitions and trimming rules.

II. Cash and Intangible Capital: Patterns in the Data

This section documents three empirical patterns in the international panel. First, intangible-capital intensity rises in all four advanced economies between 1987 and 2024, while cash holdings rise in most countries in the sample. Second, within every country, firms with more intangible capital hold more cash. Third, the positive relation between cash and intangible capital remains statistically significant within firms after controlling for standard cash determinants and absorbing firm and year fixed effects. Together, these facts show that the cash-intangible-capital relation documented by Falato et al. (2022) for the United States is not specific to the U.S. sample or their original sample period.

Figure 1 shows the evolution of intangible-capital intensity and cash holdings by country. Intangible-capital intensity rises steadily in the four advanced economies and remains comparatively flat in the four emerging economies. Cash holdings also increase in the advanced economies. Among emerging economies, the pattern is more mixed: cash ratios rise in India, Thailand, and Brazil, but decline modestly in Indonesia.

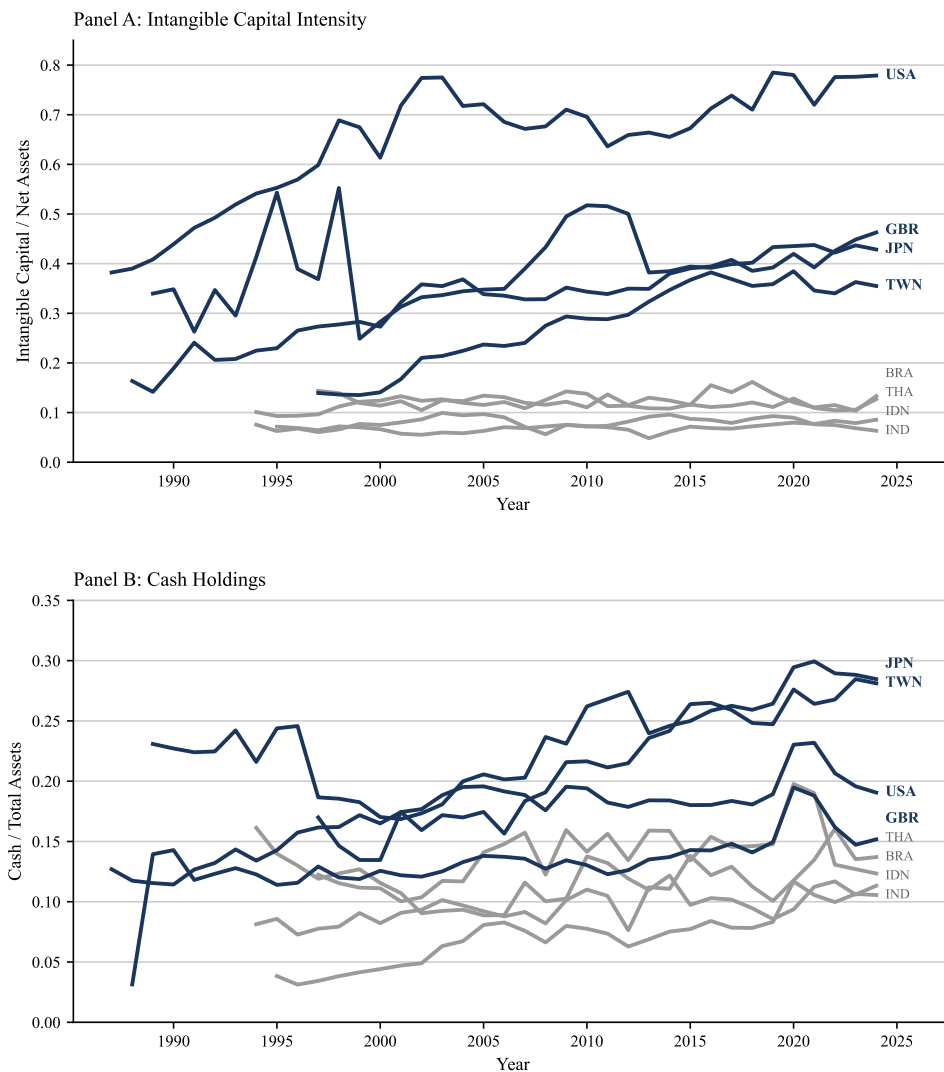


Figure 1. Intangible capital intensity and cash holdings. The figure plots annual equal-weighted country averages. Panel A shows intangible capital scaled by total assets net of cash. Panel B shows cash and short-term investments scaled by total assets. Coloured lines denote advanced economies: the United States, the United Kingdom, Japan, and Taiwan. Grey lines denote emerging economies: Brazil, Thailand, Indonesia, and India. The sample period is 1987–2024.

Figure 2 shows that within each country, firms with more intangible capital hold more cash. Each panel plots a binned scatter of the cash ratio against the intangible-capital ratio, after standardising both variables within country. The relation is positive in all eight countries. The raw firm-level correlations are larger in the advanced economies, ranging from 0.42 to 0.59, than in the emerging economies, where they range from 0.16 to 0.24.

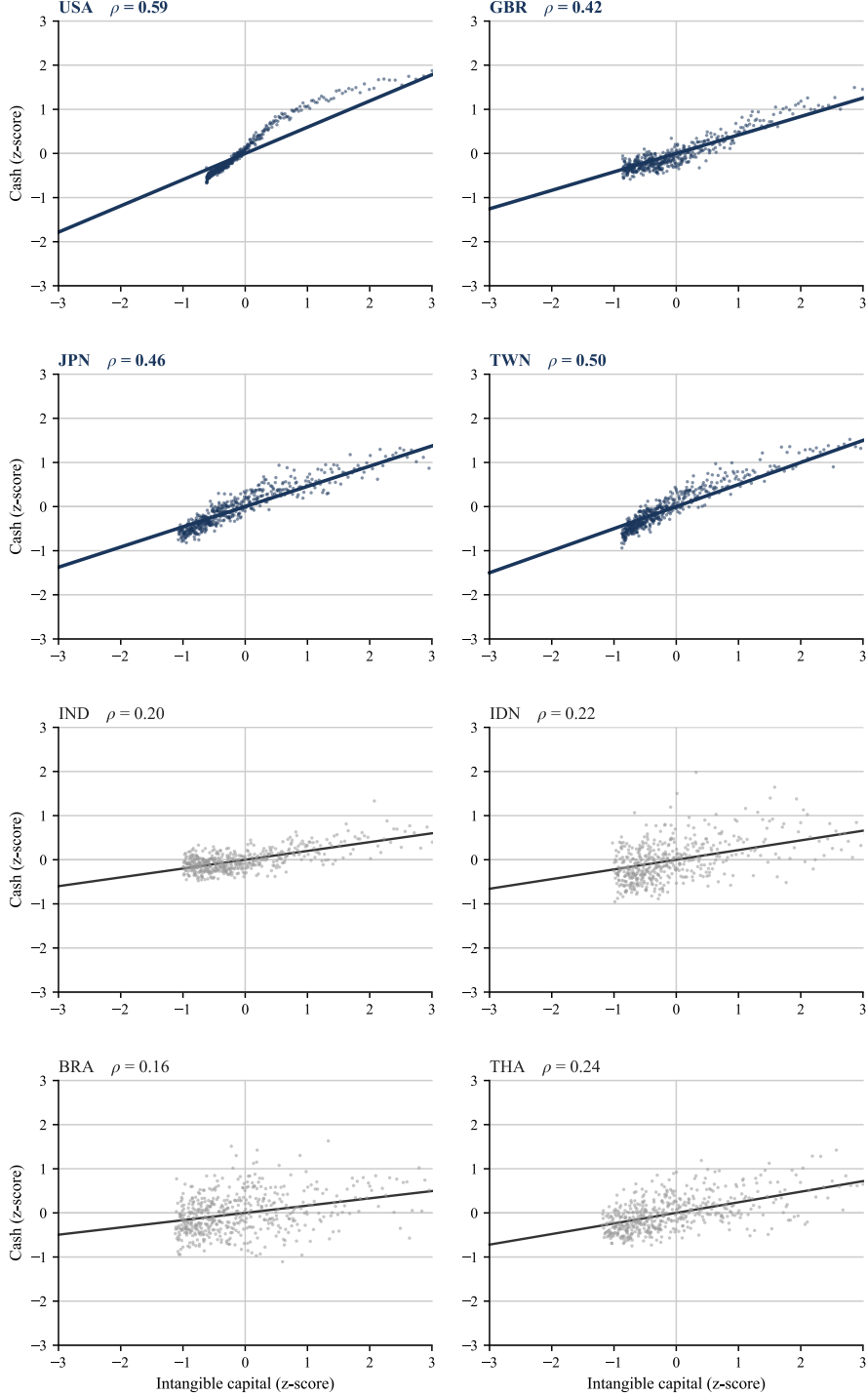


Figure 2. Cash and intangible capital across countries. Binned scatter of the cash ratio against the intangible-capital ratio at the firm-year level, by country. Both variables are standardised within country. Top rows: advanced economies (United States, United Kingdom, Japan, Taiwan). Bottom rows: emerging economies (Brazil, India, Indonesia, Thailand). Sample: 1987–2024.

We next ask whether this relation survives the standard controls used in the cash-holdings literature. For each country, we estimate firm-level panel regressions of the cash ratio on the intangible-capital ratio, firm fixed effects, year fixed effects, and the control variables in Falato et al. (2022).⁴ The firm fixed effects absorb time-invariant differences across firms, while the year fixed effects absorb country-wide shocks common to firms each year. β , the coefficient on the intangible-capital ratio, is thus estimated from changes within the same firm over time, after removing year effects and standard cash determinants.

Table II reports the estimates. The coefficient on intangible capital is positive and statistically significant at the 1% level in every country. The point estimates range from 0.029 in the United States to 0.530 in Thailand. These coefficients should not be read as a ranking of the strength of the intangible-collateral channel across countries. They are within-firm slopes, identified from changes in firms' intangible-capital ratios over time. They therefore depend on the amount and type of within-firm variation in intangible capital, the scale of the ratio, and the remaining cash determinants in each country. The structural model in Sections III to V is therefore needed to quantify how much intangible capital contributes to changes in cash holdings over time and to differences in cash holdings across countries.

Table II
Cash Holdings and Intangible Capital: Cross-Country Estimates

This table reports country-level panel regressions of cash holdings on intangible capital. The dependent variable is cash and short-term investments scaled by total assets. The main independent variable is intangible capital scaled by total assets net of cash. Columns 1–4 report advanced economies: the United States, the United Kingdom, Japan, and Taiwan. Columns 5–8 report emerging economies: India, Indonesia, Brazil, and Thailand. All regressions include firm and year fixed effects and the control variables in Falato et al. (2022): industry cash-flow volatility, firm size, cash flow over assets, capital expenditures over assets, acquisitions over assets, and a dividend-payer indicator. We omit market-to-book because comparable year-end market values are not consistently available for the full non-U.S. sample. The sample includes firms with at least three firm-year observations. Continuous variables are winsorised at the 1st and 99th percentiles within country. Standard errors clustered at the firm level are shown in parentheses. *** denotes significance at the 1% level.

| | <i>Advanced Economies</i> | | | | <i>Emerging Economies</i> | | | |
|----------------|---------------------------|---------------------|---------------------|---------------------|---------------------------|---------------------|---------------------|---------------------|
| | USA | GBR | JPN | TWN | IND | IDN | BRA | THA |
| IK/Net Assets | 0.029*** (0.001) | 0.087*** (0.005) | 0.154*** (0.009) | 0.191*** (0.011) | 0.175*** (0.040) | 0.483*** (0.102) | 0.371*** (0.069) | 0.530*** (0.079) |
| Observations | 126,791 | 16,090 | 12,216 | 18,621 | 9,889 | 1,839 | 1,693 | 3,489 |
| Adj. R-squared | 0.765 | 0.699 | 0.826 | 0.728 | 0.606 | 0.619 | 0.552 | 0.579 |

The descriptive evidence and panel regressions establish a robust positive relation between intangible capital and cash holdings in every country in the sample. This relation is present in raw firm-level correlations and remains after controlling for standard cash determinants and firm and year fixed effects. The reduced-form evidence does not, however, quantify the contribution of intangible capital to the rise in cash holdings or to cross-country differences in cash levels. Other forces, including taxes, financing costs, volatility, profitability, and interest rates, also vary across countries and over time. The remainder of the paper therefore uses the structural model to decompose these channels and measure the contribution of intangible capital to cash holdings within and across countries.

⁴ The specification follows Falato et al. (2022, Table VIII, column 2), except that we omit market-to-book because comparable year-end market values are not consistently available in Compustat Global for the full non-U.S. sample, and we relax the minimum-years requirement from five to three.

III. The Structural Model

Section II documents a positive relation between intangible capital and cash holdings across the countries in our panel. This reduced-form evidence shows that the two variables are positively associated after accounting for standard firm characteristics and fixed effects, but it does not identify the economic forces behind the relation. The coefficient on intangible capital combines the collateral effect of intangible assets with the effects of other firm characteristics, financing frictions, and country-level institutions that covary with both intangible capital and cash. To quantify the contribution of the intangible-collateral channel, we therefore adopt the structural model of Falato et al. (2022). The formal model is reported in Appendix C.

The model is useful for two reasons. First, it allows counterfactual analysis. Because the firm’s problem can be re-solved under alternative parameter values, the model can ask how cash holdings would change if one model parameter changed while the others were held fixed. Second, it gives us a common framework for comparing countries. We recalibrate the same model separately for each country and then measure the contribution of asset tangibility, financing costs, taxes, interest rates, and productivity risk in the same way across countries. This is preferable to comparing reduced-form coefficients, which reflect different sources of country-specific variation and therefore need not be directly comparable.

The model is a dynamic corporate-finance model in which firms choose investment, cash, debt, and equity issuance in the presence of financial frictions. Its central feature for our purposes is the distinction between productive capital and pledgeable capital. Tangible capital can support borrowing because it can be pledged as collateral. Intangible capital is productive but cannot be pledged. A shift from tangible to intangible capital therefore reduces debt capacity and raises the value of precautionary cash. The model is well suited to our setting because it maps intangible capital into cash holdings through a specific financing channel while allowing the strength of that channel to vary with country-level financing conditions.

We deliberately use the model without changing its structure. The intangible-collateral channel we test is not country-specific. In all countries, the model links lower pledgeability of productive capital to lower debt capacity and higher cash demand. The relevant external-validity test is therefore whether the same mechanism, recalibrated to local financing conditions, can account for cash holdings outside the United States.

A. Model Intuition

The firm chooses investment, financing, and cash holdings to maximise the present value of payouts to shareholders. Each period, it decides how much to invest, how to finance investment, and how much cash to carry forward. Output is produced from two stocks of capital. Tangible capital is productive and can be pledged as collateral. Intangible capital is productive but cannot be pledged. The key friction is therefore that, for intangible-intensive firms, productive capacity does not translate fully into debt capacity.

The firm has three sources of financing: retained cash, debt, and external equity. Each source is costly in a different way. Debt benefits from the corporate tax shield but is limited by collateral. Equity issuance relaxes financing constraints but entails fixed and proportional issuance costs, so the firm uses it only when internal funds and debt are insufficient. Cash provides financial flexibility, but it earns a lower return than the firm’s cost of funds. Investment is also costly to adjust, so the firm cannot frictionlessly adjust its capital stock each period.

Productivity is uncertain, so profits vary over time. Holding cash is costly because it earns a low return, but it gives the firm financial flexibility when profits are low, investment opportunities are valuable, or external finance is expensive. Tangible capital reduces the need for cash because it can support borrowing. Intangible capital has the opposite effect: it raises productive capacity without increasing collateral value, thereby increasing the firm's demand for precautionary cash.

B. The Intangible-Collateral Channel

The model's key mechanism is the intangible-collateral channel. When lenders accept only tangible capital as collateral, a decline in the pledgeability of the firm's capital stock reduces debt capacity. Intangible capital may raise output, but because it is harder to verify, seize, and redeploy than physical assets, it does not relax the borrowing constraint in the same way. Firms with more intangible capital therefore face a wider gap between productive capacity and debt capacity. Because external equity is costly, these firms hold more cash as a precautionary buffer.

The strength of this mechanism is governed by the *asset-tangibility parameter*, θ . A higher θ means that a larger share of the firm's productive capital can be pledged as collateral; a lower θ means that the firm's capital stock is less pledgeable and therefore more intangible-intensive. Thus, θ should be read inversely: declines in θ represent shifts toward intangible capital. In the counterfactuals, θ is the moving part used to isolate the intangible-collateral channel: changing θ while holding the other calibrated parameters fixed gives the model-implied contribution of asset tangibility to cash holdings.

C. Other Determinants of Cash

The model accommodates international variation through country-specific parameter values. This is important because the countries in our sample differ in real interest rates, corporate tax rates, profitability risk, and the cost of external equity. These differences affect the relative cost of debt, equity, and internal finance, and therefore influence optimal cash holdings. We recalibrate the relevant parameters separately for each country, allowing the cost of debt, the tax shield, equity-issuance frictions, profitability, and productivity risk to vary across financing environments.

This structure is useful for our research question because it separates the intangible-collateral channel from other determinants of cash holdings. The contribution attributed to θ is not a residual that absorbs all international differences in cash. It is the contribution of asset tangibility within a model that also allows financing costs, tax treatment, profitability, and risk to differ across countries. At the same time, country-specific institutions such as creditor rights, bankruptcy enforcement, and financial development are not modelled directly. They enter the decomposition only to the extent that they are reflected in the calibrated parameters.

IV. Calibration and Estimation

This section describes how we set the twelve parameters of the structural model and evaluates how well the calibrated model reproduces the data. Each parameter maps to a specific economic feature of the firm or its environment: production technology, capital adjustment costs, debt and equity-market frictions, depreciation rates, taxes, and productivity risk. Because cash holdings are the outcome of interest and are not targeted directly in the calibration, the key test is whether the model reproduces observed cash holdings country by country.

A. Strategy and Parameter Taxonomy

We calibrate the structural model separately for each country in the sample. For parameters that vary over time, we estimate separate Early- and Late-period values. Country-specific calibration is central to the analysis because the countries in our sample differ in capital composition, financing costs, tax systems, profitability, depreciation rates, and productivity risk. These differences enter the model through parameter values. Calibrating each country to its own data therefore allows the counterfactuals to measure the contribution of asset tangibility while holding fixed the other features of the local financing environment.

Within each country, we divide the parameters into three groups. The classification reflects what the data and the model can credibly identify. *Literature-fixed parameters* are taken from the literature and held constant across countries because they have no clear country-specific empirical analogue. *Calibrated parameters* have direct empirical counterparts that can be measured country by country and are set directly from the data. *SMM-estimated parameters* are chosen by simulated method of moments (SMM), which selects parameter values to minimise the distance between simulated moments and their data counterparts. Because the model is calibrated at an annual frequency, all moments are computed from annual firm-year data. Table III summarises the classification.

Table III
Calibration and Estimation Strategy

This table summarises how the twelve structural parameters are set. Panel A lists literature-fixed parameters, which are held constant across countries and taken from prior studies. Panel B lists calibrated parameters, which have direct empirical counterparts and are set from country-specific data. Panel C lists SMM-estimated parameters, which are chosen separately for each country and period by minimising the distance between simulated moments and their data counterparts. The final column reports the literature source for Panel A, the data input for Panel B, and the targeted moment for Panel C.

| Parameter | Symbol | Source / data / moment |
|--|------------|---|
| <i>Panel A: Literature-fixed parameters</i> | | |
| Output elasticity of capital | γ | Hennessy and Whited (2007) |
| Capital substitution parameter | ρ | Falato et al. (2022) |
| Fixed capital adjustment cost | F^K | Bloom (2009) |
| <i>Panel B: Calibrated parameters</i> | | |
| Tax rate | τ | Statutory rate, Falato et al. (2022) scaled |
| Real interest rate | r | Mean real one-year sovereign rate |
| Tangible depreciation | δ_T | Average depreciation of tangible capital |
| Intangible depreciation | δ_N | Average depreciation of intangible capital |
| <i>Panel C: SMM-estimated parameters</i> | | |
| Asset tangibility | θ | Average asset tangibility |
| Fixed operating cost | F^O | Average operating profitability |
| Productivity-shock volatility | σ_z | Idiosyncratic profit volatility |
| Equity issuance fixed cost | ϕ_0 | Frequency of equity issuance |
| Equity issuance proportional cost | ϕ_1 | Average equity issuance size |

B. Calibrated Parameters

Panel A reports three literature-fixed parameters that govern production and investment adjustment. These parameters are held constant across countries because they are deep technology parameters with no clear country-specific empirical analogue. The output elasticity of capital, γ , governs the curvature of the production function in capital and is set to 0.6, following Hennessy and Whited (2007) and Falato et al. (2022). The capital substitution parameter, ρ , governs the elasticity of substitution between tangible and intangible capital. We set ρ to 1, following the conservative specification in Falato et al. (2022), which corresponds to an elasticity of substitution of 0.5. The fixed capital adjustment cost, F^K , is common to tangible and intangible capital and governs the lumpiness of firm investment. We set F^K to 0.005 of installed capital, following Bloom (2009).

Panel B reports four calibrated parameters that vary by country and period. The corporate tax rate, τ , is the statutory corporate tax rate, scaled following Falato et al. (2022) to account for the relative burden of corporate and personal taxation (Appendix D). The real interest rate, r , is the average real sovereign yield over the relevant country-period window, computed as the nominal one-year sovereign yield less realised CPI inflation (Appendix E). The tangible and intangible depreciation rates, δ_T and δ_N , are firm-weighted country-period averages computed from the data. The tangible depreciation rate is based on accounting depreciation of tangible capital. The intangible depreciation rate partly reflects the composition of intangible capital, because knowledge capital and organisational capital depreciate at different rates. Cross-country variation in δ_N therefore captures differences in the mix between knowledge and organisational capital.

C. Estimated Parameters

For each country and period, we estimate the five parameters in Panel C by simulated method of moments. The estimation chooses parameter values that minimise the distance between targeted simulated moments and their data counterparts. Each parameter is paired with the moment it most directly affects: asset tangibility, θ , with average asset tangibility; the fixed operating cost, F^O , with average operating profitability; productivity-shock volatility, σ_z , with within-firm profit variance; the fixed equity-issuance cost, ϕ_0 , with the frequency of equity issuance; and the proportional equity-issuance cost, ϕ_1 , with average equity-issuance size. The parameters interact in the model and affect several moments simultaneously, but these pairings provide the main discipline for the estimation. We do not report standard errors for the SMM-estimated parameters because the parameters are used to construct counterfactual decompositions rather than to test hypotheses about individual structural coefficients. We instead evaluate the calibration by how well the model reproduces the untargeted cash moment. Appendix F describes the SMM procedure in detail.

The two equity-issuance parameters, ϕ_0 and ϕ_1 , are matched to moments derived from a proxy for seasoned equity offerings. Falato et al. (2022) identify equity-issuance events using the Securities Data Company database (SDC), which records public equity offerings at the firm-year level. Because comparable SDC coverage is not available for the full international sample, we replace the SDC indicator with an accounting-based proxy constructed from Compustat data. Appendix G describes the proxy construction.

Table IV reports the calibrated and estimated values of all twelve parameters by country and period.

Table IV
Parameter Values

This table reports the twelve structural parameter values by country and period. Panel A reports literature-fixed parameters, which are held constant across countries and periods. Panel B reports calibrated parameters set directly from country-period data. Panel C reports SMM-estimated parameters matched to the targeted moments in Table III. The corporate tax parameter, τ , is scaled from the Falato et al. (2022) U.S. calibration using statutory corporate tax rates. Brazil and Indonesia do not pass the calibration fit criterion and are reported for transparency but excluded from the counterfactual decompositions. Values are reported to three decimal places.

| | <i>Early Period</i> | | | | | | | | <i>Late Period</i> | | | | | | | |
|---|---------------------|-------|-------|-------|-------|-------|--------------|--------------|--------------------|-------|-------|-------|-------|-------|--------------|--------------|
| | USA | GBR | JPN | TWN | IND | THA | <i>IDN</i> | <i>BRA</i> | USA | GBR | JPN | TWN | IND | THA | <i>IDN</i> | <i>BRA</i> |
| <i>Panel A: Literature-fixed parameters</i> | | | | | | | | | | | | | | | | |
| γ | 0.600 | 0.600 | 0.600 | 0.600 | 0.600 | 0.600 | <i>0.600</i> | <i>0.600</i> | 0.600 | 0.600 | 0.600 | 0.600 | 0.600 | 0.600 | <i>0.600</i> | <i>0.600</i> |
| ρ | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | <i>1.000</i> | <i>1.000</i> | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | <i>1.000</i> | <i>1.000</i> |
| F^K | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | <i>0.005</i> | <i>0.005</i> | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | <i>0.005</i> | <i>0.005</i> |
| <i>Panel B: Calibrated parameters</i> | | | | | | | | | | | | | | | | |
| τ | 0.187 | 0.170 | 0.248 | 0.134 | 0.193 | 0.161 | <i>0.163</i> | <i>0.173</i> | 0.165 | 0.126 | 0.188 | 0.107 | 0.186 | 0.126 | <i>0.139</i> | <i>0.194</i> |
| r | 0.013 | 0.033 | 0.005 | 0.023 | 0.013 | 0.022 | <i>0.022</i> | <i>0.043</i> | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | <i>0.024</i> | <i>0.042</i> |
| δ_T | 0.123 | 0.109 | 0.050 | 0.082 | 0.054 | 0.067 | <i>0.064</i> | <i>0.063</i> | 0.129 | 0.196 | 0.076 | 0.078 | 0.063 | 0.064 | <i>0.063</i> | <i>0.090</i> |
| δ_N | 0.186 | 0.192 | 0.192 | 0.179 | 0.197 | 0.200 | <i>0.200</i> | <i>0.199</i> | 0.183 | 0.189 | 0.189 | 0.174 | 0.197 | 0.200 | <i>0.199</i> | <i>0.197</i> |
| <i>Panel C: SMM-estimated parameters</i> | | | | | | | | | | | | | | | | |
| θ | 0.683 | 0.896 | 0.806 | 0.851 | 0.941 | 0.879 | <i>0.938</i> | <i>0.875</i> | 0.604 | 0.708 | 0.723 | 0.759 | 0.874 | 0.855 | <i>0.929</i> | <i>0.895</i> |
| F_O | 2.508 | 2.027 | 2.579 | 3.083 | 3.826 | 3.310 | <i>2.856</i> | <i>1.722</i> | 3.330 | 2.100 | 2.008 | 3.993 | 3.882 | 3.189 | <i>2.882</i> | <i>3.215</i> |
| σ_z | 0.287 | 0.266 | 0.079 | 0.220 | 0.227 | 0.284 | <i>0.243</i> | <i>0.296</i> | 0.384 | 0.342 | 0.192 | 0.278 | 0.261 | 0.445 | <i>0.235</i> | <i>0.233</i> |
| ϕ_0 | 0.015 | 0.022 | 0.200 | 0.034 | 0.015 | 0.029 | <i>0.033</i> | <i>0.022</i> | 0.008 | 0.001 | 0.013 | 0.010 | 0.006 | 0.006 | <i>0.029</i> | <i>0.011</i> |
| ϕ_1 | 0.017 | 0.024 | 0.200 | 0.019 | 0.021 | 0.027 | <i>0.031</i> | <i>0.020</i> | 0.011 | 0.043 | 0.013 | 0.016 | 0.017 | 0.001 | <i>0.029</i> | <i>0.014</i> |

D. Model Fit

We evaluate the calibration in two steps. First, we examine the *targeted moments* used in the SMM estimation. These moments assess whether the model can reproduce the empirical counterparts used to discipline the five estimated parameters. Second, we examine the *untargeted cash moment*. This is the more important test for our purposes because cash holdings are the outcome variable of interest and do not enter the SMM objective function. If the model reproduces cash holdings despite not targeting them directly, it provides evidence that the calibrated economic mechanisms are relevant for explaining corporate cash holdings. This distinction between moments used to discipline the calibration and moments used to assess model fit follows the validation logic in Falato et al. (2022) and is consistent with broader practice in structural corporate finance (Bazdresch, Kahn, and Whited, 2018).

The calibration passes this test in six of the eight countries in our sample: the United States, the United Kingdom, Japan, Taiwan, India, and Thailand. Brazil and Indonesia do not pass the cash-fit criterion. We retain them in the calibration figures and tables for transparency but exclude them from the counterfactual decompositions in Section V.

Figure 3 reports the targeted-moment fit for each country, averaged across the Early and Late periods. Among the six countries that pass the cash-fit criterion, the model matches asset tangibility and operating profitability closely. Idiosyncratic profit volatility is somewhat overestimated, with model-implied volatility above the data in five of the six passing countries. Equity-issuance frequency is also matched closely in most countries. The weakest targeted moment is average equity-issuance size, where the model overpredicts the data most clearly for Japan. One possible explanation is institutional from Hoshi, Kashyap, and Scharfstein (1991): Japanese listed firms historically relied more heavily on main-bank financing, with banks serving as both lenders and shareholders of client firms. Because our model represents external finance through debt and public equity, it may not fully capture this bank-centred financing channel. We interpret this explanation cautiously. The key point is that Japan still passes the calibration because the untargeted cash ratio, the main outcome of interest, is matched within the two-percentage-point criterion.

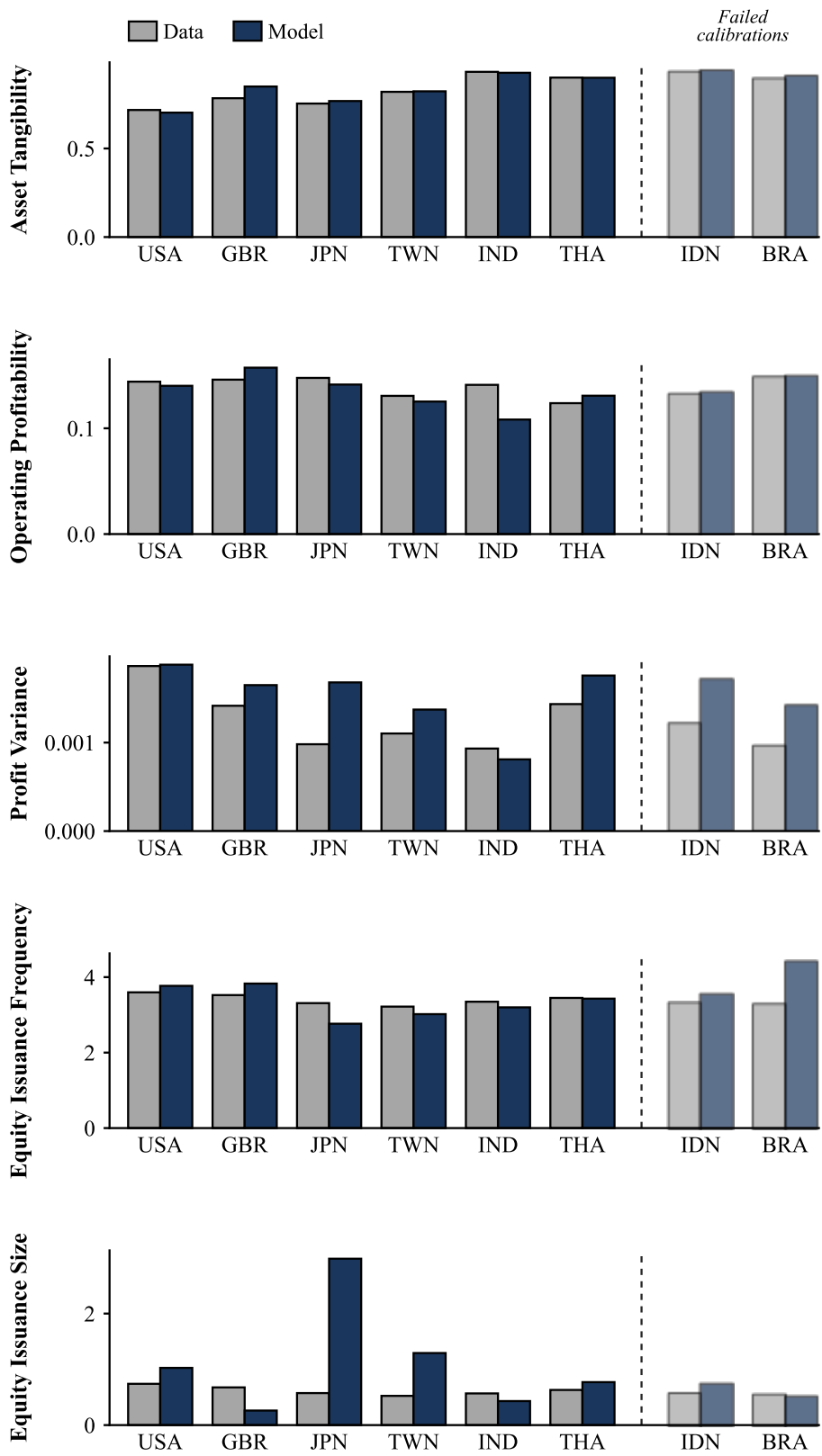


Figure 3. Targeted-moment fit by country. The figure compares model-implied moments with their data counterparts for the five targeted moments used in the SMM estimation: asset tangibility, operating profitability, profit variance, equity-issuance frequency, and average equity-issuance size. Bars report averages across the Early and Late periods. Dark blue bars denote model-implied moments, and grey bars denote data moments. The vertical dashed line separates the six countries that pass the cash-fit criterion from Brazil and Indonesia, which do not pass and are shown in faded shading. Period-specific values are reported in Appendix H.

Figure 4 reports model-implied and empirical cash ratios separately for the Early and Late periods. Panel A reports the levels, and Panel B reports the fit gap, defined as model minus data. For the six countries that pass the cash-fit criterion, the model-implied cash ratio is within two percentage points of the data in both periods. The model also reproduces the rise in cash holdings documented in Section II: cash rises in both the data and the model in five of the six passing countries, and the model-implied increase is close to the empirical increase.

Brazil and Indonesia do not pass the cash-fit criterion. The model overpredicts the Indonesian cash ratio by approximately 4 percentage points in the Early period and 10 percentage points in the Late period. For Brazil, the model converges to a near-zero cash ratio in both periods, generating gaps of approximately 12 and 16 percentage points. Because the targeted moments are matched reasonably well in both countries, the mismatch arises mainly in the untargeted cash moment. We interpret this as evidence that the model cannot simultaneously match the targeted moments and reproduce observed cash holdings in these two countries. Because the counterfactual decompositions require a credible fit to the untargeted cash moment, we report Brazil and Indonesia for transparency but exclude them from the analysis in Section V.

The two cases differ. In Indonesia, the issue is mainly one of cash levels rather than cash dynamics. Empirical cash holdings are nearly flat from the Early to the Late period, and calibrated asset tangibility changes little. The model therefore captures the absence of a strong intangible-collateral shift but overpredicts the level of cash in both periods. Indonesia also has the second-smallest sample in the panel and very high asset tangibility, which may contribute to the level mismatch.

In Brazil, the mismatch is more severe. Brazil has the smallest sample in the panel, high asset tangibility, and the highest real interest rate in the sample. A high real interest rate raises the opportunity cost of holding cash, while high tangibility increases debt capacity. Together, these forces push model-implied cash toward zero. In addition, Brazil's calibrated θ rises from the Early to the Late period, whereas the intangible-collateral channel predicts higher cash when tangibility falls. Brazil therefore moves against the mechanism that the model is designed to quantify, even though empirical cash holdings rise over the same period.

Appendix H also reports net-leverage fit as an additional diagnostic. The model captures leverage less tightly than cash, so we use it only as a supplementary diagnostic and retain the untargeted cash ratio as the calibration-passing criterion.

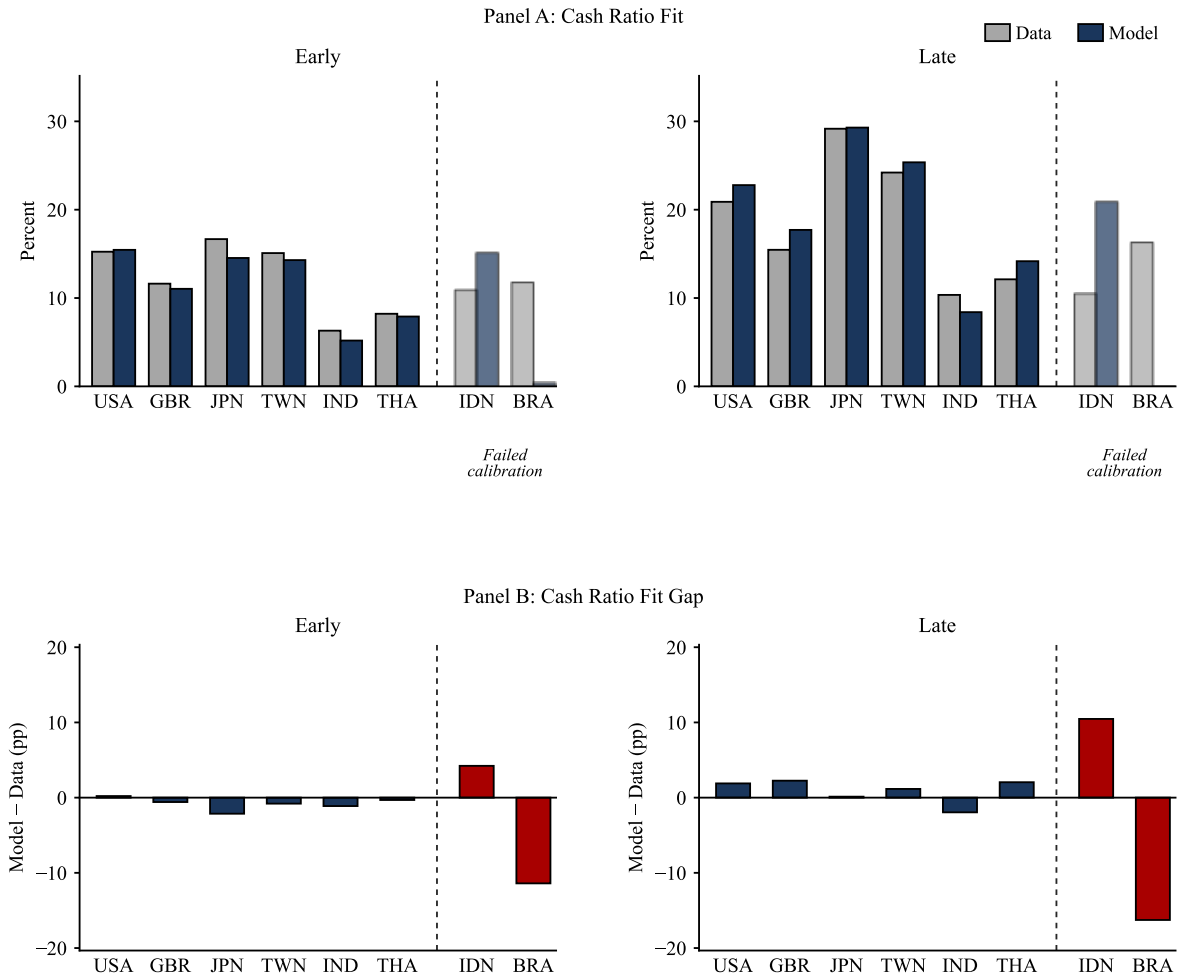


Figure 4. Cash-ratio fit by country and period. This figure reports empirical and model-implied cash ratios by country, separately for the Early and Late periods. Panel A reports cash-ratio levels, expressed as a percentage of total assets. Dark blue bars denote model-implied cash ratios and grey bars denote data moments. Panel B reports the fit gap, defined as model minus data, in percentage points. In Panel B, dark blue bars denote the six countries that pass the cash-fit criterion; red bars denote Brazil and Indonesia, which do not pass and are excluded from the counterfactual decompositions. The cash ratio is untargeted in the calibration.

V. Results

The counterfactuals show that the intangible-collateral channel is quantitatively important in the advanced economies where intangible capital is large and increasing. *In the time series*, the shift toward intangible capital accounts for an average of 55% of the model-implied rise in corporate cash holdings in the four advanced economies in our sample. *In the cross-section*, differences in asset tangibility account for 52% of the cross-country variance in model-implied cash. The mechanism documented by Falato et al. (2022) for the United States therefore also appears important in the other advanced economies in our sample, although its strength varies across countries.

A. Intangible-Collateral Channel Within Countries

The time-series counterfactual quantifies how much of each country’s model-implied increase in cash holdings is explained by the shift toward intangible capital. Mechanically, the exercise works through θ : lower θ means lower asset tangibility and therefore a more intangible-intensive capital stock. We conduct the exercise for the six countries that pass the cash-fit criterion. For each country, we hold all parameters at their Late-period values and reset θ to its Early-period value. This removes the observed decline in asset tangibility while leaving the other country-specific parameters at their Late-period values. We interpret the difference between baseline and counterfactual cash holdings as the model-implied contribution of the change in θ . The residual reflects the joint contribution of the remaining country-specific parameters. Because Early-period start years differ across countries, the estimates should be read as within-country decompositions rather than directly comparable cross-country magnitudes.

Table V reports the time-series counterfactuals. In the four advanced economies, the shift toward intangible capital accounts for between 40% and 73% of the model-implied increase in cash holdings between the Early and Late periods. The model-implied contribution is positive and substantial in each case: 40% in the United States, 73% in the United Kingdom, 63% in Japan, and 43% in Taiwan. These results suggest that the intangible-collateral channel is economically meaningful in all four advanced economies in our sample, rather than being specific to the United States. By contrast, the contribution is small in Thailand, at 6%, and negative in India, at -56% .

Figure 5 presents the time-series counterfactuals graphically. Each panel plots the baseline model-implied change in cash holdings from the Early to the Late period and the counterfactual change obtained by holding θ fixed at its Early-period value. Since θ measures asset tangibility, holding it fixed removes the model-implied effect of the shift toward intangible capital. The shaded area represents the contribution of the change in θ . The figure reinforces the pattern in Table V: the contribution is substantial in the four advanced economies, small in Thailand, and negative in India.

Table V
Within-Country Decomposition of the Early-to-Late Rise in Cash

This table reports the decomposition of the model-implied rise in cash holdings from the Early to the Late period for each of the six countries that pass the cash-fit criterion. The change in intangible capital column reports the change in intangible-capital intensity between the Early and Late periods. Δ Cash Model is the model-implied change in the country's cash-to-assets ratio. The θ contribution is the model-implied portion of Δ Cash Model generated by the change in θ , holding the other country-specific parameters fixed. Because θ is an asset-tangibility parameter, a decline in θ corresponds to a shift toward intangible capital. Other parameters is the residual portion of Δ Cash Model generated by the joint movement of the remaining country-specific parameters: F^O , σ_z , ϕ_0 , ϕ_1 , τ , and r . Values in parentheses are percentage-point contributions to the cash ratio.

| Country | Δ Intangible Capital Intensity | Δ Cash Model | θ Contribution | Other Parameters |
|----------------|---------------------------------------|---------------------|-----------------------|------------------|
| United States | +13% | +7.3 pp | +40% (+2.9 pp) | +60% (+4.4 pp) |
| United Kingdom | +27% | +6.7 pp | +73% (+4.9 pp) | +27% (+1.8 pp) |
| Japan | +13% | +14.8 pp | +63% (+9.3 pp) | +37% (+5.5 pp) |
| Taiwan | +12% | +11.1 pp | +43% (+4.8 pp) | +57% (+6.3 pp) |
| Thailand | +4% | +6.3 pp | +6% (+0.4 pp) | +94% (+5.9 pp) |
| India | +8% | +3.2 pp | -56% (-1.8 pp) | +156% (+5.0 pp) |

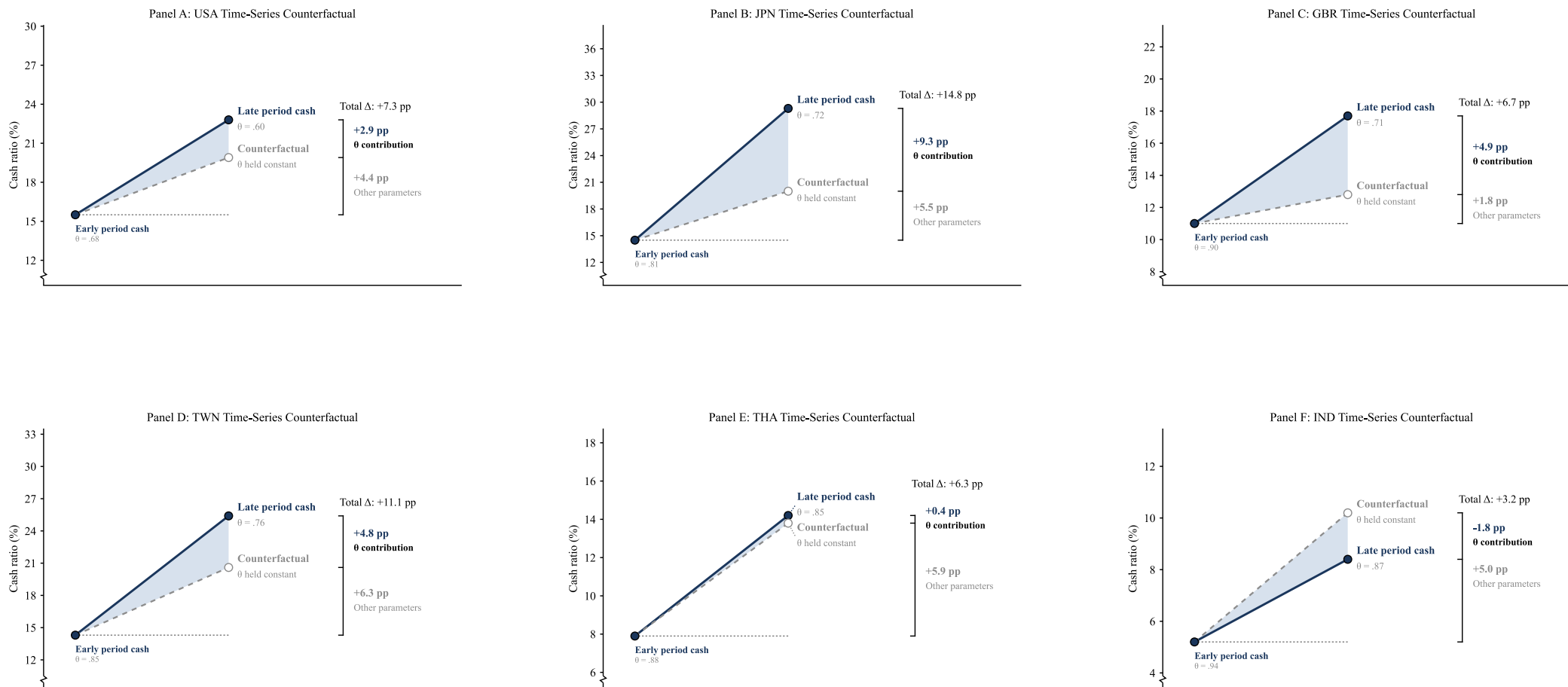


Figure 5. Within-country counterfactual decomposition of the rise in cash. The figure reports the time-series counterfactual for each of the six countries that pass the cash-fit criterion. Each panel shows three model-implied cash ratios: Early-period cash, baseline Late-period cash, and counterfactual Late-period cash obtained by holding θ at its Early-period value while all other parameters take their Late-period values. The solid blue line traces the baseline model-implied change from the Early to the Late period. The dashed grey line traces the counterfactual change with θ held fixed. Because θ measures asset tangibility, the shaded area represents the model-implied contribution of the shift toward intangible capital to the rise in cash. Early- and Late-period θ values are reported below the corresponding points. Vertical scales vary across panels. Brazil and Indonesia are omitted because they do not pass the cash-fit criterion.

B. Intangible-Collateral Channel Across Countries

The within-country exercise shows that the intangible-collateral channel is economically meaningful in the advanced economies in our sample. We now ask a separate question: how much of the cross-country *dispersion* in cash holdings is explained, in the model, by differences in asset tangibility rather than by other country-specific parameters. Cash holdings differ substantially across the six countries that pass the cash-fit criterion. In the Late period, model-implied cash ranges from 8.4% in India to 29.3% in Japan, generating a cross-country variance of 49.3 pp².

For each country, we ask what its cash holdings would be if its θ were set to the cross-country average rather than to its own value. Since θ is the model's asset-tangibility parameter, and lower θ corresponds to higher intangible-capital intensity, this exercise removes cross-country differences in the model's intangible-capital channel. In the *equalise- θ counterfactual*, θ is set to the equal-weighted average of the six Late-period θ values, 0.75, while all other parameters remain at their country-specific Late-period values. We then compare the cross-country variance of model-implied cash with the baseline variance, where each country keeps its own calibrated Late-period parameter vector. The reduction in variance is the model-implied contribution of cross-country differences in θ .

We also run the mirror exercise. Here, θ remains at its country-specific Late-period value, while all other country-specific parameters are set to their cross-country averages. This removes cross-country differences in the other drivers of cash holdings, including financing costs, tax treatment, profitability, depreciation rates, productivity risk, and equity-issuance frictions, while preserving cross-country differences in asset tangibility.

Table VI Panel B reports the results. The cross-country variance of model-implied cash falls from 49.3 pp² in the baseline to 23.7 pp² when θ is equalised across countries, a reduction of 52%.⁵ When all other country-specific parameters are equalised jointly, the variance falls to 22.1 pp², a reduction of 55%. Thus, in the model, differences in asset tangibility alone explain roughly half of the cross-country dispersion in cash holdings, a contribution comparable to that of all other country-specific parameters combined.

⁵ Using the Falato et al. (2022) full-sample value of $\theta = 0.660$ instead of the cross-country mean as the equalisation anchor raises the θ contribution from 52% to 63% of cross-country variance. The conclusion that θ accounts for roughly half of cross-country cash dispersion is therefore not sensitive to the choice of anchor.

Table VI
Cross-Country Cash Holdings and Counterfactual Decomposition

This table reports the cross-country dispersion of model-implied cash holdings in the Late period and decomposes that dispersion into the contribution of asset tangibility, θ , and the joint contribution of all other country-specific parameters. Panel A reports Late-period θ and model-implied cash for each of the six countries that pass the cash-fit criterion, along with the cross-country variance of model-implied cash. Panel B reports the variance of model-implied cash under three parameter configurations. Baseline uses each country's own Late-period parameter vector. Equalise θ sets θ in each country to the cross-country mean while leaving all other parameters at their country-specific Late-period values. Equalise all other country-specific parameters sets all country-specific parameters other than θ to their cross-country means while leaving θ at its country-specific Late-period value. % Variance Reduction is calculated as $1 - \text{Var}(\text{counterfactual}) / \text{Var}(\text{baseline})$. The two variance reductions need not sum to 100% because the effects of θ and the other country-specific parameters are not additively separable in the nonlinear model. Brazil and Indonesia are excluded because they do not pass the cash-fit criterion.

Panel A: Cross-country cash holdings under calibrated parameters

| USA | JPN | GBR | TWN | THA | IND | Variance Across Countries (pp ²) |
|------|------|------|------|------|-----|--|
| 22.8 | 29.3 | 17.7 | 25.4 | 14.2 | 8.4 | 49.30 |

Panel B: Counterfactual decomposition of cross-country variance

| Scenario | Variance Across Countries (pp ²) | % Variance Reduction |
|--|--|----------------------|
| Baseline (no equalisation) | 49.30 | |
| Equalise asset tangibility (θ) | 23.69 | - 52% |
| Equalise all other country-specific parameters | 22.14 | - 55% |

C. Interpretation

The two counterfactuals deliver a consistent message. The intangible-collateral channel is an important driver of corporate cash holdings in the advanced economies in our panel. *In the time-series counterfactual*, changes in θ explain between 40% and 73% of the model-implied rise in cash holdings in the United States, the United Kingdom, Japan, and Taiwan. The average contribution across these four countries is 55%. These shares are below the 75% contribution that Falato et al. (2022) report for the United States, but they remain large enough to make the channel economically important. The evidence therefore points to intangible capital as a central driver of corporate cash holdings across advanced economies.

The same conclusion does not hold for the two emerging economies that pass the calibration. The θ contribution is small in Thailand, at 6%, and negative in India, at -56%, even though model-implied cash rises in both countries. Thailand is consistent with the model's logic. Thailand enters the Late period with high asset tangibility, and θ changes little over time. When most capital is already tangible and pledgeable, the intangible-collateral channel has limited room to operate. Firms can support borrowing with the tangible capital they already hold, so the model does not generate a large additional demand for cash through this channel.

India is harder to interpret. India also enters the Late period with high asset tangibility, with θ equal to 0.87, the highest value among the six passing countries. This gives the channel limited room to operate. However, the negative θ contribution in India is not easy to rationalise from the movement in θ alone, since θ falls between the Early and Late periods. The model-implied rise in Indian cash is instead driven mainly by the other country-specific parameters, especially the financing-cost environment, rather than by the intangible-collateral channel. We therefore treat the India result as a boundary case. The decomposition shows that the channel does not explain India's model-implied cash increase, but it does not establish why India differs economically from the advanced economies.

The advanced-emerging split is nevertheless informative. Thailand and India have the two highest Late period θ values in the passing sample, at 0.85 and 0.87. This means that most of their capital remains tangible and pledgeable in the model. By contrast, the four advanced economies have lower Late period θ values, between 0.60 and 0.76. The channel is therefore strongest where the model sees capital as less pledgeable. This is exactly where the intangible-collateral mechanism should matter most: when productive capital increasingly fails to support debt capacity.

The cross-sectional counterfactual gives a complementary result. The time-series exercise asks whether changes in asset tangibility explain the rise in cash within countries. The cross-sectional exercise asks whether differences in asset tangibility explain why cash levels differ across countries. Equalising θ across the six passing countries reduces the cross-country variance of model-implied cash by 52%. Equalising all other country-specific parameters jointly reduces the variance by 55%. Asset tangibility therefore accounts for roughly as much cross-country cash dispersion as the remaining country-specific parameters combined: taxes, interest rates, depreciation rates, operating costs, productivity risk, and equity-issuance costs. The two shares need not sum to 100%, because the effects of θ and the other parameters interact in the nonlinear model.

These findings should be read with three caveats. First, the time-series counterfactuals are within-country decompositions. The Early period starts in different years across countries, and the model-implied cash rise used as the denominator is country-specific. The percentages should therefore not be read as a strict cross-country ranking. The 55% figure is best interpreted as a summary of the advanced-economy results.

Second, the cross-sectional result is conditional on calibration success. Brazil and Indonesia are excluded because the model does not match their untargeted cash ratios closely enough. The 52% variance share therefore applies to the six countries that pass calibration, not to the original eight-country panel.

Third, the counterfactuals are model-based decompositions. They measure how much model-implied cash changes when θ or the other parameters are changed inside the calibrated structural model. They should therefore be interpreted as evidence on economic magnitude and direction within the model, not as exact statistical estimates of universal effect sizes.

Taken together, the results point to intangible capital as a central driver of corporate cash holdings across advanced economies. The time-series evidence is economically meaningful in all four advanced economies, and the cross-sectional evidence shows that differences in asset tangibility account for roughly half of the cash dispersion among the calibrated countries. The evidence is weaker in emerging economies. Thailand fits the model's logic because tangibility remains high and stable. India does not provide a clean economic interpretation, beyond showing that its model-implied cash rise is driven by parameters other than the intangible-collateral channel. The overall conclusion is therefore not that the mechanism explains cash holdings everywhere. It is that the channel is economically important where intangible capital is large enough, and sufficiently increasing, for collateral constraints to matter.

VI. Conclusion

This paper asks whether the intangible-collateral channel documented by Falato et al. (2022) for the United States explains corporate cash holdings internationally. The evidence supports the channel in the advanced economies in our panel, but not in the emerging economies. In the United States, the United Kingdom, Japan, and Taiwan, falling asset tangibility accounts for between 40% and 73% of the model-implied rise in cash holdings. The average contribution is 55%. In Thailand, the contribution is small. In India, it is negative. The channel therefore accounts for a large share of the rise in cash within advanced economies, but not within every country.

The cross-country evidence provides a novel insight. Equalising asset tangibility across the six calibrated countries removes 52% of the cross-country variance in model-implied cash holdings. Equalising all other country-specific parameters jointly removes 55%. Differences in intangible-capital intensity therefore account for roughly half of the cross-country dispersion in cash levels. Their contribution is comparable to all other country-specific parameters combined.

The comparison with Falato et al. (2022) helps interpret the U.S. result. We find that falling tangibility accounts for 40% of the model-implied U.S. cash increase over 1987 to 2024. Falato et al. (2022) report 75% for 1970 to 2010. The difference is consistent with our later and shorter sample, in which the rise in intangible capital is smaller than in their original U.S. sample. The result therefore supports the mechanism in a different U.S. sample period but also shows that its estimated contribution depends on when intangible capital rises most sharply.

Taken together, the results point to intangible capital being a central driver of corporate cash holdings in advanced economies. As firms shift from tangible to intangible assets, productive capital becomes less pledgeable, debt capacity falls, and the value of precautionary cash rises. Where this shift is large, the intangible-collateral channel is quantitatively important. Where tangibility remains high and changes little, other forces dominate cash policy.

The findings, as well as the limitations (discussed in Section V.C), point to natural extensions. The first is to expand the country panel. A wider panel would allow the advanced-emerging contrast to be tested more formally and would make the cross-country variance decomposition less sensitive to individual countries. The second is to adapt the model to emerging-economy settings. Brazil and Indonesia do not pass the calibration, and the channel is weak in Thailand and India. This suggests that cash policy in high-tangibility, lower-cash environments may require additional institutional or financial frictions not captured by the Falato et al. (2022) framework. The third extension would be to also examine the channel by industry or firm size, since intangible capital is unlikely to matter equally across sectors or across the firm-size distribution. Industry-specific intangible-capital measures, such as those estimated from market prices by Ewens, Peters, and Wang (2025), would be useful for testing whether the results are robust to alternative capitalisation assumptions.

These extensions would refine the quantitative estimates, but they do not change the main conclusion. In the advanced economies in our panel, the intangible-collateral channel accounts for a large share of the rise in corporate cash holdings and a large share of the dispersion in cash across countries. The evidence is weaker in emerging markets, which is itself an interesting finding, for which we encourage further research.

References

- Almeida, Heitor, Murillo Campello, and Michael S. Weisbach, 2004, The cash flow sensitivity of cash, *Journal of Finance* 59, 1777–1804.
- Bates, Thomas W., Ching-Hung Chang, and Jianxin Daniel Chi, 2018, Why has the value of cash increased over time?, *Journal of Financial and Quantitative Analysis* 53, 749–787.
- Bates, Thomas W., Kathleen M. Kahle, and René M. Stulz, 2009, Why do U.S. firms hold so much more cash than they used to?, *Journal of Finance* 64, 1985–2021.
- Bazdresch, Santiago, R. Jay Kahn, and Toni M. Whited, 2018, Estimating and testing dynamic corporate finance models, *Review of Financial Studies* 31, 322–361.
- Bloom, Nicholas, 2009, The impact of uncertainty shocks, *Econometrica* 77, 623–685.
- Corrado, Carol, Charles Hulten, and Daniel Sichel, 2009, Intangible capital and U.S. economic growth, *Review of Income and Wealth* 55, 661–685.
- Directorate-General of Budget, Accounting and Statistics, Executive Yuan, 2024, Consumer Price Index, Republic of China (Taiwan), <https://eng.stat.gov.tw>, accessed 18 March 2026.
- Ewens, Michael, Ryan H. Peters, and Sean Wang, 2025, Measuring intangible capital with market prices, *Management Science* 71, 407–427.
- Federal Reserve Bank of St. Louis, 2024, Federal Reserve Economic Data (FRED), <https://fred.stlouisfed.org>, accessed 18 March 2026.
- Falato, Antonio, Dalida Kadyrzhanova, Jae Sim, and Roberto Steri, 2022, Rising intangible capital, shrinking debt capacity, and the U.S. corporate savings glut, *Journal of Finance* 77, 2799–2852.
- Hart, Oliver, and John Moore, 1994, A theory of debt based on the inalienability of human capital, *The Quarterly Journal of Economics* 109, 841–879.
- Hennessy, Christopher A., and Toni M. Whited, 2007, How costly is external financing? Evidence from a structural estimation, *Journal of Finance* 62, 1705–1745.
- Holston, Kathryn, Thomas Laubach, and John C. Williams, 2017, Measuring the natural rate of interest: International trends and determinants, *Journal of International Economics* 108, S59–S75.
- Huang, Rongbing, and Jay R. Ritter, 2022, The puzzle of frequent and large issues of debt and equity, *Journal of Financial and Quantitative Analysis* 57, 170–206.
- Hoshi, Takeo, Anil Kashyap, and David Scharfstein, 1991, Corporate structure, liquidity, and investment: Evidence from Japanese industrial groups, *The Quarterly Journal of Economics* 106, 33–60.
- Kiyotaki, Nobuhiro, and John Moore, 1997, Credit cycles, *Journal of Political Economy* 105, 211–248.

- LSEG, 2024, Datastream macroeconomic and financial database, London Stock Exchange Group, accessed 18 March 2026.
- McLean, R. David, Jeffrey Pontiff, and Akiko Watanabe, 2009, Share issuance and cross-sectional returns: International evidence, *Journal of Financial Economics* 94, 1–17.
- Miller, Merton H., 1977, Debt and taxes, *Journal of Finance* 32, 261–275.
- Nikolov, Boris, and Toni M. Whited, 2014, Agency conflicts and cash: Estimates from a dynamic model, *Journal of Finance* 69, 1883–1921.
- OECD, 2024, *Corporate Tax Statistics*, 2024 Edition, OECD Publishing, Paris, <https://www.oecd.org/tax/tax-policy/corporate-tax-statistics-database.htm>, accessed 18 March 2026.
- Peters, Ryan H., and Lucian A. Taylor, 2017, Intangible capital and the investment-q relation, *Journal of Financial Economics* 123, 251–272.
- Pinkowitz, Lee, René M. Stulz, and Rohan Williamson, 2016, Do U.S. firms hold more cash than foreign firms do?, *Review of Financial Studies* 29, 309–348.
- Rampini, Adriano A., and S. Viswanathan, 2013, Collateral and capital structure, *Journal of Financial Economics* 109, 466–492.
- Shleifer, Andrei, and Robert W. Vishny, 1992, Liquidation values and debt capacity: A market equilibrium approach, *Journal of Finance* 47, 1343–1366.
- Tax Foundation, 2024, Corporate Tax Rates around the World, 2024, <https://taxfoundation.org/data/all/global/corporate-tax-rates-by-country-2024/>, accessed 18 March 2026.
- World Bank, 2024, World Development Indicators, <https://databank.worldbank.org/source/world-development-indicators>, accessed 18 March 2026.

Appendix A: Coverage Rates for SG&A and R&D

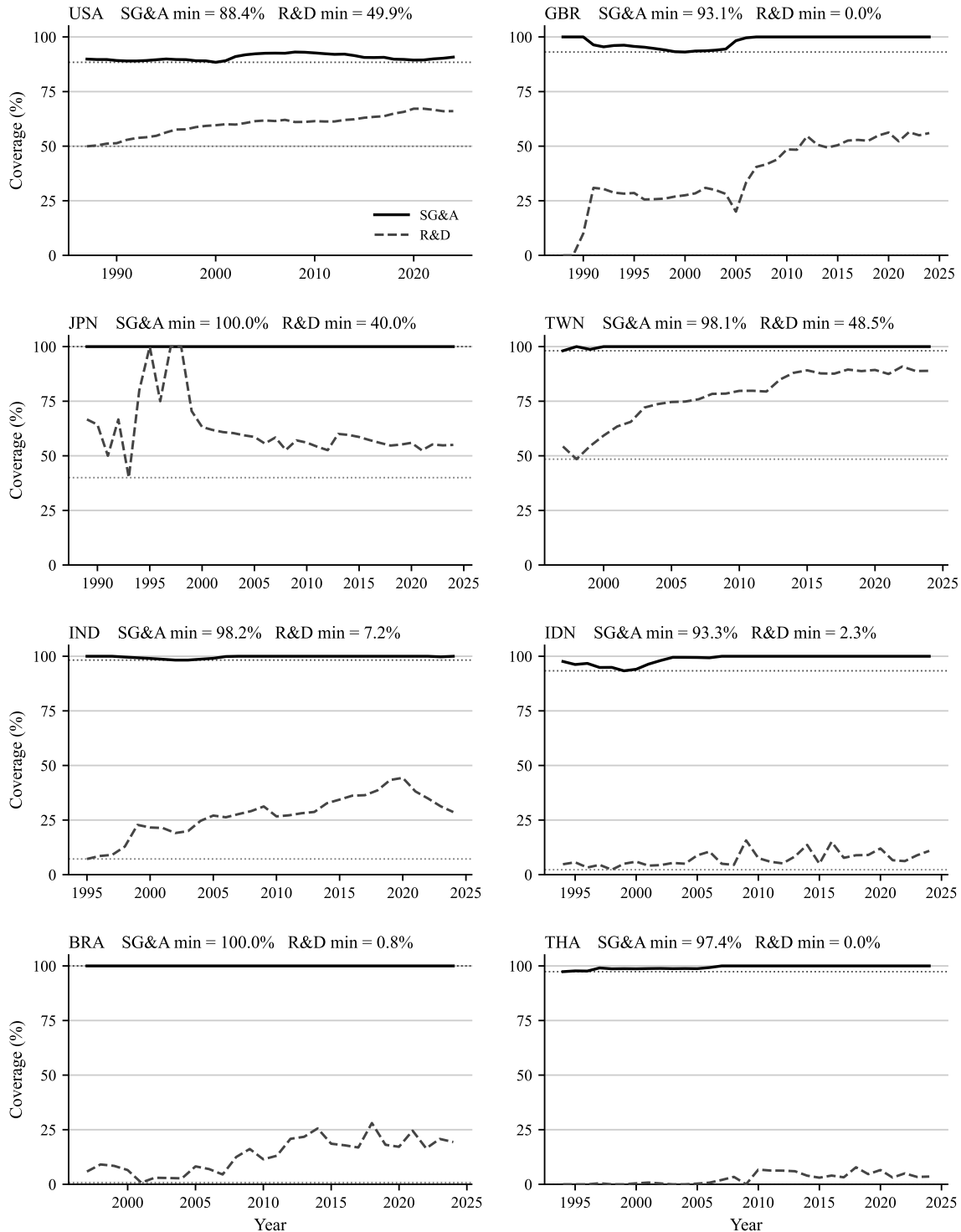


Figure A1. Annual country-level coverage of SG&A and R&D. This figure plots the share of firm-years with non-missing SG&A expense (*xsga*) and R&D expense (*xrd*) in each country and year, as a fraction of all firm-years in the corresponding annual Compustat sample. Panels report four advanced economies (United States, United Kingdom, Japan, Taiwan) and four emerging economies (Brazil, India, Indonesia, Thailand), in that order. The solid line denotes SG&A coverage and the dashed line denotes R&D coverage. The sample period begins in the first year each country has non-zero Compustat coverage. Data are from Compustat North America (United States) and Compustat Global (all other countries).

Appendix B: Variable Definitions and Trimming Rules

B.1 Compustat Item Definitions

- che = cash and short-term investments
- at = total assets
- xrd = research and development expense
- xsga = selling, general, and administrative expense
- dlc = debt in current liabilities
- dlts = long-term debt

B.2 Trimming Rules

For descriptive plots and summary statistics, firm-year observations are trimmed at the country level. Specifically, we drop observations for which any of the descriptive ratios, cash ratio or intangible-capital ratio, lies outside its country-specific 2.5th or 97.5th percentile. This trimming rule is used only for descriptive statistics and figures.

Appendix C: The Structural Model

This appendix outlines the structural model of Falato et al. (2022) used throughout the paper. We make no changes to the model.

C.1 Technology and Production

The firm produces output from two capital inputs, tangible capital K_T and intangible capital K_N , subject to an idiosyncratic productivity shock Z that follows a geometric random walk. Operating profits are

$$\Pi(Z, K_T, K_N) = Z^{1-\gamma} \cdot \Phi(K_T, K_N)^\gamma - Z \cdot F_O, \quad (\text{C.1})$$

where γ is the curvature of the profit function and F_O is a fixed operating cost proportional to Z . The capital aggregator Φ has the constant-elasticity-of-substitution form

$$\Phi(K_T, K_N) = [\theta \cdot (K_T / \theta)^{-\rho} + (1 - \theta) \cdot (K_N / (1 - \theta))^{-\rho}]^{-1/\rho}. \quad (\text{C.2})$$

The elasticity of substitution between the two capital types is $1 / (1 + \rho)$. The asset-tangibility parameter $\theta \in (0, 1)$ governs the long-run mix between tangible and intangible capital. The productivity shock evolves as

$$\log Z' = \log Z + \log \eta', \quad \log \eta \sim N(-0.5\sigma_z^2, \sigma_z^2),$$

where σ_z is the volatility of log productivity innovations.

C.2 Capital Adjustment Costs

For each capital type $i \in \{T, N\}$, adjustment carries a fixed (non-convex) cost. The adjustment cost is

$$G_i(K_i', K_i) = [K_i' - (1 - \delta_i) \cdot K_i] + F^K \cdot K_i, \quad (\text{C.3})$$

where δ_i is the type-specific depreciation rate and F^K is the per-unit fixed cost, equal for the two capital types.

C.3 Debt Market Friction

The firm's net financial position B can be positive (debt) or negative (cash); the two are mutually exclusive at the optimum. The firm issues only risk-free debt collateralised by capital. Only tangible capital is pledgeable, so the borrowing constraint is

$$B' \leq \bar{B}(K_T') \equiv (1 - \delta_T) \cdot K_T' / [1 + r(1 - \tau)], \quad (\text{C.4})$$

where τ is the corporate tax rate and r is the risk-free rate. Intangible capital does not enter (C.4); the absence is the formal statement of the intangible-collateral channel.

C.4 Equity Market Friction

The firm can issue new equity E in any period. Issuance carries a fixed plus proportional cost,

$$\phi(E) = \phi_0 \cdot (K_T + K_N) + \phi_1 \cdot E, \quad (\text{C.5})$$

with ϕ_0 a fixed cost proportional to firm size and ϕ_1 a marginal underwriting fee.

C.5 The Firm's Recursive Problem

Let $v_T^K, v_N^K, v_E \in \{0, 1\}$ be indicators for adjustment of tangible capital, adjustment of intangible capital, and equity issuance, and collect them in $v = (v_T^K, v_N^K, v_E)$. The dividend payout is

$$D(v) = (1 - \tau) \cdot \Pi(Z, K_T, K_N) - \sum_{i \in \{T, N\}} [v_i^K \cdot G_i(K_i', K_i) - \tau \cdot \delta_i \cdot K_i] - [1 + r(1 - \tau)] \cdot B + B' + v_E \cdot E \quad (\text{C.6})$$

subject to $D(v) \geq 0$. The firm's recursive problem is

$$W(K_T, K_N, B, Z) = \max \{ D(v) - v_E \cdot [E + \phi(E)] + (1/(1 + r)) \cdot \mathbb{E}_Z[W(K_T', K_N', B', Z')] \}, \quad (\text{C.7})$$

subject to $D(v) \geq 0$, the borrowing constraint (C.4), and the productivity process. The problem is homogeneous of degree one in $(K_T, K_N, B, K_T', K_N', B', Z)$, so we normalise by Z and reduce the state space from four dimensions to three: $k_T = K_T / Z, k_N = K_N / Z, b = B / Z$.

C.6 Solution Method

The model has no closed-form solution. We solve it numerically by value-function iteration on a discrete grid in (k_T, k_N, b) . Given the optimal policy, we simulate one thousand firms over one hundred years across five independent panels. The simulated moments (the average cash ratio, the size and frequency of equity issuance, the asset tangibility, and the operating profitability) are matched to their data counterparts in Section IV.

Appendix D: Tax Rate Adjustment

The corporate-tax parameter τ governs the after-tax cost of debt and the size of the corporate tax shield in the structural model. Falato et al. (2022), following Nikolov and Whited (2014), calibrate τ below the statutory corporate rate to approximate the gross statutory rate net of the offsetting differential personal taxation of debt and equity income. They set τ to 0.25 for their Early period and 0.20 for their Late period. We retain this convention and apply it country by country.

For country c and sub-period p , we set

$$\tau(c, p) = \tau(US, p) \times \frac{s(c, p)}{s(US, p)}, \quad (\text{D.1})$$

where $\bar{\tau}_{c,p}^{\text{stat}}$ is the period-average statutory corporate income tax rate and $\tau_{\text{US},p}^{\text{FKSS}}$ is the corresponding Falato et al. (2022) US anchor. The implied scaling ratio is 0.54 in the Early period and 0.57 in the Late period, indicating that personal taxes offset roughly half of the gross corporate tax shield in the Falato et al. (2022) calibration. We apply this offset fraction as a uniform proxy across countries, so cross-country variation in τ reflects cross-country variation in statutory rates while holding the personal-tax adjustment constant.

We considered the alternative of computing τ directly from the Miller (1977) net-tax-advantage formula using country-specific personal tax rates on interest and equity income. This approach proved unreliable in our setting. Implied τ values are highly sensitive to assumed interest withholding tax rates and generate economically implausible cross-country variation: the formula returns a *rising* US τ between the two sub-periods, a *negative* UK τ in the Late period, and values close to the headline corporate rate for Japan and Taiwan. The proportional scaling approach avoids these issues at the cost of assuming a constant personal-tax offset across countries. For India, we use the statutory corporate income tax rate without adjustment for the Dividend Distribution Tax (1997–2020), which was a corporate-level levy on dividend distributions rather than a standard corporate income tax; including it would overstate τ 's role as a measure of the net tax advantage of debt.

Statutory rates are taken from the OECD Corporate Tax Statistics database (OECD, 2024) where available, and from the Tax Foundation historical corporate income tax dataset (Tax Foundation, 2024) for country-years not covered by OECD. Period averages are computed over each sub-period window. A more granular country-specific construction of the personal-tax offset would require comparable period-average personal income and dividend tax rates for all eight countries, which are not consistently available, and is left as a natural extension.

Appendix E: Interest Rates and CPI

E.1 Real Interest Rates

The real interest rate r enters the model through the borrowing constraint and the firm's discount factor. We compute country-period real rates in three steps. First, we collect annual nominal sovereign yields for each country. Following Falato et al. (2022, Table I), who use the average real one-year US Treasury rate, we prioritise short-term yields. We use the one-year sovereign yield where available: from FRED for the United States, Japan, and the United Kingdom (Federal Reserve Bank of St. Louis, 2024), and from LSEG Datastream (LSEG, 2024) for Indonesia, India, and Taiwan. For Thailand we use the one-year yield from 2000 onward; for Brazil the one-year yield from 2009 onward. For earlier years, we use the first available observation. We take all nominal yields as the December observation, or the closest available end-of-year observation where December is unavailable.

Second, we compute annual realised inflation from the CPI series as $\pi_t = \frac{\text{CPI}_t}{\text{CPI}_{t-1}} - 1$ and convert nominal yields to real yields using the Fisher equation:

$$r_t = \frac{1+i_t}{1+\pi_t} - 1. \quad (\text{E.1})$$

We use the Fisher form rather than the linear approximation $r_t \approx i_t - \pi_t$, because the linear form understates real rates in country-year cells with high inflation, including Brazil and

Indonesia in the late 1990s. We average r_t over each country-period window to obtain the calibrated value of r reported in Table IV.

We apply a floor of $r \geq 0.005$ to each period average. The floor binds in six of the eight countries in the Late period, where observed real rates are near zero or negative. The floor reflects three considerations. First, the firm's Bellman equation requires the discount factor $\beta = 1/(1 + r) < 1$, which fails as r approaches zero from below. Second, the near-zero and negative real rates observed after 2009 in the advanced economies reflect the post-crisis monetary-policy environment rather than the long-run equilibrium real rate of interest. Estimates of the natural rate in Holston, Laubach, and Williams (2017) place the equilibrium real rate in the 0.5%–1.5% range across the advanced economies in our sample. Third, Falato et al. (2022, Table V) report that r contributes negligibly to model-implied cash dynamics, so the calibration is not materially sensitive to the exact level of r within this range.

E.2 CPI

CPI series are used to compute annual inflation for the Fisher conversion and to express selected variables and thresholds in constant-2010 local-currency terms. CPI-deflated total assets are used in firm-size measures; the USD 10 million size threshold used in the SEO proxy is converted to local currency at 2010 average exchange rates and expressed in real terms; and the real intangible-investment flow used in the depreciation calibration is CPI-deflated. The cash ratio and intangible-capital ratio are formed from numerator and denominator values in the same currency-year and are therefore invariant to CPI deflation.

CPI data come from FRED for the United States (series CPIAUCSL; Federal Reserve Bank of St. Louis, 2024), the World Bank World Development Indicators for the United Kingdom, Japan, Brazil, India, Indonesia, and Thailand (series FPCPI.TOTL; World Bank, 2024), and the Directorate-General of Budget, Accounting and Statistics for Taiwan (DGBAS, 2024).

Appendix F: SMM Procedure

The SMM procedure adjusts the five estimated parameters until the simulated and data moments agree. We measure the distance between them by the scalar objective

$$Q(p) = \sum \left(\frac{m_{\text{model}}(p) - m_{\text{data}}}{m_{\text{data}}} \right)^2. \quad (\text{F.1})$$

summed across the five targeted moments m , where $p = (\theta, F_0, \sigma_z, \phi_0, \phi_1)$ is the parameter vector, $m_{\text{model}}(p)$ is the simulated counterpart of moment m at p , and m_{data} is the country-period data moment. Dividing by m_{data} expresses each residual as a relative deviation and places moments measured on different scales on a common footing.

At each iteration we solve the model at the current p , compute the simulated moments, and evaluate Q . The Levenberg-Marquardt rule proposes the next p by combining the gradient and curvature of Q through the Jacobian of the simulated moments with respect to p . We approximate the Jacobian numerically by perturbing one parameter at a time and re-solving the model. A trust-region cap bounds the proposed step so that no single iteration moves p outside the local region in which the Jacobian approximation is reliable. The algorithm iterates until Q can no longer be meaningfully reduced.

We do not report standard errors for the SMM-estimated parameters. The parameters enter Section V only through counterfactual decompositions, not through tests on individual structural coefficients, so inference on those coefficients is not the relevant object. We assess the calibration instead by how well the model reproduces the untargeted cash moment, which does not enter Q .

Appendix G: SEO Proxy Construction

The proxy is constructed in three steps: a sample restriction, an indicator flag, and the size variable that enters the targeted moments.

We retain firm-years with total assets above USD 10 million in 2010 prices, CPI-deflated and converted to local currency at 2010 average exchange rates, to remove micro-cap firms whose mechanical share movements generate false positives. A retained firm-year is flagged as a seasoned equity offering, $seo = 1$, if two conditions hold jointly. The first condition is that stock-issuance proceeds exceed 25% of total assets, $sstk / at > 25\%$. We take this relative-size approach from Huang and Ritter (2022) and calibrate the 25% cutoff so that the proxy frequency on the 1970–2010 US sample matches the SDC-derived frequency reported by Falato et al. (2022). The second condition is that split-adjusted shares outstanding rise by between 20% and 300% over the year, where split-adjusted shares are $csho \times ajex$ for the United States and $cshoi \times ajexi$ for Compustat Global. We take the share-growth approach from McLean, Pontiff, and Watanabe (2009). The 20% lower bound separates externally raised equity from compensation-related dilution, and the 300% upper bound removes stock splits, reverse mergers, and adjustment-factor errors.

The frequency moment is the mean of the proxy indicator. The size moment is the mean of $(sstk - prstk) \cdot 1\{seo = 1\} / at$, floored at zero, which replaces the SDC indicator in the Falato et al. (2022) size formula with our proxy indicator. We compute both moments separately by country and period. On the 1970–2010 US sample, the proxy reproduces both the SDC-derived frequency and size moments reported by Falato et al. (2022). For the seven non-US countries, where the SDC moments are not observable, the proxy rests on the assumption that the same filter captures SDC-style issuance behaviour with comparable fidelity to the United States.

Appendix H: Calibration Diagnostics

H.1 Period-Specific Targeted-Moment Fit

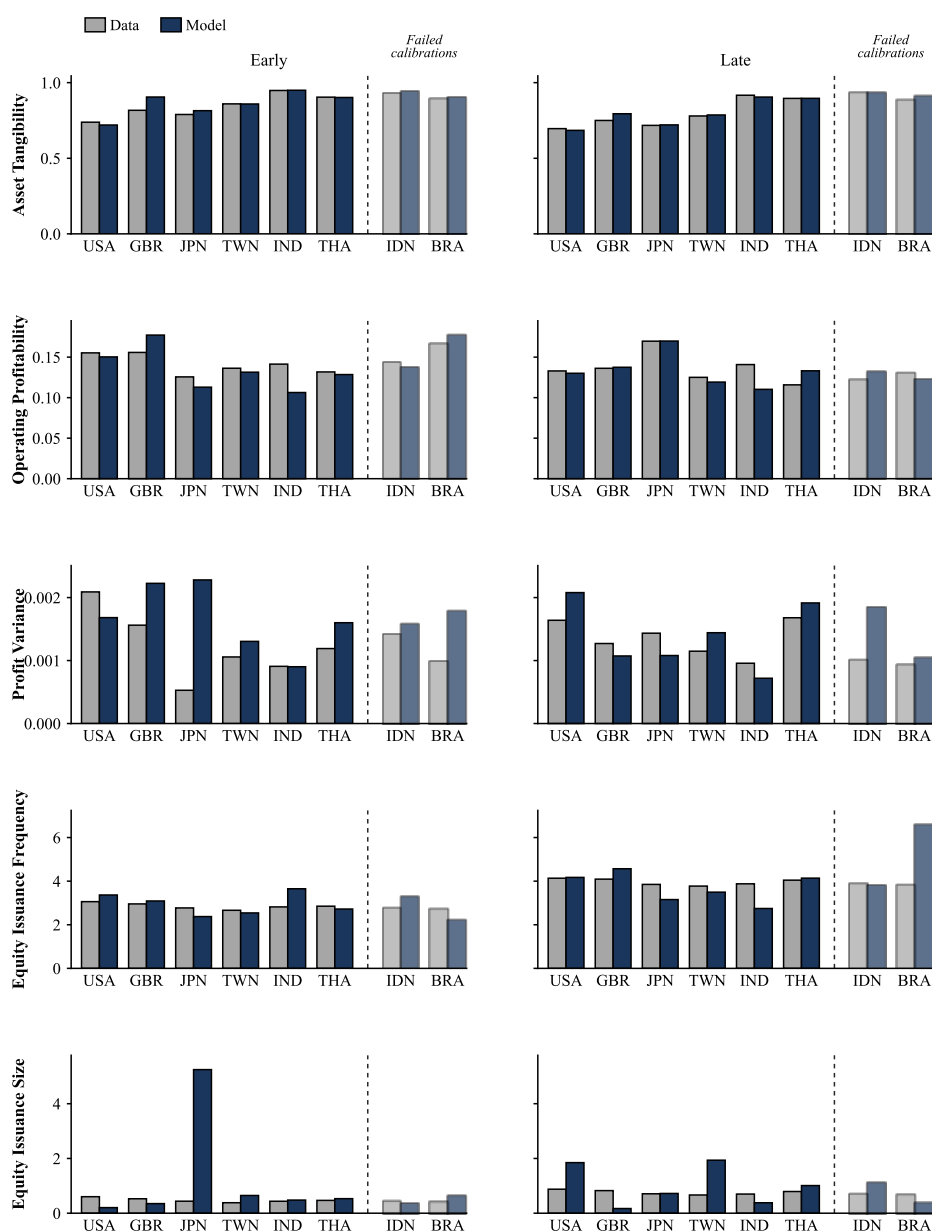


Figure H.1. Period-specific targeted-moment fit. This figure compares model-implied moments with their empirical counterparts for the five moments targeted in the SMM estimation, separately for the Early and Late periods. Rows report asset tangibility, operating profitability, idiosyncratic profit variance, equity-issuance frequency, and average equity-issuance size. Grey bars denote data moments, and dark blue bars denote model-implied moments. The dashed vertical line separates the six countries that pass the cash-fit criterion from Brazil and Indonesia, which do not pass and are reported for transparency only. Brazil and Indonesia are excluded from the counterfactual decompositions.

H.2 Net-Leverage Fit Diagnostic

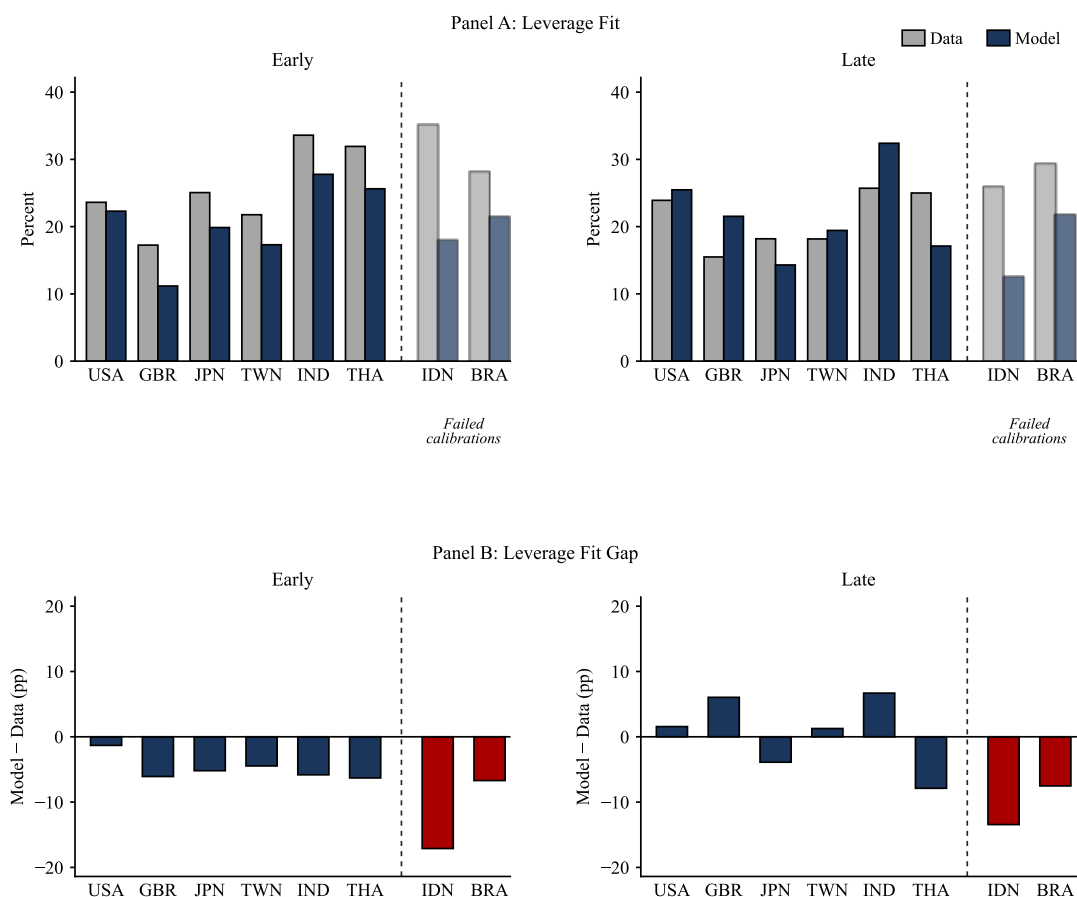


Figure H.2. Net-leverage fit diagnostic. This figure compares empirical and model-implied net leverage by country and period. Panel A reports leverage levels in the Early and Late periods, expressed as a percentage of assets. Panel B reports the leverage fit gap, defined as model minus data, in percentage points. Grey bars denote data moments, and dark blue bars denote model-implied moments. Red bars in Panel B denote Brazil and Indonesia, which do not pass the cash-fit criterion and are excluded from the counterfactual decompositions. The dashed vertical line separates the six passing countries from the failed calibrations. The figure is reported as a supplementary diagnostic; the calibration-passing criterion is based on the untargeted cash ratio.

Appendix I: AI Disclosure

In preparing this thesis, we made use of LLMs. Their primary uses were assisting with coding and checking grammatical and stylistic errors. All outputs by LLM tools were reviewed before inclusion and all economic content and interpretations in this paper are our own.