Intangible Capital Around the World

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Abstract

We estimate the value of intangible capital across 77 countries through the valuation approach of a neoclassical model of investment with two heterogeneous types of capital inputs: physical capital and intangible capital. Using data on public listed firms across the world, we infer the importance of intangible capital for the firm's market value in each country. Our results show that intangible capital is crucial for the model's success in capturing the variation in firm's market value across all economies. We find that intangible capital on average accounts for over half of the market value of firms in all countries, with significant cross country heterogeneity. Furthermore, firms with a larger share of their value driven by intangible capital have higher expected equity returns than firms with a lower share. The relative return of intangible capital to physical capital across the globe helps describe the common risk for investors across countries.

Key Words: Valuation, Neoclassical Investment, Structural Estimation, Intangible Capital, Risk Premium

JEL Classification: D21, D22, E22, E24, G12, G32

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1 Introduction

How much does intangible capital contribute to a firm's market value? We answer this question through the lens of a neoclassical model of investment with two inputs–physical capital (e.g. plants and machines) and intangible capital (e.g. brand name, stock of knowledge). We estimate the model to quantify the relative importance of intangible capital for firm value across the world, for all the publicly traded firms in 77 countries. We find that while there is substantial heterogeneity across countries, intangible capital is a crucial determinant of firm value, accounting for over 50% of a firm's market value in the last decade. In most regions, firms with a larger share of their value attached to intangible capital have higher expected equity return than firms with a lower share, implying that risk premium of intangible capital is larger than that of physical capital. Intangible capital constitutes a considerable fraction of financial wealth owned by investors. The relative return of intangible capital to physical capital, separates the fluctuation of wealth in intangible capital versus the wealth of physical capital, helps describe the marginal utility of wealth accurately.

We use a generalized neoclassical model of investment to decompose the market value of the firm between physical and intangible capital. In the model, changing the quantity of the capital inputs is costly, which we capture through standard adjustment cost functions. Under this framework, the equilibrium market value of the firm is contingent on the shadow price and the quantity of each installed input. These shadow prices capture the replacement cost of the input and can be easily estimated from investment data once we specify an adjustment costs function. Furthermore, if we assume that both the operating profit function and the adjustment costs function exhibit homogeneity of degree one, the market value of each input is the product of the input's shadow price and the corresponding stock variable. Consequently, the total market value of the firm becomes the sum of the market values of all inputs. This additive characteristic facilitates a straightforward computation of each input's contribution to the firm's overall value.

We take this model to a large cross section of publicly traded firms around the world by measuring the firm-level stocks of each capital input. Accounting information of listed companies are from the Compustat (North America and Global). For physical capital, the data is readily available from the firm's balance sheet. However, for intangible capital, acquiring capital stock data is challenging due to its inherent nature. Drawing from the methodologies of prior studies, such as (Eisfeldt and

Papanikolaou, 2013) and (Peters and Taylor, 2017), we construct firm-level measures of intangible stock using accounting data related to Selling, General and Administrative (SG&A) expenses, in each country. (Corrado, Hulten, and Sichel, 2009) use the capitalized expense in R&D, software, advertising, employee training to measure the aggregate amount of intangible capital in United States. For measuring the intangible capital at the firm-level, (Lev and Radhakrishnan, 2005) document SG&A serves as a comprehensive measure of investment expense of intangible capital, encompassing multiple facets. It reflects the value of skilled labor force (capturing training costs), knowledge capital (often including R&D expenditures), brand capital (accounting for advertising expenses), and other operational expenses. We employ the perpetual inventory method to aggregate these expenditures, enabling us to derive the capital stocks for intangible capital.

Our estimation methodology follows (Belo et al., 2022). The estimation process involves minimizing the difference between observed and model-generated valuation ratios, specifically the market value of equity plus net debt-to-book value of capital stocks. We estimate adjustment cost parameters for both physical and intangible capital at the individual country and regional levels. For large equity markets, we estimate country specific adjustment cost parameters. These are 18 countries including all major economies in the world. The publicly listed firms in these countries account for 28% of world GDP and 9% of global value added. For other countries, we adopt a strategy of pooling these nations into nine distinct regions based on United Nations statistics criteria, and estimate region-specific adjustment parameters. In total, our analysis covers 77 countries, whose the listed companies represent 34% of world GDP and 11% of global value added, including both individual countries and regions. Due to data availability most of our analysis focus on the last 15 years, the start date varies per country, mostly starting in the mid 2000 and ends in 2020. Leveraging the estimated adjustment cost parameters, we apply our model to decompose the value of firms into physical and intangible capital for each of these countries. Next, we provide an overview of our key empirical findings.

Our initial analysis demonstrates that the neoclassical model of investment, incorporating multiple inputs, aligns well with the data across diverse economies. In major markets where country-specific parameters are estimated, the model effectively accounts for both time-series and cross-sectional variations in valuation ratios across portfolios. The cross-country average time-series

R^2 stands at 33%, while the cross-sectional R^2 reaches 69%. For the region-based estimation, the model exhibits robust explanatory power, yielding a cross-region average time-series R^2 of 44% and a cross-sectional R^2 of 68%. Including intangible capital and admitting the heterogeneity of capitals, the Q-theory model successfully explains the variation of firm valuation across the world.

We get a first glimpse of the importance of intangible capital by comparing the model fit of our benchmark model, that includes physical and intangible capital, to the one that excludes intangible capital. When we restrict the analysis to physical-capital-only at the country level, the model fit turns negative for the majority of countries, indicating its failure to capture the dispersion of firm-valuation ratios. This discrepancy is consistent when examining regions, collectively emphasizing the pivotal role of intangible capital in capturing firm value.

Furthermore, we find that the estimated adjustment cost of intangible capital varies across countries and that this heterogeneity is important for capturing firm value. Examining larger equity markets, the physical capital adjustment cost parameter varies from 0.86 for Japan to 8.59 for the USA, with a cross-country average of 4.18 and a standard deviation of 1.93. For Germany, the UK, and India, the estimated parameters hover around this average, registering values of 6.21, 6.24, and 4.76, respectively. In contrast, the intangible capital adjustment cost parameter displays greater variability, ranging from 2.42 for Japan to 30.77 for China. The cross-country average stands at 10.82, with a standard deviation of 6.36. The USA, UK, and Canada align closely with this average, featuring estimated values of 15.69, 8.47, and 11.44, respectively. At the regional level, the pattern remains similar, with average values of 4.83 (physical) and 11.43 (intangible), accompanied by standard deviations of 2.37 and 3.88, respectively. To underscore the significance of country-specific adjustment cost parameters, we conduct a counterfactual exercise. In this scenario, assuming that all countries share the same adjustment cost parameter as the United States, the R^2 becomes negative once more. These results show that not only intangible capital is crucial to capture firm's value but there are country level factors that make this capital heterogeneous.

Our key finding highlights that intangible capital significantly contributes to the market value of firms across all countries. Utilizing the estimated parameters of geography-specific and capital-specific adjustment costs, we calculate the market share of intangible capital for each firm and each time point. In the country-specific estimation, the cross country average value of intangible capital represents 50.66% of the firm's market value. Importantly, there exists substantial heterogeneity in the market share of intangible capital, ranging from 63.56% in the USA to 33.41% in South Korea. Apart from the United States, the top five countries with the highest intangible market shares include China (61.73%), the UK (61.57%), France (59.42%), and Hong Kong (59.24%).

Notably, for all countries except Germany and France, the cost of adjusting intangible capital is higher than the cost of adjusting physical capital. On average, the adjustment cost of intangible capital is twice as large as that of physical capital, where the market share of intangible capital surpasses book value by an average of 15.81%. Similar asymmetric costs emerge in the regional estimation. Collectively, these findings underscore the pivotal role of intangible capital as a key input in the production and value creation for firms worldwide.

We leverage the estimated firm-level market share of intangible capital to investigate the risk premium associated with heterogeneous capitals across different regions. The intangible capital is empirically associated with a larger positive risk premium than physical capital. The high adjustment cost of intangible capital, influenced by the depth of capital markets, results in a dispersed and time-varying risk exposure to aggregate shocks across firms. Utilizing the firm-level cross-sectional regression, we confirm that the market share of intangible capital is empirically associated with a significant positive risk premium for financial market investors. Across all firms in our sample, 1% increase in the market share of intangible capital corresponds to an additional 0.077% return per year. For firms located in Asia, the risk premium is 0.079% per year, point estimates are similar for North America and Europe (0.070% and 0.090%, respectively).

Our structural estimation confirms that intangible capital constitutes a large fraction of financial wealth in listed firms. Among firms in which valuation has a large share contributed by the intangible capital, average return is higher. The systematic fluctuation associated with the valuation of intangible capital is distinct from that of physical capital. Existing asset pricing models cannot explain the risk premium in longing intangible capital and shorting the physical capital. Theoretically, the spread in return of intangible capital with respect to physical capital works as the sufficient statistic for investor's marginal utility of wealth. Empirically, we find that a two-factor model that includes the relative return of capitals and the market factor prices the cross-section of firms sorted on composition of capitals and industry portfolios across regions in the globe.

Additional 1 unit of risk exposure to the relative return of capitals, yields positive risk premium 7.439% annually. We document the relative return of intangible capital is positively correlated with the relative price of product in industries utilizing more intangible capital, and negatively correlated with the price of raw materials.

Our research is closely aligned with the extensive literature on valuation and production-based asset pricing, with a specific focus on the role of intangible capital. (Hall, 2001) discusses the valuation of securities is overly high compared to the price of installed capital in late 1990s. The omitted intangible capital provides a candidate explanation. (Belo et al., 2022) provides a decomposition of the value of North American firms, considering physical capital, labor, and two types of intangibles—brand capital and knowledge capital. (Crouzet and Eberly, 2021) explains the quantitative tension between physical-capital investment rate and the firm valuation, using the adjustment cost estimates from (Belo et al., 2022) to decompose the long-run evolution of firm valuation. (Peters and Taylor, 2017) incorporate organization capital for the total book capital, adjust the measure for the Tobin's Q, and to explain the total firm investment. (Eisfeldt and Papanikolaou, 2013) show that firms with more organization capital are riskier than firms with less organization capital. (Eisfeldt, Kim, and Papanikolaou, 2020) and (Gulen et al., 2022) include intangible capital for Value factor. Adjusted measure of firm valuation ratio improves the asset pricing factor models. (Hansen, Heaton, and Li, 2012) study the risk characteristics of intangible capital. In international macro-finance, research on the cross-section of equity valuation is emerging. To our knowledge, our paper is the first attempt for quantifying market value of intangible capital in global economy. Adjustment cost of intangible capital is larger than that of physical capital in most countries and regions. Shadow price of intangible capital is large, compared to that of physical capital. In countries such as China, India, there is weak protection of intellectual properties and compliance of employee contract, growing intangible capital implies larger increase in firm valuation ratio. For firms residing in countries, composition of book capital understates the importance of intangible capital in the valuation.

Our work directly talks to the cross-country study of equity market. Across countries, there exist the geographical heterogeneity in the distribution of risk exposure. When using the firm characteristic variables to describe the risk exposure, the correlation between firm characteristic and risk premia differs across countries. It is an open difficulty to identify firms with high risk premium. (Chui, Titman, and Wei, 2010) investigate the heterogeneity of culture, the return volatility, and the momentum strategy. (Fama and French, 2012) examine the asset pricing models of local factors, the size, value, and momentum across 4 regions built from 23 countries. Regional factors better capture the time-series variations of stock return, but the risk premium of regional factors depends on each market. (Asness, Moskowitz, and Pedersen, 2013) documented it is difficult to establish the universal conclusion about the performance of value strategy. (Vincenz, 2023) includes intangible capital to the book asset, adjusts the book-market ratio, build the cross-section investment strategy by longing the value firms and shorting the growth firms. Across 4 regions, North America, Europe, Japan and Asia-Pacific, (Vincenz, 2023) found value firms generates higher return than growth firms during 1983-2021. (Bolton and Kacperczyk, 2023) and (Zhang, 2023) investigates the risk premium of carbon emission across countries. Developed markets have high-emission firms with higher expected return, while this conclusion is less clear for the firms locating in emerging market. Market environment differs across countries. Compared to above research, this paper quantifies the local capital market using the Generalized-Q theory, estimates the shadow price of intangible capital and that of physical capital at firm-level, to measure composition of capitals in the firm valuation in the dynamic environment. Differentiating heterogeneous capital inputs provides the simple description of firm valuation and the risk profile. The composition of capitals in firm valuation provides a comparable measure of firm-level risk exposure for different countries. Firms with high share of intangible capital are riskier than the firms with more physical capital. Higher risk premium in the intangible capital versus the physical capital cannot be explained by asset pricing models in the literature.

Quantitative asset pricing theories discuss risk premium related to heterogeneous capitals and production inputs, using explanations such as the heterogeneous duration, investment cost shock, financial leverage and real option[1]. In (Tuzel, 2010), capital of structure has smaller depreciation rate than the capital of equipment, risk exposure to aggregate productivity shock is larger. In (Lin,

[1]From the aspect of time-series risk premium, (Hsu, 2009) documented the technology growth predicts the aggregate equity excess return in U.S. and G-7 countries. In (Garleanu, Panageas, and Yu, 2012), infrequent exogenous technology breakthrough helps explain the time-varying risk premia and the return predictability. In (Kung and Schmid, 2015), endogenous technology innovation helps explain the quantitative puzzle of equity premium of time series.

2012), R&D expenditure is used for improving the total productivity and productivity specific to physical capital. Expected return is higher among firms with intensive R&D expense, and the lower among firms with physical capital investment. (Belo, Lin, and Bazdresch, 2014) uses the adjustment cost shock and aggregate productivity shock to simultaneously explain why high employee growth rate and physical capital investment negatively predict equity return. (Li, 2011) documented R&D intensity predicts firm equity return. For firms that in face of large R&D intensity, they are more likely be financially constrained, hence the dividend flow is riskier. (Gu, 2016) documented the risk premium of R&D intensity is stronger in competitive industries, where firms have higher replacement rate. (Ai et al., 2020) discusses the asset with low collateralizability has high risk compensation for the countercyclical financial market friction. (Zhang, 2019) uses option value of transiting to automation yields lower expected return in firms with more low-skilled labor force.

This paper considers the firm-level investment decision, estimated a stylized firm model of two capital inputs and adjustment cost in investment. Estimation found high adjustment cost in accumulating the intangible capital. Firm valuation ratio is higher when there is larger book share of intangible capital and high investment rate in intangible capital. However, in empirical investigation associated to risk premium, although the firms with more intangible capital are typically the growth firm under the classification using book-market ratio, these firms demonstrate higher expected return. Standard quantitative explanations for value premium[2] and return anomaly of investment don't provide direct answer to the risk premium of intangible capital across firms and countries. The relative return of capitals is negatively correlated to financial intermediary equity-capital ratio. But the systematic risk measure of financial market liquidity doesn't fully explain the higher risk premium associated with the intangible capital. We find the price of copper commodity has negative risk premium, and is subsumed to relative return of capitals that is a sufficient statistic of systematic risk. (Eisfeldt and Papanikolaou, 2013) explain the systematic risk measured using OMK portfolio return reflects deterioration of frontier technology efficiency of new firms[3]. This paper supplements

[2]In (Gomes, Kogan, and Zhang, 2003), value firms have low profitability, capital in place has higher market beta than the growth firms. However, the investment outcome is not explicitly delineated for the individual firm. (Zhang, 2005) uses the asymmetric investment cost to explain the value premium. In (Papanikolaou, 2011)(Kogan and Papanikolaou, 2013), the investment-goods specific technology shock differs from the productivity shock in consumption goods. Growth opportunity has larger risk exposure to IST-shock of negative price of risk. Dispersion in risk exposure to IST shock explains the value premium. In (Ai, Croce, and Li, 2013), firms with more vintage capital have lower valuation ratio, prone to the long-run productivity shock, hence yields higher expected return.

[3]OMK portfolio return is return spread of firms with high ratio of organization capital versus the firms with

empirical facts related to the common fluctuation in valuation of capitals, raw material price and output price. The larger risk premium of intangible capital with respect to physical capital is more consistent with high price of risk, not the quantity of risk.

Our work also talks to the recent literature of modern corporate sector in international finance. (Karabarbounis and Neiman, 2014) document the declining labor share of income in national accounting data, both in the United States and globally. (Chen, Karabarbounis, and Neiman, 2017) investigated the increasing corporate saving in the private corporate sector. (De Loecker and Eeckhout, 2018) document the increasing dispersion of markup. (Falato et al., 2022) provide an explanation for the simultaneous shift toward the intangible capital and the corporate saving. (Altomonte et al., 2021) claim that the frictions in intangible investments can lead to the dispersion of markup at firm-level. Our work investigates the role of capital market environment in the valuation of intangible capital, by quantifying the difficulty of intangible capital investment for countries. High valuation of intangible capital can be the result of its high shadow price. Our empirical estimation adds to above literature, in understanding the financial market implications of intangible capital across countries. Specifically, dispersion in shadow price of intangible capital helps explain the dispersion of risk exposure and the cross-section variation of risk premium.

The rest of the paper proceeds as follows. Section 2 presents the model. Section 3 introduces the functional forms, describes the estimation procedure. Section 4 describes the data and Section 5 presents the contribution of intangible capital to firm value. Section 6 discuss the risk premia of heterogeneous capitals. Finally, Section 7 concludes. The Appendix has additional results and robustness checks.

2 The Model of the Firm

We consider a neoclassical model of the firm as in (Belo et al., 2022)(we use the consistent notation with Belo et al. (2022) whenever possible) with several quasi-fixed inputs. Time is discrete and the horizon is infinite. Firms choose costlessly adjustable inputs (e.g., materials, energy) each period,

less organization capital. This time series is constructed using North American firms, demonstrates high negative correlation with capital reallocation and CEO turnover during 1970-2008 in (Eisfeldt and Papanikolaou, 2013). For limitation of available high-frequency data, this paper doesn't examine the impacts of aggregate shocks over turnover of top executives and firm entry across countries .

while taking their prices as given, to maximize operating profits (revenues minus the expenditures on these inputs). Because we treat intangible capital as quasi-fixed inputs, investments in intangible capital is excluded from our definition of operating profits. Then, taking these operating profits as given, firms optimally choose the physical and intangible capital investments, and debt to maximize their market value of equity.

To save on notation, we denote a firm's i set of capital as $\boldsymbol{K_{it}}$ (variables in bold represent a vector). This set includes the physical capital stock (K_{it}^P) and the intangible capital stock (K_{it}^I). Similarly, we denote a firm's i set of investments in the inputs at time t, as $\boldsymbol{I_{it}}$. This set includes the investment in physical capital (I_{it}^P) and the investment in intangible capital (I_{it}^I).

The law of motion of the firm's capital inputs is given by:

$$K_{it+1}^P = I_{it}^P + (1 - \delta_{it}^P) K_{it}^P \tag{1}$$

$$K_{it+1}^I = I_{it}^I + (1 - \delta_{it}^I) K_{it}^I \tag{2}$$

where δ_{it}^P and δ_{it}^I are the exogenous depreciation rates of physical and intangible capital, respectively.

2.1 Technology

The operating profit function for firm i at time t is $\Pi_{it} \equiv \Pi(\boldsymbol{K_{it}}, \boldsymbol{X_{it}})$, in which $\boldsymbol{X_{it}}$ denotes a vector of exogenous aggregate and firm-specific shocks. Firms incur adjustment costs when investing. The adjustment costs function is denoted $C_{it} \equiv C(\boldsymbol{I_{it}}, \boldsymbol{K_{it}})$. This function is increasing and convex in investment, and decreasing in the capital stocks. For physical and intangible capital inputs these costs include, for example, planning and installation costs, and costs related with production being temporarily interrupted. We assume that the firm's operating profit function and adjustment costs function are both homogeneous of degree one and we specify the functional forms in the empirical section below.

2.2 Taxable Profits and Firm's Payouts

Firms can issue debt to finance their operations.[4] At the beginning of time t, firm i issues an amount of debt, denoted B_{it+1}, which must be repaid at the beginning of time $t+1$. r^B_{it} denotes the gross corporate bond return on B_{it}.

We can write taxable corporate profits, denoted TCP, as operating profits minus intangible capital investments (which are expensed), physical capital depreciation, adjustment costs, and interest expense:

$$TCP_{it} = \Pi_{it} - I^I_{it} - \delta^P_{it} K^P_{it} - C_{it}.$$

Thus, adjustment costs are expensed, consistent with treating them as foregone operating profits.

Let τ_{it} be the corporate tax rate. The firm' payout, denoted D, is then given by:[5]

$$D_{it} \equiv (1-\tau_t)[\Pi_{it} - C_{it} - I^I_{it}] - I^P_{it} + B_{it+1} - r^B_{it} B_{it} + \tau_t \delta^P_{it} K^P_{it} + \tau_t (r^B_{it} - 1) B_{it}, \tag{3}$$

in which $\tau_t \delta^P_{it} K^P_{it}$ is the depreciation tax shield, and $\tau_t (r^B_{it} - 1) B_{it}$ is the interest tax shield.

2.3 Equity Value

Firm i takes the stochastic discount factor, denoted $M_{t+\triangle t}$, from period t to $\triangle t$ as given when maximizing its cum-dividend market value of equity:

$$V_{it} \equiv \max_{\{\mathbf{I}_{it+\triangle t}, \mathbf{K}_{it+\triangle t+1}, B_{it+\triangle t+1}\}_{\triangle t=0}^{\infty}} E_t \left[\sum_{\triangle t=0}^{\infty} M_{t+\triangle t} D_{it+\triangle t} \right], \tag{4}$$

subject to a transversality condition given by $\lim_{T\to\infty} E_t[M_{t+T} B_{it+T+1}] = 0$, and the laws of motion for the capital inputs given by equations (1).

Let $P_{it} \equiv V_{it} - D_{it}$ be the ex-dividend equity value. In the online appendix we show that, given the homogeneity of degree one of the operating profit and adjustment costs functions, the firm's

[4] We include debt in the model to better fit the data, but for parsimonious reasons we keep the financing side of the firm as simple as possible.

[5] Note that physical capital investment and intangible capital investments are treated differently given the different accounting rules. Investment in physical capital is spread out over time and expensed as depreciation, while the intangible capital costs are mostly treated as expenses at the time that they occur.

value maximization implies that:

$$P_{it} + B_{it+1} = q_{it}^P K_{it+1}^P + q_{it}^I K_{it+1}^I, \tag{5}$$

in which

$$q_{it}^P \equiv 1 + (1 - \tau_t)\partial C_{it}/\partial I_{it}^P \tag{6}$$

$$q_{it}^I \equiv (1 - \tau_t)\left[1 + \partial C_{it}/\partial I_{it}^I\right] \tag{7}$$

and $\partial C_{it}/\partial x$ denotes the first derivative of the adjustment costs function with respect to variable x, q_{it}^P, and q_{it}^I measure the shadow prices of physical capital and intangible capital, respectively (the Lagrange multipliers of equations (1) to (2)). The valuation equation (5) is simply an extension of (Hayashi, 1982)'s result to a multi-factor inputs setting.

According to equation (5) the firm's market value is given by the sum of the value of the firm's installed capital inputs. This additive feature allows us to compute the fraction of firm value that is attributed to each input (henceforth referred simply as "input-shares") in a straightforward manner as follows:

$$\mu_{it}^P = \frac{q_{it}^P K_{it+1}^P}{q_{it}^P K_{it+1}^P + q_{it}^I K_{it+1}^I} \tag{8}$$

$$\mu_{it}^I = \frac{q_{it}^I K_{it+1}^I}{q_{it}^P K_{it+1}^P + q_{it}^I K_{it+1}^I} \tag{9}$$

The fundamental goal of the empirical analysis is to characterize these input-shares, including their variation across countries and over time.

3 Estimation Methodology

In this section we specify the functional forms and describe the estimation procedure.

3.1 Functional Forms

The valuation equation (5) only requires the specification of the adjustment costs function, not of the operating profit function. We consider the following quadratic adjustment costs function:

$$C_{it} = \frac{\theta_P}{2}\left(\frac{I^P_{it}}{K^P_{it}}\right)^2 K^P_{it} + \frac{\theta_I}{2}\left(\frac{I^I_{it}}{K^I_{it}}\right)^2 K^I_{it}, \tag{10}$$

in which $\theta_P, \theta_I > 0$ are the parameters that control the magnitude of the adjustment costs of each input.

This functional form implies that the shadow prices of the capital inputs can be inferred from firm-level data on investment, capital stocks, and taxes, and are given by:

$$q^P_{it} \equiv 1 + (1-\tau_t)\theta_P\left(\frac{I^P_{it}}{K^P_{it}}\right) \tag{11}$$

$$q^I_{it} \equiv (1-\tau_t)\left[1 + \theta_I\left(\frac{I^I_{it}}{K^I_{it}}\right)\right] \tag{12}$$

We adopt a simple quadratic adjustment cost specification for parsimonious reasons and to avoid parameter proliferation. There are several implicit assumptions in our simple specification, such as using gross flows, smooth, convex and symmetric adjustment costs. See (Belo et al., 2022) for a discussion of these assumptions.

Denote the firm's total (effective) dollar amount of capital inputs (physical capital stock and intangible capital stock) as $A_{it} = K^I_{it} + K^P_{it}$. Accordingly, we write a firm's valuation ratio ($VR_{it} \equiv (P_{it} + B_{it+1})/A_{it+1}$) as:

$$VR_{it} = q^P_{it}\frac{K^P_{it+1}}{A_{it+1}} + q^I_{it}\frac{K^I_{it+1}}{A_{it+1}}. \tag{13}$$

The following comparative static analysis of equilibrium outcome explains the quantitative implication of parameters θ_P, θ_I over the firm valuation ratio. Consider the general situation of positive adjustment cost coefficients. All else equal, firm valuation ratio increases with $\left(\frac{I^I_{it}}{K^I_{it}}\right)\cdot\frac{K^I_{it+1}}{A_{it+1}}$, the incremental increase is determined by $(1-\tau_t)\cdot\theta_I$[6]. Investing intangible capital is more costly

[6] Denote $c(i)$ as home country of firm i, the country-specific cost parameters are $(\theta_{P,c(i)}, \theta_{I,c(i)})$ and corporate tax rate is $\tau_{c(i),t}$. Consider the parameter value is $\theta_{I,c(i)} = 16$, additional 10% in investment rate $\frac{I^I_{it}}{K^I_{it}}$, the corresponding increase of firm valuation ratio is $(1-\tau_{c(i),t})\theta_{I,c(i)}\cdot\frac{K^I_{it+1}}{A_{it+1}} = 0.40$ assuming the firm has the amount of intangible

than that of physical capital in countries where $\theta_I > \theta_P$. Given large discrepancy of cost coefficients $\theta_I - \theta_P$, across firms who have similar investment rates, valuation ratio increases with amount of intangible capital in total assets $\frac{K^I_{it+1}}{A_{it+1}}$[7]. The $\Theta = (\theta_P, \theta_I)$ is the set of parameters of the model to be estimated. The cost parameters imply the sensitivity of firm valuation ratio to investment rates in each type of capital. Across countries, firm-level distribution of valuation ratio and composition of capitals are different. We estimate the cost parameters to delineate the heterogeneity of market, and ultimately quantify the importance of intangible capital in value.

3.2 Estimation Procedure

The valuation equation (5) links firm value to the value of its capital inputs. The left-hand side (LHS) of equation (13) can be directly measured in the data from equity price and debt data (and measures of the capital stocks, which we discuss below). The right hand side (RHS) of equation (13) is the predicted valuation ratio from the model, which we will denote as $\widehat{VR}_{it}$, and depends on firm-level real variables and model parameters.

Equation (13) establishes an exact relationship between a firm's observed valuation ratio and its model-implied valuation ratio at each time-period. However, due to the noise in firm-level data and the sensitivity of their moments to entry and exit and missing observations, using equation (13) and firm-level data to directly estimate the model parameters is challenging. Therefore, we follow the same methodology as (Belo et al., 2022) and estimate portfolio-level moments. The portfolio estimation methodology targets the cross-sectional mean at the portfolio level and aligning the realized time series of portfolio-level valuation ratios with the model's predictions, provide robust estimates. Further, to avoid the attenuation bias from extreme years in the sample, we use rolling-window aggregation and estimate the accumulated moments during the window of H periods. This

capital in total assets as $\frac{K^I_{it+1}}{A_{it+1}} = 0.4$ and corporate tax rate $\tau_{c(i),t} = 0.35$. When the adjustment cost coefficient is $\theta_{I,c(i)} = 8$, the corresponding increase of firm valuation ratio is 0.20.

[7]All else equal, given additional 10% in $\frac{K^I_{it+1}}{A_{it+1}}$ assuming $(\theta_{P,c(i)}, \theta_{I,c(i)}) = (8, 16)$, the investment rate in intangible capital $\frac{I^I_{it}}{K^I_{it}} = 0.20$ and 0.15 for the physical capital, the corresponding increase of firm valuation ratio is $(1 - \tau_{c(i),t}) \cdot \left[\theta_{I,c(i)} \left(\frac{I^I_{it}}{K^I_{it}}\right) - \theta_{P,c(i)} \left(\frac{I^P_{it}}{K^P_{it}}\right)\right] = 1.30$. Consider the countries with less costly investment in intangible capital $(\theta_{P,c(i)}, \theta_{I,c(i)}) = (8, 8)$, under the same assumption for firm investment rates and country tax rate, additional 10% of $\frac{K^I_{it+1}}{A_{it+1}}$ in the firm corresponding to increase of firm valuation ratio as 0.26, much smaller than the change of valuation ratio in previous calibration.

estimation methodology inherits the spirit of long-horizon estimation as (Parker and Julliard, 2005) and (Belo, Deng, and Salomao, 2022).

We proceed as follows. In theory, at each point in time, any cross-sectional moment of the observed firm-level valuation ratios in the LHS of equation (13) should be equal to any corresponding cross-sectional moment of the model-implied firm-level valuation ratios in the RHS of equation (13). Accordingly, for each portfolio j and for each year t, we compute the cross-sectional mean observed and model-implied valuation ratios ($\overline{VR}_{jt}$ and $\widehat{\overline{VR}}_{jt}$, respectively) of the firms in the portfolio as follows:

$$\overline{VR}_{jt} = \sum_{h=0}^{H} \sum_{i} \frac{VR_{it+h}}{N_{jt+h}}$$

$$\widehat{\overline{VR}}_{jt}(\Theta) = \sum_{h=0}^{H} \sum_{i} \frac{\widehat{VR}_{it+h}}{N_{jt+h}} \;,\; i \in \text{portfolio } j,$$

where Θ represents the vector of structural parameters, $\Theta = [\theta_P, \theta_I]$, and N_{jt} is the number of firms in portfolio j at time t. We target cross-sectional mean valuation ratios because these moments capture the economic behavior of a typical (average) firm in the economy, which is what the theoretical model is designed to study.

We then proceed under the standard assumption that the portfolio-level valuation ratio moments are observed with error by the econometrician:

$$\overline{VR}_{jt} = \widehat{\overline{VR}}_{jt}(\Theta) + \varepsilon_{jt}, \tag{14}$$

where ε captures measurement error in the portfolio-level moments.[8] Based on equation (14), we then estimate the model parameters by minimizing the squared distance between the portfolio-level observed and model-implied valuation ratio moments at each point in time:

$$\widehat{\Theta} = \arg\min_{\Theta} \frac{1}{TN} \sum_{t=1}^{T} \sum_{j=1}^{N} \left(\overline{VR}_{jt} - \widehat{\overline{VR}}_{jt}(\Theta) \right)^2, \tag{15}$$

[8]Mismeasured components of the valuation ratio such as the market value of debt and the capital inputs can be better observed by firms than by econometricians. Furthermore, the intrinsic value of equity can temporarily diverge from the market value of equity.

where T is the number of years in the sample, and N is the number of portfolios. An attractive feature of our estimation approach is that it corresponds to a simple linear ordinary least squares (OLS) estimation of (modified) portfolio-level average valuation ratios on portfolio-level averages of firm-characteristics. This is due to the linear relationship between the model-implied valuation ratio and the parameters, combined with the use of portfolio-level cross-sectional means as target moments.[9]

3.3 Portfolio Sorts

As noted above, the estimation is performed at the portfolio-level. We form two sets of portfolios sorted on the following variables: $\left(\frac{I^P_{it}}{K^P_{it}}\right)\left(\frac{K^P_{it+1}}{A_{it+1}}\right)$, $\left(\frac{I^I_{it}}{K^I_{it}}\right)\left(\frac{K^I_{it+1}}{A_{it+1}}\right)$. These variables have the maximal correlation with the firm-valuation ratio. Sorting on these variables avoids the weak identification of model parameters. In the appendix, we show that the results are robust to different choices of sorting variables. We then follow Fama and French (1993) in constructing the portfolios. Specifically, we sort all firms in each year t into ten portfolios based on the deciles of the sorting variable of each firm for the fiscal year ending in $t-1$. The portfolios are re-balanced at the end of each year. This procedure gives a total of 20 portfolios.

4 Data

In this section we provide a general description of the data. Additional details about data sources and harmonization of measures are available in the Section E in appendix. Our goal is to compare the contribution of the different inputs across country, focusing on physical and intangible capital. We use place of headquarter for the country definition.[10]

[9]To show this claim more formally, define the following variables: $\overline{VR}^M_{jt} = \frac{1}{N_{jt}}\sum_{i\in j}\frac{(P_{jt}+B_{jt+1}-K^P_{jt+1}-(1-\tau_t)K^I_{jt+1})}{A_{jt+1}}$ (the modified valuation ratio), $\overline{IPA}_{jt} = \frac{1}{N_{jt}}\sum_{i\in j}(1-\tau_t)\frac{I^P_{it}}{K^P_{it}}\frac{K^P_{it+1}}{A_{it+1}}$, and $\overline{IKA}_{jt} = \frac{1}{N_{jt}}\sum_{i\in j}(1-\tau_t)\frac{I^I_{it}}{K^K_{it}}\frac{K^I_{it+1}}{A_{it+1}}$,. We can then write equation (14) as:

$$\overline{VR}^M_{jt} = \theta_P\overline{IPA}_{jt} + \theta_I\overline{IKA}_{jt} + \varepsilon_{jt} \tag{16}$$

which establishes a linear relation between the portfolio-level modified valuation ratio and portfolio-level characteristics. Thus, our objective function in (15) corresponds to a simple linear OLS regression of equation (16).

[10]For robustness check, we also consider defining the location of firm as its residing country. The result is similar.

We construct firm-level measures of market value, input investment and stock using the financial reports of publicly-traded firms in each country. For firms in United States and Canada, we collect the annual balance sheet information from Compustat North America Annual Fundamentals and stock price information provided by the Compustat-CRSP linked dataset. For firms located in other countries, we collect the annual information using the data from Compustat Global Annual Fundamentals and stock prices from Compustat Global Security Daily.

We set the currency as the U.S. dollar for all countries. For each country, we use the GDP and population provided by the database National Accounts Main Aggregates, from United Nations Statistics Division (UNSD). The frequency is annual and varies per country. For major economies the data is from 2000-2020 (see Table 1 for individual country sample). We deflate the variables using the country-specific consumer price index.[11]

We estimate the adjustment cost parameters by country for the economies with large equity market, which we define as the country having data for at least 200 firms in 2020. As described in Table 1, 18 countries satisfy this requirement: Australia, Canada, China, France, Germany, Hong Kong, India, Indonesia, Israel, Japan, Malaysia, Poland, Singapore, South Korea, Taiwan, Thailand, United Kingdom, United States of America. For the rest of the countries, to ensure the sample size, we estimate the adjustment cost parameters by pooling countries into a region according to their location and following the region criteria of United Nation statistics. We use the classification of sub-region, as the definition of region in our estimation. Under this criteria, there are 17 regions in total. For the 4 regions as Melanesia, Micronesia, Polynesia, Central Asia, we don't have valid observations of listed firms locating in these regions.

When estimating the parameters per region, we exclude the countries estimated individually. This procedure avoids the double-accounting of observations. In 3 regions as Northern America, Eastern Asia, Australia and New Zealand, we don't have valid observations of listed firms locating in these regions after the large economies are selected out (United States, Canada, China, Japan, India, Australia). In Africa, Egypt and Zimbabwe are excluded because the hyperinflation generates inconsistent measure of firm-level capital. The two Sub-regions *Northern Africa* and *Sub-Saharan*

[11]Due to the hyper-inflation, we include firms locating in Zimbabwe after year 2010. For other countries with hyper-inflation, we restrict the ceiling of inflation rate as 25% per year, when computing the investment rate and capital stock.

Africa are are merged as *Africa* for sufficient observations inside this region. As such, the final sample is composted with 18 large countries and 9 regions. The regions are: *Southern Asia* (Bangladesh, Sri Lanka, Pakistan), *South-Eastern Asia* (Philippines, Viet Nam), *Western Asia* (United Arab Emirates, Bahrain, Cyprus, Jordan, Kuwait, Oman, Palestine, Qatar, Saudi Arabia, Turkey), *Southern Europe* (Spain, Greece, Croatia, Italy, Malta, Serbia, Slovenia), *Eastern Europe* (Bulgaria, Hungary, Romania, Russia, Ukraine), *Northern Europe* (Denmark, Estonia, Finland, Ireland, Iceland, Lithuania, Latvia, Norway,Sweden), *Western Europe* (Austria, Belgium, Switzerland, Luxembourg, Netherlands, Portugal), *Africa* (Cote D'ivoire, Ghana, Kenya, Mauritius, Morocco„ Nigeria,Tunisia, South Africa, Zambia, Zimbabwe), *Latin America and the Caribbean* (Argentina, Brazil, Chile, Colombia, Cayman Island, Jamaica, Mexico, Peru).

Overall, our analysis studies 77 countries across multiple regions. In the next subsection we describe the construction of specific variables, including the measurement of the intangible capital stocks, and report descriptive statistics of the key variables used in the analysis.

4.1 Measure

4.1.1 Physical Capital

The initial physical capital stock, K_{it}^{P}, is given by net property, plant, and equipment (data item PPENT). The capital depreciation rate, δ_{it}^{P}, is the amount of depreciation (data item DP) divided by the beginning of the period capital stock.[12] We then construct a measure of the firm's capital stock at current prices. Specifically, we construct an investment-price adjusted capital stock that accounts for changes in the real cost of physical capital investment by repricing last period's capital stock using today's price of investment (P_t^P) as $K_{t+1}^{P} = K_t^P(1-\delta_t)\frac{P_{t+1}^P}{P_t^P} + I_{t+1}$. Following (Belo et al., 2022) we infer physical capital investment from the law of motion of capital using the equation of law of motion (with adjustment of inflation). This procedure guarantees that the investment and capital stock are consistent with the law of motion for physical capital in the model.

[12]Negative depreciation of capital is not well-defined. If the depreciation rate is greater than 1, we impute the rate as 1.

4.1.2 Intangible Capital

Following (Eisfeldt and Papanikolaou, 2013) we construct a measure of intangible capital based on Selling, General and Administrative (SG&A) expense data (Compustat data item XSGA)[13] We calculate the installed amount of capital using the perpetual inventory method as follows:

$$K^I_{j,t+1} = \mathrm{I}^I_{j,t+1} + (1-\delta^I) \cdot K^I_{j,t} \cdot \frac{P^I_{t+1}}{P^I_t}. \tag{17}$$

where P^I_t is approximated as the CPI of home country in local currency [14].

We set investment expenditure to be equal to 30% of SG&A expense following (Eisfeldt and Papanikolaou, 2013) and (Peters and Taylor, 2017)[15]. The depreciation rate, δ^I, is calibrated as 20%. We set the initial amount of capital as

$$K^I_{j,0} = \frac{I^I_{j,0}}{g^I_{\mathrm{Ind}(j)} + \delta^I - \pi^I_{\mathrm{Ind}(j)} \cdot (1-\delta^I)}. \tag{18}$$

in which $I^I_{j,0}$ is the firm's investment in intangible capital in the first year in the sample, and $\pi^I_{\mathrm{Ind}(j)}$ is the average price growth rate, in the industry, in each country. We let $g^I_{\mathrm{Ind}(j)}$ be industry-specific and set it equal to the average growth rate of the SG&A expense in that industry. We consider the first 2-digits of NAICS industry code to classify the industry in each country. Once we have the initial amount of capital, we derive the new amount of capital in equation (17) , using the depreciation rate, SG&A expenses, and investment price index. The investment rate on intangible capital is then given by the ratio of the current period investment and the amount of intangible

[13] In the US and Canada, firms report the detailed expenditure of R&D and advertising, estimation could differentiate heterogeneous capital inputs such as knowledge and brand, (see (Belo et al., 2022)). Firms in other countries don't universally report these details. The quantity of investment in intangible capital cannot be inferred from the historical records related to goodwill and other intangible assets in balance sheet. These are valuation-based measures. When comparing the valuation of firms across countries, the SG&A expense is the most comparable measure for the investment expenditure in intangible capital.

[14] Here, the depreciation rate of intangible capital is calibrated as the constant value. So the sub-script of depreciation rate is neglected in equation 17.

[15] The fraction of firms disclosing detailed expense of R&D and advertising, is not comparable across countries. For listed companies residing outside of North America, a small subsample discloses the R&D expense. In alternative calibration, we compute the amount of intangible capital following the procedure in (Peters and Taylor, 2017). The full R&D expense is acknowledged as the investment expenditure. For the firms with knowledge capital that can be directly measured, the total amount of intangible capital is slightly larger than the benchmark measure. Estimation outcome of the model, and country-level statistics are similar. Estimating for intangible capital investment expenditure of detailed categories in SG&A expense is a separated research investigation.

capital at the beginning of the period I_t^I/K_t^I.

4.1.3 Additional Firm-level Variables and National Account Variables

We measure the debt value B_{it}, as book value of net total debt referring (Belo et al., 2022). We calculate the net debt as long-term debt (Compustat data item DLTT) plus short-term debt (data item DLC), minus cash (data item CHE). We set the measure as zero when they are missing. The market value of equity, P_{it}, is the closing price per share (data item PRCCF) times the number of common shares outstanding (data item CSHO). The market value is calculated at the year-end price during the fiscal year of the firm. All nominal value in local currency are converted into the nominal USD dollar amount, using the annual-average exchange rate. We measure the tax rate, τ_t, as the corporate income tax rate from the Tax Foundation, available for each country. When we lack the information of corporate tax income rate, we use the corporate income tax rate from the Compustat Global-Economic Indicators. Stock variables with subscript t ($t+1$ for debt) are measured and recorded at the end of year t, while flow variables with subscript t are measured over the course of year t and recorded at the end of year $t+1$.

4.2 Summary Statistics

Table 1 and Table 2 present key statistics about the main countries and regions studied. These tables show that the sample of 77 countries is representative of the total production across the world. Our total sample (large individual countries and regions) includes 17,069 firms, and the sales represent 34.10% of the world GDP in 2020. For the main equity markets, the 18 countries include 13,698 firms, and the sales represent 28.23% of world GDP in 2020. For these countries, per capital GDP in 2020 ranges from $1,849 for India to $58,148 for US. In Table 2 we present the regional statistics by aggregating individual countries inside each region.[16]

We set the starting-year to the year when the country/region has sufficient firm-year observations.In Table 1 and Table 2, Column (1) reports the starting year for each country/region. The end-year is 2020 for all countries/regions.

[16]For each country in each region, these statistics are reported in Table 14 in the appendix.

4.3 Preview of the Firm Level Data

Table 3 and 4 report key summary statistics of the observed valuation ratios and their model-implied components according to equation (13), for the major equity markets and regions.

The median valuation ratio across all major markets is 1.44 with heterogeneity across countries. While China has the maximum valuation ratio of 2.94, Japan has the lowest valuation at 0.84. In terms of the average size of the scaled input as intangible capital, which amounts to 38% of total book capital on average across major economies. This is lowest for China, accounting for 20% and highest for France standing at 67%. For regions, the figure is similar, with average valuation ratio across all regions at 1.38 and average intangible capital share at 36%.

According to equations (11) to (12), the investment rates determine the shadow prices of the labor and capital inputs. Columns (2) and (3) shows that, in the pooled sample, investment in intangible capital is on average higher than investment in physical capital for the majority of countries, with the exception of France and Sweden. The average investment rate in intangible capital across countries is 25%, with a maximum of 32% in China and a minimum of 19% in India. The average physical capital investment rate is 16%, with a minimum of 3% in India and maximum of 24% in USA. Across regions, the average physical capital investment is 8% and intangible is 20%.

Column (7) of the tables reports the investment rate cross-correlations.The table shows that, as expected, the investment rates are all positively correlated among each other. The correlations range between 17% and 42% for major equity markets and 17% to 31% for regions. These correlations are significantly smaller than one, thus suggesting that the investment rate of the different capital inputs have different variations in the data. Distinguishing the shadow prices might help explain the variation in market value.

5 Estimation Results

This section presents the primary empirical findings. Subsection 5.1 details the estimates of parameters and the model's overall fit for the baseline model that includes physical and intangible capital inputs. In subsection 5.2, we describe the estimates and model fit when employing an alternative specification that considers only physical capital. This analysis underscores the significance of intangible capital in capturing the market value of the firm. Subsection 5.3 discusses the model-implied breakdown of firm value, decomposing the market value between the two inputs.

5.1 Parameter Estimates and Model Fit

In Table 5, columns (1) and (2) present the estimates of adjustment cost parameters for the model applied to larger equity markets where there is sufficient data to estimate country-level parameters. All estimates are positive and statistically significant, which implies that we cannot reject the hypothesis that these inputs are subject to zero adjustment costs. Notably, there is considerable heterogeneity across countries, with the adjustment cost parameters for intangible capital consistently higher than those for physical capital. The cross-country average adjustment cost coefficient for physical capital (θ_P) is 4.18, while the average adjustment cost coefficient of intangible capital (θ_I) is 10.82.

The dispersion in the estimated adjustment cost coefficient of intangible capital θ_I is more pronounced than that for physical capital. The standard deviation of estimates across countries for physical capital is 1.93, ranging from 0.86 for Japan to 8.59 for USA. In contrast, the cross-country standard deviation for intangible capital estimates is 6.36. Notably, θ_I estimates are relatively low for European countries such as France (7.06), Germany (8.41) and the U.K. (8.47), but high in North American countries like the United States (15.69) and Canada (11.44).The situation is less straightforward for Asia, where estimates are low for Japan (2.42), South Korea (3.73) , Hong Kong (7.24) and Singapore (6.76), and high in China (30.77), India (19.16) and Taiwan (13.98). Eurpean countries such as France and Germany, have small difference in the estimated adjustment cost coefficient of intangible capital. The estimated adjustment cost coefficient of intangible capital has much larger dispersion in Asia, as countries are different in their economic development status, hence market environment for firm operation are different.

The model including both the physical capital and intangible capital fits the data well, when we evaluate the model-fitness using the cross-sectional fitness measure and the time-series fitness measure. Table 5 shows that the cross-sectional R^2 is high, with an average of 69% across countries, even though the model estimation does not explicitly targets this moment. The average time-series R^2 is 33%. In terms of average valuation ratio errors, the model scaled mean absolute error (m.a.e./$\overline{\text{VR}}$) is 18% on average. The good model-fit implies that the generalized Q-theory model with intangible and physical capital describes the valuation of firms well across a wide variety of countries.

The implication of intangible capital over firm valuation is different for firms residing in countries with costly investment and firms in less costly countries. In countries where the adjustment cost coefficient of intangible capital is large, the marginal value of investment in intangible capital is large. Investment rate in intangible capital, the amount of intangible capital compared to total amount of capitals, implies the the large variation in firm valuation ratio.

As demonstrated by the dispersed estimates of adjustment cost coefficient in each country, the market environment for accumulating physical capital and intangible capital differs across countries. This heterogeneity is crucial for explaining firm valuation ratio across countries. In Table 5, Columns (6) to (8) displays the fitness of model assuming that the adjustment cost coefficients for all countries equal to the estimated cost coefficients for the US ($\theta_P = 8.59$ and $\theta_I = 15.69$). The estimated R^2 is negative for a wide range of countries, implying mispecification of common market environment for accumulating physical capital and intangible capital. One can compare the investment rate $\frac{I^I_{it}}{K^I_{it}}$ and the shadow price $(1-\tau_t)\left[1+\theta_I\left(\frac{I^I_{it}}{K^I_{it}}\right)\right]$, to assess the role of cost coefficient in firm valuation ratio and the economic importance of geographical variation. For example, the estimated cost coefficient is ($\theta_P = 6.56$ and $\theta_I = 7.06$) for France. The corporate tax rate, median investment rates are quantitatively similar with United States. For a firm residing in France, shadow price of intangible capital is almost half of the counter-part firm of same investment rate residing in United States. Valuation is much lower than the firm operating in United States. There is smaller discrepancy in firm valuation ratio, across firms of high investment rate of intangible capital and that of low rate. Counter-factual estimation is biased from the reality.

Turning to the analysis of the per region estimation of the model, Table 4, columns (1) and (2) show that all the adjustment cost parameters are positive. The patterns are similar to the ones in the main equity markets. Investment in intangible capital is consistently more costly than the investment of physical capital. For physical capital, the cross-region average adjustment cost coefficient is 4.83, while this statistic is 11.43 for the intangible capital. Similar with Table 5, the dispersion of estimated parameter θ_I is larger than the parameter for physical capital θ_P . For the adjustment cost coefficient of intangible, the standard deviation equal to 3.88. For physical capital, the standard deviation is 2.37. The model fitness is high across regions. Table 6 shows that the cross sectional R^2 is high, with an average of 68% across regions and 44% for the time-series R^2. In terms of average valuation ratio errors, the model scaled mean absolute error (m.a.e./$\overline{\text{VR}}$) is 18% on average across regions. Northern Europe and Latin American & Caribbean have particular high model-fitness. In Northern Europe, cross-sectional R^2 is 82% and time-series R^2 as 49%. In Latin American & Caribbean, corresponding statistics are 86% and 62%. Again, columns (6) to (8) display the poor model-fitness when we assume US parameters.

Overall, the estimation results show that adjustment costs of the inputs vary across countries and regions, especially for intangible capital. The estimation results of Table 5 and Table 6 illustrate the importance of quantifying the heterogeneous market environment using country/region specific adjustment cost parameters.

In Table 5 and Table 6, there is geographical variation in cost parameters, especially the intangible capital. All else equal, when the adjustment cost parameter of intangible capital is much larger than that of physical capital, intangible capital contributes to a larger fraction of firm value. The model abstractly describes how costly it is to acquire and install the new capitals. There are multiple explanations for the high cost. Table 17 uses cross-sectional regression, describes how market environment in each country correlates with the cost parameter of intangible capital and the parameter of physical capital in 26 markets where there are comprehensive national statistics. Two aspects of market environment are considered: (1) protection of intellectual property, (2) compliance of employment contract. The cost parameter of intangible capital is negatively correlated with protection of intellectual properties, compliance of employment contract[17].

[17] In markets with strong protection of intellectual properties, the application for patent and trademark is less costly. The report of CEPII provides qualitative evaluation over three dimensions: trade secrets and industrial patents, industrial counterfeiting and intangible goods (copyright etc.). The indicator B602 reports the combined assessment of intellectual property protection. The cost parameter of intangible capital is negatively correlated with this indicator of intellectual property protection. The cost parameter of physical capital has weak correlation. As the alternative measure of intellectual property protection, we use the time-series average statistic of intellectual property protection from the World Intellectual Property Organization (WIPO) during 2015-2019 to examine the correlation. The regression outcome is qualitatively similar.

The cost parameter of intangible capital reflects the retention cost of key talents. In labor markets where there is formal employment contract and compliance, the operation expenses related to recruiting, compensation for terminating existing employment contract, are lower. The Center for Prospective Studies and International Information (CEPII) collects survey outcome for questions related to minimum wage, dismissal procedures to evaluate how the labor market of a country comply with the employment law. In the 2016 version of report, the indicator D600 summarizes the extent of compliance of employment contract. The cost parameter of intangible capital is negatively

5.2 Physical Capital Only Model

To help understand the role of various capital inputs in firm valuation, Tables 7 and 8 report the parameter estimates and model fitness for the counter-factual model where the firm uses only physical capital for the capital inputs in production. To provide a meaningful comparison of the model fit in terms of R^2,we employ the same set of firms used in the baseline model estimation.

The model with only the physical-capital input, allows for the comparison for the Generalized Q-theory model and the standard-Q theory model. Comparing the adjustment cost coefficient of physical-capital, estimated in Table 5, we observe that the estimated adjustment cost coefficient of physical capital is significantly larger in this single-capital model, with an across country average of 12.38 and dispersion of 4.78. These results imply that under the mis-specified single-capital model, the point estimates of physical capital adjustment cost coefficient is biased due to the latent correlation between the physical capital investment rate and the intangible capital investment rate. The model-fitness statistics displayed in columns (3) to (5) show that neglecting intangible capital significantly hinders the explanation for the firm-valuation.The per region estimation of the single-capital model presented in Table 8 tells a similar story, with higher physical capital adjustment cost parameters and lower model-fitness.

In summary, these findings underscore the importance of the intangible capital input in modern corporations that heavily rely on a high-skill labor force and new technology. A more accurate quantitative evaluation of the contribution of intangible capital is described in the next subsection.

5.3 The Value of Intangible and Physical Capital

The parameter estimate allows us to compute the model-implied shadow prices of each input, and hence evaluate the contribution of each input for firm value (input-shares) based on each input's market value. Specifically, using the estimates reported in Table 5 and 6 , we compute the model-implied scaled value of each capital input, the values of $q^P_{it}\frac{K^P_{it+1}}{A_{it+1}}$ and $q^I_{it}\frac{K^I_{it+1}}{A_{it+1}}$, for each firm and

correlated with this indicator of compliance of employment contract. In single-variate cross-sectional regression $\theta_{I,c} = a + \beta_{\theta_I} \times X_c + \varepsilon_c$, the slope coefficient $\beta_{\theta_I}$is statistically significant negative. There is no dicernible correlation between the cost parameter of physical capital and the compliance of employment contract, in the corresponding regression $\theta_{P,c} = a + \beta_{\theta_P} \times X_c + \varepsilon_c$. When considering permanent contracts, protection with respect to individual dismissal as alternative proxies for formal protection of right of employees, the cost parameter of intangible capital has the similar negative correlation.

in each year. We then substitute these values in equations (8) to (9) to compute the shares of each capital inputs.[18]To characterize the data in a comprehensive yet parsimonious manner, we summarize the properties of the firm-level input-shares in the economy. We compute the median of intangible share in each year and each country, then calculate the mean across years for each country/region.

In Table 9, column (1) shows that intangible capital is an important determinant of firm's market values across all countries. The cross-country average share of intangible capital is 50.66% . There is significant heterogeneity across countries on this statistic, with the cross country dispersion of 9.33%. While USA sits on top of the intangible market share, with about 63.56% of the market valuation coming from it, South Korea is on the bottom with 33.41%. Large economies, like UK and China have above average intangible capital market shares, with respectively 61.57% and 61.73%. Figure 1 visualizes the share of intangible capital for each countries in our sample. Across countries, the darkness of color illustrates the share of intangible capital. As shown in Figure 1, the Northern European area and Western European area have particular high intangible market share, while the East Asian area has relatively lower share. Inside the Asia-Pacific area, the cross-firm median intangible market share of China is 63.05%, higher than the that statistic of Japan 48.15%, as shown in the Figure 1.

Turning to the analysis across regions, Column (1) in Table 10 shows that the importance of the intangible capital for each regions. The cross region average is 50.26% . Overall, this analysis shows that the intangible capital inputs are important determinants of firms' market values across the world. Next we discuss the magnitude of adjustment costs with respect to the firm output, compare the share of intangible capital in the total capital inputs and the share of intangible capital in the market valuation.

5.3.1 Implied Adjustment Costs

Next, we assess the economic significance of adjustment costs associated with the two inputs across major economies and regions. This evaluation serves a dual purpose: first, to gauge the model's compatibility with the data based on economically reasonable parameter values, and second, to gain

[18]Note that, with this procedure, the input-shares add up to 100% by construction. For succinct description of estimation results, we report the share of intangible capital in firm valuation.

insights into the documented high importance of intangible capital inputs for firm valuation.

Specifically, using the functional form specification in equation (10) and the parameter estimates, the realized adjustment costs of each input (denoted as CP and CI) can be computed as a fraction of firm's total annual sales as follows:

$$\frac{CP_{it}}{Y_{it}} = \frac{\frac{\theta_P}{2}\left(\frac{I_{it}^P}{K_{it}^P}\right)^2 K_{it}^P}{Y_{it}} \tag{19}$$

$$\frac{CI_{it}}{Y_{it}} = \frac{\frac{\theta_I}{2}\left(\frac{I_{it}^I}{K_{it}^I}\right)^2 K_{it}^I}{Y_{it}}. \tag{20}$$

Table 9, columns (2) and (3), reports the average realized adjustment costs of each input, computed as the time-series average of cross-sectional medians of the ratios in equations (19) – (20). The across countries average adjustment cost of intangible capital is around 5.82% of annual sales. This cost is, for most major equity markets, higher than the adjustment costs for physical capital, which average about 2.73% of sales. China stands out as having the highest adjustment cost of intangible capital, followed by US. For physical capital, US and European countries top the list.

Table 10 shows the numbers for regions, with cross region average intangible capital adjustment cost at 4.74% of sales. Northern Europe sits at the top, with costs aggregate above this average. The physical adjustment cost is on average lower, with aggregate measure of 2.23% of sales.

Overall the adjustment costs calculated point towards a costly adjustment of intangible capital, both across major equity markets and regions. In the next subsection, we discuss how this adjustment costs explains the high market value of intangible capital.

5.3.2 Book versus Market

In this subsection we compare the book share of the inputs to its market share. When an input is costly to adjust, naturally the installed values of the inputs are valuable to the firm, because the accumulated capital inputs avoid adjustment costs in the future. If adjustment costs are zero, the shadow prices of the inputs in equations (11) and (12) are simply one (physical capital) and $(1-\tau_t)$ (intangible capital)). As a result, the value of each capital input is given by its book-value (adjusting for the tax rate), and the fraction of firm value attributed to each capital input (input-shares) can be directly computed from equations (8) and (9).

As Table 9 illustrates, the market share departs from the book share, due to different adjustment costs of intangible and physical capital. Column (4) lists the book share of intangible capital. Compared to the 50.66% average cross country market share, the cross-country average book share is 34.85%, for the major equity markets. China stands out with a 21.02% book share of intangible capital versus a 61.73% market share. For the US and UK, while the book share is lower than market, the difference is less stark (in the US it goes from 51.81% to 63.56% and in the UK 56.16% to 61.57%).

The observed high market value of intangible capital can be attributed to two distinct channels. The first is the quantity channel, where a high book share corresponds to a high market share. This pattern is evident in the United Kingdom and developed European countries. The second channel is the valuation channel, where a high market share is observed when intangible capital investment is costly. This is particularly true for East Asia. Notably, China exhibits the highest intangible investment cost θ_I in entire whole sample.

Conversely, Japan stands out with a very low adjustment cost parameter for intangible capital. Consequently, we observe a substantial difference between the book and market value of intangible capital in China, but a relatively smaller difference in Japan (book at 38.52% and market at 46.20%). This observation extends to South Korea, where the adjustment cost parameter of intangible capital closely aligns with that of physical capital. These findings highlight the interplay between the quantity and valuation channels in explaining the market value of intangible capital across different economies.

The book share of intangible capital is low in countries where there is weak protection of patents and trade marks, insufficient compliance of employment law. However, accumulating intangible capital is costly in these countries, and shadow price is high. The market environment has opposite effects over the quantity of intangible capital and the valuation channel. The market share of intangible capital depends on the combined effects.

6 Risk-Premium of Capitals

Financial market investors determine the valuation of cashflows from each capital inputs using the stochastic discount factor. When the operating profit contributed by the intangible capital has stronger correlation to the stochastic discount factor, the expected return of intangible capital required by for investors will be larger, compared with physical capital. Firm operating profit can be separated into the cashflow contributed by the physical capital and that of the intangible capital. The profitability of physical capital and that of intangible capital are subject to different sources of risk [19], associated amounts of risk premium are different. The firm valuation can be interpreted as the portfolio of intangible capital and physical capital. The share of intangible capital in firm valuation works as an alternative measure of risk exposure.

Previous estimation using Q-theory model utilizes the variation of firm valuation, investment rates and composition of book capital, to infer the adjustment cost of each capital inputs for each market. Estimation provides the shadow price of capitals, hence the accurate composition of capitals in valuation. It amends the composition of book capital using the firm-level investment rate. Estimation takes the geographical heterogeneity into consideration. The institutional environment of intellectual properties protection, employment law compliance are summarized by the adjustment cost of intangible capital. The share of intangible capital is a comparable measure of risk exposure, for firms locating in different countries.

When the firm manager has high valuation for the future cashflows generated by the intangible capital, we observe the high investment rate in intangible capital. This helps us know in which years the intangible capital has high valuation. In markets where the R&D expense has low conversion rate into patents or the vocational training doesn't match the requirement of skill set, it is costly to accumulate the intangible capital. Under this situation, valuation of the intangible capital is high due to the high cost. This helps us know in which markets the intangible capital has high valuation. Subsection 6.1 investigates whether the firm-level composition of capitals in valuation describe the cross-sectional variation of risk exposure to systematic risk. The empirical facts at firm-

[19] The productivity of installed equipments is improved when new technology is adopted such as automation of assembly line. The revenue from plant and equipment depends on combining inputs of raw materials or upper-stream intermediate goods. Existing patents, skill and experience accumulated by employees, help the firm earn higher revenue. The extent of how these intangible capitals boost the firm sale is prone to the replacement risk of competing patents and technologies owned by other firms.

level demonstrate the risk premium in intangible capital is relatively larger than that of physical capital. The relative risk premium of intangible capital are quantitatively large across markets. Subsection 6.2 further shows that across countries, equity in a country has relatively larger risk premium where the valuation has larger contribution from the intangible capital .

The composition of capitals in valuation is informative about the risk premium and hence the risk exposure to systematic risk. The cross-section variation of risk exposure provides an alternative way to track the common risk [20]. We calculate the relative return of intangible capital to physical capital using firms in all countries, diversify the country-specific shock, to obtain the common shock. Subsection 6.3 shows that existing asset pricing models cannot explain the risk premium in longing intangible capital and shorting the physical capital. The relative return of capitals describes the systematic risk. Larger risk exposure to the relative return of capitals yields the higher expected return.

6.1 Risk Premium of Firm

The estimation in Table 5 and Table 6 allows us to trace the variation of risk-premium across firms using the market-share of intangible capital. Table 11 tests whether intangible capital generates different amount of risk-premium, using Fama-Macbeth (2nd step) regression.

We calculate the annual excess return $r^e_{i,t+1}$ for each firm with respect to risk-free rate. All returns are expressed in US dollars and are adjusted for stock splits and dividends. The risk-free rate uses the short-term U.S. Treasury rate. We use the following regression to evaluate the role of intangible capital in predicting excess return:

$$r^e_{i,t+1} = a + \lambda_\mu \times \mu^I_{i,t} + \overrightarrow{\lambda}'_Z \times \vec{Z}_{i,t} + a_{c(i)} + a_{Ind(i)} + e_{i,t+1}. \tag{21}$$

where $\mu^I_{i,t}$ is the market share of intangible capital, in the end of period. The excess return $r^e_{i,t+1}$ is from the beginning of period $t+1$ to the end of period. The estimated λ_μ captures the premium associated with this input, reflects how the risk premium of intangible capital differs from that of

[20](Sandulescu, Trojani, and Vedolin, 2021) estimate the stochastic discount factors for developed markets, using the equity indices, interest rates and exchange rate. They estimate the common component of stochastic discount factors to find the common shocks.

physical capital [21]. The model with two capital inputs provides the simple description for firm valuation. Although the amount of capitals, the investment rates, the adjustment cost parameters are sufficient statistics for firm valuation, expected return of firm equity might depends on other state variables. We control for a number of other known return predictors in $\vec{Z}_{i,t}$ and fixed effects. Specifically, we control for size (market capitalization), value (book to market), reversal, momentum, idiosyncratic volatility and market beta. The term $a_{c(i)}$ is the country fixed effect. The term $a_{Ind(i)}$ is the industry fixed effect. Table 11 shows that investors obtain the relative risk premium in holding intangible capital compared with physical capital in each region.

Column (1) assumes across regions and industries, risk premium associated with market share of intangible capital are identical. Composition of capitals are sufficient statistics for expected return. As illustrated in Table 11, the estimate of coefficients λ_μ is statistically positive with an average 0.077 in the annual cross-sectional regressions. To put this number in perspective, the difference in market share of intangible capital between the top 90th percentile and the bottom 10th percentile is 64%, implying that the top decile of has 4.9% higher excess return annually than the bottom decile[22].

Column (2) includes other firm characteristic variables, risk premium λ_μ has point estimate 0.065, in the similar amount to Column (1). When pooling all the firms together, point estimates of risk premia are roughly the weighted outcome across major regions. Columns (3)-(5) separate the sub-sample for each major region, risk premium associated with market share of intangible capital are quantitatively similar. Column (3) uses sub-sample of firms residing in Asia, the risk premium λ_μ has point estimate 0.079. The point estimate is 0.074 for sub-sample of North America, and 0.090 for firms residing in Europe. Appendix Table 20 reports the point estimate of risk premium of other firm characteristic variables. Risk premium of book-market ratio has different point estimates across major regions, reported in Columns (2)-(7). Estimation in previous section shows the geographical heterogeneity in adjustment cost. Intuitively, in countries where

[21] Equation 21 is equivalent to equation $r^e_{i,t+1} = \underline{a} + \lambda_I \times \mu_{I,i,t} + \lambda_P \times \mu_{P,i,t} + \overrightarrow{\lambda}'_Z \times \vec{Z}_{i,t} + a_{c(i)} + a_{Ind(i)} + e_{i,t+1}$. The market share of capitals $\mu_{I,t}, \mu_{P,t}$ is interpreted as the portfolio weight of different real assets owned by the firm. The slope term λ_I can be interpreted as the expected return from intangible capital, and λ_P for the risk premium associated with physical capital. There are two capital inputs in firm valuation $\mu_{I,t} + \mu_{P,t} = 1$. The slope term is $\lambda_\mu = \lambda_I - \lambda_P$ and the intercept term is $a = \underline{a} + \lambda_P$. Positive λ_μ indicates the risk premium of intangible capital is larger than that of physical capital.

[22] Appendix Table 18 estimates the equation $r^e_{i,t+1} = a + \lambda_\mu \times \mu_{I,i,t} + e_{i,t+1}$,the point estimate of λ_μ is 0.109, the correspondin calculation of implied excess return is 6.936%.

the adjustment cost parameters are high, shadow price of production capitals are high, book-market ratio is low. There is no simple interpretation for the risk premium associated with firm characteristic variables such as size and book-market ratio. Appendix Table 21 estimates the equation $r^e_{i,t+1} = \underline{a} + \lambda_I \times \frac{q^I_{it}K^I_{it+1}}{V_{i,t+1}} + \lambda_P \times \frac{q^P_{it}K^P_{it+1}}{V_{i,t+1}} + \overrightarrow{\lambda}'_Z \times \vec{Z}_{i,t} + a_{c(i)} + a_{Ind(i)} + e_{i,t+1}$ admitting the equation error of firm valuation, where $\frac{q^I_{it}K^I_{it+1}}{V_{i,t+1}} = \mu_{I,t} \times \frac{q^P_{it}K^P_{it+1} + q^I_{it}K^I_{it+1}}{V_{i,t+1}}$. The equation error in $V_{i,t+1}$ avoids the collinear relationship in $\mu_{I,t} + \mu_{P,t} = 1$. Among major regions, risk premium of intangible capital λ_I is statistically significantly positive. Estimation outcome is qualitatively consistent with Table 11. Across regions, the point estimates of risk premia are slightly different. Among firms residing in different major regions, firm cash flow correlates with aggregate shocks in different extent, level of expected return differs. However, regions demonstrate similarity in terms of risk premium assoicated with the intangible capital and physical capital. Within each region and industry, firms with intangible capital has higher expected return than firms with physical capital.

6.2 Risk Premium of Countries

Countries are in different stages of economic development. The accumulated intangible capital has smaller amount in the emerging market. As in Figure 1, across countries, we observe geographical variation in share of intangible capital in listed companies.

In Table 22, we investigate whether the share of intangible capital in a country predicts the excess return of stock market indices. We construct the indices of stock market for each country, using these listed firms with available balance-sheet information[23]. The country-level measure of share of intangible capital and other variables of underlying firm outcomes describes each equity indices, describes the traded companies in each country. We examine whether the share of intangible capital predicts the holding-return of market indices using the same cross-sectional regression as specified in equation 21. Across these stock market indices, 1% of share intangible capital adds 0.167% excess return annually, after controlling the firm fundamental information and country-year characteristics

[23] Table 51 in appendix shows that the sub-sample with estimated share of intangible capital accounts for 67.98% of the sample with available balance-sheet information (47.95% of sample with balance-sheet information, if the equity security of primary issuance is not rigorously matched with each firm). The number 67.98% (47.95%) takes the average of coverage ratio, across the available stock indices in the Compustat-Global dataset. Here, the sub-sample with estimated share of intangible capital, differs from the sample with available balance-sheet information, because the information of sale and capital investment is incomplete for certain firms.

related to economic growth and exchange rate. Estimation outcome is qualitatively similar [24] with the firm-level estimation in Table 11. Investing the corporate sector locating in countries with high share of intangible capital generates higher financial return. Investors can purchase ETF and mutual funds that provide the easy access and specialized management of rebalancing the global equity portfolios, and make investment tracking equity market indices in these countries.

The firm-level estimation in Table 11 includes the fixed effect of country to remove the average excess return across firms within the country. Across firms, share of intangible capital indicates the larger systematic risk in cashflow and hence the larger risk compensation required by investors. This channel of cashflow extends to the country-level traded corporate sector. Given the high fraction of intangible capital, large systematic risk exposure helps explain the high expected return observed in the equity indices of certain countries in Table 22 .

In Figure 3, we illustrate the positive correlation between the market share of intangible capital and the expected excess return of equity. We calculate the average share of intangible capital and average excess return for each country. Panel (a) of Figure 3 shows that countries with higher share of intangible capital in valuation, have high expected excess return during the sample-period. In Panel (b) of Figure 3, the share in book capital understates the importance of of intangible capital in valuation across Asian countries. The weak protection of intellectual properties renders the high cost in converting research expenditure, advertising expense into protected patents and trademark. Hence, we observe intangible capital contributes the larger share of valuation μ_I than its share of book capital $\overline{\mu}_I$ in emerging markets of certain Asian countries. Composition of valuation is more informative than the composition of book capital when explaining the variation of risk premium across countries.

6.3 Explanation of Risk Premium

There is higher risk premium of intangible capital compared to physical capital. Previous subsection of cross-sectional test indicates the risk premium associated with market share of intangible capital

[24] Across countries, we observe variation in share of intangible capital, due to geographical variation in economic development and specialized industries. In the country-level estimation of Table 22, risk premium of the share of intangible capital has larger point estimate. The firm-level estimation in Table 11 includes the fixed effect. Appendix Table 18 estimates the equation $r^e_{i,t+1} = \underline{a} + \lambda_\mu \times \mu_{I,i,t} + e_{i,t+1}$ without separating the country fixed effects and industry fixed effects. The risk premium λ_μ reflects the country-level variation. Point estimate is larger than the estimation in Table 11.

is different from risk premium related to firm characteristic variables such as size and book-market ratio. Subsection 6.3.1 implements time-series test for relative return of intangible capital to physical capital, to investigate what aggregate shocks induce the different fluctuations in valuation of intangible capital and that of physical capital. Subsection 6.3.2 examines whether the aggregate shocks reflected in relative return of capitals are systematic risk priced in global equity portfolios. Subsection 6.3.3 investigates candidate explanation for the amount of risk premium.

6.3.1 Time-Series Test

We calculate the relative return of intangible capital to physical capital, as the realized return from investing the top 30% firms with high share of intangible capital and shorting the 30% firms with low share (equivalently, firms with high share of physical capital) across all the countries in the sample[25]. The difference of excess returns $r_{Intan-Phy,t}$ has volatility 17.476%, time-series average return $E[r_{Intan-Phy,t}]$ as 6.130%. Table 12 shows that existing asset pricing models cannot explain the relative risk premium of intangible capital to physical capital.

Table 12 examines whether risk factors in other asset pricing models documented in the literature can explain the asymmetric fluctuation and the excess return between intangible capital and physical capital. For each asset pricing model of traded factors $\overrightarrow{f}$, the time-series regression $r_{Intan-Phy,t} = \alpha + \overrightarrow{f}_t \cdot \overrightarrow{\beta} + e_t$ is estimated. Factor loading $\overrightarrow{\beta}$ describes the common fluctuation between existing traded factors and the relative return of capitals $r_{Intan-Phy}$. Under the null hypothesis $H_0 : \alpha = 0$, the risk premium is completely explained by the common fluctuation, $E[r_{Intan-Phy,t}] = E[\overrightarrow{f}_t] \cdot \overrightarrow{\beta}$. Estimation outcomes reported in Table 12 reject the null hypothesis for asset pricing models documented in the literature.

The relative return of capitals is almost orthogonal to the U.S. market factor. Column (1) shows the small time-series R^2 around zero. Column (2) shows that there exists negative correlation between relative return of capitals and the traded factor of equity-capital ratio of U.S. financial

[25] Appendix Table 24 describes the composition of capitals, the excess return and Sharpe ratio for the three groups of firms classified by the market share of intangible capital. The average market share of intangible capital is 25.854%, book share is 15.719% for the firms with low share. For the firms with high share, the average market share of intangible capital is 81.350%, book share is 63.510% . After diversifying the firm-level and country-level shocks, the portfolio of intangible capital has volatility of the excess return as 44.457%, time-series average return is 11.306%. For the portfolio of firms of more physical capital, volatility of the excess return is 47.473%, time-series average return is 5.175%.

intermediary in (He, Kelly, and Manela, 2017), with factor loading $\beta_{hkm^r} = -0.134$. But the time-series R^2 is as small as 0.12, and the intercept coefficient has large positive point estimate $\alpha = 5.995$ (with standard error 2.012). The traded factors of Intermediary-CAPM cannot fully explain the risk premium in the relative return of capitals. In Column (3), the traded factors are from the Fama-French 5 factor model in (Fama and French, 2015) and the momentum factor. The time-series R^2 increases to 0.28, because the value factor and the relative return of capitals are correlated. The value premium documented in early asset pricing literature suggests the value firms of high book-market ratio have higher expected return. In previous estimation, the shadow price of intangible capital is larger than physical capital in most countries. If the value premium still holds, firms of intangible capital are supposed to have lower expected return. But in Table 12, the relative return of capitals has large positive intercept coefficient $\alpha = 5.066$ (with standard error 2.104). This indicates the relative return of capitals contains systematic risk that is not summarized by the value factor. The relative return of capitals reflects different economic fluctuations from the value spread. Column (4) further examines the Q-factor model with expected growth factor in (Hou et al., 2021), the intercept coefficient has large positive point estimate $\alpha = 4.608$ (with standard error 2.143) . In (Verdelhan, 2018), currency portfolios that have positive correlation to the dollar factor has higher average return. (Chaieb, Langlois, and Scaillet, 2021) includes the dollar factor and carry factor to describe the systematic risk for equity portfolios in different countries. Column (5) constructs the dollar factor and the carry factor in the similar approach of (Verdelhan, 2018). The relative return of capitals is positively correlated to the dollar factor, but the correlation doesn't explain the high average return in longing the intangible capital and shorting the physical capital.

The fraction of intangible capital in firm value is calculated using the investment rate and the adjustment cost parameters. These parameters are estimated using the full sample. As an alternative simple measure, we separate the firms of intangible capital and firms of physical capital using the book share. Appendix Table 28 shows the estimation outcomes are qualitatively similar with Table 12. But this alternative time series has larger volatility.

Multiple aggregate shocks result in the asymmetric fluctuation in valuation of intangible capital versus that of physical capital. Table 29 describes time series of primitive shocks, the pairwise correlation, and their correlation to relative return of capitals. The shock in discount rate is reflected in the variation of interest rate. The commodity price change reflects the demand of industry production and the supply of raw materials. Column (1) uses the change in U.S. treasury yield rate $\frac{1+r_{t+1,h_0\to h_1}}{1+r_{t,h_0\to h_1}}$ from $h_0 = 1$ year to $h_1 = 3$ years after [26].The relative return of capitals has negative correlation to the increase of yield rate. Correlation coefficient is -0.26, with small standard error 0.07. In Column (2), The correlation coefficient is also negative when considering the long-horizon rate from 5 years to 10 years. Intangible capital of long duration and physical capital of short duration might explain this correlation. Columns (3)-(5) examines the price change in main commodity contracts. These are future contract with settlement date in next month. Fluctuation in price is calculated as $\frac{E_{t+1}[S_{t+2}]}{E_t[S_{t+2}]}$ with $E_{t+1}[S_{t+2}]$ as near-settlement future contract and $E_t[S_{t+2}]$ as the 2-month future contract in previous month.[27] The relative return of capitals is negatively correlated to the price shocks in {"Gas Oil","Copper","Corn"}[28]. One simple interpretation is that physical capital of high productivity substitutes the use of raw materials. Simultaneously, the valuation of physical capital decreases relative to that of intangible capital. Scarcity of commodity price is mitigated. This anticipation is reflected by the decline of commodity price, specifically the oil and metal for industry-usage.

6.3.2 Common Risk

Section 5 shows that the intangible capital accounts for a large chunk of financial wealth in equity assets. The importance of intangible capital to investors' marginal utility of wealth is self-evident. Aggregate shocks invoke the asymmetric fluctuation in valuation of capitals. The relative return of intangible capital to physical capital, separates the fluctuation of wealth in intangible capital versus

[26]The interim yield rate is calculated as $r_{t+1,h_0\to h_1} = \frac{h_1}{h_1-h_0} \cdot \frac{1+r_{t+1,0\to h_1}}{1+r_{t,0\to h_1}} - \frac{h_0}{h_1-h_0} \cdot \frac{1+r_{t+1,0\to h_0}}{1+r_{t,0\to h_0}}$ where $r_{t+1,0\to h_1}$is the yield-to-maturity of 3-year Treasury Bond. These are the nominal yield rate, without further adjustment of inflation protection. Similar calculation is used for the yield rate from 5 years to 10 years.

[27]The period is short, the risk adjustment $\triangle r_t$ in the future contract has small variation $E_t[M_{t+1} \cdot E_{t+1}[S_{t+2}]] \approx \frac{E_t[S_{t+2}]}{1+r_t^f+\triangle r_t}$. When the reported transaction price of 2-month future contract $F_{t,0\to 2} = E_t[S_{t+2}]$ is not reported, the transaction price is linear interpolation of other future contracts with nearby tenor.

[28]For a commodity that generates sizable impact over the financial wealth of intangible capital and that of physical capital, there are requirements for its economic impact. For other raw material contracts in energy commodity {"Brent Crude Oil", "WTI Crude Oil"}, correlations are similar. The "Light Crude Oil" traded in NYMEX demonstrates different fluctuation. The relative return of capitals has weak negative correlation with other non-precious metal contracts {"Aluminium","Steel Rebar","Zinc"}. Correlation with other agricultural contracts{"Oats","Soybean", "Wheat" } has large standard error. In the rolling-window of 36-month estimation addresses the concern of outlier periods of extreme market condition and time-varying volatility of commodity prices. The yield rate, energy price and copper price almost maintain the same sign of correlation coefficient. Correlation of corn price is smaller in the subsample around 2016.

the wealth of physical capital, helps describe the stochastic discount factor accurately. Table 13 uses Fama-Macbeth two-step regression to examine whether the relative return of capitals describes systematic risk priced in global equity portfolios.

Firms participate in the global supply chain and financial markets are integrated, we include the equity market index of the United States (U.S. market factor) for describing the systematic risk. The excess return of financial assets is in dollar amount. This time series captures the fluctuation of financial wealth of U.S. investor[29]. Appendix Table 31 describes the correlation of the two risk factors. We use the spread return of portfolio of high book share of capital versus that of low share, as the alternative measure of relative return of capitals. The two time series have high correlation. We construct portfolios that diversify the country-specific shock in each region of Asia, North America, Europe, and the Rest of World. Within each region, firms are sorted into 10 portfolios based on the most recent available book share of intangible capital in firm valuation. Appendix Table 30 describes the portfolios.

The correlations to U.S. market factor and the relative return of capitals summarize the variation of risk premium in portfolios of different countries and industries. Column (1) in Table 13 estimates the benchmark asset pricing model. The first step of Fama-Macbeth regression calculates the risk exposures to the two risk factors for each portfolio. For each testing asset k, risk exposure $\overrightarrow{\beta_k}$ is estimated from the time-series regression of the form $r^e_{k,t} = a + \overrightarrow{f_t} \times \overrightarrow{\beta_k} + \nu_k$. In the second step, the risk premium $\overrightarrow{\lambda}$ is estimated from cross-section regression: $E[r^e_{k,t+1}] = \lambda_0 + \overrightarrow{\lambda} \times \overrightarrow{\beta_k} + \nu_k$ where $\overrightarrow{\beta_k}$ is estimated in the first-step time-series regression. For each testing asset k, $E[r^e_{k,t+1}]$ is the sample average excess return. Across the 40 global equity portfolios, correlations to the relative return of capitals β_{intan} and the U.S. market factor β_{mkt} explain the expected return $E[r^e_{k,t+1}]$. When the portfolio has additional 1 unit of risk exposure, the expected return will be larger by $\widehat{\lambda_{intan}} = 7.439\%$ annually. The Mean Absolute Error (MAE) of cross-section regression is $\frac{1}{K}\sum_k |E[r^e_{k,t+1}] - \widehat{E[r^e_{k,t+1}]}|$ where $\widehat{E[r^e_{k,t+1}]} = \widehat{\lambda}_0 + \widehat{\lambda_{intan}} \times \beta_{intan} + \widehat{\lambda_{mkt}} \times \beta_{mkt}$. Estimation has MAE as 1.853%[30].

Columns (2)-(5) in Table 13 examine asset pricing models with multiple risk factors. The risk

[29]The market factor using all the equity assets around the globe has high similarity with the U.S. market factor.

[30]In Panel (A) of Table 32, we observe much larger MAE when the relative return of capitals is omitted in the benchmark asset pricing model. Panel (B) of Table 32 reports the estimation of alternative asset pricing model, where the alternative measure of relative return of capitals uses the recent book share to group firms into portfolios. In Panel (B), point estimate of risk premium $\widehat{\lambda}_{intan-book}$ is 8.124% annually, but the pricing error is slightly larger. Risk premium of the market factor has inaccurate point estimate.

premium in the relative return of capitals maintains the similar point estimate. Relative return of capitals reflects aggregate shocks that are not described by risk factors in existing asset pricing model. U.S. financial institution is influential in the global financial market. Table 12 shows realized return of intangible capital versus physical capital tends to be larger when the U.S. financial sector has high market leverage. Column (2) reports the estimation outcome when the asset pricing model includes the equity-capital ratio of financial intermediary. The risk premium in the relative return of capitals has point estimate $\widehat{\lambda_{intan}} = 7.594\%$. Point estimate for the financial intermediary equity-capital ratio is inaccurate. Estimation of Column (3) introduces the size factor, profitability factor and other traded factors in Fama-French 6-factor model. The point estimate of $\widehat{\lambda_{intan}}$ is slightly smaller, after considering the joint covariation with other traded factors. MAE decreases to 1.730%. Compared with the simple asset pricing model of two risk factors, decrease of pricing error is small. Asset pricing model of Column (4) includes the traded factors in the Q-5 factor model. The risk premium in the relative return of capitals maintains the positive point estimate. Pricing error decreases, but in small magnitude. This observation echoes the findings in Table 26[31], the U.S. market factor and the relative return of capitals attain the high Sharpe ratio comparable with the Fama-French 6 factor model and the Q-5 factor model, and there is small improvement when including more traded factors. The two time-series of risk factors summarize the main component of systematic risk priced in global equity portfolios.

(Lewellen,Nagel, 2009) doubts that the Fama-Macbeth two-step regression might be an invalid test for an asset pricing model, when the testing assets have strong linear correlation in returns. When using the testing assets of industry portfolios, we observe similar point estimate and small pricing error. Columns (1)-(5) in Table 39 use industry portfolios in Asia, Europe and North America and FTSE sector indices to estimate the multi-factor asset pricing models. Comparing

[31] Appendix Table 27 investigates whether the unique component of systematic risk contained in the relative return of capitals increases the risk premium of existing asset pricing models. We calculate the maximum squared Sharpe ratio obtainable from factors in the multi-factor models, as in (Barillas and Shanken, 2017; Barillas et al., 2020; Gulen et al., 2022). Panel (A) reports the outcome of existing models, U.S. market factor has Sharpe ratio 0.303. In Column (4), the Q-5 factor model has Sharpe ratio of 0.463. Panel (B) reports the outcome of the new asset pricing model with the relative return of capitals. An asset pricing model has small gain of risk premium from adding another risk factor when it is redundant (a linear combination of other factors) or with a high amount of idiosyncratic noise. The two-factor model of U.S. market factor and the relative return of capitals, attains the high Sharpe ratio as 0.472. This is comparable to the Sharpe ratio of existing Q-5 factor model, with estimated value 0.463 in Column (4) of Panel (A). Alternative asset pricing model with other traded factors are reported in Columns (3)-(5). The minimal combination of U.S. market factor and the relative return of capitals already explains a considerable fraction of systematic risk.

to the estimation in Table 13, point estimate of risk premium in relative return of capitals is quantitatively similar, in different specification of multi-factor models[32]. These observations are consistent with the fact that there are aggregate shocks uniquely described by relative return of capitals. The alternative measure of relative return of capitals is constructed by firm-level book share of intangible capital. The estimation outcome in industry portfolios are qualitatively similar.

Intangible capital constitutes a considerable fraction of financial wealth owned by investors. Valuation of intangible capital has different fluctuation from that of physical capital. Table 29 documents the relative return of capitals has common variation with primitive shocks of yield rate and commodity price. Compared with estimation using specific time series of shock, relative return of capitals summarizes these aggregate shocks. Appendix Table 37 examines the risk premia for the yield rate and the commodity price shock. Estimation includes the market portfolio for describing the systematic risk. Column (1) reports the estimation for the short-term yield rate. Pricing error in cross-section regression is large, indicating the omitted component of systematic risk. Column (5) reports the estimation for the copper price shock. MAE is 2.007%, comparable with the estimation of benchmark asset pricing model in Table 13. Point estimate of risk premium is -39.233% with small standard error. The magnitude of risk premium is large due to the high volatility in the copper price. In Columns (3)-(4), risk premium for the corn price and energy price shocks have negative point estimate. The magnitude of risk premium is large for the similar reason. Panel (B) reports estimation using industry portfolios as the testing assets. Risk premium of commodity price is negative. Table 38 examines asset pricing model that includes the relative return of capitals, and primitive shocks that contribute to its variation. Specific non-traded risk factor of primitive shock is incomplete description of systematic risk. The relative return of capitals conveys other primitive shocks. Point estimate of risk premium in the relative return of capitals is similar with the estimation of benchmark asset pricing model in Table 13. Relative return of capitals and market portfolio are sufficient statistics for fluctuation in financial wealth, describe the principal component of systematic risk.

[32]Estimation of multi-factor asset pricing models with high-dimension has strong requirement for the variation in risk exposure across testing assets. In Column (3) of Fama-French 6 factor model, risk premium of size factor has large positive point estimate, different from the estimation in Table 13. Point estimate of risk premium of other traded factors has large standard error. In Column (4) of Q-factor model, risk premium of profit factor has larger standard error, compared to the estimation using testing assets of capital composition.

6.3.3 Propagation of Aggregate Shocks

There are multiple explanations for where the aggregate shocks origin in the global economy. The amount of risk premium in relative return of capitals is more consistent with the input demand change from the production technology improvement in downstream industries. Common fluctuation in price of raw material, output product and valuation of physical capital reflect this short-run aggregate shock. The larger risk premium of intangible capital is from its risk exposure to aggregate shocks of small volatility and high price of risk. Aggregate shocks are of different price of risk and volatility. Price of risk, rather than the quantity of risk, explains the larger risk premium related to intangible capital.

The common fluctuation in relative return of capitals and commodity price reflect the production demand of industries. Across industries, intangible capital and physical capital used in production have different compositions. When the productivity of physical capital grows faster than that of intangible capital, we observe the price decreases more in the industries using more physical capital. Table 40 uses the OLS regression to verify there is asymmetric covariation with relative return of capitals in producer price change. We use the following regression to describe the fluctuation of producer price change across industries:

$$p_{i,t} = \beta_{\overline{\mu}\cdot intan} \times \overline{\mu}^{I}_{i,t-1} \times r_{Intan-Phy,t} + \beta_{\overline{\mu}\cdot mkt} \times \overline{\mu}^{I}_{i,t-1} \times r_{mkt-US,t} + \beta_{\overline{\mu}} \times \overline{\mu}^{I}_{i,t-1} + a_{c,t} + a_i + e_{i,t+1}.$$

where $p_{i,t}$ is the change of producer price index harmonized in U.S. dollar. The $\overline{\mu}_{I,i}$ is the ratio between the amount of intangible capital versus the total amount of intangible capital and physical capital. We use 13 NACE-R2 industries in 12 countries of European Union with available industry level information from EU-KLEMS capital accounts. This estimation is for the production outcome, so the adjustment of corporate tax benefit is not included here. At the industry-level, we include the knowledge capital (R&D), brand capital (advertising) for the intangible capital[33]. The physical capital uses the definition of PPENT in preceding firm-level estimation. The $r_{Intan-Phy,t}$ is the realized relative return of capitals in the same month. Market portfolio is important for describing the systematic risk. Estimation include the interacted term with market factor. The country and time fixed effect $a_{c,t}$ describes the country-level business cycle and the exchange rate change. The

[33] EU-KLEMS calculates the intangible capital of different types using historical R&D expense, Advertising expense, Vocational Training expense, etc.

industry fixed effect a_i describes the industry-specific long-run growth. Estimation rejects the null hypothesis of $H_0 : \beta_{\overline{\mu}\cdot intan} = 0$. The slope coefficient of interacted term $\beta_{\overline{\mu}\cdot intan}$ is positive, and the standard error is small. Across industries with high book share of physical capital, producer price change has relatively larger negative correlation to relative return of capitals. These are typically industries of the petroleum products and metal products. The industries of pharmaceutical products demonstrate inert price change.

There is common fluctuation in raw material price, product price, and valuation of intangible capital versus physical capital. For producers, improvement in downstream productivity efficiency leads to the decline in prices of raw material and product price. Aggregate productivity shocks specific to physical capital input are more volatile than that of intangible capital. Treasury yield rates reflect the expectation of aggregate production output in the near future. The interplay between the discount rate and the economy production further amplifies the fluctuation of firm valuation to these fundamental shocks in production technology. Formal structural asset pricing models in further research, can provide more accurate quantitative explanation.

7 Conclusion

We incorporate intangible capital into the neoclassical model of investment and estimate its contribution of each input for explaining firm market values across 77 countries between 2006 and 2020. For the major markets, where we estimate country specific parameters, the model performs well in explaining both the time-series and the cross-sectional variation of the valuation ratios across portfolios, with an cross country average time-series R^2 of 33% and a cross-sectional R^2 of 69%. For the region estimation, the model also has good explanatory power, with an cross-region average time-series R^2 of 44% and a cross-sectional R^2 of 68%.

We find that the importance of the intangible capital for firm value varies across countries and regions and is substantial, ranging from 33.41% to 63.56% . We show that financial markets assign large and positive values to the installed stocks of the capital inputs because they are costly to adjust, thus firm valuation contains the compensation for the cost of adjusting the inputs. The adjustment cost of intangible capital is higher than that of physical capital. When quantifying the market environment for accumulating intangible capital for each country/region, we observe dispersed point estimates of adjustment cost parameters. In countries with weaker protection in intellectual property, the adjustment cost parameter of intangible capital is relatively larger, valuation of intangible capital is relatively higher.

We observe the risk premium of intangible capital is relatively larger than that of physical capital, across firms in different countries. Intangible capital constitutes a considerable fraction of financial wealth owned by investors. The relative return of intangible capital to physical capital, separates the fluctuation of wealth in intangible capital versus the wealth of physical capital, helps describe the systematic risk.

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A Tables

Table 1: Descriptive Statistics for Countries

The table below reports the snapshot of selected statistics of listed corporations and selected national statistics in the economy, in the year 2020. **Sample** is the start year where the analysis is performed for each country, the end year is 2020 for all countries. **Firms** counts the average number of listed firms with qualified financial reports. $\frac{Y}{GDP}$ reports the ratio of total output produced by firms, over the GDP of home-country, in the unit of percentage. $\frac{VA}{GDP}$ reports the ratio of total value-added (COGS-SALES) by firms, over the GDP of home-country, in the unit of percentage. **Per capita** reports the GDP per capita of firms' home-country, in the unit of dollars in constant price of year 2015. All national statistics comes from the UN-stat. All statistics of listed corporations are calculated by authors. **Total** summarizes the statistics for listed corporations locating in countries listed as a share of all 200 countries in the UN-Stat.

	Start	Firms	$\frac{Y}{GDP}$ (%)	$\frac{VA}{GDP}$ (%)	Per Capita (USD)
	(1)	(2)	(3)	(4)	(5)
Australia	2004	354	17.49	6.73	53244
Canada	2000	342	27.79	8.35	42391
China	2001	1371	20.06	4.60	10166
France	2007	285	48.22	18.98	35700
Germany	2006	283	38.50	13.13	40992
Hong Kong	2002	517	145.36	43.37	41715
India	2001	1055	19.83	7.74	1849
Indonesia	2000	220	13.96	4.07	3757
Israel	2008	158	25.12	8.82	39912
Japan	2000	1556	92.14	27.15	34637
Malaysia	2002	483	36.76	10.12	10617
Poland	2007	224	11.74	2.94	14681
Singapore	2002	284	51.14	10.58	56423
South Korea	2000	419	63.75	17.76	31674
Taiwan	2001	976	-	-	-
Thailand	2000	310	40.39	10.08	6199
UK	2000	523	32.10	11.18	42455
USA	2000	2002	40.66	14.68	58148
Total		13698	28.23	9.02	

Table 2: Descriptive Statistics for Regions

The table below reports the snapshot of selected statistics of listed corporations and selected national statistics in each region, in the year 2020. **Sample** is

the start year where the analysis is performed for each country, the end year is 2020 for all countries. **Firms** counts the average number of listed firms with qualified financial reports, we aggregate across countries. $\frac{Y}{GDP}$ reports the ratio of total output produced by firms, over the GDP of home-country, in the unit of percentage. $\frac{VA}{GDP}$ reports the ratio of total value-added (SALES- COGS) by firms, over the GDP of home-country, in the unit of percentage. **Per capita** reports the GDP per capita of firms' home-country, in the unit of dollars in constant price of year 2015. For those macro variables, we calculate each country individually and average across countries. All national statistics comes from the UN-stat. All statistics of listed corporations are calculated by authors. **Total** summarizes the statistics for listed corporations locating in countries listed, including the ones from Table 1.

	Start (1)	Firms (2)	$\frac{Y}{GDP}$ (%) (3)	$\frac{VA}{GDP}$ (%) (4)	Per Capita (USD) (5)	Countries (6)
Southern Asia	2006	321	8.71	2.32	2420	Bangladesh, Sri Lanka, Pakistan
South-eastern Asia	2000	163	13.62	4.03	2963	Philippines, Viet Nam
Western Asia	2004	439	14.28	4.56	21548	United Arab Emirates, Bahrain, Cyprus Jordan, Kuwait, Oman, Palestine, Qatar, Saudi Arabia, Turkey
Eastern Europe	2009	167	13.38	5.05	9041	Bulgaria, Hungary, Romania, Russia, Ukraine
Northern Europe	2000	370	28.52	10.63	46491	Denmark, Estonia, Finland, Ireland, Iceland, Lithuania, Latvia, Norway, Sweden
Southern Europe	2004	362	15.35	4.88	20506	Spain, Greece, Croatia, Italy, Malta, Serbia, Slovenia
Western Europe	2002	251	73.39	24.00	64281	Austria, Belgium, Switzerland, Luxembourg Netherlands, Portugal
Africa	2006	260	13.24	4.30	3374	Cote Divoire, Ghana, Kenya, Mauritius, Morocco, Nigeria,
L.America and the Carib.	2000	355	47.07	11.79	18182	Argentina, Brazil, Chile, Colombia, Cayman Islands, Jamaica, Mexico, Peru
Total		17024	34.10	11.19		All countries

Table 3: Descriptive Firm Statistics for Countries

This table reports the median and standard-deviation of firm-level selected characteristics across all firms in the each country. Data is winsorized with [2%,98%]. Firm valuation is Q. Installed physical capital is $K^P$with investment flow equal to I^P. Installed intangible capital is $K^I$with investment flow equal to I^I.

		$\frac{Q}{K^I+K^P}$ (1)	$\frac{I^P}{K^P}$ (2)	$\frac{I^I}{K^I}$ (3)	$\frac{K^I}{K^I+K^P}$ (4)	$\rho(\frac{I^P}{K^P}, \frac{I^I}{K^I})$ (5)
Australia	Median	1.58	0.22	0.31	0.37	0.30
	Std.	3.19	0.94	0.28	0.30	
Canada	Median	1.56	0.19	0.28	0.20	0.38
	Std.	2.05	0.45	0.18	0.29	
China	Median	2.94	0.16	0.32	0.20	0.35
	Std.	3.85	0.32	0.15	0.19	
France	Median	1.35	0.23	0.24	0.67	0.25
	Std.	2.12	0.39	0.11	0.24	
Germany	Median	1.43	0.21	0.24	0.58	0.26
	Std.	2.42	0.36	0.14	0.23	
Hong Kong	Median	1.38	0.17	0.28	0.41	0.18
	Std.	3.25	0.74	0.15	0.27	
India	Median	1.46	0.03	0.19	0.33	0.36
	Std.	2.67	0.32	0.16	0.21	
Indonesia	Median	1.32	0.08	0.21	0.26	0.28
	Std.	2.46	0.33	0.12	0.23	
Israel	Median	1.55	0.21	0.25	0.53	0.17
	Std.	2.33	0.61	0.09	0.25	
Japan	Median	0.84	0.13	0.22	0.46	0.42
	Std.	0.77	0.16	0.05	0.21	
Malaysia	Median	1.24	0.08	0.24	0.26	0.20
	Std.	1.88	0.30	0.12	0.19	
Poland	Median	1.15	0.11	0.25	0.38	0.37
	Std.	1.44	0.23	0.13	0.22	
Singapore	Median	1.21	0.16	0.28	0.38	0.23
	Std.	2.07	0.57	0.15	0.25	
South Korea	Median	1.02	0.11	0.25	0.26	0.31
	Std.	1.03	0.20	0.09	0.20	
Taiwan	Median	1.70	0.13	0.24	0.28	0.28
	Std.	2.16	0.29	0.09	0.20	
Thailand	Median	1.54	0.14	0.24	0.28	0.21
	Std.	1.75	0.33	0.09	0.21	
UK	Median	1.50	0.21	0.25	0.60	0.28
	Std.	2.66	0.43	0.15	0.28	
USA	Median	2.05	0.24	0.26	0.62	0.34
	Std.	2.90	0.40	0.12	0.28	
Summary of Median and Correlation						
	Median	1.44	0.16	0.25	0.38	0.28
	Average	1.49	0.16	0.25	0.39	0.29
	S.E.	0.44	0.06	0.03	0.15	0.07

Table 4: Descriptive Firm Statistics for Regions

This table reports the median and standard-deviation of firm-level selected characteristics across all firms in the each regions. Data is winsorized with [2%,98%]. Firm valuation is Q. Installed physical capital is K^P with investment flow equal to I^P. Installed intangible capital is K^I with investment flow equal to I^I.

		$\frac{Q}{K^I+K^P}$ (1)	$\frac{I^P}{K^P}$ (2)	$\frac{I^I}{K^I}$ (3)	$\frac{K^I}{K^I+K^P}$ (4)	$\rho(\frac{I^P}{K^P}, \frac{I^I}{K^I})$ (5)
Southern Asia	Median	1.22	0.03	0.20	0.19	0.17
	Std.	1.73	0.28	0.09	0.18	
South-eastern Asia	Median	1.66	0.11	0.24	0.30	0.19
	Std.	2.70	0.51	0.13	0.22	
Western Asia	Median	1.66	0.06	0.20	0.26	0.23
	Std.	2.86	0.43	0.12	0.22	
Eastern Europe	Median	0.93	0.04	0.18	0.31	0.24
	Std.	1.37	0.22	0.11	0.21	
Northern Europe	Median	1.68	0.22	0.25	0.56	0.27
	Std.	3.24	0.47	0.16	0.27	
Southern Europe	Median	1.24	0.11	0.22	0.38	0.23
	Std.	2.32	0.34	0.14	0.24	
Western Europe	Median	1.55	0.21	0.25	0.53	0.23
	Std.	3.10	0.33	0.13	0.24	
Africa	Median	1.45	0.08	0.20	0.41	0.27
	Std.	2.02	0.23	0.13	0.24	
L.Amer. & Carib.	Median	1.07	0.08	0.20	0.33	0.31
	Std.	1.58	0.46	0.11	0.24	
Summary of Median and Correlation						
	Median	1.45	0.08	0.20	0.33	0.23
	Average	1.38	0.10	0.22	0.36	0.24
	S.E.	0.26	0.06	0.02	0.11	0.04

Table 5: Parameter Estimates and Model Fit

This table reports the parameter estimates and measures of fit for the baseline model specification. The estimation uses 20 portfolios sorted based on proxies of the lagged values of the inputs (10 portfolios for each input). θ_P and θ_I are, respectively, the physical capital and intangible capital adjustment cost parameters. s.e. stands for Newey-West standard errors with three lags. $XS-R^2$ is the cross-sectional R^2, $TS-R^2$ is the time-series R^2, and $m.a.e./\overline{VR}$ is the mean absolute valuation error scaled by the absolute value of the ratio. Column (3) reports the sample that the model fit is calculated for. We calculate model fit for both the entire sample used for estimation and to allow for cross country comparison the 2006-2020 sample for which most of the countries have data. In columns (6) to (8) we calculate the implied model fit using, for all countries, the parameters estimated for the USA.

		Point Estimate		Model Fit			Using US Parameters		
		θ_P	θ_I	XS-R^2	TS-R^2	$m.a.e./\overline{VR}$	XS-R^2	TS-R^2	$m.a.e./\overline{VR}$
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Australia		2.87	11.06	0.63	0.37	0.21	-4.49	-3.05	0.50
	s.e.	(0.46)	(0.87)						
Canada		3.76	11.44	0.88	0.51	0.18	-3.13	-2.23	0.50
	s.e.	(0.27)	(0.77)						
China		4.72	30.77	0.20	-0.03	0.23	-0.50	-0.50	0.29
	s.e.	(0.92)	(3.31)						
France		6.56	7.06	0.74	0.20	0.20	-5.53	-3.50	0.52
	s.e.	(0.87)	(0.72)						
Germany		6.21	8.41	0.77	0.26	0.23	-1.81	-1.27	0.46
	s.e.	(1.26)	(1.30)						
Hong Kong		2.43	7.24	0.73	0.33	0.21	-13.87	-7.75	0.84
	s.e.	(0.39)	(0.72)						
India		4.76	19.16	0.78	0.14	0.25	0.85	-0.04	0.27
	s.e.	(0.52)	(1.26)						
Indonesia		5.74	12.99	0.85	0.51	0.18	0.68	0.34	0.20
	s.e.	(0.72)	(1.58)						
Israel		3.20	9.11	0.48	0.18	0.21	-9.73	-4.87	0.58
	s.e.	(0.41)	(0.71)						

Table continued in next page.

Table 5: Parameter Estimates and Model Fit

This table reports the parameter estimates and measures of fit for the baseline model specification. The estimation uses 20 portfolios sorted based on proxies of the lagged values of the inputs (10 portfolios for each input). θ_P and θ_I are, respectively, the physical capital and intangible capital adjustment cost parameters. s.e. stands for Newey-West standard errors with three lags. $XS - R^2$ is the cross-sectional R^2, $TS - R^2$ is the time-series R^2, and $m.a.e./\overline{VR}$ is the mean absolute valuation error scaled by the absolute value of the ratio. Column (3) reports the sample that the model fit is calculated for. We calculate model fit for both the entire sample used for estimation and to allow for cross country comparison the 2006-2020 sample for which most of the countries have data. In columns (6) to (8) we calculate the implied model fit using, for all countries, the parameters estimated for the USA.

		Point Estimate		Model Fit			Using US Parameters		
		θ_P	θ_I	XS-R^2	TS-R^2	$m.a.e./\overline{VR}$	XS-R^2	TS-R^2	$m.a.e./\overline{VR}$
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Japan		0.86	2.42	0.20	0.11	0.16	-132.64	-46.73	1.36
	s.e.	(0.49)	(0.41)						
Malaysia		2.85	11.72	0.73	0.25	0.16	-3.76	-2.90	0.39
	s.e.	(0.65)	(1.21)						
Poland		3.37	4.42	0.79	0.48	0.15	-38.14	-12.37	0.93
	s.e.	(0.47)	(0.37)						
Singapore		2.00	6.76	0.74	0.38	0.17	-43.75	-14.90	1.01
	s.e.	(0.35)	(0.53)						
South Korea		1.76	3.73	0.57	0.41	0.10	-61.29	-30.99	0.88
	s.e.	(0.34)	(0.55)						
Taiwan		4.87	13.98	0.85	0.34	0.13	-1.66	-1.35	0.25
	s.e.	(0.38)	(0.80)						
Thailand		4.49	10.28	0.78	0.33	0.20	-3.34	-0.86	0.34
	s.e.	(0.67)	(1.38)						
UK		6.24	8.47	0.84	0.56	0.17	-1.46	-0.75	0.36
	s.e.	(0.62)	(0.75)						
USA		8.59	15.69	0.89	0.69	0.15	0.89	0.69	0.15
	s.e.	(0.77)	(0.81)						
Summary of Point Estimation, Model Fitness									
	Average	4.18	10.82	0.69	0.33	0.18	-17.93	-7.39	0.55
	S.E.	1.93	6.36	0.20	0.17	0.04	32.76	12.16	0.32

Table 6: Parameter Estimates and Model Fit

This table reports the parameter estimates and measures of fit for the baseline model specification. The estimation uses 20 portfolios sorted based on proxies of the lagged values of the inputs (10 portfolios for each input). θ_P and θ_I are, respectively, the physical capital and intangible capital adjustment cost parameters. s.e. stands for Newey-West standard errors with three lags. $XS - R^2$ is the cross-sectional R^2, $TS - R^2$ is the time-series R^2, and $m.a.e./\overline{VR}$ is the mean absolute valuation error scaled by the absolute value of the ratio. The results are reported for the sample of all firms. Column (3) reports the sample that the model fit is calculated for. We calculate model fit for both the entire sample used for estimation and to allow for cross country comparison the 2006-2020 sample for which most of the countries have data.

		Point Estimate		Model Fit			Using US Parameters		
		θ_P	θ_I	XS-R^2	TS-R^2	$m.a.e./\overline{VR}$	XS-R^2	TS-R^2	$m.a.e./\overline{VR}$
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Southern Asia		4.31	18.22	0.94	0.75	0.12	0.80	0.60	0.15
	s.e.	(0.54)	(1.10)						
South-eastern Asia		4.20	12.03	0.67	0.32	0.18	-0.88	-0.62	0.29
	s.e.	(1.00)	(1.70)						
Western Asia		7.39	16.68	0.20	0.21	0.18	0.07	0.15	0.19
	s.e.	(1.07)	(2.17)						
Eastern Europe		1.00	4.52	0.51	0.18	0.17	-27.92	-9.87	0.75
	s.e.	(0.31)	(0.44)						
Northern Europe		4.45	11.21	0.82	0.49	0.21	-0.81	-0.52	0.36
	s.e.	(0.63)	(0.72)						
Southern Europe		3.77	10.74	0.76	0.56	0.20	-0.55	-0.34	0.37
	s.e.	(0.69)	(1.00)						
Western Europe		6.13	10.24	0.66	0.29	0.23	-1.23	-0.68	0.35
	s.e.	(0.95)	(1.26)						
Africa		9.47	11.23	0.72	0.50	0.16	-0.57	0.25	0.20
	s.e.	(1.12)	(0.98)						
L.Amer. & Carib.		2.76	7.96	0.86	0.62	0.13	-5.34	-4.32	0.56
	s.e.	(0.43)	(1.01)						
Summary of Point Estimation, Model Fitness									
	Average	4.83	11.43	0.68	0.44	0.18	-4.05	-1.71	0.36
	S.E.	2.37	3.88	0.21	0.18	0.03	8.59	3.19	0.18

Table 7: Counter-Factual Accounting: Single Capital

Table 7 compares the baseline estimation outcome and the counter-factual outcome where we assume the intangible capital plays no role in the production function nor the adjustment cost function. The point estimate of adjustment cost coefficient in the physical capital, and the statistics of model fit are reported.

	Point Estimate		Model Fit			Cost
	θ_P	[std]	XS-R^2	TS-R^2	$m.a.e./\overline{VR}$	c_P (% sales)
	(1)	(2)	(3)	(4)	(5)	(6)
Australia	7.96	0.75	-1.81	-1.32	0.41	12.97
Canada	8.08	0.56	-1.28	-1.11	0.38	8.52
China	16.80	0.89	-1.90	-1.63	0.39	6.95
France	17.43	1.12	-1.03	-1.61	0.38	14.12
Germany	16.55	0.99	-0.14	-0.57	0.33	12.54
Hong Kong	8.03	0.46	-0.23	-0.72	0.33	4.59
India	13.46	1.06	-2.24	-1.76	0.50	2.61
Indonesia	13.93	0.82	-0.33	-0.38	0.29	3.32
Israel	10.05	0.70	-2.11	-2.22	0.43	13.71
Japan	7.28	0.50	-3.08	-2.25	0.30	2.93
Malaysia	11.98	0.53	0.18	-1.07	0.28	3.89
Poland	10.29	0.57	-1.55	-0.92	0.30	2.92
Singapore	7.41	0.35	-0.15	-0.61	0.29	3.87
South Korea	6.56	0.40	-3.29	-1.94	0.21	1.69
Taiwan	13.37	0.54	-1.61	-1.94	0.28	5.57
Thailand	11.39	0.56	-1.02	-0.45	0.28	5.55
UK	16.66	0.91	-1.09	-0.82	0.36	12.83
USA	25.53	1.38	-1.18	-0.73	0.36	23.12
Summary of Point Estimation, Model Fitness, Adjustment Cost						
Average	12.38		-1.33	-1.23	0.34	7.87
S.E.	4.78		0.96	0.60	0.07	5.62

Table 8: Counter-Factual Accounting: Single Capital

Table 7 compares the baseline estimation outcome and the counter-factual outcome where we assume the intangible capital plays no role in the production function nor the adjustment cost function.

	Point Estimate		Model Fit			Cost
	θ_P	[std]	XS-R^2	TS-R^2	$m.a.e./\overline{VR}$	c_P (% sales)
	(1)	(2)	(3)	(4)	(5)	(6)
Southern Asia	15.07	1.04	-0.01	-0.33	0.27	3.98
South-eastern Asia	9.54	0.99	-0.72	-0.71	0.32	3.08
Western Asia	17.10	0.83	-1.38	-0.83	0.30	7.88
Eastern Europe	5.37	0.79	-6.08	-2.32	0.36	1.69
Northern Europe	15.60	1.12	-0.97	-0.92	0.40	14.17
Southern Europe	11.32	0.76	-0.48	-0.34	0.34	5.96
Western Europe	16.95	1.00	-0.65	-0.62	0.33	11.17
Africa	25.81	1.58	-4.11	-1.05	0.35	7.92
L.Amer. & Carib.	8.39	0.47	-0.19	-0.73	0.29	2.79
Summary of Point Estimation, Model Fitness, Adjustment Cost						
Average	13.91		-1.62	-0.87	0.33	6.52
S.E.	5.72		1.95	0.56	0.04	3.94

Table 9: Capital Accounting: Share of Intangible

This table reports the contribution of intangible capital in the firm valuation. The intangible share reports the share computed as the median of share across firm-portfolios. Both the statistics of share are calculated as the time-series average during the year 2016-2020 for which the sample is available for all countries.

	Market Share	Adjustment Cost		Book Share
	μ_I	c_I (% sales)	c_P (% sales)	$\overline{\mu}_I$
	(1)	(2)	(3)	(4)
Australia	54.30	9.05	4.67	33.47
Canada	34.45	5.00	3.96	16.99
China	61.73	17.03	1.95	21.02
France	59.42	7.01	5.32	57.01
Germany	55.48	6.16	4.71	48.70
Hong Kong	59.24	4.51	1.39	44.34
India	53.96	3.72	0.92	27.12
Indonesia	38.49	4.51	1.37	18.95
Israel	58.57	5.04	4.36	44.60
Japan	46.20	1.38	0.35	38.52
Malaysia	46.07	4.60	0.92	24.02
Poland	45.73	2.43	0.96	34.78
Singapore	51.66	3.31	1.05	36.63
South Korea	33.41	1.70	0.45	22.78
Taiwan	48.13	5.40	2.03	26.88
Thailand	39.84	5.38	2.18	23.56
UK	61.57	6.38	4.80	56.16
USA	63.56	12.13	7.78	51.81
Summary of Market Share, Adjustment Cost, Book Share				
Average	50.66	5.82	2.73	34.85
S.E.	9.33	3.68	2.07	12.70

Table 10: Capital Accounting: Share of Intangible per Region

This table reports the contribution of intangible capital in the firm valuation. The intangible share reports the share computed as the median of share across firm-portfolios. Both the statistics of share are calculated as the time-series average during the year 2016-2020 for which the sample is available for all countries.

	Market Share	Adjustment Cost		Book Share
	μ_I	c_I (% sales)	c_P (% sales)	$\overline{\mu}_I$
	(1)	(2)	(3)	(4)
Southern Asia	38.80	4.31	1.14	13.27
South-eastern Asia	43.71	4.18	1.36	23.47
Western Asia	47.78	4.64	3.41	24.86
Eastern Europe	42.20	1.61	0.32	30.32
Northern Europe	66.12	7.74	4.04	54.79
Southern Europe	52.80	6.07	1.98	34.64
Western Europe	56.23	7.30	4.04	45.05
Africa	57.21	3.89	2.90	36.06
L.Amer. & Carib.	47.53	2.95	0.92	30.33
Summary of Market Share, Adjustment Cost, Book Share				
Average	50.26	4.74	2.23	32.53
S.E.	8.13	1.87	1.32	11.50

Table 11: Firm-level Return Predictability

The table below reports the estimation results from stock return predicatability regressions of the form: $r^e_{i,t+1} = a + \lambda_\mu \times \mu_{I,i,t} + \overrightarrow{\lambda}'_Z \times \vec{Z}_{i,t} + a_{c(i)} + a_{Ind(i)} + e_{i,t+1}$, in which the $r^e_{i,t+1}$ is the firm-level firms's compounded annual excess stock return in the next fiscal year, $\mu_{I,i,t}$ is the available market share of intangible capital calculated using the parameters from Table 5 and Table 6. The sample is from the year 2009 to 2018 excluding the Great Fnancial Crisis and the Covid period. All the stock returns are harmonized into the USD dollar amount. Calculation of excess return use the 3-month treasury rate of United States as the risk-free rate, in the unit of percentage (%). All predicting variables are winsorized with [2%,98%], by year and country/region in Table 5 and Table 6. Columns (1) reports the time-series average risk premium using the previous equation for each year using the firm-year observation in the sample . The dummy of industry (first 2 digits of SIC code), and the dummy of home-country are included when estimating the risk-premium of market share contributed by intangible capital. In Columns(1)-(2), Newey-West 3 lagged standard error are reported. Time-series average of sample size are reported in the row of **Obs.**. Time-series average of cross-firm R^2 (after adjustment of period-sample size and the dimension of explanatory variables) are reported in the row of **Adj-**R^2. Column (2) includes the set of firm-level variables related with cross-section anomalies**.** Columns (3)-(5) reports the estimation results per major region using the identical specification and methods with Column (1). Columns (3) **Asia** uses the subsample of firms located in China, India, Malaysia, Thailand, Taiwan, Japan, South Korea, Singapore, Hong Kong, Vietnam, Israel, Turkey and countries in Southern Asia, South-eastern Asia, Western Asia; Column (4) **North America** uses the subsample of firms located in North America, with homecountry as Canada or U.S.; Columnd (5) **Europe** uses the subsample of firms located in France, Germany, UK, Poland and countries of Southern Europe, Eastern Europe, Northern Europe, Western Europe. Industry is defined as the first 2 digits of SIC code. The set of variables related with cross-section anomalies are Size, Value, Reversal, Momentum, Idiosyncratic Volatility and Market Beta. The **Size** is the log of equity valuation, after conversion into the USD dollar amount. The **BMratio(log)** is the log of book equity over the market valuation. The **Ret(-1,0)** is the recent monthly return in the month of financial report disclosure. The **Ret(-12,-2)** is the recent 11month accumulated return in the lagged month of financial report disclosure. The **IVoL(log)** is the recent 24-month log idiosyncratic volatility of monthly stock return, using the U.S. CAPM model, updated at the end of fiscal year. The **betaM(-24,0)** is the recent-24-month risk-loading toward the U.S. Equity Market Index , using the United States CAPM model. P-value of t-stat are indicated using * for p<0.10, ** for p<0.05, *** for p<0.010.

	All Countries		Major Regions		
	(1)	(2)	(3) Asia	(4) N.Amer.	(5) Europe
MarketShare	0.077***	0.065***	0.079***	0.074***	0.090***
-Intangible	(0.022)	(0.014)	(0.024)	(0.015)	(0.031)
Anomaly	No	Yes	Yes	Yes	Yes
SIC-2 FE	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Obs.	11872	11872	7633	1489	2027
Adj-R^2	0.190	0.205	0.231	0.105	0.129

Table 12: Time Series Description of Relative Return of Capitals

Table 12 reports the time-series regressions of the form: $r_{Intan-Phy,t} = \alpha + \overrightarrow{f}_t \cdot \overrightarrow{\beta} + e_t$, in which $\overrightarrow{f}$ is vector of traded factors from an asset pricing model. The $r_{Intan-Phy,t}$, the monthly relative return of intangible capital to physical capital in the world. Three portfolios are constructed using most recent market share of intangible capital $\mu_{I,t}$, calculated using the parameters from Table 5 and Table 6. Portfolios are rebalanced monthly, the $r_{k,t}$ is the porfolio of firms with high share of intangible capital, minus the portfolio return of firms with low share using breakpoints {30%,70%}. The intercept α, unexplained average return, and the vector of factor loading $\overrightarrow{\beta}$ are reported for each asset pricing model. The sample is from 2010 January to 2019 December. Standard error with Newey-West 2-period adjustment is reported. Column (1) reports the factor loadings to U.S. market factor. Column (2) reports the factor loadings to the Intermediary-CAPM, the $\beta_{hkm^r}$is the slope coefficient to the value-weighted equity return for the U.S. primary dealer sector (the traded factor in high correlation to equity-capital ratio). Column (3) reports the factor loadings to Fama-French 6 factor model. Column (4) reports the factor loadings to Q-factor model with the Growth Factor. Column (5) reports the factor loadings to traded currency factors. The β_{carry} is the slope coefficient to the carry factor, the portfolio return of currencies with low interest rate minus the portfolio return of currencies with high interest rate. The β_{dollar} is the slope coefficient to the dollar factor, the average bilateral exchange rate (base is the U.S. dollar).

Time-Series Decomposition using Asset Pricing Models										
		CAPM (1)		Intermediary-CAPM (2)		FamaFrench-6 (3)		Q-5 (4)		Currency (5)
	α	6.414 **	α	5.995 **	α	5.066 **	α	4.608 *	α	5.055 **
	(s.e.)	(1.998)	(s.e.)	(2.012)	(s.e.)	(2.104)	(s.e.)	(2.143)	(s.e.)	(1.950)
	β_{mkt}	-0.022	β_{mkt}	0.127 *	β_{mkt}	0.003	β_{mkt}	0.004	β_{carry}	0.088
	(s.e.)	(0.044)	(s.e.)	(0.070)	(s.e.)	(0.049)	(s.e.)	(0.051)	(s.e.)	(0.084)
			β_{hkm}	-0.134 **	β_{smb}	0.035			β_{dollar}	0.203 *
			(s.e.)	(0.046)	(s.e.)	(0.084)			(s.e.)	(0.092)
					β_{hml}	-0.203 *	β_{ME}	0.098		
					(s.e.)	(0.101)	(s.e.)	(0.083)		
					β_{cma}	-0.021	β_{IA}	-0.011		
					(s.e.)	(0.124)	(s.e.)	(0.116)		
					β_{rmw}	0.094	β_{ROE}	0.079		
					(s.e.)	(0.147)	(s.e.)	(0.114)		
					β_{umd}	0.177 **	β_{EG}	0.297 **		
					(s.e.)	(0.058)	(s.e.)	(0.127)		
Obs.		120		120		120		120		120
Adj-R^2		0.003		0.110		0.283		0.146		0.155

Table 13: Risk Premium of Asset Pricing Models

Table 13 reports the risk premium vector $\overrightarrow{\lambda}$ in the cross-section regression of the form: $E[r^e_{k,t+1}] = \lambda_0 + \overrightarrow{\lambda} \times \overrightarrow{\beta_k} + \nu_k$ for different asset pricing models. Asset pricing models in literature are adjusted by including the relative return of capitals, equivalently the benchmark asset pricing model (U.S. market factor and relative return of capitals) and other traded factors. Testing assets are the 40 portfolios in four major regions {Asia, North America, Europe and Rest of World}. In each month, each country/region, firms are classified into 10 decile-portfolios based on the recent book share of intangible capital. For each asset pricing model $\overrightarrow{f}$, in first step, for each testing asset k, risk exposure $\overrightarrow{\beta_k}$ is estimated from the time-series regression of the form $r^e_{k,t} = a_k + \overrightarrow{f_t} \times \overrightarrow{\beta_k} + \nu_k$; in second step, risk premium $\overrightarrow{\lambda}$ is estimated from cross-section regression using average return $E[r^e_{k,t+1}]$ and risk exposure $\overrightarrow{\beta_k}$. Column (1) reports the estimation outcome of benchmark asset pricing model $\overrightarrow{f}^{Bench} = [r_{Intan-Phy}, r^e_{mkt-US}]$, $\lambda_{intan}$is the risk premium of relative return of capitals, λ_{mkt} as the risk premium of U.S. market factor. Column (2) reports the estimation outcome of Intermediary-CAPM after supplementing the relative return of capitals $\overrightarrow{f} = [r_{Intan-Phy}, r^e_{mkt-US}, f_{hkm}]$, λ_{hkm^r} is the risk premium of non-traded factor f_{hkm}, the equity-capital ratio of U.S. intermediary. Column (3) reports the estimation outcome of Fama-French 6 factor model after supplementing the relative return of capitals, equivalently the benchmark asset pricing model with additional five traded factors $\overrightarrow{f} = [\overrightarrow{f}^{Bench}, r_{smb}, r_{hml,} r_{cma}, r_{rmw}, r_{umd}]$. The traded factors are size factor r_{smb}, value factor $r_{hml,}$, asset growth factor r_{cma}, profitability factor r_{rmw} and the momentum factor r_{umd}. Column (4) reports the estimation outcome using traded factors in Q-factor model. Column (5) reports the estimation outcome using currency traded factors. Fitness statistics of cross-section regression and counter-factual estimation are reported. MAE is the mean absolute error of cross-section regression, $\frac{1}{K}\sum_k |E[r^e_{k,t+1}] - \widehat{E[r^e_{k,t+1}]}|$. Other descriptions are identical with Table 32. Simple standard error is reported. Sample is from 2010 January to 2019 December.

Table 13: Risk Premium of Asset Pricing Models

		Other Asset Pricing Models							
	Benchmark (1)		Intermediary-CAPM (2)		FamaFrench-6 (3)		Q-5 (4)		Currency (5)
λ_{intan}	7.439 **	λ_{intan}	7.594 **	λ_{intan}	6.825 **	λ_{intan}	6.506 **	λ_{intan}	8.200 **
(s.e.)	(2.877)	(s.e.)	(2.873)	(s.e.)	(2.552)	(s.e.)	(2.617)	(s.e.)	(2.068)
λ_{mkt}	12.970 *	λ_{mkt}	11.655	λ_{mkt}	12.459 *	λ_{mkt}	1.571	λ_{mkt}	13.908 *
(s.e.)	(8.190)	(s.e.)	(8.322)	(s.e.)	(8.126)	(s.e.)	(9.169)	(s.e.)	(8.351)
		λ_{hkm}	-2.339	λ_{smb}	0.300			λ_{carry}	-0.477
		(s.e.)	(12.437)	(s.e.)	(4.162)			(s.e.)	(5.208)
				λ_{hml}	-4.904	λ_{ME}	4.095	λ_{dollar}	-1.045
				(s.e.)	(4.813)	(s.e.)	(4.014)	(s.e.)	(3.899)
				λ_{cma}	4.054 *	λ_{IA}	-1.325		
				(s.e.)	(2.672)	(s.e.)	(3.623)		
				λ_{rmw}	-3.742	λ_{ROE}	8.932 *		
				(s.e.)	(3.166)	(s.e.)	(4.847)		
				λ_{umd}	9.517	λ_{EG}	2.816		
				(s.e.)	(9.271)	(s.e.)	(3.807)		
λ_0	-0.607	λ_0	0.189	λ_0	-0.495	λ_0	10.235	λ_0	-1.749
(s.e.)	(7.551)	(s.e.)	(7.316)	(s.e.)	(7.046)	(s.e.)	(8.041)	(s.e.)	(8.003)
Statistics of Estimation Fitness									
MAE	1.853		1.798		1.730		1.729		1.882
R^2	0.758		0.770		0.808		0.811		0.761
Statistics of Counter-factual Estimation									
MAE	-		3.651		2.594		2.318		2.544
R^2	-		0.044		0.530		0.624		0.540

B Figures

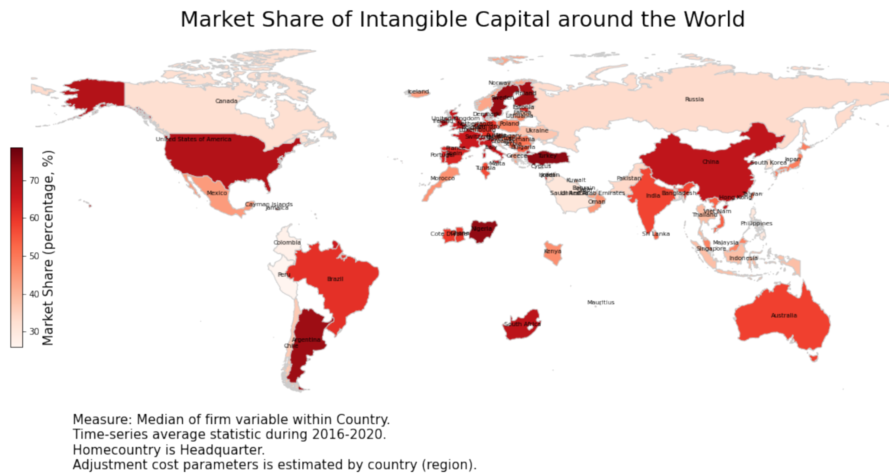


Figure 1: Contribution of Intangible Capital in Firm Value across Globe

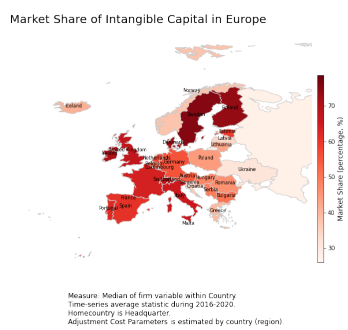


Figure 1: (a) Europe

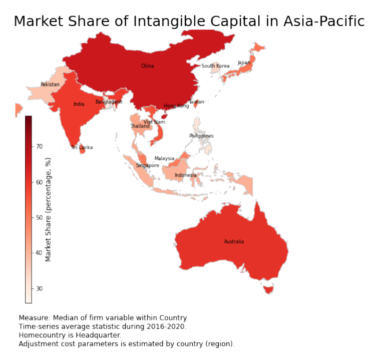


Figure 1: (b) Asia-Pacific

This figure plots the contribution of intangible capital in the firm valuation in individual countries, using the heatmap. The statistics are plotted for countries in Table 9 and Appendix Table 16. The statistic for the contribution of intangible capital in the firm valuation are graphed. The statistic is the time-series average of median market share μ_I from the year 2016 to the year 2020, using the availabe firm-year observations inside the country. The market share μ_I is estimated using the Benchmark model and Benchmark estimation specification in Table 5 and Table 6. For countries with insufficient observations of public listed firms, they are omitted in the heatmap. The sub-figure 1 (a) plots the statistics for countries in Europe. The sub-figure 1 (b) plots the statistics for Australia and countries in Asia.

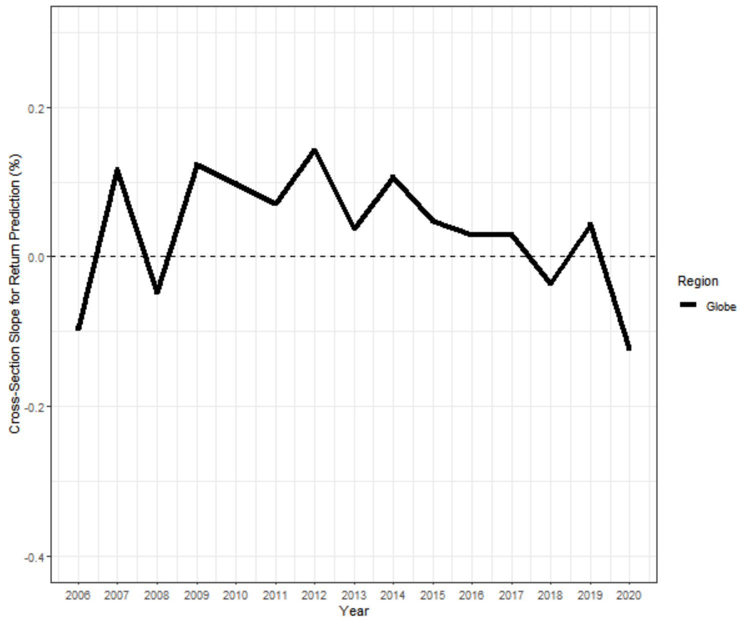
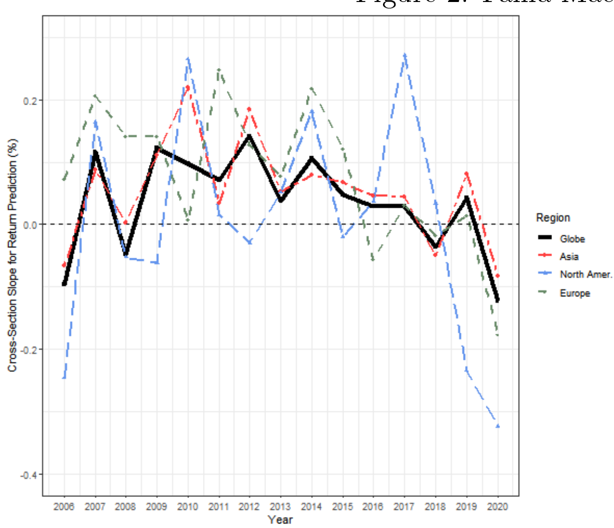


Figure 2: Fama-Macbeth Regression Slope



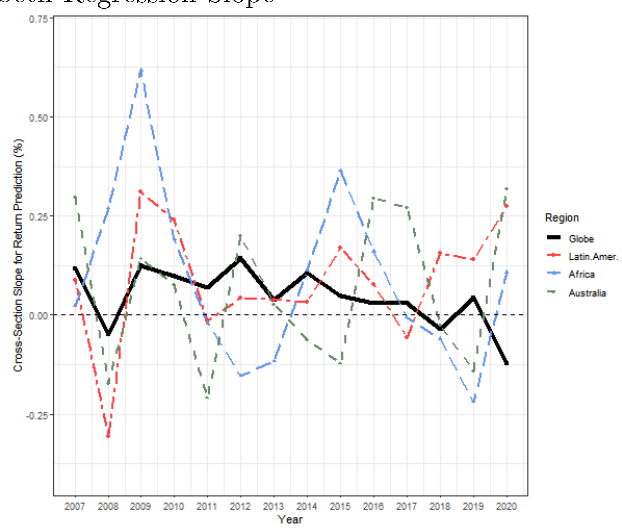


Figure 2: (a) Major Regions

Figure 2: (b) Rest of the World

This figure plots the slope of annual cross-section regression in Column (1) of Table 11. The black line **marketshare** plots the cross-section slope of **MarketShare-Intangible**. The subfigure 2 (a) plots the slope of cross-section slope for Columns (3)-(5) in Table 11, using the all the available sample during 2006-2020: the red line **Asia** uses the subsample of firms located in located in China, India, Malaysia, Thailand, Taiwan, Japan, South Korea, Singapore, Hong Kong, Vietnam, Israel, Turkey and countries in Southern Asia, South-eastern Asia, Western Asia; the blue line **North America** uses the subsample of firms located in Canada and U.S.; the green line **Europe** uses the subsample of firms located in France,Germany, Italy, UK, Poland, Sweden and countries of Southern Europe, Eastern Europe, Northern Europe, Western Europe. The subfigure 2 (b) plots the cross-section slope for the Rest of World in Table **??**.

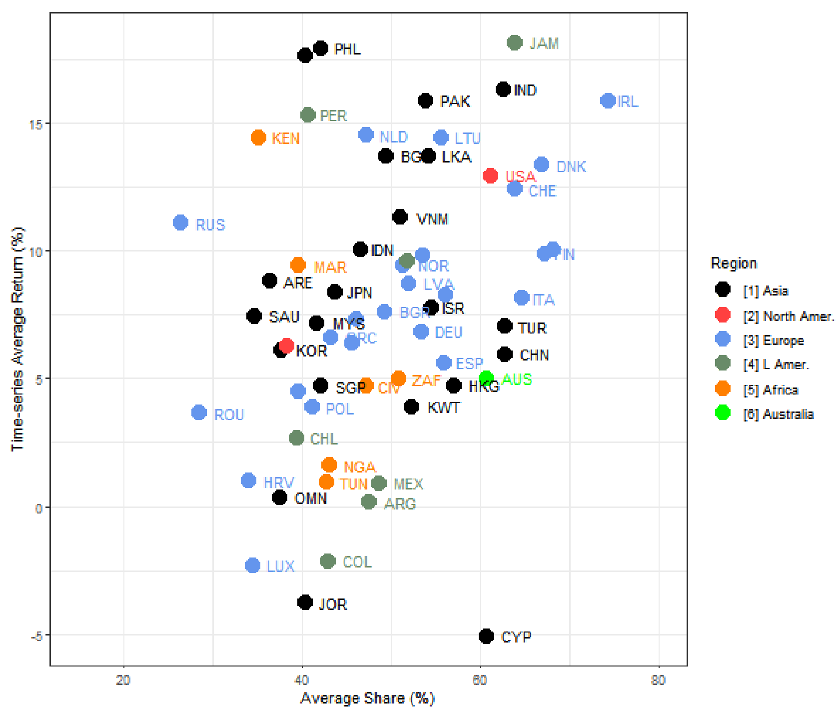


Figure 3: (a) Country-level

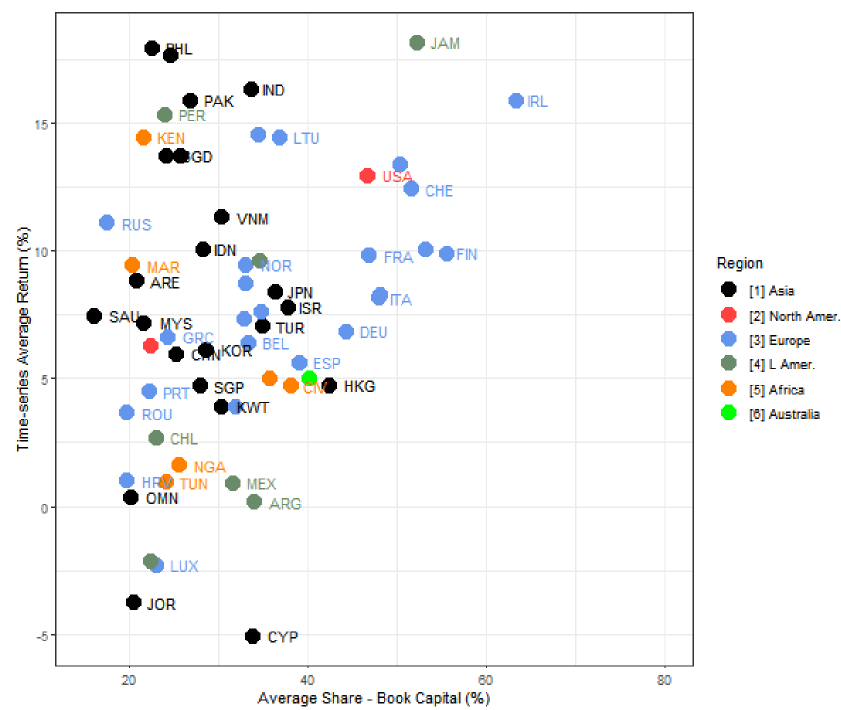


Figure 3: (b) Country-level

This figure plots the time-series average equity excess return and the time-series average share of intangible capital, for each country in Table 22. In the subfigure 3 (a), the horizontal axis is the share of intangible capital in valuation. In the subfigure 3 (b), the horizontal axis is the share of intangible capital in total book capital. The black dots plot country-level average variables in **Asia**, the blue dots for **Europe**, the red dots for **North America**.

C Additional Tables

Table 14: Descriptive Statistics

	Region (1)	Start (2)	Firms (3)	$\frac{Y}{GDP}$ (%) (4)	$\frac{VA}{GDP}$ (%) (5)	Per Capita (USD) (6)
Cote Divoire	Africa	2010	12	4.36	1.08	2313
Ghana		2013	11	4.88	1.43	2044
Kenya		2007	18	7.22	3.14	1560
Morocco		2006	32	8.91	3.52	3061
Mauritius		2014	10	14.59	3.81	9015
Nigeria		2006	49	2.38	0.81	2434
Tunisia		2007	26	6.84	1.88	3574
South Africa		2006	113	57.39	19.40	5116
Zambia		2014	8	12.39	3.57	1343
Argentina	L.America and the Carib.	2000	29	3.56	1.11	12348
Brazil		2000	119	21.05	6.97	8229
Cayman Islands		2008	21	238.48	45.49	86788
Chile		2000	70	39.78	13.26	12954
Colombia		2001	17	21.13	7.27	5889
Jamaica		2007	15	12.92	4.37	4532
Mexico		2000	58	22.07	8.73	8921
Peru		2000	42	17.57	7.15	5792
Bangladesh	Southern Asia	2008	60	2.37	0.88	1666
Sri Lanka		2006	101	11.06	3.10	4148
Pakistan		2006	168	12.71	2.97	1447
Philippines	South-Eastern Asia	2000	55	14.37	5.18	3270
Viet Nam		2007	162	12.88	2.89	2656
U.A.E.	Western Asia	2006	32	8.99	3.41	37498
Bahrain		2008	12	14.05	4.35	19343
Cyprus		2004	31	29.14	8.20	26942
Jordan		2004	45	16.70	3.67	4029
Kuwait		2005	42	19.49	7.17	24433
Oman		2004	33	11.61	2.38	13737
Palestine		2013	12	7.39	3.70	2747
Qatar		2009	15	11.52	4.84	56019
Saudi Arabia		2004	72	12.20	4.74	18691
Turkey		2004	165	11.76	3.19	12039

Table 14: Descriptive Statistics

	Region (1)	Start (2)	Firms (3)	$\frac{Y}{GDP}$ (%) (4)	$\frac{VA}{GDP}$ (%) (5)	Per Capita (USD) (6)
Spain	Southern Europe	2007	70	16.49	6.65	25254
Greece		2004	130	18.60	4.00	17778
Croatia		2006	37	16.59	5.92	12803
Italy		2007	123	7.46	2.82	28857
Malta		2015	10	7.91	4.66	29764
Portugal		2007	25	28.58	8.81	19958
Serbia		2013	14	8.18	2.79	6486
Slovenia		2007	10	18.95	3.35	23149
Bulgaria	Eastern Europe	2009	24	4.55	1.02	7904
Hungary		2009	8	12.81	3.87	14502
Romania		2009	41	4.67	1.86	10856
Russia		2009	83	40.26	17.36	9704
Ukraine		2011	12	4.62	1.17	2238
Denmark	Northern Europe	2000	55	30.01	16.13	56583
Estonia		2006	11	10.95	2.58	19803
Finland		2000	50	46.38	15.29	44692
Ireland		2000	38	64.95	25.91	79464
Iceland		2013	10	24.11	8.74	57119
Lithuania		2004	19	5.67	1.33	17666
Latvia		2006	12	2.26	1.03	15695
Norway		2005	69	18.50	6.78	74481
Sweden		2000	138	53.90	17.83	52920
Austria	Western Europe	2002	32	20.62	7.29	42898
Belgium		2002	45	22.15	8.01	40264
Switzerland		2002	102	67.21	32.60	85506
Luxembourg		2002	18	206.86	57.58	105581
Netherlands		2002	54	50.12	14.51	47156

Table 15: Descriptive Firm Statistics for Regions

	Median				Std				
	$\frac{Q}{TK}$	$\frac{I^P}{K^P}$	$\frac{I^I}{K^I}$	$\frac{K^I}{TK}$	$\frac{Q}{TK}$	$\frac{I^P}{K^P}$	$\frac{I^I}{K^I}$	$\frac{K^I}{TK}$	$\rho(\frac{I^P}{K^P}, \frac{I^I}{K^I})$
Cote Divoire	1.53	0.19	0.23	0.51	1.74	0.20	0.09	0.14	0.08
Ghana	0.86	-0.03	0.10	0.53	1.32	0.22	0.05	0.22	0.43
Kenya	0.99	0.06	0.20	0.33	1.92	0.20	0.08	0.22	0.23
Morocco	2.55	0.10	0.26	0.37	2.51	0.21	0.10	0.20	0.25
Mauritius	1.08	0.11	0.23	0.26	5.23	0.20	0.13	0.21	0.10
Nigeria	0.92	-0.01	0.15	0.42	1.69	0.22	0.10	0.22	0.32
Tunisia	2.13	0.07	0.20	0.35	1.98	0.19	0.10	0.14	0.23
South Africa	1.34	0.11	0.21	0.50	1.67	0.24	0.15	0.28	0.23
Zambia	0.74	-0.07	0.14	0.42	0.70	0.27	0.34	0.26	0.13
Argentina	0.76	-0.05	0.09	0.55	1.77	0.34	0.06	0.25	0.07
Brazil	1.09	0.09	0.19	0.42	1.69	0.47	0.12	0.24	0.37
Cayman Islands	1.34	0.18	0.31	0.26	2.44	1.27	0.19	0.25	0.16
Chile	1.33	0.09	0.22	0.25	1.27	0.22	0.08	0.19	0.32
Colombia	0.89	0.05	0.21	0.19	1.40	0.66	0.14	0.16	0.45
Jamaica	1.39	0.08	0.17	0.63	2.33	0.73	0.10	0.23	0.12
Mexico	1.10	0.08	0.21	0.35	1.38	0.27	0.08	0.21	0.20
Peru	0.65	0.10	0.23	0.20	1.13	0.33	0.10	0.15	0.32
Bangladesh	2.19	0.05	0.23	0.14	2.10	0.35	0.09	0.20	0.10
Sri Lanka	0.94	0.04	0.21	0.25	1.10	0.25	0.08	0.16	0.19
Pakistan	1.22	0.01	0.18	0.16	1.78	0.27	0.09	0.19	0.17
Philippines	1.54	0.14	0.25	0.23	3.60	0.60	0.17	0.20	0.17
Viet Nam	1.71	0.09	0.24	0.34	2.09	0.45	0.10	0.22	0.19
United Arab Emirates	1.59	0.14	0.26	0.19	2.55	0.34	0.13	0.21	0.29
Bahrain	1.57	0.14	0.24	0.24	1.84	0.55	0.09	0.23	-0.01
Cyprus	0.66	0.06	0.22	0.22	0.67	0.40	0.11	0.22	0.17
Jordan	1.65	0.04	0.22	0.19	1.83	0.20	0.09	0.16	0.15
Kuwait	2.12	0.16	0.25	0.23	5.18	0.85	0.16	0.21	0.22
Oman	1.70	0.12	0.26	0.18	1.45	0.51	0.12	0.17	0.17
Palestine	1.55	0.08	0.23	0.30	4.76	0.33	0.09	0.18	-0.01
Qatar	2.25	0.18	0.30	0.09	4.20	0.78	0.16	0.18	0.11
Saudi Arabia	2.58	0.08	0.26	0.14	3.32	0.25	0.11	0.16	0.10
Turkey	1.46	-0.02	0.14	0.41	2.05	0.32	0.07	0.22	0.20

Table 15: Descriptive Firm Statistics for Regions

	Median				Std				
	$\frac{Q}{TK}$	$\frac{I^P}{K^P}$	$\frac{I^I}{K^I}$	$\frac{K^I}{TK}$	$\frac{Q}{TK}$	$\frac{I^P}{K^P}$	$\frac{I^I}{K^I}$	$\frac{K^I}{TK}$	$\rho(\frac{I^P}{K^P}, \frac{I^I}{K^I})$
Spain	1.78	0.16	0.23	0.45	3.14	0.36	0.11	0.24	0.20
Greece	1.03	0.06	0.22	0.30	1.11	0.29	0.11	0.21	0.35
Croatia	0.93	0.08	0.20	0.28	1.10	0.20	0.12	0.17	0.35
Italy	1.60	0.19	0.24	0.52	2.85	0.40	0.16	0.25	0.15
Malta	2.65	0.12	0.29	0.24	5.75	0.45	0.10	0.31	0.21
Portugal	1.28	0.13	0.21	0.47	1.50	0.30	0.24	0.24	0.18
Serbia	0.79	0.07	0.18	0.34	0.92	0.20	0.23	0.18	0.05
Slovenia	0.99	0.10	0.20	0.34	0.78	0.15	0.11	0.20	0.31
Bulgaria	1.10	0.07	0.21	0.35	2.40	0.19	0.13	0.19	0.16
Hungary	1.05	0.09	0.17	0.42	0.90	0.17	0.13	0.23	0.24
Romania	0.62	0.03	0.19	0.32	0.56	0.15	0.10	0.18	0.21
Russia	1.03	0.03	0.16	0.28	1.24	0.24	0.11	0.22	0.22
Ukraine	0.83	-0.05	0.13	0.26	1.23	0.32	0.11	0.20	0.47
Denmark	1.17	0.17	0.23	0.57	3.71	0.34	0.13	0.24	0.22
Estonia	1.61	0.14	0.22	0.48	2.39	0.36	0.17	0.22	0.28
Finland	1.60	0.20	0.22	0.61	2.27	0.36	0.15	0.25	0.14
Ireland	2.32	0.22	0.26	0.53	2.68	0.45	0.15	0.24	0.19
Iceland	2.23	0.27	0.21	0.45	1.61	0.48	0.05	0.26	0.12
Lithuania	1.00	0.13	0.23	0.34	1.19	0.51	0.21	0.21	0.42
Latvia	0.79	0.11	0.19	0.24	1.28	0.40	0.13	0.21	0.27
Norway	1.39	0.19	0.27	0.29	3.05	0.62	0.25	0.30	0.36
Sweden	2.08	0.27	0.26	0.64	3.70	0.48	0.13	0.24	0.22
Austria	1.25	0.17	0.23	0.46	2.14	0.29	0.12	0.22	0.41
Belgium	1.52	0.19	0.24	0.49	3.09	0.29	0.11	0.24	0.28
Switzerland	1.69	0.21	0.26	0.58	2.77	0.31	0.11	0.24	0.18
Luxembourg	1.24	0.16	0.25	0.27	3.84	0.46	0.22	0.23	0.26
Netherlands	1.67	0.24	0.24	0.58	3.76	0.34	0.14	0.24	0.17

Table 16: Capital Accounting: Share of Intangible

	Market Share	Adjustment Cost		Book Share
	Market μ_I	c_I (% sales)	c_P (% sales)	Book $\overline{\mu}_I$
Cote Divoire	54.72	6.77	5.13	43.19
Ghana	55.02	1.70	3.10	40.27
Kenya	45.65	5.15	1.91	25.20
Morocco	44.88	5.93	3.04	29.62
Mauritius	35.91	5.53	4.58	25.47
Nigeria	75.71	3.16	7.28	40.11
Tunisia	52.55	3.63	1.55	31.02
South Africa	61.90	3.87	2.59	47.04
Zambia	94.61	4.08	10.92	31.23
Argentina	70.83	0.64	3.01	64.68
Brazil	57.61	2.66	1.13	41.34
Cayman Islands	46.50	4.32	2.10	30.52
Chile	36.28	3.52	0.79	21.32
Colombia	28.61	2.07	0.57	15.15
Jamaica	69.79	4.95	1.02	55.42
Mexico	44.57	3.81	0.93	27.94
Peru	25.91	2.77	0.63	14.45
Bangladesh	31.43	5.28	1.01	9.56
Sri Lanka	49.57	8.86	1.02	20.25
Pakistan	35.85	2.47	1.45	12.15
Philippines	32.44	5.99	3.50	16.50
Viet Nam	50.39	3.66	0.96	28.46
United Arab Emirates	43.33	9.01	5.41	19.40
Bahrain	31.22	7.26	10.89	21.19
Cyprus	36.15	7.46	4.16	23.23
Jordan	34.05	5.97	1.22	16.78
Kuwait	41.29	7.06	7.10	22.25
Oman	44.74	10.15	5.86	20.78
Palestine	44.85	8.63	3.43	26.53
Qatar	26.53	8.26	19.13	9.14
Saudi Arabia	32.60	7.12	2.18	12.99
Turkey	78.71	2.22	3.55	38.00

Table 16: Capital Accounting: Share of Intangible

	Market Share	Adjustment Cost		Book Share
	Market μ_I	c_I (% sales)	c_P (% sales)	Book $\overline{\mu}_I$
Spain	58.28	7.10	2.59	39.87
Greece	44.47	5.17	1.04	26.11
Croatia	43.15	4.12	1.19	28.00
Italy	60.65	7.57	3.02	44.80
Malta	28.66	10.81	5.06	16.69
Portugal	59.10	5.71	2.68	42.43
Serbia	49.52	4.38	0.82	30.91
Slovenia	38.19	1.41	1.75	25.72
Bulgaria	50.95	2.73	0.21	36.98
Hungary	48.17	1.98	0.65	35.50
Romania	47.40	3.83	0.24	32.59
Russia	35.76	1.07	0.43	26.88
Ukraine	38.06	0.88	0.84	28.19
Denmark	68.52	9.67	3.35	53.97
Estonia	58.13	4.19	1.27	45.20
Finland	70.19	6.11	2.91	58.55
Ireland	65.63	8.83	4.55	55.09
Iceland	44.52	7.07	10.91	34.93
Lithuania	45.71	3.84	1.94	34.99
Latvia	41.24	6.46	2.73	28.25
Norway	43.72	6.04	6.76	26.56
Sweden	71.59	9.69	5.32	62.06
Austria	51.96	6.58	3.87	39.17
Belgium	51.15	5.80	4.00	37.96
Switzerland	62.40	8.87	3.91	52.81
Luxembourg	36.07	4.34	4.30	26.53
Netherlands	57.86	7.07	5.10	49.98

Table 17: Country-level Distribution Characteristic

The table below reports the correlation of **Adjustment Cost Parameters** $\overrightarrow{\theta}$ and **Institution Environment** in each country. In Columns (1)-(2), slope is reported for regression: $\theta_{I,c} = a + \beta \times X_c + \varepsilon_c$. Estimated cost coeffiicient of intangible capital θ_I is from Table 5 and Table 6. In Columns (1), the **Intellectual Property Protection IPProtection**$_c$ is the survey outcome of "respect for intellectual property". In Columns (2), the **Formal Labor Market EmploymentLaw**$_c$ is the survey outcome of "compliance with employment law". These statistics are from "Institutional Profiles Database" (IPD) provided by the Centre for Prospective Studies and International Information (CEPII). For cost parameters estimated in Table 6, country-level measure is weighted by the amount of total book capital $K_P + K_I$ of firms in sample. In Columns (3)-(4), slope is reported for regression of adjustment cost of physical capital.

	Cost Coefficients			
	Intangible Capital θ_I		Physical Capital θ_P	
	(1)	(2)	(3)	(4)
IP Protection	-4.265***		0.007	
	(1.130)		(0.534)	
Employment Law		-4.579***		-0.381
		(1.162)		(0.553)
Constant	23.763***	26.210***	4.358**	5.654***
	(3.530)	(3.989)	(1.669)	(1.899)
Observations	26	26	26	26
Adjusted R^2	0.346	0.368	-0.042	-0.021

Statistic	N	Mean	St. Dev.	Min	Max
IP Protection	62	2.817	0.982	1.000	4.000
Labor Protection	62	3.336	0.716	1.000	4.000

Table 18: Firm-level stock return predictability regressions - Univariate Analysis

The table below reports the estimation results from stock return predicatability regressions of the form: $r^e_{i,t+1} = a + \lambda_\mu \times \mu_{I,i,t} + e_{i,t+1}$. P-value of t-stat are indicated using * for p<0.10, ** for p<0.05, *** for p<0.010.

		Regions					
	(1) All	(2) Asia	(3) North Amer.	(4) Europe	(5) L. Amer.	(6) Africa	(7) Aus.
MarketShare	0.109***	0.126***	0.073***	0.123**	0.105***	0.120*	0.183***
-intangible	(0.033)	(0.039)	(0.022)	(0.059)	(0.018)	(0.065)	(0.040)
Constant	6.248***	6.843***	9.035***	2.079	3.908	−3.291	−2.514
	(0.814)	(0.773)	(3.167)	(3.045)	(4.583)	(3.736)	(5.143)
Anomaly	No	No	No	No	No	No	No
SIC-2 FE	No	No	No	No	No	No	No
Country FE	No	No	No	No	No	No	No
Obs.	11872	7633	1489	2027	250	207	266
Adj-R^2	0.003	0.004	0.007	0.007	0.003	0.006	0.006

Table 19: Firm-level stock return predictability regressions - Fixed Effects

The table below reports the estimation results from stock return predicatability regressions of the form: $r^e_{i,t+1} = a + \lambda_\mu \times \mu_{I,i,t} + a_{c(i)} + a_{Ind(i)} + e_{i,t+1}$. Specification is identical with Column (1) in Table 11. Estimation includes the **country fixed effects** and **industry fixed effects.** Columns (2)-(4) report the estimation results using sub-sample of major regions. Definitions of major regions are identical with Table 11. Column (5) **Latin America** uses the subsample of firms located in countries of Latin America and the Caribbean; Column (6) **Africa** uses the subsample of firms located in countries of Sub-Saharan Africa and Northern Africa. Column (7) **Australia** uses the subsample of firms located in Australia. Newey-West 3 lagged standard errors are reported. Definitions of major regions are identical with Table 11. P-value of t-stat are indicated using * for p<0.10, ** for p<0.05, *** for p<0.010.

		Regions					
	(1)All	(2) Asia	(3) North Amer.	(4) Europe	(5) L. Amer.	(6) Africa	(7) Aus.
MarketShare	0.077***	0.082***	0.050***	0.072***	0.108***	0.091	0.106***
-intangible	(0.022)	(0.028)	(0.015)	(0.028)	(0.028)	(0.067)	(0.029)
Constant	−0.229	−0.709	2.685	−1.688	7.235	13.864	−1.891
	(2.743)	(4.152)	(4.303)	(11.127)	(17.462)	(11.402)	(6.074)
Anomaly	No	No	No	No	No	No	No
SIC-2 FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	11872	7633	1489	2027	250	207	266
Adj-R^2	0.190	0.214	0.051	0.088	0.156	0.157	-0.008

Table 20: Firm-level stock return predictability regressions - Firm Characteristics

The table below reports the estimation results from stock return predicatability regressions of the form: $r^e_{i,t+1} = a + \lambda_\mu \times \mu_{I,i,t} + \overrightarrow{\lambda}'_Z \times \vec{Z}_{i,t} + a_{c(i)} + a_{Ind(i)} + e_{i,t+1}$ in Table 11. Estimation includes the firm-level characteristic variables, country fixed effects and industry fixed effects. Specification is identical with Column (2) in Table 11. P-value of t-stat are indicated using * for p<0.10, ** for p<0.05, *** for p<0.010.

		Regions					
	(1) All	(2) Asia	(3) North Amer.	(4) Europe	(5) L. Amer.	(6) Africa	(7) Aus.
MarketShare	0.065***	0.079***	0.074***	0.090***	0.099***	0.109	0.060*
-intangible	(0.021)	(0.024)	(0.015)	(0.031)	(0.024)	(0.074)	(0.031)
Size	−1.837***	−2.105***	0.341**	0.330	−0.997***	2.365***	−1.733***
	(0.136)	(0.486)	(0.134)	(0.249)	(0.136)	(0.893)	(0.402)
BMratio	0.825***	2.836**	8.407**	5.465***	−0.015	7.528***	8.173**
	(0.288)	(1.305)	(4.118)	(0.558)	(0.079)	(0.935)	(3.549)
Reversal	3.663	6.047**	0.537	3.188	10.764	−6.451	2.760
	(2.864)	(3.037)	(4.999)	(2.166)	(9.437)	(9.267)	(15.118)
Momentum	1.553	1.785	−2.151	8.705***	8.530***	5.984	6.432**
	(1.999)	(1.961)	(1.390)	(2.113)	(1.575)	(4.778)	(2.919)
IVol	−6.160***	−7.015***	−3.407***	−4.562***	−3.560	−3.375**	−3.812
	(0.416)	(0.516)	(1.218)	(0.914)	(3.178)	(1.687)	(2.996)
Market Beta	1.604**	1.262	0.176	1.895**	1.475	3.672	1.651
	(0.806)	(0.813)	(0.313)	(0.940)	(1.389)	(3.054)	(1.241)
Constant	−5.247**	−7.007	−15.358***	−22.865	2.128	−9.987	−16.417**
	(2.178)	(7.185)	(3.836)	(14.998)	(23.728)	(9.663)	(6.737)
SIC-2 FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	11872	7633	1489	2027	250	207	266
Adj-R^2	0.205	0.231	0.105	0.129	0.194	0.205	0.088

Table 21: Firm-level stock return predictability regressions - Valuation Shares

The table below reports the estimation results from stock return predicatability regressions of the form: $r^e_{i,t+1} = a + \lambda_I \times \widetilde{\mu}_{I,i,t} + \lambda_P \times \widetilde{\mu}_{P,i,t} + \overrightarrow{\lambda}'_Z \times \vec{Z}_{i,t} + a_{c(i)} + a_{Ind(i)} + e_{i,t+1}$, in which $\widetilde{\mu}_{I,i,t} = q^I_{it} \frac{K^I_{it+1}}{V_{it}}$, is the valuation of intangible capital denominated by reported firm valuation, and $\widetilde{\mu}_{P,i,t} = q^P_{it} \frac{K^P_{it+1}}{V_{it}}$ is the valuation of physical capital. Definitions of regions are identical with Table 11. P-value of t-stat are indicated using * for p<0.10, ** for p<0.05, *** for p<0.010.

		Regions					
	(1) All	(2) Asia	(3) North Amer.	(4) Europe	(5) L. Amer.	(6) Africa	(7) Aus.
Share $\widetilde{\mu}_I$	0.054***	0.052***	0.041***	0.023*	0.078***	0.044*	0.008
	(0.011)	(0.016)	(0.015)	(0.013)	(0.007)	(0.025)	(0.010)
Share $\widetilde{\mu}_P$	−0.002	−0.008	−0.025*	−0.019***	−0.021	−0.060**	0.026
	(0.007)	(0.013)	(0.013)	(0.003)	(0.021)	(0.025)	(0.020)
Size	−3.130***	−3.202***	−0.396	−0.035	−2.306***	2.210***	−2.650***
	(0.276)	(0.284)	(1.148)	(0.167)	(0.587)	(0.723)	(0.376)
BMratio	0.686***	2.161*	7.444**	5.280***	−0.178	7.611***	7.661***
	(0.238)	(1.174)	(3.389)	(0.684)	(0.143)	(0.935)	(2.609)
Reversal	4.943*	6.609**	0.533	3.609	12.575	−1.900	3.240
	(2.816)	(3.061)	(5.172)	(2.269)	(9.207)	(9.553)	(15.134)
Momentum	2.267	2.061	−2.198	8.911***	9.245***	6.083	6.585**
	(1.881)	(1.899)	(1.613)	(2.102)	(1.820)	(5.383)	(3.121)
IVol	−6.208***	−7.025***	−3.428***	−4.591***	−3.797	−3.193*	−4.039
	(0.457)	(0.536)	(1.098)	(0.925)	(3.228)	(1.898)	(2.998)
Market Beta	1.392**	1.198	−0.104	1.825**	1.357	3.415	1.708
	(0.674)	(0.732)	(0.307)	(0.900)	(1.357)	(2.956)	(1.167)
Constant	1.974	1.255	−7.826***	−16.924	12.425	−2.891	−11.893
	(2.779)	(7.057)	(2.364)	(12.735)	(22.803)	(9.219)	(8.469)
SIC-2 FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	11872	7633	1489	2027	250	207	266
Adj-R^2	0.207	0.233	0.107	0.127	0.197	0.204	-0.191

Table 22: Country-level Return Predictability

The table below reports the estimation results from stock return predicatability regressions of the form: $r^e_{c,t+1} = a + \lambda_\mu \times \mu_{I,c,t} + \vec{\lambda}'_Z \times \vec{Z}_{c,t} + e_{c,t+1}$, in which the $r^e_{c,t+1}$ is the country-level market-valuation weighted excess stock return in the next fiscal year, $\mu_{I,c,t}$ is the market-valuation weighted share of intangible capital across firm-level variable. The firm-level share of intangible capital is calculated using the parameters from Table 5 and Table 6. The sample is from year 2009 to 2018, each country is required to have available description of economic status. All the stock returns are harmonized into the USD dollar amount. Calculation of excess return use the 3-month treasury rate of United States as the risk-free rate, in the unit of percentage (%). At firm-level, all variables are winsorized with [2%,98%], by year and country (region) in Table 5 and Table 6. Columns (1) to (3) reports the time-series average risk premium using the previous equation for each year, using the country-year observation in the sample. Column (2) includes the set of variables related with the country-year economic indicators. Column (3) includes the set of variables related with cross-section anomalies, and the country-year economic indicators. The set of variables related with cross-section anomalies are Size, Value, Reversal, Momentum, Idiosyncratic Volatility, Market Beta. In each year, the set of country-level variables are market-valuation weighted firm-level variables. Economic indicators include the growth of GDP per capita in the previous year, the growth of bilateral exchange rate (to USD dollar) in the previous year, the total GDP in constant USD dollar of 2015. The United States is excluded when the estimation uses the exchange rate. P-value of t-stat are indicated using * for $p<0.10$, ** for $p<0.05$, *** for $p<0.010$.

	Countries with Economic Indicators		
	(1)	(2)	(3)
IntangibleShare	0.167**	0.184***	0.147***
	(0.078)	(0.060)	(0.057)
GDP per capita		0.952***	0.893***
		(0.178)	(0.081)
Currency		−0.688***	−0.812***
		(0.165)	(0.191)
Country Size		−0.414	1.013
		(0.514)	(1.250)
Constant	−0.265	8.512	4.121
	(3.439)	(14.837)	(28.386)
Anomaly	No	No	Yes
Obs.	62	61	61
Adj-R^2	0.018	0.087	0.171

Table 23: Risk Premium of Traded Equity Index

Table 23 reports the average excess return and volatility of equity market index for countries with available MSCI indices during the same sample period. Other descriptions are identical with Table 26.

	Panel (A)									
	AUS	AUT	BEL	CAN	CHE	DEU	DNK	ESP	FIN	FRA
Annualized Return (%)	1.788	0.991	4.553	2.028	6.200	4.255	10.375	-1.876	2.996	3.730
Volatility (%)	66.752	86.338	61.387	53.144	48.021	69.418	61.480	85.316	72.076	66.285
Sharpe Ratio	0.027	0.011	0.074	0.038	0.129	0.061	0.169	-0.022	0.042	0.056

	Panel (B)								
	GBR	HKG	ITA	JPN	NLD	NOR	NZL	SGP	SWE
Annualized Return (%)	1.605	6.277	-0.524	4.792	6.616	0.772	7.557	2.171	5.268
Volatility (%)	52.998	67.863	85.218	45.024	60.561	77.528	64.344	62.465	66.745
Sharpe Ratio	0.030	0.092	-0.006	0.106	0.109	0.010	0.117	0.035	0.079

Table 24: Description of Portfolios

Table 24 reports sample average market share of intangible capital, book share, excess return (%), volatility, Sharpe ratio for the $r_{intan-k,t}$, the monthly return of portfolio grouped by composition of capitals. Three portfolios are constructed using most recent market share of intangible capital $\mu_{I,t}$, calculated using the parameters from Table 5 and Table 6. Portfolios are rebalanced monthly, the $r_{k,t}$ is the porfolio of firms with high share of intangible capital, minus the portfolio return of firms with low share using breakpoints {30%,70%}. For portfolios of book share, firms are sorted using most recent book share of intangible capital $\overline{\mu}_{I,t}$ and grouped into three portfolios.The sample is from 2010 January to 2019 December. Other descriptions are identical with Table 11.

	Portfolios of Market Share				Portfolios of Book Share			
	Physical	Medium	Intangible	Intan-Phy	Physical	Medium	Intangible	Intan-Phy
Mean μ	25.854	58.105	81.350	55.496	27.926	54.091	75.488	47.563
Mean $\overline{\mu}$	15.719	41.171	63.510	47.791	11.733	35.060	64.780	53.046
Excess Return	5.175	10.446	11.306	6.130	3.972	10.267	11.516	7.544
Volatility	47.473	42.508	44.457	17.746	50.310	43.449	42.189	23.016
Sharpe	0.109	0.246	0.254	0.345	0.079	0.236	0.273	0.328

Table 25: Description of Portfolios: Factor Loadings

Table 25 reports the factor loading vector $\overrightarrow{\beta}$ and intercept α, the unexplained excess return, in the time-series regressions of the form: $r_{k,t} = \alpha_k + \overrightarrow{\beta}_k \times \vec{f_t} + e_{k,t}$. The $r_{k,t}$ is the monthly return of portfolio grouped by composition of capitals, using firms in all countries. The traded factors $\vec{f} = [r^e_{mkt-k,t}, r_{smb-k,t}, r_{hml-k,t}, r_{cma-k,t}, r_{rmw-k,t}, r_{umd-k,t}]$ are the Fama-French 5 factors and momentum factor. Portfolios are contructed by sorting firms with market share of intangible capital, or the book share of intangible capital. Description of portfolios is in Table 24.

	Portfolios of Market Share			Portfolios of Book share		
	Physical	Medium	Intangible	Physical	Medium	Intangible
Intercept α	-6.148	-1.790	-1.083	-7.332	-1.683	-1.043
(s.e.)	(4.642)	(4.281)	(4.566)	(5.034)	(4.464)	(4.207)
β_{mkt}	0.924 ***	0.924 ***	0.926 ***	0.925 ***	0.913 ***	0.934 ***
(s.e.)	(0.109)	(0.101)	(0.107)	(0.118)	(0.105)	(0.099)
β_{smb}	-0.082	-0.151	-0.047	-0.076	-0.119	-0.112
(s.e.)	(0.185)	(0.171)	(0.182)	(0.201)	(0.178)	(0.168)
β_{hml}	-0.019	-0.132	-0.222	-0.003	-0.111	-0.221
(s.e.)	(0.223)	(0.206)	(0.220)	(0.242)	(0.215)	(0.202)
β_{cma}	-0.082	0.031	-0.103	-0.111	0.047	-0.073
(s.e.)	(0.275)	(0.253)	(0.270)	(0.298)	(0.264)	(0.249)
β_{rmw}	-0.078	-0.113	0.016	-0.089	-0.164	0.042
(s.e.)	(0.324)	(0.299)	(0.319)	(0.351)	(0.312)	(0.294)
β_{umd}	-0.219 *	-0.075	-0.042	-0.206 *	-0.105	-0.040
(s.e.)	(0.128)	(0.118)	(0.126)	(0.139)	(0.123)	(0.116)
Obs.	0.835	0.899	0.866	0.751	0.868	0.939
R^2	0.835	0.899	0.866	0.870	0.912	0.809

Table 26: Sharpe Ratio of Relative Return of Capitals

Table 26 reports sample average excess return (%), volatility, Sharpe ratio for portfolio returns . Column (1) reports the statistics for the $r_{Intan-Phy}$, the monthly relative return of intangible capital to physical capital in the world. Three portfolios are constructed using most recent market share of intangible capital $\mu_{I,t}$, calculated using the parameters from Table 5 and Table 6. Portfolios are rebalanced monthly, the $r_{Intan-Phy,t}$ is the porfolio of firms with high share of intangible capital, minus the portfolio return of firms with low share using breakpoints {30%,70%}. Column (2)-(6) report the Sharpe ratio for relative return of capitals that is neutral to asset pricing models $\hat{r}_{Intan-Phy,t} = r_{Intan-Phy,t} - \overrightarrow{\beta} \cdot \overrightarrow{f}_t$, the residual from the time-series regressions of the form: $r_{Intan-Phy,t} = \alpha + \overrightarrow{\beta} \cdot \overrightarrow{f}_t + e_t$, in which the vector $\overrightarrow{f}$ is vector of traded factors from an asset pricing model. Column (2) uses the single factor of U.S. market factor. Column (3) uses the Intermediary-CAPM, U.S. market factor and the value-weighted equity return for the U.S. primary dealer sector. Column (4) uses the Fama-French 6 factor model. Column (5) uses the Q-factor model with Growth Factor. Column (6) uses the carry factor and the dollar factor constructed from the currency returns. The sample is from 2010 January to 2019 December. Other descriptions are identical with Table 12.

	Relative Return of Capitals	Relative Return Neutral to an Asset Pricing Model				
		CAPM	Intermediary-CAPM	FamaFrench-6	Q-5	Currency
	(1)	(2)	(3)	(4)	(5)	(6)
Excess Return	6.130	6.414	5.730	5.066	4.608	5.055
Volatility	17.746	17.721	16.760	15.028	16.399	16.310
Sharpe Ratio	0.345	0.362	0.358	0.337	0.281	0.310

Table 27: Sharpe Ratio of Asset Pricing Models

Table 27 reports the Sharpe ratio of each asset pricing model $\overrightarrow{f}$. Panel (A) reports the Sharpe ratio of an asset pricing model without relative return of capitals. Panel (B) reports the Sharpe ratio of each new asset pricing model $[r_{Intan-Phy}, \overrightarrow{f}]$ as nested model of relative return of capitals and an existing model. The sample is from 2010 January to 2019 December. Other descriptions are identical with Table 12.

	Panel (A): Asset Pricing Models				
	CAPM	Intermediary-CAPM	FamaFrench-6	Q-5	Currency
	(1)	(2)	(3)	(4)	(5)
Sharpe Ratio	0.303	0.313	0.400	0.463	0.176

	Panel (B): New Asset Pricing Models				
	CAPM	Intermediary-CAPM	FamaFrench-6	Q-5	Currency
	(1)	(2)	(3)	(4)	(5)
Sharpe Ratio	0.472	0.475	0.523	0.542	0.546

Table 28: Time Series Description of Relative Return of Capitals: Book Share

Table 28 reports the time-series regressions of the form: $r_{Intan-Phy,t} = \alpha + \overrightarrow{f}_t \cdot \overrightarrow{\beta} + e_t$, in which $\overrightarrow{f}$ is vector of traded factors from an asset pricing model. The $r_{Intan-Phy,t}$, the monthly relative return of intangible capital to physical capital in the world. Three portfolios are constructed using most recent book share of intangible capital $\overline{\mu}_{I,t}$. Other descriptions are identical with Table 12.

Time-Series Decomposition using Asset Pricing Models										
		CAPM (1)		Intermediary-CAPM (2)		FamaFrench-6 (3)		Q-5 (4)		Currency (5)
	α	7.940 **	α	7.572 **	α	6.289 *	α	4.935 *	α	5.640 *
	(s.e.)	(2.725)	(s.e.)	(2.744)	(s.e.)	(2.869)	(s.e.)	(2.923)	(s.e.)	(2.659)
	β_{mkt}	-0.030	β_{mkt}	0.128	β_{mkt}	0.009	β_{mkt}	0.030	β_{carry}	0.275 **
	(s.e.)	(0.061)	(s.e.)	(0.096)	(s.e.)	(0.067)	(s.e.)	(0.070)	(s.e.)	(0.114)
			β_{hkm}	-0.150 **	β_{smb}	-0.036			β_{dollar}	0.175
			(s.e.)	(0.062)	(s.e.)	(0.115)			(s.e.)	(0.126)
					β_{hml}	-0.217 *	β_{ME}	0.072		
					(s.e.)	(0.138)	(s.e.)	(0.113)		
					β_{cma}	0.038	β_{IA}	0.049		
					(s.e.)	(0.170)	(s.e.)	(0.158)		
					β_{rmw}	0.131	β_{ROE}	0.253 *		
					(s.e.)	(0.200)	(s.e.)	(0.156)		
					β_{umd}	0.166 *	β_{EG}	0.349 *		
					(s.e.)	(0.079)	(s.e.)	(0.173)		
Obs.		120		120		120		120		120
Adj-R^2		0.003		0.087		0.177		0.197		0.229

Table 29: Time Series Description of Primitive Shocks

The table below reports sample average change rate, volatility, pairwise correlation, and correlation to relative return of capitals for each time series of primitive shocks described in Subsection 6.3. Columns (1) describes the time series of change in treasury yield rate $\frac{1+r_{t+1,h_0\to h_1}}{1+r_{t,h_0\to h_1}}$ from $h_0=1$ year to $h_1=3$ years. Yield rate is calcuated as $r_{t+1,h_0\to h_1}=\frac{h_1}{h_1-h_0}\cdot\frac{1+r_{t+1,0\to h_1}}{1+r_{t,0\to h_1}}-\frac{h_0}{h_1-h_0}\cdot\frac{1+r_{t+1,0\to h_0}}{1+r_{t,0\to h_0}}$ where $r_{t+1,0\to h_1}$is the yield-to-maturity of nominal Treasury Bond. Column (2) describes the time series of change in yield rate from 5 years to 10 years. Column (3) describes the price change in corn contract traded in CBOT. Unexpected change of price is calculated as $\frac{E_{t+1}[S_{t+2}]}{E_t[S_{t+2}]}$ with $E_{t+1}[S_{t+2}]$ as near-settlement future contract $F_{t+1,0\to 1}$ and $E_t[S_{t+2}]$ as the 2-month future contract $F_{t,0\to 2}$ in previous month. Column (4) describes the price change in Gas Oil contract traded in ICE. Column (5) describes the High Grade Copper Contract traded in COMEX. Panel (B) reports the pairwise correlation coefficient for these time series. Panel (C) reports the correlation coefficent between the time series and the relative return of capitals. Estimation uses General Method of Moments. Standard error of correlation coefficient has Newey-West adjustment of 2 periods. P-value of t-stat are indicated using * for p<0.10, ** for p<0.05, *** for p<0.010.

Panel (A): Time-Series Description

	(1) Short-Yield	(2) Long-Yield	(3) Corn	(4) Gas Oil	(5) Copper
Mean Growth	-0.067	-0.277	-2.389	-2.648	-3.222
Volatility	2.435	2.896	75.013	82.964	58.875

Panel (B): Pairwise Correlation of Time Series

	(1) Short-Yield	(2) Long-Yield	(3) Corn	(4) Gas Oil	(5) Copper
corr(Short-Yield,x)		0.63 ***	0.06	0.02	0.05
(s.e.)		(0.06)	(0.09)	(0.12)	(0.09)
corr(Long-Yield,x)			0.12 *	0.09	0.27 **
(s.e.)			(0.08)	(0.07)	(0.09)
corr(Corn,x)				0.09	0.11
(s.e.)				(0.09)	(0.10)
corr(Gas Oil,x)					0.39 **
(s.e.)					(0.08)

Panel (C): Correlation to Relative Return of Capitals

	(1) Short-Yield	(2) Long-Yield	(3) Corn	(4) Gas Oil	(5) Copper
corr(Relative Return,x)	-0.26 **	-0.33 **	-0.20 **	-0.28 **	-0.31 **
(s.e.)	(0.07)	(0.10)	(0.07)	(0.08)	(0.07)

Table 30: Description of Portfolios in Major Regions

Table 30 reports sample average market share of intangible capital, book share, excess return (%), volatility of excess return, Sharpe ratio for portfolios. In each major region {Asia, North America, Europe, Rest of World}, firms are classified into 10 decile-portfolios based on the recent book share of intangible capital. Portfolio is rebalanced monthly. Panels (A)-(D) report statistics for portfolios of each major region separately. Average number of firms is reported as Mean Num. Average market valuation is reported as Mean Value, in unit of million U.S. dollar. The sample is from 2010 January to 2019 December.

Panel (A): Portfolios in Asia

	Physical	2	3	4	5	6	7	8	9	Intangible
Mean Num.	841	840	838	836	835	834	832	831	830	829
Mean Value	1092	851	781	696	729	710	827	911	914	708
Mean μ	21.760	30.286	36.630	43.156	48.979	55.707	60.219	67.649	75.037	85.013
Mean $\overline{\mu}$	8.185	14.325	18.421	23.383	28.135	33.431	39.002	45.426	55.928	70.417
Excess Return	1.531	1.559	6.455	4.037	7.384	5.792	6.148	10.158	8.363	10.177
Volatility	49.737	51.676	52.303	51.495	50.192	47.991	47.973	52.847	47.115	48.787
Sharpe	0.031	0.030	0.123	0.078	0.147	0.121	0.128	0.192	0.178	0.209

Panel (B): Portfolios in North America

	Physical	2	3	4	5	6	7	8	9	Intangible
Mean Num.	145	145	145	145	145	144	144	144	144	144
Mean Value	1184	929	1551	1551	1420	1462	1317	903	511	194
Mean μ	22.214	35.695	49.927	60.614	67.646	72.158	76.160	80.233	84.964	90.091
Mean $\overline{\mu}$	9.052	18.634	30.933	40.604	49.567	58.115	65.308	72.707	80.010	88.883
Excess Return	8.908	8.912	15.313	14.351	12.441	13.492	12.547	11.809	16.979	15.747
Volatility	52.621	47.844	48.699	45.374	41.200	41.983	45.606	53.349	50.176	57.689
Sharpe	0.169	0.186	0.314	0.316	0.302	0.321	0.275	0.221	0.338	0.273

Panel (C): Portfolios in Europe

	Physical	2	3	4	5	6	7	8	9	Intangible
Mean Num.	224	223	222	221	220	219	219	218	217	216
Mean Value	661	567	681	459	441	574	464	456	264	217
Mean μ	19.876	34.358	45.597	55.670	62.369	68.438	72.854	76.595	82.238	89.246
Mean $\overline{\mu}$	10.136	21.431	32.338	42.314	48.319	55.729	61.000	66.412	76.838	85.656
Excess Return	2.799	4.105	8.074	11.318	9.976	7.397	7.878	9.700	11.021	11.826
Volatility	65.135	64.770	55.532	59.195	55.432	53.760	53.536	49.380	58.278	59.762
Sharpe	0.043	0.063	0.145	0.191	0.180	0.138	0.147	0.196	0.189	0.198

Panel (D): Portfolios in Rest of World

	Physical	2	3	4	5	6	7	8	9	Intangible
Mean Num.	67	67	67	66	66	66	66	66	65	65
Mean Value	97	96	85	58	59	67	109	44	54	27
Mean μ	15.822	26.376	36.826	47.099	53.956	60.962	67.109	76.100	80.856	88.668
Mean $\overline{\mu}$	7.158	11.473	16.700	23.104	30.002	37.386	45.031	56.994	70.112	84.130
Excess Return	2.579	1.359	2.521	3.753	6.503	4.136	1.865	5.808	11.660	-6.164
Volatility	66.645	70.768	75.061	59.148	57.153	67.076	61.191	71.526	72.706	107.153
Sharpe	0.039	0.019	0.034	0.063	0.114	0.062	0.030	0.081	0.160	-0.058

Table 31: Time Series Description of Risk Factors

The table below reports sample average change rate, volatility, pairwise correlation for each risk factor described in Subsection 6.3.2. In Panel (A), Column (1) describes the time series of relative return of intangible capital versus the physical capital. Relative return of capitals is the spread return of portfolios sorted using the recent market share of intangible capital. Detailed description is in Subsection 6.3. Column (2) describes the spread return of portfolios sorted using the recent market share of intangible capital. Portfolios are built in the similar way. Portfolios are described in Table 24. Panel (B) reports the pairwise correlation coefficient for each pair of risk factors. Estimation uses General Method of Moments. Standard error of correlation coefficient has Newey-West adjustment of 2 periods. P-value of t-stat are indicated using * for $p<0.10$, ** for $p<0.05$, *** for $p<0.010$.

	Panel (A): Time-Series Description		
	(1) Intan-Phy	(2) BIntan-Phy	(3) MKT
Mean Growth	6.130	7.544	13.012
Volatility	17.746	23.016	42.999

	Panel (B): Pairwise Correlation of Time Series		
	(1) Intan-Phy	(2) BIntan-Phy	(3) MKT
corr(Intan-Phy,x)		0.53 **	-0.05
(s.e.)		(0.11)	(0.09)
corr(BIntan-Phy,x)			-0.06
(s.e.)			(0.09)

Table 32: Risk Premium of Common Risk

Table 32 reports the risk premium vector $\overrightarrow{\lambda}$ in the cross-section regression of the form: $E[r^e_{k,t+1}] = \lambda_0 + \overrightarrow{\lambda} \cdot \overrightarrow{\beta_k} + \nu_k$ using portfolios in all countries. In each month, each region, firms are sorted into 10 decile-portfolios based on the recent book share of intangible capital estimated. Countries are grouped into regions of Asia, North America, Europe and Rest of World. In Panel (A), Column (3) reports the formal estimation outcome using relative return of capitals, in same definition with Table 12 and Table 26. The factor loading vector $\overrightarrow{\beta}$ is estimated from the time-series regressions of the form:$r^e_{k,t} = a + \beta_{k,Intan} \times r_{Intan-Phy,t} + \beta_{k,mkt-US} \times r^e_{mkt-US,t} + e_{k,t}$ in which $r^e_{mkt-US,t}$ is the excess return of U.S. market index, the capital-specific risk is measured using the $r_{Intan-Phye,t}$ the relative return of intangible capital to physical capital estimated in Table 26. Zero-beta rate λ_0 is included. Column (1) reports the estimation outcome in the cross-section regression of the form: $E[r^e_{k,t+1}] = \lambda_0 + \lambda_{mkt} \times \beta_{k,mkt-US} + \nu_k$ using the risk exposure to U.S. market factor. Column (2) reports the estimation outcome in the cross-section regression of the form: $E[r^e_{k,t+1}] = \lambda_0 + \lambda_{intan} \times \beta_{k,Intan} + \nu_k$ using the risk exposure to global intangible capital factor. Panel (B) reports the estimation outcome using relative return of capitals constructed using book share of capital. Simple standard error and the standard error with Gibbons-Ross-Shanken correction are reported. The sample is from 2010 January to 2019 December.

		Panel (A)		Panel (B)	
	CAPM	Relative Return		Book-Relative Return	
	(1)	(2)	(3)	(4)	(5)
λ_{intan}		6.916 **	7.439 **		
(s.e.)		(2.817)	(2.877)		
(GRS)		(3.432)	(3.637)		
$\lambda_{intan-book}$				7.339 **	8.124 **
(s.e.)				(2.745)	(2.985)
(GRS)				(3.570)	(3.817)
λ_{mkt}	7.838		12.970 *		-5.548
(s.e.)	(7.912)		(8.190)		(8.219)
(GRS)	(8.956)		(10.064)		(9.604)
λ_0	0.301	12.144	-0.607	13.200 **	18.147 **
(s.e.)	(7.460)	(3.884)	(7.551)	(4.288)	(7.049)
(GRS)	(7.581)	(4.166)	(8.538)	(4.499)	(7.511)
Obs.	40	40	40	40	40
MAE	3.635	2.465	1.853	2.289	2.219
RMSE	4.653	3.077	2.355	3.141	3.082
Adj-R^2	0.057	0.587	0.758	0.570	0.586

Table 33: Description of Industry Portfolios in Major Regions

Table 33 reports sample average market share of intangible capital, book share, excess return (%), volatility of excess return, Sharpe ratio for the industry portfolios. In each major region in {Asia, North America, Europe, Rest of World}, firms are grouped into 9 major industries {Consumer NonDurables; Consumer Durables; Manufacturing; Energy; HiTech-Business Equipment; Telcm-Telephone and Television Transmission; Shops-Wholesale and Retail; Healthcare; and Other} based on classification of Fama-French 10-industry. Firms in utility industry are not included in the sample. Panels (A)-(D) report statistics for portfolios of each major region separately. Other description is identical with Table 30.

Panel (A): Industry Portfolios in Asia

	NonDur.	Durables	Manufact.	Energy	HiTech	Telcm	Shops	Healthcare	Other
Mean Num.	1242	559	2722	138	1172	122	899	471	1020
Mean Value	944	795	2284	332	1097	485	744	651	888
Mean μ	58.425	53.036	47.260	35.935	56.379	39.689	61.058	67.182	41.148
Mean $\overline{\mu}$	35.390	30.811	24.082	13.924	34.891	26.659	42.386	44.888	20.564
Excess Return	1.531	1.559	6.455	4.037	7.384	5.792	6.148	10.158	8.363
Volatility	49.737	51.676	52.303	51.495	50.192	47.991	47.973	52.847	47.115
Sharpe	0.031	0.030	0.123	0.078	0.147	0.121	0.128	0.192	0.178

Panel (B): Industry Portfolios in North America

	NonDur.	Durables	Manufact.	Energy	HiTech	Telcm	Shops	Healthcare	Other
Mean Num.	111	59	303	34	331	45	230	148	185
Mean Value	951	240	1725	562	3168	710	1606	1520	538
Mean μ	67.606	45.345	57.112	19.875	67.539	49.677	65.525	70.100	49.418
Mean $\overline{\mu}$	49.356	30.555	36.282	8.313	55.056	28.111	48.467	56.035	25.215
Excess Return	10.177	8.908	8.912	15.313	14.351	12.441	13.492	12.547	11.809
Volatility	48.787	52.621	47.844	48.699	45.374	41.200	41.983	45.606	53.349
Sharpe	0.209	0.169	0.186	0.314	0.316	0.302	0.321	0.275	0.221

Panel (C): Industry Portfolios in Europe									
	NonDur.	Durables	Manufact.	Energy	HiTech	Telcm	Shops	Healthcare	Other
Mean Num.	323	89	606	66	279	48	249	150	387
Mean Value	804	261	1341	243	329	271	530	484	521
Mean μ	60.119	48.174	52.735	21.479	60.561	34.305	63.936	65.870	60.644
Mean $\overline{\mu}$	46.523	34.779	34.896	12.158	56.673	25.194	49.161	54.213	47.632
Excess Return	16.979	15.747	2.799	4.105	8.074	11.318	9.976	7.397	7.878
Volatility	50.176	57.689	65.135	64.770	55.532	59.195	55.432	53.760	53.536
Sharpe	0.338	0.273	0.043	0.063	0.145	0.191	0.180	0.138	0.147

Panel (D): Industry Portfolios in Rest of World									
	NonDur.	Durables	Manufact.	Energy	HiTech	Telcm	Shops	Healthcare	Other
Mean Num.	107	19	134	33	39	18	84	43	184
Mean Value	108	6	110	45	11	59	161	71	126
Mean μ	56.941	51.772	43.103	39.247	75.586	32.451	62.771	57.294	44.918
Mean $\overline{\mu}$	32.383	30.196	24.012	16.105	64.485	26.589	44.585	31.347	24.557
Excess Return	9.700	11.021	11.826	2.579	1.359	2.521	3.753	6.503	4.136
Volatility	49.380	58.278	59.762	66.645	70.768	75.061	59.148	57.153	67.076
Sharpe	0.196	0.189	0.198	0.039	0.019	0.034	0.063	0.114	0.062

Table 34: Estimation using Other Testing Assets

Table 34 reports the risk premium vector $\overrightarrow{\lambda}$ in the cross-section regression of the form: $E[r^e_{k,t+1}] = \lambda_0 + \lambda_{intan} \times \beta_{k,Intan-Phy} + \lambda_{mkt} \times \beta_{k,mkt-US} + \nu_k$ using different sets of testing assets. Column (1)-(2) use the 40 portfolios in four regions {Asia, North America, Europe and Rest of World}. In each major region, firms are sorted into 10 decile-portfolios based on the recent book share of intangible capital. Description of portfolios is in Table 30. Column (3)-(4) use the 27 industry portfolios in three major regions {Asia, North America, Europe}. In each major region, the firms are grouped into 9 industries. Description of portfolios is in Table 33. Column (5)-(6) use the 34 sector-indices in FTSE - Eurofirst 300. Column (7)-(8) use the 19 MSCI equity market indices in Table 23. Other descriptions are identical with Table 32. Sample is from 2010 January to 2019 December. Simple standard error and the standard error with Gibbons-Ross-Shanken correction are reported. Number of portfolios is reported.

	Risk Premium of Common Risk							
	Capital		Industry		FTSE		MSCI	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
λ_{intan}	6.916 **	7.439 **	4.492 *	6.918 **	3.443	8.364 **	5.370 *	5.610 *
(s.e.)	(2.817)	(2.877)	(2.411)	(2.402)	(2.959)	(3.184)	(2.990)	(2.852)
(GRS)	(3.432)	(3.637)	(2.972)	(3.109)	(3.425)	(4.036)	(3.521)	(3.404)
λ_{mkt}		12.970 *		10.224 *		14.193 *		0.218
(s.e.)		(8.190)		(5.976)		(7.766)		(8.227)
(GRS)		(10.064)		(7.681)		(9.833)		(9.485)
λ_0	12.144 **	-0.607	10.519 **	1.466	8.078 *	-3.863	8.794 *	8.048
(s.e.)	(3.884)	(7.551)	(3.480)	(4.616)	(4.173)	(6.244)	(4.015)	(5.887)
(GRS)	(4.166)	(8.538)	(3.589)	(5.093)	(4.250)	(7.243)	(4.193)	(6.173)
N	40	40	27	27	34	34	19	19
MAE	2.465	1.853	2.483	1.485	3.060	2.340	1.574	1.590
RMSE	3.077	2.355	3.119	2.034	3.847	2.865	1.849	1.845
R^2	0.587	0.758	0.374	0.734	0.174	0.542	0.604	0.606

Table 35: Estimation using Testing Assets in Regions

Table 35 reports the risk premium vector $\overrightarrow{\lambda}$ in the cross-section regression of the form: $E[r^e_{k,t+1}] = \lambda_0 + \lambda_{mkt} \times \beta_{k,mkt-US} + \lambda_{intan} \times \beta_{k,Intan-Phy} + \nu_k$ using subsets of 67 portfolios in different regions. Among four regions {Asia, North America, Europe and Rest of World}. In each region, the firms are sorted into 10 decile-portfolios based on the recent share of intangible capital estimated in Table 5 and Table 6. Among three regions {Asia, North America, Europe}. In each region, the firms are sorted into 9 major industries {Consumer; NonDurables; Consumer Durables; Manufacturing; Energy; HiTech-Business Equipment; Telcm-Telephone and Television Transmission; Shops-Wholesale and Retail; Healthcare; and Other}. Panel (A) reports the estimation outcome using portfolios of firms locating in Asia. Panel (B) for North America, Panel (C) for Europe and Panel (D) for the firms locating in {Argentina, Australia, Brazil, Chile, Morocco, Nigeria, Peru, South Africa}. Other descriptions are identical with Table 32. Sample is from 2010 January to 2019 December.

Risk Premium of Common Risk

	Panel (A): Asia			Panel (B): North America		
	(1)	(2)	(3)	(1)	(2)	(3)
λ_{intan}		5.836 *	7.244 **		4.805 *	6.992 **
(s.e.)		(2.565)	(2.706)		(2.730)	(2.872)
(GRS)		(3.151)	(3.404)		(3.262)	(3.540)
λ_{mkt}	-2.307		9.255	0.883		8.226
(s.e.)	(7.250)		(7.466)	(6.829)		(7.445)
(GRS)	(8.261)		(9.143)	(7.886)		(9.055)
λ_0	7.784 *	8.509 *	1.539	11.504 *	13.415 **	4.575
(s.e.)	(4.642)	(4.185)	(4.464)	(5.530)	(3.834)	(6.289)
(GRS)	(4.648)	(4.404)	(4.933)	(5.531)	(3.970)	(6.885)
N	19	19	19	19	19	19
MAE	2.254	1.440	1.172	2.024	1.722	1.133
RMSE	2.787	1.822	1.534	2.660	1.927	1.328
R^2	0.009	0.576	0.699	0.004	0.477	0.752

	Panel (C): Europe			Panel (D): Rest of World		
	(1)	(2)	(3)	(1)	(2)	(3)
λ_{intan}		4.406 *	6.138 *		7.895 *	9.278 *
(s.e.)		(2.458)	(2.687)		(5.011)	(5.011)
(GRS)		(3.010)	(3.331)		(5.717)	(6.039)
λ_{mkt}	-2.713		8.977	-5.811		10.692
(s.e.)	(7.305)		(7.906)	(13.027)		(10.698)
(GRS)	(8.313)		(9.416)	(13.723)		(13.026)
λ_0	10.606 *	11.102 **	2.126	8.839	13.499 *	4.454
(s.e.)	(6.045)	(4.496)	(6.497)	(10.756)	(6.678)	(9.804)
(GRS)	(6.057)	(4.632)	(7.027)	(10.853)	(7.304)	(11.378)
N	19	19	19	10	10	10
MAE	2.646	1.945	1.962	2.890	2.583	2.498
RMSE	3.373	2.703	2.454	4.253	3.350	3.212
R^2	0.014	0.367	0.478	0.016	0.389	0.438

Table 36: Time Series Description of Risk Factors

The table below reports orrelation to primitive shocks for each risk factor described in Subsection 6.3.2. Rows are risk factors described in Table 31. Columns are primitive shocks described in Table 37. Sample and calculation of correlation coefficient are identical.

	Correlation to Primitive Shocks				
	(1) Short-Yield	(2) Long-Yield	(3) Corn	(4) Gas Oil	(5) Copper
corr(Intan-Phy,x)	-0.26 **	-0.33 **	-0.20 **	-0.28 **	-0.31 **
(s.e.)	(0.07)	(0.10)	(0.07)	(0.08)	(0.07)
corr(BIntan-Phy,x)	-0.19 *	-0.24 **	-0.12	-0.26 **	-0.31 **
(s.e.)	(0.09)	(0.09)	(0.10)	(0.08)	(0.09)
corr(MKT,x)	0.30 **	0.47 **	-0.03	0.15 *	0.20 *
(s.e.)	(0.08)	(0.10)	(0.09)	(0.08)	(0.10)

Table 37: Risk Premium of Discount Rate and Commodity Price Shock

Table 37 reports the risk premium vector $\overrightarrow{\lambda}$ in the cross-section regression of the form: $E[r^e_{k,t+1}] = \lambda_0 + \overrightarrow{\lambda} \cdot \overrightarrow{\beta_k} + \nu_k$ for different asset pricing models. Zero-beta rate λ_0 is included. For each testing asset, the factor loading vector $\overrightarrow{\beta_k}$ is estimated from the time-series regressions of the form $r^e_{k,t} = a_k + \overrightarrow{f_t} \times \overrightarrow{\beta_k} + \nu_k$. Asset pricing models are, $\overrightarrow{f} = [f_x, r^e_{mkt-US}]$, with a non-traded risk factor of primitive shock and U.S. market factor. In Column (1) and Column (6), the non-traded risk factor f_x is the change in U.S. Treasury yield rate from 1 year to 3 year. In Column (2) and Column (7) use the yield rate from 5 year to 10 year. In Column (3) and Column (8), the non-traded risk factor is the unexpected price change in corn, calculated using the near-settlement future contract traded in CBOT. Column (4) and Column (9) use the unexpected price change in gas oil contract traded in ICE. Column (5) and Column (10) use the unexpected price change in high grade copper contract traded in COMEX. These time series of primitive shocks are described in Subsection 6.3 . In Panel (A), testing assets are 40 portfolios sorted using on the recent book share of intangible capital in four regions {Asia, North America, Europe and Rest of World}. In each major region, firms are sorted into 10 decile-portfolios based on the recent book share of intangible capital. Description of portfolios is in Table 30. Estimations reported in Panel (B) use the testing assets of 27 industry portfolios in three major regions {Asia, North America, Europe} and and 34 sector-indices in FTSE - Eurofirst 300. The 27 industry portfolios in regions is described in Table 33. Simple standard error and the standard error with Gibbons-Ross-Shanken correction are reported. The sample is from 2010 January to 2019 December.

	Panel (A) Capital Portfolios					Panel (B) Industry Portfolios				
	(1) [1,3]	(2) [5,10]	(3) Corn	(4) Gas Oil	(5) Copper	(6) [1,3]	(7) [5,10]	(8) Corn	(9) Gas Oil	(10) Copper
λ_x	0.510	-0.594	-47.513 *	-61.093 **	-39.233 **	-0.301	-0.822 *	-44.267 **	-40.435 *	-28.341 **
(s.e.)	(0.527)	(0.416)	(21.863)	(22.927)	(16.264)	(0.372)	(0.424)	(16.761)	(18.603)	(11.037)
(GRS)	(0.586)	(0.540)	(27.475)	(30.637)	(20.952)	(0.438)	(0.563)	(20.749)	(22.334)	(13.630)
λ_{mkt}	7.356	14.403 *	13.217 *	11.204	8.240	2.925	14.858 *	6.696	5.315	5.876
(s.e.)	(8.029)	(8.704)	(8.243)	(8.045)	(7.919)	(6.330)	(6.576)	(5.744)	(6.132)	(5.918)
(GRS)	(9.144)	(10.599)	(10.776)	(11.135)	(10.616)	(7.530)	(8.650)	(7.782)	(7.966)	(7.783)
λ_0	1.361	-5.095	-1.251	0.492	3.891	3.064	-6.158	3.751	3.360	2.747
(s.e.)	(7.522)	(8.355)	(7.646)	(7.443)	(7.241)	(4.367)	(5.330)	(4.127)	(4.272)	(4.153)
(GRS)	(7.730)	(9.445)	(9.302)	(9.635)	(9.014)	(4.426)	(6.241)	(4.820)	(4.822)	(4.709)
N	40	40	40	40	40	61	61	61	61	61
MAE	3.692	3.171	2.692	2.435	2.007	3.292	2.778	2.725	2.801	2.659
RMSE	4.600	4.312	3.688	2.890	2.675	4.276	3.482	3.447	3.875	3.531
R^2	0.078	0.189	0.407	0.636	0.688	0.036	0.361	0.374	0.208	0.343

Table 38: Estimation of Asset Pricing Models with Non-traded Risk Factors

Table 38 reports the risk premium vector $\overrightarrow{\lambda}$ in the cross-section regression of the form: $E[r^e_{k,t+1}] = \lambda_0 + \overrightarrow{\lambda} \cdot \overrightarrow{\beta_k} + \nu_k$ for different asset pricing models. Zero-beta rate λ_0 is included. For each testing asset, the factor loading vector $\overrightarrow{\beta_k}$ is estimated from the time-series regressions of the form $r^e_{k,t} = a_k + \overrightarrow{f_t} \times \overrightarrow{\beta_k} + \nu_k$. Asset pricing models are, $\overrightarrow{f} = [r_{Intan-Phy,t}, r^e_{mkt-US}, f_{shock}]$, with benchmark asset pricing model of relative return of capitals and U.S. market factor, and non-traded risk factors of primitive shocks. These time series of primitive shocks are described in Subsection 6.3 . Testing assets are 40 portfolios sorted using on the recent book share of intangible capital in four regions {Asia, North America, Europe and Rest of World}. Simple standard error are reported. The standard error with Gibbons-Ross-Shanken correction are reported for the risk factors in benchmark asset pricing model. Other descriptions of estimation and statistics are identical with Table 32.

	(1)	(2)	(3)	(4)	(5)	(6)
λ_{intan}	8.048 **	7.634 **	7.956 **	6.872 **	7.165 **	7.913 **
(s.e.)	(2.471)	(2.613)	(2.916)	(2.885)	(2.741)	(2.255)
(GRS)	(3.275)	(3.402)	(3.723)	(3.666)	(3.484)	(3.110)
λ_{mkt}	13.373 *	13.957 *	12.316 *	12.832 *	12.565 *	14.061 *
(s.e.)	(8.278)	(8.706)	(8.163)	(8.182)	(8.107)	(8.985)
(GRS)	(10.307)	(10.708)	(10.170)	(10.117)	(9.930)	(11.272)
$\lambda_{Yield-S}$	-0.250					-0.152
(s.e.)	(0.386)					(0.406)
$\lambda_{Yield-L}$		-0.113				-0.103
(s.e.)		(0.468)				(0.434)
λ_{Corn}			3.635			-1.118
(s.e.)			(18.974)			(19.300)
λ_{GasOil}				-22.621		-22.125
(s.e.)				(16.591)		(15.219)
λ_{Copper}					-7.715	-4.701
(s.e.)					(14.984)	(16.360)
λ_0	-1.225	-1.510	-0.338	-0.355	-0.179	-1.848
(s.e.)	(7.687)	(8.222)	(7.560)	(7.540)	(7.520)	(8.511)
N	40	40	40	40	40	40
MAE	1.845	1.819	1.852	1.801	1.833	1.753
RMSE	2.324	2.338	2.310	2.278	2.351	2.212
R^2	0.765	0.762	0.767	0.774	0.759	0.787

Table 39: Estimation of Asset Pricing Models using Other Testing Assets

Table 38 reports the risk premium vector $\overrightarrow{\lambda}$ in the cross-section regression of the form: $E[r^e_{k,t+1}] = \lambda_0 + \overrightarrow{\lambda} \cdot \overrightarrow{\beta_k} + \nu_k$ for different asset pricing models. Zero-beta rate λ_0 is included. For each testing asset, the factor loading vector $\overrightarrow{\beta_k}$ is estimated from the time-series regressions of the form $r^e_{k,t} = a_k + \overrightarrow{f_t} \times \overrightarrow{\beta_k} + \nu_k$. Testing assets are 27 industry portfolios in three major regions {Asia, North America, Europe} and 34 sector-indices in FTSE - Eurofirst 300. Estimation outcomes reported Columns (1)-(5) have identical specification with Table 13. Column (6) reports estimation outcome for asset pricing mode $\overrightarrow{f} = [r_{Intan-Phy,t}, r^e_{mkt-US}, \overrightarrow{f}_{shock}]$, with benchmark asset pricing model of relative return of capitals and U.S. market factor, and non-traded risk factors of primitive shocks. These time series of primitive shocks are described in Subsection 6.3. Simple standard error are reported. The standard error with Gibbons-Ross-Shanken correction are reported for the risk factors in benchmark asset pricing model. Other descriptions of estimation and statistics are identical with Table 13.

		Other Asset Pricing Models									
	Benchmark (1)		Intermediary-CAPM (2)		FamaFrench-6 (3)		Q-5 (4)		Currency (5)		Non-traded (6)
λ_{intan}	7.872 **	λ_{intan}	7.505 **	λ_{intan}	6.562 **	λ_{intan}	6.006 **	λ_{intan}	7.528 **	λ_{intan}	8.171 **
(s.e.)	(2.480)	(s.e.)	(2.505)	(s.e.)	(2.582)	(s.e.)	(2.529)	(s.e.)	(2.898)	(s.e.)	(2.418)
(GRS)	(3.241)	(GRS)	(3.272)	(GRS)	(3.294)	(GRS)	(3.225)	(GRS)	(3.679)	(GRS)	(3.304)
λ_{mkt}	11.379 *	λ_{mkt}	11.742 *	λ_{mkt}	8.219	λ_{mkt}	3.848	λ_{mkt}	11.984 *	λ_{mkt}	13.125 *
(s.e.)	(6.072)	(s.e.)	(6.088)	(s.e.)	(6.807)	(s.e.)	(6.507)	(s.e.)	(6.854)	(s.e.)	(6.663)
(GRS)	(7.915)	(GRS)	(8.028)	(GRS)	(8.593)	(GRS)	(8.252)	(GRS)	(8.744)	(GRS)	(8.850)
		λ_{hkm}	0.636	λ_{smb}	6.270 *			λ_{carry}	-3.028	$\lambda_{Yield-S}$	-0.101
		(s.e.)	(8.540)	(s.e.)	(3.788)			(s.e.)	(5.238)	(s.e.)	(0.358)
				λ_{hml}	-5.139	λ_{ME}	6.680 *	λ_{dollar}	1.017	$\lambda_{Yield-L}$	-0.202
				(s.e.)	(3.971)	(s.e.)	(4.075)	(s.e.)	(3.925)	(s.e.)	(0.445)
				λ_{cma}	-0.833	λ_{IA}	-1.419			λ_{Corn}	-15.196
				(s.e.)	(2.671)	(s.e.)	(3.025)			(s.e.)	(14.261)
				λ_{rmw}	-2.120	λ_{ROE}	2.803			λ_{GasOil}	14.626
				(s.e.)	(2.696)	(s.e.)	(3.256)			(s.e.)	(16.911)
				λ_{umd}	6.503	λ_{EG}	3.222			λ_{Copper}	2.314
				(s.e.)	(6.885)	(s.e.)	(3.198)			(s.e.)	(11.179)
λ_0	-0.356	λ_0	-1.198	λ_0	2.493	λ_0	7.166 *	λ_0	0.150	λ_0	-1.334
(s.e.)	(4.434)	(s.e.)	(4.410)	(s.e.)	(5.163)	(s.e.)	(4.835)	(s.e.)	(5.276)	(s.e.)	(5.190)
N	61		61		61		61		61		61
MAE	2.058		2.007		1.885		1.929		1.931		1.983
RMSE	2.770		2.645		2.490		2.520		2.569		2.526
R^2	0.596		0.631		0.673		0.665		0.652		0.664

Table 40: Common Fluctuation in Product Price

The table below reports the estimation results from OLS regressions of the form: $p_{i,t} = \beta_{intan} \times \overline{\mu}_{I,i,t-1} \times r_{Intan-Phy,t} + \beta_{mkt} \times \overline{\mu}_{I,i,t-1} \times r^{e}_{mkt-US,t} + \beta_{\mu} \times \overline{\mu}_{I,i,t-1} + a_{c,t} + a_i + e_{i,t+1}$. The price of producer uses 13 industries in 12 countries of European Union: AUT, CZE, DEU, GRC, FIN, FRA, NLD, PRT, GBR, BEL, ESP, ITA, DNK, SWE. The industries use NACE-R2 classification: {C10-C12, Food products, beverages and tobacco; C13-C15, Textiles, wearing apparel, leather and related products; C16-C18, Wood and paper products; printing and reproduction of recorded media; C19, Petroleum products; C20, Chemicals and chemical products; C21, Basic pharmaceutical products and pharmaceutical preparations; C22-C23, Rubber and plastics products, and other non-metallic mineral products; C24-C25, Basic metals and fabricated metal products, except machinery and equipment; C26, Computer, electronic and optical products; C27, Electrical equipment; C28, Machinery and equipment; C29-C30, Transport equipment; C31-C33, Other manufacturing}. The share of intangible capital in capital inputs of production uses the most recent statistics of EU KLEMS. Physical capital is classified as: {RStruc, Residential structures; TraEq, Transport Equipment; OCon, other buildings and structures; OMach, Other Machinery and Equipment; IT, Computing equipment; CT Communications equipment}. Intangible capital is classified as {Soft_DB, Computer software and databases; RD, Research and development; OIPP, Other IPP assets; AdvMRes, Advertising (brand) and market research; Design; POCap, Purchased and own account organisational capital; VT, Training}. Producer price is converted to U.S. dollar. The sample is from 2010 January to 2019 December.

	Producer Price Change		
	(1)	(2)	(3)
$\overline{\mu}\times$Relative Return of Capitals	0.306***	0.308***	0.290***
	(0.091)	(0.040)	(0.036)
$\overline{\mu}\times$Market Return	−0.038	−0.028*	−0.049***
	(0.038)	(0.016)	(0.015)
$\overline{\mu}$	−0.002	−0.002	−0.001
	(0.003)	(0.001)	(0.001)
Relative Return of Capitals	0.080**	-	-
	(0.034)	-	-
Market Return	0.024*	-	-
	(0.014)	-	-
Country FE	Yes	Yes	-
Time FE	No	Yes	-
Country × Time FE	No	No	Yes
Industry FE	Yes	Yes	Yes
Observations	10,560	10,560	10,560
Adjusted R^2	0.008	0.811	0.921

Table 41: Model Fit in Full Sample

This table reports the measures of fit for the base line model specification in Table (5). We calculate model fit for the entire sample used for estimation in columns (4) to (6). The beginning year for each country is reported in Column (3).

		Point Estimate		Start	Model Fit		
		θ_P	θ_I		XS-R^2	TS-R^2	$m.a.e./\overline{VR}$
		(1)	(2)	(3)	(4)	(5)	(6)
Australia		2.87	11.06	2004	0.61	0.31	0.20
	s.e.	(0.46)	(0.87)				
Canada		3.76	11.44	2000	0.90	0.54	0.16
	s.e.	(0.27)	(0.77)				
China		4.72	30.77	2001	0.25	0.16	0.26
	s.e.	(0.92)	(3.31)				
France		6.56	7.06	2007	0.74	0.20	0.20
	s.e.	(0.87)	(0.72)				
Germany		6.21	8.41	2006	0.77	0.26	0.23
	s.e.	(1.26)	(1.30)				
Hong Kong		2.43	7.24	2002	0.82	0.30	0.21
	s.e.	(0.39)	(0.72)				
India		4.76	19.16	2001	0.90	0.35	0.25
	s.e.	(0.52)	(1.26)				
Indonesia		5.74	12.99	2000	0.94	0.58	0.21
	s.e.	(0.72)	(1.58)				
Israel		3.20	9.11	2008	0.48	0.18	0.21
	s.e.	(0.41)	(0.71)				
Japan		0.86	2.42	2000	0.36	0.11	0.16
	s.e.	(0.49)	(0.41)				
Malaysia		2.85	11.72	2002	0.78	0.25	0.15
	s.e.	(0.65)	(1.21)				
Poland		3.37	4.42	2007	0.79	0.48	0.15
	s.e.	(0.47)	(0.37)				
Singapore		2.00	6.76	2002	0.81	0.39	0.16
	s.e.	(0.35)	(0.53)				
South Korea		1.76	3.73	2000	0.66	0.42	0.15
	s.e.	(0.34)	(0.55)				
Taiwan		4.87	13.98	2001	0.90	0.42	0.13
	s.e.	(0.38)	(0.80)				
Thailand		4.49	10.28	2000	0.90	0.42	0.21
	s.e.	(0.67)	(1.38)				
UK		6.24	8.47	2000	0.89	0.53	0.18
	s.e.	(0.62)	(0.75)				
USA		8.59	15.69	2000	0.90	0.66	0.15
	s.e.	(0.77)	(0.81)				

Table 42: Parameter Estimates and Model Fit

This table reports the measures of fit for the base line model specification in Table (5). We calculate model fit for the entire sample used for estimation in columns (4) to (6). The beginning year for each region is reported in Column (3).

		Point Estimate		Start	Model Fit		
		θ_P	θ_I		XS-R^2	TS-R^2	$m.a.e./\overline{VR}$
		(1)	(2)	(3)	(4)	(5)	(6)
Southern Asia		4.31	18.22	2006	0.94	0.75	0.12
	s.e.	(0.54)	(1.10)				
South-eastern Asia		4.20	12.03	2000	0.67	0.32	0.18
	s.e.	(1.00)	(1.70)				
Western Asia		7.39	16.68	2004	-0.50	0.01	0.22
	s.e.	(1.07)	(2.17)				
Eastern Europe		1.00	4.52	2009	0.51	0.18	0.17
	s.e.	(0.31)	(0.44)				
Northern Europe		4.45	11.21	2000	0.86	0.48	0.22
	s.e.	(0.63)	(0.72)				
Southern Europe		3.77	10.74	2004	0.76	0.52	0.20
	s.e.	(0.69)	(1.00)				
Western Europe		6.13	10.24	2002	0.69	0.31	0.25
	s.e.	(0.95)	(1.26)				
Africa		9.47	11.23	2006	0.72	0.50	0.16
	s.e.	(1.12)	(0.98)				
L.Amer. & Carib.		2.76	7.96	2000	0.88	0.61	0.16
	s.e.	(0.43)	(1.01)				

Table 43: Parameter Estimates and Model Fit

This table reports the parameter estimates and measures of fit for the baseline model specification as in Table 5. The estimation procedure adjusts the sector-specific formation rate of intangible capital suggested by (Gulen et al., 2022). The estimation uses 20 portfolios sorted based on proxies of the lagged inputs in valuation equation (10 portfolios for each input). θ_P and θ_I are, respectively, the physical capital and intangible capital adjustment cost parameters. s.e. stands for Newey-West standard errors with three lags. $XS-R^2$ is the cross-sectional R^2, $TS-R^2$ is the time-series R^2, and $m.a.e./\overline{VR}$ is the mean absolute valuation error scaled by the absolute value of the ratio. We calculate model fit for the 2006-2020 sample for which most of the countries have data.

		Point Estimate		Model Fit		
		θ_P (1)	θ_I (2)	XS-R^2 (3)	TS-R^2 (4)	$m.a.e./\overline{VR}$ (5)
Australia		2.20	7.28	0.48	0.36	0.20
	s.e.	(0.40)	(0.60)			
Canada		3.51	8.22	0.78	0.39	0.19
	s.e.	(0.28)	(0.65)			
China		5.06	23.45	0.11	-0.09	0.23
	s.e.	(0.85)	(2.51)			
France		6.42	4.46	0.71	0.22	0.19
	s.e.	(0.74)	(0.53)			
Germany		6.03	5.36	0.78	0.25	0.21
	s.e.	(1.00)	(0.89)			
Hong Kong		2.34	5.18	0.77	0.33	0.20
	s.e.	(0.32)	(0.49)			
India		4.58	14.87	0.77	0.13	0.24
	s.e.	(0.50)	(1.01)			
Indonesia		5.42	10.06	0.78	0.44	0.17
	s.e.	(0.60)	(1.32)			
Israel		2.56	6.33	0.51	0.15	0.18
	s.e.	(0.36)	(0.48)			
Japan		0.89	1.26	0.19	0.12	0.16
	s.e.	(0.48)	(0.35)			
Malaysia		2.21	9.10	0.74	0.27	0.15
	s.e.	(0.53)	(0.82)			
Poland		3.36	2.98	0.71	0.46	0.16
	s.e.	(0.44)	(0.31)			
Singapore		1.72	4.99	0.71	0.38	0.17
	s.e.	(0.31)	(0.39)			
South Korea		1.56	2.16	0.30	0.23	0.10
	s.e.	(0.30)	(0.39)			
Taiwan		4.43	10.21	0.84	0.25	0.13
	s.e.	(0.31)	(0.49)			
Thailand		4.37	7.80	0.64	0.26	0.20
	s.e.	(0.67)	(1.18)			
UK		5.76	5.11	0.76	0.47	0.18
	s.e.	(0.55)	(0.54)			
USA		7.87	10.87	0.79	0.60	0.15
	s.e.	(0.69)	(0.57)			
Summary of Point Estimation, Model Fitness						
	Average	3.90	7.76	0.63	0.29	0.18
	S.E.	1.89	5.04	0.22	0.16	0.03

Table 43: Parameter Estimates and Model Fit

This table reports the parameter estimates and measures of fit for the baseline model specification, as in Table 6. The estimation procedure adjusts the sector-specific formation rate of intangible capital suggested by (Gulen et al., 2022). The estimation uses 20 portfolios sorted based on proxies of the lagged inputs in valuation equation (10 portfolios for each input). θ_P and θ_I are, respectively, the physical capital and intangible capital adjustment cost parameters. s.e. stands for Newey-West standard errors with three lags. $XS - R^2$ is the cross-sectional R^2, $TS - R^2$ is the time-series R^2, and $m.a.e./\overline{VR}$ is the mean absolute valuation error scaled by the absolute value of the ratio. The results are reported for the sample of all firms. We calculate model fit for the 2006-2020 sample for which most of the countries have data.

		Point Estimate		Model Fit		
		θ_P (1)	θ_I (2)	XS-R^2 (3)	TS-R^2 (4)	$m.a.e./\overline{VR}$ (5)
Southern Asia		4.35	15.23	0.93	0.70	0.13
	s.e.	(0.66)	(1.18)			
South-eastern Asia		3.07	10.29	0.49	0.20	0.19
	s.e.	(0.74)	(1.24)			
Western Asia		7.28	13.01	0.02	0.12	0.19
	s.e.	(1.17)	(1.96)			
Eastern Europe		1.08	2.96	0.53	0.17	0.16
	s.e.	(0.27)	(0.36)			
Northern Europe		4.64	7.52	0.73	0.42	0.21
	s.e.	(0.58)	(0.55)			
Southern Europe		3.59	8.05	0.75	0.54	0.19
	s.e.	(0.62)	(0.78)			
Western Europe		5.69	7.45	0.57	0.22	0.23
	s.e.	(0.81)	(0.87)			
Africa		10.21	8.60	0.40	0.39	0.17
	s.e.	(1.26)	(0.99)			
L.Amer. & Carib.		2.75	6.42	0.83	0.65	0.13
	s.e.	(0.38)	(0.86)			
Summary of Point Estimation, Model Fitness						
	Average	4.74	8.84	0.58	0.38	0.18
	S.E.	2.56	3.42	0.26	0.20	0.03

Table 44: Parameter Estimates and Model Fit

This table reports the parameter estimates and measures of fit for the baseline model specification as in Table 5. The estimation uses 40 portfolios sorted based on proxies of the lagged values of the inputs (20 portfolios for each input). θ_P and θ_I are, respectively, the physical capital and intangible capital adjustment cost parameters. s.e. stands for Newey-West standard errors with three lags. $XS-R^2$ is the cross-sectional R^2, $TS-R^2$ is the time-series R^2, and $m.a.e./\overline{VR}$ is the mean absolute valuation error scaled by the absolute value of the ratio. We calculate model fit for the 2006-2020 sample for which most of the countries have data.

		Point Estimate		Model Fit		
		θ_P	θ_I	XS-R^2	TS-R^2	$m.a.e./\overline{VR}$
		(1)	(2)	(3)	(4)	(5)
Australia		2.60	11.35	0.51	0.30	0.23
	s.e.	(0.33)	(0.66)			
Canada		3.66	11.61	0.86	0.48	0.19
	s.e.	(0.21)	(0.60)			
China		5.02	29.81	0.14	-0.06	0.24
	s.e.	(0.78)	(2.80)			
France		6.20	7.27	0.67	0.16	0.23
	s.e.	(0.72)	(0.56)			
Germany		5.94	8.64	0.73	0.24	0.25
	s.e.	(0.91)	(0.93)			
Hong Kong		2.12	7.68	0.70	0.31	0.23
	s.e.	(0.27)	(0.50)			
India		4.77	19.11	0.77	0.14	0.25
	s.e.	(0.39)	(0.94)			
Indonesia		4.83	14.19	0.79	0.41	0.21
	s.e.	(0.50)	(1.10)			
Israel		2.63	9.79	0.42	0.15	0.25
	s.e.	(0.39)	(0.62)			
Japan		0.88	2.42	0.21	0.11	0.16
	s.e.	(0.36)	(0.32)			
Malaysia		2.66	11.93	0.69	0.22	0.18
	s.e.	(0.44)	(0.88)			
Poland		3.37	4.43	0.75	0.43	0.18
	s.e.	(0.43)	(0.31)			
Singapore		1.78	7.05	0.65	0.32	0.20
	s.e.	(0.27)	(0.43)			
South Korea		1.65	3.83	0.51	0.32	0.12
	s.e.	(0.25)	(0.39)			
Taiwan		4.78	14.07	0.82	0.32	0.14
	s.e.	(0.31)	(0.65)			
Thailand		4.04	10.94	0.72	0.30	0.21
	s.e.	(0.45)	(0.92)			
UK		6.08	8.56	0.81	0.50	0.18
	s.e.	(0.46)	(0.58)			
USA		8.53	15.72	0.88	0.68	0.15
	s.e.	(0.59)	(0.59)			
Summary of Point Estimation, Model Fitness						
	Average	3.97	11.02	0.65	0.30	0.20
	S.E.	1.92	6.17	0.21	0.17	0.04

Table 44: Parameter Estimates and Model Fit

This table reports the parameter estimates and measures of fit for the baseline model specification, as in Table 6. The estimation uses 40 portfolios sorted based on proxies of the lagged values of the inputs (20 portfolios for each input). θ_P and θ_I are, respectively, the physical capital and intangible capital adjustment cost parameters. s.e. stands for Newey-West standard errors with three lags. $XS - R^2$ is the cross-sectional R^2, $TS - R^2$ is the time-series R^2, and $m.a.e./\overline{VR}$ is the mean absolute valuation error scaled by the absolute value of the ratio. The results are reported for the sample of all firms. We calculate model fit for the 2006-2020 sample for which most of the countries have data.

		Point Estimate		Model Fit		
		θ_P (1)	θ_I (2)	XS-R^2 (3)	TS-R^2 (4)	$m.a.e./\overline{VR}$ (5)
Southern Asia		3.75	18.91	0.89	0.64	0.15
	s.e.	(0.49)	(0.88)			
South-eastern Asia		3.27	15.06	0.69	0.35	0.18
	s.e.	(0.85)	(1.48)			
Western Asia		5.78	19.04	0.23	0.15	0.20
	s.e.	(0.62)	(1.49)			
Eastern Europe		1.21	4.29	0.40	0.10	0.21
	s.e.	(0.32)	(0.38)			
Northern Europe		4.05	11.55	0.79	0.44	0.22
	s.e.	(0.45)	(0.52)			
Southern Europe		3.56	11.01	0.74	0.51	0.22
	s.e.	(0.54)	(0.80)			
Western Europe		5.41	10.86	0.56	0.22	0.26
	s.e.	(0.77)	(0.91)			
Africa		8.87	11.50	0.61	0.40	0.19
	s.e.	(0.91)	(0.82)			
L.Amer. & Carib.		2.39	8.49	0.83	0.56	0.16
	s.e.	(0.30)	(0.71)			
Summary of Point Estimation, Model Fitness						
	Average	4.25	12.30	0.64	0.37	0.20
	S.E.	2.09	4.48	0.20	0.18	0.03

Table 45: Parameter Estimates and Model Fit

This table reports the parameter estimates and measures of fit for the baseline model specification as in Table 5. The estimation uses 60 portfolios sorted based on proxies of the lagged firm-level variables, {valuation ratio, book-share of intangible capital, investment rate in physical capital, investment rate in intangible capital, inputs in valuation equation } (10 portfolios for each input). θ_P and θ_I are, respectively, the physical capital and intangible capital adjustment cost parameters. s.e. stands for Newey-West standard errors with three lags. $XS-R^2$ is the cross-sectional R^2, $TS-R^2$ is the time-series R^2, and $m.a.e./\overline{VR}$ is the mean absolute valuation error scaled by the absolute value of the ratio. We calculate model fit for the 2006-2020 sample for which most of the countries have data.

		Point Estimate		Model Fit		
		θ_P	θ_I	XS-R^2	TS-R^2	$m.a.e./\overline{VR}$
		(1)	(2)	(3)	(4)	(5)
Australia		2.61	12.40	0.31	0.30	0.27
	s.e.	(0.41)	(0.80)			
Canada		3.63	12.55	0.50	0.39	0.24
	s.e.	(0.25)	(0.79)			
China		2.37	37.69	0.27	0.17	0.27
	s.e.	(0.96)	(3.23)			
France		7.69	6.59	0.35	0.19	0.27
	s.e.	(1.06)	(0.65)			
Germany		7.93	7.32	0.43	0.25	0.29
	s.e.	(1.35)	(1.09)			
Hong Kong		1.89	8.70	0.29	0.23	0.29
	s.e.	(0.34)	(0.89)			
India		4.71	20.41	0.38	0.15	0.30
	s.e.	(0.52)	(1.25)			
Indonesia		5.59	14.31	0.35	0.32	0.24
	s.e.	(0.54)	(1.54)			
Israel		2.81	9.91	0.21	0.14	0.27
	s.e.	(0.45)	(0.73)			
Japan		1.65	1.98	0.10	0.07	0.23
	s.e.	(0.41)	(0.34)			
Malaysia		3.14	12.17	0.29	0.19	0.24
	s.e.	(0.68)	(1.06)			
Poland		3.84	4.35	0.33	0.33	0.22
	s.e.	(0.49)	(0.39)			
Singapore		2.34	6.75	0.23	0.23	0.25
	s.e.	(0.32)	(0.55)			
South Korea		2.00	3.67	0.16	0.18	0.16
	s.e.	(0.28)	(0.56)			
Taiwan		4.74	15.01	0.34	0.25	0.20
	s.e.	(0.46)	(1.01)			
Thailand		4.58	10.71	0.36	0.28	0.24
	s.e.	(0.47)	(1.07)			
UK		6.25	8.95	0.39	0.35	0.24
	s.e.	(0.54)	(0.68)			
USA		8.54	16.35	0.50	0.48	0.21
	s.e.	(0.73)	(0.84)			
Summary of Point Estimation, Model Fitness						
	Average	4.24	11.66	0.32	0.25	0.25
	S.E.	2.12	7.80	0.10	0.10	0.03

Table 45: Parameter Estimates and Model Fit

This table reports the parameter estimates and measures of fit for the baseline model specification, as in Table 6. The estimation uses 60 portfolios sorted based on proxies of the lagged firm-level variables, {valuation ratio, book-share of intangible capital, investment rate in physical capital, investment rate in intangible capital, inputs in valuation equation } (10 portfolios for each input). θ_P and θ_I are, respectively, the physical capital and intangible capital adjustment cost parameters. s.e. stands for Newey-West standard errors with three lags. $XS-R^2$ is the cross-sectional R^2, $TS-R^2$ is the time-series R^2, and $m.a.e./\overline{VR}$ is the mean absolute valuation error scaled by the absolute value of the ratio. The results are reported for the sample of all firms. We calculate model fit for the 2006-2020 sample for which most of the countries have data.

		Point Estimate		Model Fit		
		θ_P (1)	θ_I (2)	XS-R^2 (3)	TS-R^2 (4)	$m.a.e./\overline{VR}$ (5)
Southern Asia		3.88	20.15	0.49	0.45	0.20
	s.e.	(0.54)	(1.80)			
South-eastern Asia		3.92	13.42	0.32	0.24	0.24
	s.e.	(0.63)	(1.33)			
Western Asia		8.60	16.25	0.25	0.22	0.25
	s.e.	(1.22)	(1.88)			
Eastern Europe		1.32	4.68	0.13	0.10	0.24
	s.e.	(0.30)	(0.56)			
Northern Europe		3.80	12.37	0.43	0.34	0.27
	s.e.	(0.50)	(0.72)			
Southern Europe		3.92	11.24	0.43	0.39	0.26
	s.e.	(0.59)	(0.84)			
Western Europe		6.34	10.47	0.31	0.23	0.29
	s.e.	(0.85)	(0.98)			
Africa		11.69	10.45	0.33	0.36	0.23
	s.e.	(1.15)	(0.69)			
L.Amer. & Carib.		3.28	7.73	0.37	0.34	0.21
	s.e.	(0.44)	(0.87)			
Summary of Point Estimation, Model Fitness						
	Average	5.19	11.86	0.34	0.30	0.24
	S.E.	2.99	4.26	0.10	0.10	0.03

Table 46: Parameter Estimates and Model Fit

This table reports the parameter estimates and measures of fit for the baseline model specification as in Table 5. For firms with different incorporation location from its headquarter location, they are excluded from the sample. The estimation uses 20 portfolios sorted based on proxies of the lagged inputs in valuation equation (10 portfolios for each input). θ_P and θ_I are, respectively, the physical capital and intangible capital adjustment cost parameters. s.e. stands for Newey-West standard errors with three lags. $XS-R^2$ is the cross-sectional R^2, $TS-R^2$ is the time-series R^2, and $m.a.e./\overline{VR}$ is the mean absolute valuation error scaled by the absolute value of the ratio. We calculate model fit for the 2006-2020 sample for which most of the countries have data. Estimation in Hong Kong is excluded because there isn't sufficient size of sample for firms with identical incorporation location and headquarter location.

		Point Estimate		Model Fit		
		θ_P	θ_I	XS-R^2	TS-R^2	$m.a.e./\overline{VR}$
		(1)	(2)	(3)	(4)	(5)
Australia		2.83	11.08	0.61	0.36	0.21
	s.e.	(0.45)	(0.86)			
Canada		3.79	11.33	0.86	0.48	0.18
	s.e.	(0.28)	(0.78)			
China		3.72	39.01	0.30	0.15	0.23
	s.e.	(0.90)	(3.24)			
France		6.76	6.98	0.74	0.21	0.20
	s.e.	(0.89)	(0.73)			
Germany		6.28	8.30	0.76	0.25	0.23
	s.e.	(1.31)	(1.34)			
India		4.75	19.15	0.78	0.13	0.25
	s.e.	(0.52)	(1.26)			
Indonesia		5.72	13.08	0.85	0.50	0.17
	s.e.	(0.72)	(1.59)			
Israel		2.97	9.22	0.39	0.10	0.21
	s.e.	(0.43)	(0.71)			
Japan		0.87	2.41	0.20	0.10	0.16
	s.e.	(0.49)	(0.41)			
Malaysia		2.82	11.78	0.73	0.23	0.16
	s.e.	(0.65)	(1.22)			
Poland		3.37	4.42	0.78	0.48	0.16
	s.e.	(0.51)	(0.37)			
Singapore		2.05	6.45	0.56	0.32	0.17
	s.e.	(0.31)	(0.48)			
South Korea		1.80	3.71	0.56	0.41	0.10
	s.e.	(0.33)	(0.54)			
Taiwan		4.99	14.10	0.85	0.33	0.13
	s.e.	(0.38)	(0.80)			
Thailand		4.44	10.37	0.78	0.33	0.20
	s.e.	(0.67)	(1.38)			
UK		6.34	8.46	0.83	0.53	0.18
	s.e.	(0.68)	(0.80)			
USA		8.67	15.73	0.89	0.69	0.15
	s.e.	(0.78)	(0.82)			
Summary of Point Estimation, Model Fitness						
	Average	4.25	11.50	0.67	0.33	0.18
	S.E.	1.98	8.07	0.20	0.16	0.04

Table 46: Parameter Estimates and Model Fit

This table reports the parameter estimates and measures of fit for the baseline model specification, as in Table 6. For firms with different incorporation location from its headquarter location, they are excluded from the sample. The estimation uses 20 portfolios sorted based on proxies of the lagged inputs in valuation equation (10 portfolios for each input). θ_P and θ_I are, respectively, the physical capital and intangible capital adjustment cost parameters. s.e. stands for Newey-West standard errors with three lags. $XS - R^2$ is the cross-sectional R^2, $TS - R^2$ is the time-series R^2, and $m.a.e./\overline{VR}$ is the mean absolute valuation error scaled by the absolute value of the ratio. The results are reported for the sample of all firms. We calculate model fit for the 2006-2020 sample for which most of the countries have data.

		Point Estimate		Model Fit		
		θ_P (1)	θ_I (2)	XS-R^2 (3)	TS-R^2 (4)	$m.a.e./\overline{VR}$ (5)
Southern Asia		4.31	18.22	0.94t	0.75	0.12
	s.e.	(0.54)	(1.10)			
South-eastern Asia		3.99	12.36	0.66	0.33	0.18
	s.e.	(0.91)	(1.73)			
Western Asia		7.50	16.72	0.14	0.19	0.19
	s.e.	(1.09)	(2.15)			
Eastern Europe		0.94	4.27	0.51	0.18	0.17
	s.e.	(0.36)	(0.42)			
Northern Europe		4.66	11.13	0.80	0.47	0.21
	s.e.	(0.65)	(0.74)			
Southern Europe		5.42	9.49	0.81	0.59	0.19
	s.e.	(0.76)	(0.99)			
Western Europe		6.93	9.73	0.67	0.29	0.23
	s.e.	(1.07)	(1.30)			
Africa		9.30	11.56	0.71	0.49	0.16
	s.e.	(1.19)	(1.01)			
L.Amer. & Carib.		2.63	8.11	0.84	0.62	0.13
	s.e.	(0.43)	(1.05)			
Summary of Point Estimation, Model Fitness						
	Average	5.08	11.29	0.68	0.43	0.18
	S.E.	2.41	4.00	0.22	0.19	0.03

Table 47: Parameter Estimates and Model Fit

This table reports the parameter estimates and measures of fit for the baseline model specification as in Table 5. The estimation procedure didn't include the rolling-window aggregation. The estimation uses 20 portfolios sorted based on proxies of the lagged inputs in valuation equation (10 portfolios for each input). θ_P and θ_I are, respectively, the physical capital and intangible capital adjustment cost parameters. s.e. stands for Newey-West standard errors with three lags. $XS-R^2$ is the cross-sectional R^2, $TS-R^2$ is the time-series R^2, and $m.a.e./\overline{VR}$ is the mean absolute valuation error scaled by the absolute value of the ratio. We calculate model fit for the 2006-2020 sample for which most of the countries have data.

		Point Estimate		Model Fit		
		θ_P (1)	θ_I (2)	XS-R^2 (3)	TS-R^2 (4)	$m.a.e./\overline{VR}$ (5)
Australia		2.54	11.20	0.58	0.31	0.24
	s.e.	(0.37)	(0.80)			
Canada		3.37	12.07	0.90	0.42	0.21
	s.e.	(0.26)	(0.78)			
China		4.29	31.87	0.19	-0.03	0.31
	s.e.	(0.91)	(3.29)			
France		4.94	8.08	0.63	0.12	0.23
	s.e.	(0.75)	(0.69)			
Germany		4.64	10.02	0.73	0.18	0.26
	s.e.	(1.23)	(1.27)			
Hong Kong		2.31	7.11	0.72	0.28	0.26
	s.e.	(0.37)	(0.69)			
India		4.41	19.43	0.73	0.19	0.28
	s.e.	(0.46)	(1.28)			
Indonesia		4.58	14.26	0.82	0.41	0.22
	s.e.	(0.59)	(1.44)			
Israel		2.35	9.45	0.46	0.08	0.26
	s.e.	(0.32)	(0.69)			
Japan		0.42	2.63	0.20	0.07	0.18
	s.e.	(0.42)	(0.39)			
Malaysia		2.35	12.30	0.70	0.20	0.19
	s.e.	(0.55)	(1.08)			
Poland		3.44	4.54	0.77	0.23	0.28
	s.e.	(0.66)	(0.50)			
Singapore		1.21	7.61	0.62	0.23	0.25
	s.e.	(0.37)	(0.55)			
South Korea		1.13	4.24	0.56	0.28	0.13
	s.e.	(0.25)	(0.45)			
Taiwan		3.67	15.70	0.77	0.13	0.18
	s.e.	(0.41)	(0.92)			
Thailand		3.33	11.60	0.74	0.24	0.23
	s.e.	(0.57)	(1.26)			
UK		5.42	9.14	0.83	0.47	0.19
	s.e.	(0.55)	(0.73)			
USA		7.08	16.84	0.87	0.59	0.17
	s.e.	(0.68)	(0.89)			
Summary of Point Estimation, Model Fitness						
	Average	3.42	11.56	0.66	0.24	0.23
	S.E.	1.63	6.54	0.20	0.15	0.05

Table 47: Parameter Estimates and Model Fit

This table reports the parameter estimates and measures of fit for the baseline model specification, as in Table 6. The estimation procedure didn't include the rolling-window aggregation. The estimation uses 20 portfolios sorted based on proxies of the lagged inputs in valuation equation (10 portfolios for each input). θ_P and θ_I are, respectively, the physical capital and intangible capital adjustment cost parameters. s.e. stands for Newey-West standard errors with three lags. $XS-R^2$ is the cross-sectional R^2, $TS-R^2$ is the time-series R^2, and $m.a.e./\overline{VR}$ is the mean absolute valuation error scaled by the absolute value of the ratio. The results are reported for the sample of all firms. We calculate model fit for the 2006-2020 sample for which most of the countries have data.

		Point Estimate		Model Fit		
		θ_P (1)	θ_I (2)	XS-R^2 (3)	TS-R^2 (4)	$m.a.e./\overline{VR}$ (5)
Southern Asia		3.10	19.43	0.94	0.62	0.17
	s.e.	(0.47)	(0.99)			
South-eastern Asia		2.72	13.68	0.43	0.13	0.25
	s.e.	(0.80)	(1.53)			
Western Asia		5.19	20.05	0.12	0.09	0.23
	s.e.	(0.98)	(2.11)			
Eastern Europe		0.66	4.80	0.48	0.10	0.22
	s.e.	(0.30)	(0.48)			
Northern Europe		3.28	12.57	0.81	0.37	0.24
	s.e.	(0.50)	(0.74)			
Southern Europe		2.68	11.64	0.71	0.40	0.25
	s.e.	(0.53)	(0.90)			
Western Europe		4.62	11.40	0.58	0.19	0.27
	s.e.	(0.78)	(1.12)			
Africa		8.36	11.86	0.65	0.42	0.20
	s.e.	(0.98)	(0.89)			
L.Amer. & Carib.		2.17	8.51	0.84	0.50	0.17
	s.e.	(0.35)	(0.91)			
Summary of Point Estimation, Model Fitness						
	Average	3.64	12.66	0.62	0.31	0.22
	S.E.	2.08	4.52	0.24	0.18	0.03

Table 48: Statistics of Sample for Countries

This table reports statistics of constructing the sample for the benchmark estimation. Column (1) and Column (2) report the number of observations, the number of firms in the initial sample of data constructed with Compustat Global and Compustat North-America. Column (3) and Column (4) report the number of observations, the number of firms in the formal sample of data, after requirement of reporting XSGA, PPENT and other sample requirement. Description of sample requirement is in Appendix E. **Sale, Asset, Physical** and **Intangible** report the coverage of nominal dollar amount of sale, Compustat Item-AT, physical capital stock, intangible capital stock, during the 2nd stage of sample preparation, where extrene firm-year observations are excluded from the sample. All ratios are in percentage (%).

	Sample Size				2nd-stage Coverage (%)			
	Preliminary Sample		Qualified Sample		Sale	Asset	Physical	Intangible
	(1) Obs	(2) Firm	(3) Obs	(4) Firm	(5)	(6)	(7)	(8)
Australia	33676	2690	6150	1143	94.88	77.57	88.00	98.29
Canada	39981	3621	10187	1382	96.56	90.30	96.53	94.06
China	64919	5668	27696	3162	79.89	64.41	93.94	83.71
France	16354	1217	4657	539	94.73	86.75	94.37	96.91
Germany	16047	1112	5050	572	92.95	88.69	91.11	93.75
Hong Kong	20977	1474	9966	1106	96.53	89.21	97.10	97.45
India	66824	3879	21309	2316	88.99	89.23	87.79	93.48
Indonesia	8121	652	4990	478	90.42	90.33	86.62	93.36
Israel	7774	616	2750	363	95.16	89.66	92.62	95.73
Japan	82035	4489	41668	2531	86.37	64.48	82.13	85.72
Malaysia	18959	1176	9190	930	94.48	88.96	94.96	95.94
Poland	9773	829	3586	444	88.97	81.87	86.75	94.00
Singapore	11966	811	5407	625	93.55	88.55	86.95	96.39
South Korea	21149	2185	9057	1114	94.43	62.03	96.40	94.49
Taiwan	31682	2297	19640	1897	95.18	90.17	96.17	95.11
Thailand	10533	713	7030	603	96.56	90.17	95.90	96.90
U.K.	40655	3313	15139	1855	94.47	87.11	94.91	95.81
U.S.A.	166234	15860	82283	8982	97.05	90.33	93.72	97.04

Table 49: Statistics of Sample for Regions

	Sample Size				2nd-stage Coverage (%)			
	Preliminary Sample		Qualified Sample		Sale	Asset	Physical	Intangible
	(1) Obs	(2) Firm	(3) Obs	(4) Firm	(5)	(6)	(7)	(8)
Cote Divoire	291	22	137	19	97.40	79.65	91.77	99.60
Ghana	203	15	88	13	100.00	69.29	100.00	100.00
Kenya	584	37	257	31	100.00	84.82	100.00	100.00
Morocco	1060	60	526	51	99.12	84.16	99.65	98.60
Mauritius	391	38	72	19	81.99	40.00	68.64	92.87
Nigeria	1692	113	771	96	93.96	83.35	97.69	93.85
Tunisia	676	49	367	42	81.14	84.37	80.97	77.35
South Africa	5837	406	1958	253	73.96	75.51	82.83	65.68
Zambia	243	14	56	12	95.93	46.28	94.63	68.18
Argentina	1244	78	613	59	96.75	76.63	97.28	94.10
Brazil	6146	432	2597	285	90.23	74.03	94.49	90.94
Cayman Islands	858	123	269	72	92.19	77.30	84.84	85.73
Chile	2832	152	1601	133	90.78	89.34	90.60	89.19
Colombia	658	45	332	32	100.00	89.25	100.00	100.00
Jamaica	514	50	205	30	99.74	80.08	99.75	99.43
Mexico	2581	166	1362	114	97.50	83.66	98.25	98.15
Peru	1599	90	889	79	96.74	88.81	97.93	98.08
Bangladesh	2149	218	781	129	96.88	90.08	96.23	91.91
Sri Lanka	3039	201	1580	152	78.81	88.12	93.80	84.84
Pakistan	6044	348	2834	262	91.47	90.17	85.26	83.49
Philippines	3133	182	1157	131	99.43	85.77	99.01	98.96
Viet Nam	5326	494	2273	343	85.83	90.16	86.84	84.05
U.A.E.	892	73	481	54	85.15	85.28	92.98	69.75
Bahrain	296	18	154	16	100.00	83.70	100.00	100.00
Cyprus	1078	81	527	59	81.26	84.86	88.62	62.27
Jordan	2035	120	798	89	98.27	91.41	97.91	96.74
Kuwait	1448	97	670	82	98.26	83.75	96.95	98.43
Oman	1086	69	572	51	98.63	87.73	99.30	99.02
Palestine	202	16	95	15	100.00	92.23	100.00	100.00
Qatar	280	21	175	16	100.00	81.02	100.00	100.00
Saudi Arabia	1963	161	1252	120	97.68	89.94	96.41	97.06
Turkey	4751	352	2999	278	94.20	89.79	95.83	92.86

Table 50: Statistics of Sample for Regions

	Sample Size				2nd-stage Coverage (%)			
	Preliminary Sample		Qualified Sample		Sale	Asset	Physical	Intangible
	(1) Obs	(2) Firm	(3) Obs	(4) Firm	(5)	(6)	(7)	(8)
Spain	3267	225	979	122	93.55	85.73	83.60	97.57
Greece	4369	294	2599	241	95.47	87.98	94.08	89.02
Croatia	1336	92	560	65	94.18	83.71	87.77	93.73
Italy	5708	527	1728	254	93.43	82.17	94.23	93.40
Malta	233	20	60	13	100.00	46.51	100.00	100.00
Portugal	1173	82	354	42	99.42	76.13	97.83	99.98
Serbia	251	38	114	20	100.00	87.69	100.00	100.00
Slovenia	521	31	144	20	99.07	61.02	91.57	99.08
Bulgaria	741	68	304	45	89.57	80.64	75.09	88.13
Hungary	458	41	191	22	100.00	88.02	100.00	100.00
Romania	1979	139	504	98	98.36	75.34	99.17	97.14
Russia	2847	226	1169	165	99.66	83.92	99.63	99.52
Ukraine	281	23	124	21	100.00	83.78	100.00	100.00
Denmark	3477	270	1389	136	99.69	89.04	93.89	99.49
Estonia	332	26	160	17	100.00	77.29	100.00	100.00
Finland	3297	231	1075	129	96.15	84.85	90.06	97.82
Ireland	2469	168	1076	99	97.88	83.93	89.97	97.33
Iceland	295	25	80	12	100.00	60.15	100.00	100.00
Lithuania	504	38	325	33	100.00	96.15	100.00	100.00
Latvia	502	34	173	20	100.00	85.22	100.00	100.00
Norway	4739	487	1105	183	94.25	80.42	90.37	97.73
Sweden	12428	1154	3036	420	95.25	87.47	94.49	95.81
Austria	1876	134	609	65	90.67	86.63	92.86	91.97
Belgium	2615	175	870	98	97.45	87.26	99.43	99.06
Switzerland	5160	320	2218	205	93.94	88.40	85.35	95.12
Luxembourg	796	81	357	44	88.24	85.61	94.20	81.35
Netherlands	4232	307	1340	169	94.77	87.18	97.00	94.55

Table 51: Descriptive Statistics for Equity Index

The table below reports the descriptive statistics for sample used in the Table 11. **Index Abbrev.** is the identifier of equity index reported in Compustat-Index dataset. **Decription of Index** is the description of index reported in Compustat-Index dataset. **Firm Number** is the time-series average number of firms included in the index constitute. **1st stage-Coverage (%)** is the time-series average coverage of market valuation, between the firms with balance sheet information reported in Compustat-Global and the firms reported in the index constitute. **2nd stage-Coverage (%)** is the time-series average coverage of market valuation, between the firms with estimated share of intangible capital and the firms reported in the index constitute. **Relative Coverage (%)** is the time-series average coverage of market valuation, between the firms with estimated share of intangible capital and the firms reported in Compustat-Global.

Index Abbrev.	Description of Index	Firm Number	1st stage (%)	2nd stage(%)	Relative (%)
AEX	Amsterdam Stock Exchange	10.91	30.18	16.20	50.77
ATHENS	Athens Stock Exchange	36.68	48.00	31.47	67.32
ASX	Australian Stock Exchange	212.96	30.26	16.66	55.41
BOMBAY	Bombay Stock Exchange	50.22	63.26	39.23	60.85
BOVESPA	Brazilian Stock Exchange	16.00	48.30	22.96	48.64
DNK	Copenhagen Stock Exchange	11.86	60.92	29.66	50.43
TECDAX	Deutschier Aktien TECDAX (Perf)	20.53	75.06	38.70	52.36
STOXX	Dow Jones STOXX Indices	247.52	38.73	24.70	63.00
BEL	Euronext Brussels Stock Exchange	39.52	44.41	28.02	62.92
DAX	Germany Major Exchange Indices	260.57	49.83	40.02	78.59
HANGSENG	Hong Kong Stock Exchange	18.78	30.18	16.49	61.59
TUR	Istanbul Stock Exchange	11.19	37.27	36.06	96.85
JASDAQ	Japanese Over the Counter Exchange	346.87	44.06	16.19	37.17
KOR	Korea Stock Exchange	143.73	75.53	67.05	88.81
KLSE	Kuala Lumpur Stock Exchange	20.83	35.64	26.88	73.32
MEX	Mexican Stock Exchange	18.77	66.86	51.41	76.69
OMX	Nordic Baltic Marketplace Indices	84.86	62.74	44.95	71.61
OSE	Oslo Stock Exchange	14.18	47.01	29.91	57.41
CAC	Paris Bourse Exchange	20.41	48.74	29.43	60.02
PRT	Portugal Stock Exchange	13.05	52.81	46.79	87.06
SBF	SBF France Indices	165.74	51.38	31.47	60.99
SGP	Singapore Index	12.61	25.71	21.15	82.06
ESP	Spanish Stock Exchanges	64.57	35.47	20.22	58.49
SPI	Swiss Market Index - Performance	104.65	48.99	36.82	75.19
TWN	Taiwan Index	629.09	73.44	62.28	84.96
TSE	Tokyo Stock Exchange	1059.57	56.77	43.94	77.42
AUT	Vienna Stock Exchange	18.30	39.31	32.41	82.23
WIG	Warsaw Stock Exchange	168.96	33.59	24.47	81.14
Summary of Relative Coverage					
Average					67.98
S.E.					14.21

D Math Appendix

This appendix section provides the proof for the valuation equation 5. The proof is direct extension of (Hayashi, 1982) with consideration of multiple types of capital inputs and debt.

Theorem [Hayashi,1982]: Denote $P_{it} \equiv V_{it} - D_{it}$ be the ex-dividend equity value. If profit function $\Pi(.)$ and cost function $C(.)$ are Constant Return to Scale, firm's value maximization implies that

$$P_{it} + B_{it+1} = q_{it}^{P} K_{it+1}^{P} + q_{it}^{I} K_{it+1}^{I}, \tag{22}$$

in which

$$\begin{aligned} q_{it}^{P} &= 1 + (1-\tau_t) \cdot \tfrac{\partial C_{it}}{\partial I_{it}^{P}}, \\ q_{it}^{I} &= (1-\tau_t) \cdot (1 + \tfrac{\partial C_{it}}{\partial I_{it}^{I}}). \end{aligned} \tag{23}$$

Proof:

The Bellman equation of firm equity valuation is

$$V(X_{it}, K_{it}^{P}, K_{it}^{I}) \equiv \max_{\{L_{it+\triangle t}, \mathbf{I}_{it+\triangle t}, \mathbf{K}_{it+\triangle t+1}, B_{it+\triangle t+1}\}_{\triangle t=0}^{\infty}} D_{it} + E_t \left[M_{t+1} \cdot V(X_{it+1}, K_{it+1}^{P}, K_{it+1}^{I}) \right], \tag{24}$$

$$s.t. \quad \begin{aligned} D_{it} \equiv (1-\tau_t)[\Pi_{it} - C_{it} - I_{it}^{I}] \quad & -I_{it}^{P} + B_{it+1} - r_{it}^{B} B_{it} \\ & + \tau_t \delta_{it}^{P} K_{it}^{P} + \tau_t (r_{it}^{B} - 1) B_{it}. \end{aligned} \tag{25}$$

$$K_{it+1}^{P} = I_{it}^{P} + (1-\delta_{it}^{P}) K_{it}^{P} \tag{26}$$

$$K_{it+1}^{I} = I_{it}^{I} + (1-\delta_{it}^{I}) K_{it}^{I} \tag{27}$$

The X_{it} is vector of state variables of aggregate productivity and firm productivity. Optimal physical capital investment reflects the marginal value of physical capital (K_{it+1}^{P}):

$$\underbrace{1 + (1-\tau_t) \frac{\partial C_{it}}{\partial I_{it}^{P}}}_{q_{it}^{P}\text{: Physical Capital Marginal q}} = E_t \left[M_{t+1} \cdot \frac{\partial V}{\partial K^{P}} (X_{it+1}, K_{it+1}^{P}, K_{it+1}^{I}) \right] \tag{28}$$

Optimal intangible capital investment reflects the marginal value of intangible capital (K^I_{it+1}):

$$\underbrace{(1-\tau_t)\left[1+\frac{\partial C_{it}}{\partial I^I_{it}}\right]}_{q^I_{it}\text{: Intangible Capital Marginal q}} = E_t\left[M_{t+1}\cdot\frac{\partial V}{\partial K^I}(X_{it+1},K^P_{it+1},K^I_{it+1})\right] \tag{29}$$

We assume the Modigliani-Miller environment, total firm valuation is irrelevant of capital structure. Equity value maximization implies the total firm valuation maximization, $r^B_{it}B_{it} + V(X_t,\mathbf{K}_{it}) = \overline{V}(X_t,\mathbf{K}_{it})$. If profit function $\Pi(.)$ and cost function $C(.)$ are Constant Return to Scale w.r.t $\mathbf{K}_{it} = (K^P_{it}, K^I_{it})$, firm's value maximization implies that

$$\overline{V}(X_t, a\cdot K^P_{it}, a\cdot K^I_{it}) = a\cdot\overline{V}(X_t,K^P_{it},K^I_{it}), \tag{30}$$

Homogeneity of Degree One implies the equation below,

$$\frac{\partial\overline{V}}{\partial K^P}(X_t, a\cdot K^P_{it}, a\cdot K^I_{it})\cdot K^P_{it} + \frac{\partial\overline{V}}{\partial K^I}(X_t, a\cdot K^P_{it}, a\cdot K^I_{it})\cdot K^I_{it} = a\cdot\overline{V}(X_t,K^P_{it},K^I_{it}), \tag{31}$$

At $a=1$, the total firm valuation is quantity of capital(s) multiplied by the marginal valuation of capital(s). In the Modigliani-Miller environment, total firm valuation is irrelevant of debt. Marginal value of physical capital for the equity valuation is identical with the first-order partial derivative of total firm valuation,

$$\frac{\partial V}{\partial K^P}V(X_t,\mathbf{K}_{it}) = \frac{\partial\overline{V}}{\partial K^P}(X_t,\mathbf{K}_{it}), \tag{32}$$

The similar equation holds for the new amount of intangible capital. Previously, we denote the $q^P_{it}(X_t) = E_t\left[M_{t+1}\cdot\frac{\partial V}{\partial K^P}(X_{it+1},\mathbf{K}_{it+1})\right]$, substituting the equation (32) yields $q^P_{it} = E_t\left[M_{t+1}\cdot\frac{\partial\overline{V}}{\partial K^P}(X_{it+1},\mathbf{K}_{it+1})\right]$, shadow price of physical capital is the expected marginal value for total firm valuation. Replacing the expected marginal value of capital, The expected total firm valuation is written as

$$
\begin{aligned}
E_t\left[M_{t+1}\cdot \overline{V}(X_{it+1},\mathbf{K}_{it+1})\right] &= E_t\left[M_{t+1}\cdot (\tfrac{\partial \overline{V}}{\partial K^P}(X_{it+1},\mathbf{K}_{it+1})\cdot K^P_{it+1} + \tfrac{\partial \overline{V}}{\partial K^I}(X_{it+1},\mathbf{K}_{it+1})\cdot K^I_{it+1})\right] \\
&= q^P_{it}(X_t)\cdot K^P_{it+1} + q^I_{it}(X_t)\cdot K^I_{it+1}
\end{aligned},
$$

Recall the total firm valuation is equity plus the debt, we arrive to the expected equity value $E_t\left[M_{t+1}\cdot (V(X_{it+1},\mathbf{K}_{it+1})\right]$ prior to dividend payout,

$$
\begin{aligned}
E_t\left[M_{t+1}\cdot \overline{V}(X_{it+1},\mathbf{K}_{it+1})\right] &= E_t\left[M_{t+1}\cdot (V(X_{it+1},\mathbf{K}_{it+1}) + r^B_{it+1}B_{i,t+1})\right] \\
&= E_t\left[M_{t+1}\cdot (V(X_{it+1},\mathbf{K}_{it+1})\right] + E_t\left[M_{t+1}\cdot r^B_{it+1}B_{i,t+1}\right]
\end{aligned},
$$

The model considers the one-period debt. The new amount of debt equals the expected repayment in next period, $B_{i,t+1} = E_t\left[M_{t+1}\cdot r^B_{it+1}B_{i,t+1}\right]$. Equity value of current period is the payout and the expected equity value of next period, $V_{it} = D_{it} + E_t\left[M_{t+1}\cdot V(X_{it+1},\mathbf{K}_{it+1})\right]$. Combining these equations, we conclude, if profit function $\Pi(.)$ and cost function $C(.)$ are Constant Return to Scale w.r.t $\mathbf{K}_{it}$, firm's value maximization implies that

$$
V_{it} + B_{it+1} = D_{it} + q^P_{it}(X_{it})\cdot K^P_{it+1} + q^I_{it}(X_{it})\cdot K^I_{it+1}, \tag{33}
$$

Let $P_{it} \equiv V_{it} - D_{it}$ be the ex-dividend equity value, the equation is further simplified as

$$
P_{it} + B_{it+1} = q^P_{it}(X_{it})\cdot K^P_{it+1} + q^I_{it}(X_{it})\cdot K^I_{it+1}, \tag{34}
$$

Q.E.D.

E Data Appendix

E.1 Construction of Data

E.1.1 Summary of Data

1. Firm Fundamental
   - Data Source: Compustat Global, Compustat North America
   - Main data fields: Capital Stock, Capital Expenditure, Depreciation
   - Granularity: Firm
2. Stock Price
   - Data Source: Compustat Global-Security Daily, Compustat-CRSP linked
   - Main data fields: Capital Stock, Capital Expenditure, Depreciation
   - Granularity: Firm
3. Deflator
   - Data Source: CPI in OECD statistic
   - Main data fields: Capital Price
   - Granularity: Country
4. Tax Rate of Corporate Income
   - Data Source: Tax Foundation, Compustat Global -Economic Indicators
   - Main data fields: Corporate Tax
   - Granularity: Country

E.1.2 Main Measure

Variable	Measure	Alternative Measure
Price, Physical Capital	OECD CPI	UN stat
Price, Intangible Capital	OECD CPI	UN stat
Quantity, Physical Capital	Compustat, PPENT	-
Quantity, Intangible Capital	Compustat, XSGA	-
Value of Equity	Compustat-Security Daily	Datastream
Value of Debt	Compustat, Book Debt	
Home Country	Headquarter	Incorporation

E.1.3 Harmonization

- Currency specification

Home Country	Currency
All	USD

- Currency definition in each data source

Dataset	Currency
Compustat-Fundamental	Currency Reported
Compustat-Security Daily	Currency Reported

- Currency Crosswalk

Dataset	From	To
Compustat Global-Exchange Rate	Currency Reported	USD

- Region Crosswalk

Dataset	From	To
UNSD-M49 standard	ISO code	Sub-region code

E.2 Detailed Construction of Variable

E.2.1 Firm-level Data

We use Compustat Global from Capital IQ to collect the accounting information of listed firms incorporated in United Kindom and Continental European countries. We use the information in the annual financial report.

Definition of Country: We use the location of incorporation as the country of a firm. For robustness check, we also consider defining the location of firm as the location of headquarter.

Sample Quality Control: we remove firms in financial service industry (SIC:6000-6999), utility industry (SIC: 4900-4999), and public service industry (SIC: 9000-9999). For firms with both international version of financial report (DATFMT as HIST) and domestic version of financial report (DATFMT as Standard) in the same fiscal year, we use the international-version of financial report. For firms with restatement of financial reports, we use the most recent version of financial report.

Industry Code: The primary industry code is NAICS 6-digit code. For firm-year observations without the historical industry information `NAICSH`, we impute it with the nearby industry information, if none of these information is available, we use the current industry information `NAICS`. We also consider the production input market linked by SIC 4-digit code. Similarly, we use the historical industry information imputed with the nearby industry information.

Corporate Event: We check the firm-year observations with major acquisition event, using the footnote variables `SALE_FN`. For firms with major merge and acquisition event, the `SALE_FN` is flagged as AC. Based on this criteria, this situation is rare for the European countries, hence, we didn't implement this filter.

E.2.2 Currency Conversion

We conduct conversion of currency for all nominal variables. We use the sub-dataset Exchange Rate provided by Compustat Global to convert the currency of financial reports into nominal USD amount.

We use the 12-month (backward) moving-average exchange rate to convert the currency. For example, if a firm reports its income statement on Dec-31st-2010, we use the average month-end exchange rate during Jan-2010 and Dec-2010.

We use the sub-dataset Security Daily provided by Compustat Global to calculate the market value of outstanding common stock issued by the firms. Each firm in Compustat Global has the unique identifier `GVKEY`, a unique identifier `PRIROW` for the primary issued common stock. Each common stock in Security Daily has a unique identifier `IIN` and a unique firm identifier `GVKEY`. We require the security `IIN` matched with the firm `PRIROW`, and the identical firm identifier `GVKEY`.

We calculate the market value as the market-close price multiplied by the outstanding shares $\text{V} = \text{PRCCF} \cdot \text{CSHOC}$.

We use the month-end market value in the month of financial report date. We convert the market value into the nominal USD amount, in the similar method with the firm fundamental variables.

E.3 Classification of Region

The United Nations Statistics Division (UNSD) classifies 17 Sub-regions: Northern Africa, Northern America, Eastern Asia, Southern Asia, South-eastern Asia, Southern Europe, Australia and New Zealand, Melanesia, Micronesia, Polynesia, Central Asia, Western Asia, Eastern Europe, Northern Europe, Western Europe, Sub-Saharan Africa, Latin America and the Caribbean. We decide pooling the observations into the region following the procedure below:

- We impose the basic quality requirement for the firm-level observations, summarize the sample by each country.
- When the number of firm-level observation inside the country surpasses 9 observations, we start to include the country in our sample.
- If the average number of firm-level observations surpass 200 observations, we label the country as an independent large economy. For the remaining observations, we use the Sub-region code of UNSD to pool the observations. Compared to other countries in Western Asia, Israel has high income per person and higher book share of intangible capital, we consider the country Israel separately.
- Due to the extreme years of hyper-inflation, the sample of Egypt and the sample Zimbabwe are discontinued after the preliminary sample requirement of firm investment rates. We remove the two countries to ensure the stationary sample.
- Due to the small sample size, the two Sub-regions, Northern Africa and Sub-Saharan Africa are combined together.

After implementing above procedure, we end up with 18 large countries and 9 regions.

The 18 large economies are Australia, Canada, China, Germany, France, UK, Hong Kong, India, Indonesia, Israel, Japan, South Korea, Malaysia, Poland, Singapore, Thailand, Taiwan, USA.

For the 4 regions as Melanesia, Micronesia, Polynesia, Central Asia, we don't have valid observations of listed firms locating in these regions. For the 3 regions as Northern America, Eastern Asia, Australia and New Zealand, we don't have valid observations of listed firms locating in these regions. The large economies such as Canada, China, Japan, India, Australia are considered separately. Subsample of Mexico, New Zealand has small number of firms. Estimation doesn't have the sufficient observations.

After these steps, we arrive to the 9 regions: Southern Asia, South-eastern Asia, Western Asia, Eastern Europe, Northern Europe, Southern Europe, Western Europe, Africa, Latin America and the Caribbean.

E.4 Sample Requirement

The sample requirement refers (Belo et al, 2022). Additional requirement for firm-level observations is included, to address the firm-level noise in economies of small sample. We decide the qualified firm-year observations following the criteria and procedure below: In the 1st stage, we require non-missing firm variables and nominal amount of capital stock surpassing the minimal threshold.

- We require non-missing and positive sale $Y_{i,t}$, previous-period sale $Y_{i,t-1}$, 2-period lagged sale $Y_{i,t-2}$, similarly for physical capital $K^P_{i,t}$ and intangible capital $K^I_{i,t}$.
- We require non-missing firm valuation $Q_{i,t}$ (equity valuation plus net debt value), investment rate in physical capital $i^P_{i,t}$, investment rate in intangible capital $i^I_{i,t}$, corporate income tax rate $\tau_{i,t}$.
- We require the physical capital greater than 1 million USD dollars, the intangible capital greater than 1 million USD dollars, to avoid the extreme firm-year observations among tiny firms.

In the 2nd stage, we exclude extreme firm-year observations based on the distribution of firm variables within each country.

- We require the change of firm sale $\frac{Y_{i,t}-Y_{i,t-1}}{Y_{i,t-1}}$ within the percentile $(2\%, 98\%)$ with respect to its country-year panel, to avoid the extreme firm-year observations.

- We require the firm size (physical capital and intangible) within the percentile $(2\%, 100\%)$ with respect to its country-year panel, to avoid the high idiosyncratic noise among tiny firms. In particular, the firm size is required to be within the $(30\%, 100\%)$ with respect to its country-year panel among China, Japan and South Korea. We check the coverage of aggregate sale, physical capital and intangible capital, removal of tiny-small firms generates negligible impact.

- We require the ratio of firm valuation $\frac{Q_{i,t}}{K^P_{i,t}+K^I_{i,t}}$ within the percentile $(2\%, 98\%)$ with respect to its country-year panel, to avoid the extreme observations of firm valuation in the left-tail and right-tail.

- We require firm-year observations with non-zero intangible investment rate in the current year and previous year. We remove abnormal firm-year observation reporting zero XSGA-expense in continuously recent two years (around 1%).

Aside from above general requirement of sample quality. We adopt country-specific requirement for countries with small size of sample, in Latin America, Africa, Western Europe and Eastern Europe.