The Value of 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 heterogenous types of capital: physical capital (e.g. plants and machines) and intangible capital (e.g. brand name, stock of knowledge). We find that the neoclassical model of investment with these two inputs fits the data well for the major economies. In addition, we show that the good model fit is a consequence of the inclusion of intangible capital and country/region specific adjustment cost parameters. Finally, we find that intangible capital accounts for a large share of the market value of firms in all countries. The growth of intangible capital value is faster in the emerging economies such as China, but slower in the developed economies such as the United States. Our estimation result explains the geography of intangible investment premium, by inferring the latent parameter for intangible capital valuation.

Key Words: Firm Valuation, Structural Estimation, Intangibles, Neoclassical investment
JEL Classification: D21, D22, E22, E24, G12, G32

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1 Introduction

What is the contribution of intangible capital for a firm's market value? Does this contribution varies across countries? And what is the expected return of investing in intangible capital? We answer these questions through the lens of a generalized neoclassical model of investment with two capital inputs: physical and intangible capital. Through structural estimation, and using data for a large cross section of publicly traded firms in 79 countries, we use the model to quantify the relative importance of intangible capital across the world, its variation over time and across countries, and also the expected return of investing in intangible capital.

In the model, changing the quantity of the capital inputs is costly, which we capture through standard adjustment cost functions. The firm's equilibrium market value depends on the shadow price and the quantity of each installed input, and the shadow prices can be inferred from investment data through the specification of an adjustment costs function. If the operating profit function and the adjustment costs function are both homogeneous of degree one, the market value of each input is the product of the input's shadow price and the corresponding stock variable. The total market value of the firm is then the sum of the market value of all the inputs, and this additive property allows us to compute the contribution of each input for firm value in a straightforward manner.

To take the model to the data, we need to measure the firm-level stocks of each capital input. For physical capital, the data is readily available from the firm's reports. For intangible capital, the capital stock data is not readily available given its nature. Following previous studies, see (Eisfeldt and Papanikolaou, 2013) and Peters and Taylor (2017), we construct firm-level measures of intangible stock from accounting data on Selling, General and Administrative (SG&A) expenses, a measure that is well populated in the data for our countries and includes many types of intangible capital.[1]As shown by Lev and Radhakrishnan (2005) SG&A is a broad measure of the multiple components of intangible capital, it captures the value of the skilled labor force (as it accounts for the costs of training workers), knowledge capital (as it often includes R&D expenditures), and brand capital (as it accounts for advertising expenses), and which also includes other operational expenses. We accumulate this expenditures using the perpetual inventory method to obtain the capital stocks for intangible capital.

Our estimation methodology follows Belo et al. (2022). We estimate the model by minimizing the distance between the observed and the model-implied valuation ratios (market value of equity plus net debt-to-book value of capital stocks). To reduce the impact of measurement error in firm-level data, we estimate the model using portfolio-level moments. We target the cross-sectional portfolio-level mean and match the realized time series of the portfolio-level valuation ratios.

Using data from Compustat (North America and Global), we estimate adjustment cost parameters for physical and intangible capital for individual countries and regions. For larger equity markets, where the data quality is superior, we estimate country specific adjustment cost parameters. We estimate these parameters for 18 countries, that include all major economies and account for 28% of world GDP and 9% of global value added. For the remaining countries, to overcome the data quality problem, we estimate the adjustment cost parameters by pooling these remaining countries into a region according to their location and following the region criteria of United Nation statistics. We estimate the region specific adjustment parameters for ten regions. In total, including the individual countries and the regions, our analysis includes 77 countries

[1] Other measures as expenditure of R&D or brand while well populated in the US and Canada (see Belo et al. (2022)) is missing for the majority of the sample for other countries.

that represent 34% of world GDP and 11% of global value added. Using the estimated adjustment costs parameters, we use our model to decompose the value of the firms into physical and intangible capital for these countries.

Our main findings can be summarized as follows. First, we show that the neoclassical model of investment with two capital inputs fits the data well in most economies. 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 a cross country average time-series R^2 of 24% and a cross-sectional R^2 of 65%. For the region estimation, the model also has good explanatory power, with an cross region average time-series R^2 of 30% and a cross-sectional R^2 of 61%. North Europe have particular good fit, with cross sectional R^2 above 81 and time-series above 37. While the success of the multiple capital input neoclassical investment model for US and Canada is known (see (Belo et al., 2022)), it is interesting (and surprising) that it also performs well for a wide range of countries.

Second, we find that the good model fit is a consequence of the inclusion of intangible capital and country/region specific adjustment cost parameters. For country level analysis, the average cross-country fit of the physical capital only model the R^2 drops significantly. While the one capital model fits decently for some countries, like Canada and Australia, for all countries the fit is significantly worst when compared to the baseline that includes intangible capital. On average, including intangible capital improves the fit about 108%. For regions, while the single capital model fits decently for Southern and South-eastern Asia, the fit is still significantly worst than when we include intangible capital. These results already point towards the importance of the intangible capital in explaining firm value.

To show the importance of the country specific adjustment cost parameters, we perform a counterfactual exercise of assuming that all countries have the same adjustment cost parameter as the one for the US. With that assumption, the R^2, becomes negative, implying that the model fits worst than an horizontal line at the average. This result eludes to our find that adjustment costs vary significantly across country and regions. For the larger equity markets, the physical capital parameter goes from 0.42 for Japan to 7.08 for USA, with a cross country average of 3.42 and standard deviation of 1.63. Germany, UK and the India values are around that average, with estimated values of 4.64, 5.42 and 4.41 respectively. The intangible capital adjustment cost parameter is larger and more volatile than the physical capital one. The estimates range from 2.63 for Japan to 31.87 for China, with an cross country average of 11.56 and standard deviation of 6.54. The USA, UK and Canada are around that average, with estimated values of 16.84, 12.07 and 9.14. For regions, the figure is similar, with an average of 3.64 (12.66) and standard deviation of 2.08 (4.52) for physical (intangible).

Third, we find that intangible capital accounts for a large share of the market value of firms in all countries. For the per country estimation, the value of intangible capital is on average 53.15% of the firm market value. There is a large heterogeneity in the market share of intangible capital, ranging from 67.38% in USA and 35.60% in South Korea. Besides Sweden, top 5 intangible market share countries include France (65.22%), UK (64.37%), China(63.05%) and Israel (61.87%). For all countries, besides Germany and France, the cost of adjustment of intangible is higher than the cost of adjusting physical capital. On average, the adjustment cost of intangible is 3 times larger than the physical capital. This implies that the market shares of intangible capital are on average 18.30% higher than the book value (that assumes zero costs of adjustments). The picture is similar for per region estimation, with market share of intangible capital being 21.08% higher than book. Together, these results imply that intangible capital is a key input of production and value for firms across the world.

The geography-specific and capital-specific adjustment cost quantifies the quality of capital markets across countries. We take the deep parameters of geography-specific and capital-specific adjustment cost to construct the market share of intangible capital for each firm and each time point. Both the monthly Fama-Macbeth cross-sectional regression, and the annual Panel OLS regression confirms that the market share of intangible capital brings empirically significant positive risk premium for financial market investors. For firms locating in Asia, increasing 1% the market share of intangible capital, brings 0.072% additional return per year, while for firms locating in Asia, the slope of risk premium is 0.076% per year. These results imply that high adjustment cost of intangible capital from the poor quality of capital markets, leads to the time-varying risk-exposure toward the aggregate shocks across firms in the globe. For practice of asset management and wealth management across the globe, quantifying the market environment for intangible capital helps identify the risk-exposure toward the aggregate economic shocks accurately and timely.

Our work is closely related to the large literature on valuation and production based asset pricing, we focus our discussion on the part that also discusses intangible capital. (Belo et al., 2022) decomposition of the value of the firms in North America across physical capital, labor and two intangibles brand and knowledge capital. Taking the adjustment cost estimated in (Belo et al., 2022) to decompose the long-run evolution of firm valuation, (Crouzet and Eberly, 2021) explains the quantitative tension between physical investment rate and the firm valuation. Peters and Taylor (2017) incorporate organization capital into the measurement of a novel proxy for the Tobin's Q which explains total firm investment in physical and intangible capital better than standard proxies. Eisfeldt and Papanikolaou (2013) show that firms with more organization capital, a form of intangible capital, are riskier than firms with less organization capital. Hansen et al. (2012) study the risk characteristics of intangible capital. In international macro-finance, research on the cross-section of equity valuation is scarce. To our knowledge, our paper is the first attempt for accounting value of intangible capital in global economy.

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 empirical results. In Section 6 we discuss risk premium properties of intangible capital. 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 their notation whenever possible) with two quasi-fixed inputs. Time is discrete and the horizon infinite. Firms choose costlessly adjustable inputs (e.g., materials, energy) each period, 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^P_{it}) and the intangible capital stock (K^I_{it}). 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^P_{it}) and the investment in intangible capital (I^I_{it}).

The laws of motion of the firm's capital inputs are given by:

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

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

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 hiring, 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.[2] 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_{it}^{B} 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:

$$TCP_{it} = \Pi_{it} - I_{it}^{I} - \delta_{it}^{P}K_{it}^{P} - C_{it}.$$

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:[3]

$$D_{it} \equiv (1-\tau_t)[\Pi_{it} - C_{it} - I_{it}^{I}] - I_{it}^{P} + B_{it+1} - r_{it}^{B}B_{it} + \tau_t\delta_{it}^{P}K_{it}^{P} + \tau_t(r_{it}^{B}-1)B_{it}, \quad (3)$$

in which $\tau_t\delta_{it}^{P}K_{it}^{P}$ is the depreciation tax shield, and $\tau_t(r_{it}^{B}-1)B_{it}$ is the interest tax shield.

[2] 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.

[3] 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.

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 and labor given by equations (1).

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

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

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:

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

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:

$$q_{it}^P \equiv 1 + (1-\tau_t)\theta_P\left(\frac{I_{it}^P}{K_{it}^P}\right) \tag{11}$$

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

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.

3.2 Estimation Procedure

The valuation equation (5) links firm value to the value of its capital inputs. Since firm values are not necessarily stationary, it is useful to scale the variables in this equation for estimation purposes. Hence, we scale the variables in the equation by dividing them by the sum of the firm's capital inputs, which we denote as A_{it+1}, a measure of the firm's total (effective) sales. Accordingly, we write a firm's valuation ratio ($VR_{it} \equiv (P_{it} + B_{it+1})/A_{it+1}$) as:

$$VR_{it} = q_{it}^P \frac{K_{it+1}^P}{A_{it+1}} + q_{it}^I \frac{K_{it+1}^I}{A_{it+1}}. \tag{13}$$

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 point in time. However, due to 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 provide robust estimates when the data is noisy and is less sensitive, and hence more stable, to firm entry and exit, and to missing firm-level observations

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:

$$\overline{VR}_{jt} = \sum_i \frac{VR_{it}}{N_{jt}}$$

$$\widehat{\overline{VR}}_{jt}(\Theta) = \sum_i \frac{\widehat{VR}_{it}}{N_{jt}}\ ,\ i \in \text{portfolio } j,$$

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.[4]

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.[5] 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:

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

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.[6]

Finally, we compute Newey-West standard errors with lag equal to three years, to account for possible cross-sectional and time-series correlations.

[4]Arguably, our model is less appropriate for the valuation of superstar firms, such as Apple or Facebook, which are likely to derive a large part of their market value from features not captured by our model.

[5]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.

[6]To show this claim more formally, define the following variables: $\overline{VR}^{M}_{jt} = \frac{1}{N_{jt}} \sum_{i \in j} \frac{\left(P_{jt} + B_{jt+1} - K^{P}_{jt+1} - (1-\tau_t) K^{I}_{jt+1}\right)}{A_{jt+1}}$ (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).

3.3 Portfolio Sorts

As noted above, the estimation is performed at the portfolio-level, which requires the specification of a sorting variable to create the portfolios. To minimize the influence of a particular choice of sorting variable on the results, we consider several sorting variables. In addition, it is useful to sort on variables that are likely to generate a large dispersion in the RHS variables in equation (13), in order to span the state space and thus improve the identification of the model parameters. Accordingly, we form two sets of portfolios sorted on the following variables: $\left(\frac{I_{it}^P}{K_{it}^P}\right)\left(\frac{K_{it+1}^P}{A_{it+1}}\right)$, $\left(\frac{I_{it}^I}{K_{it}^I}\right)\left(\frac{K_{it+1}^I}{A_{it+1}}\right)$. Since these variables exhibit positive serial correlation, sorting on these variables is likely to generate a dispersion in the realized (i.e., after portfolio-formation) values of the RHS variables in equation (13). We then follow Fama and French (1993) in constructing the portfolios. Specifically, we sort all stocks 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 data appendix. Our goal is to compare the contribution of the different inputs across country, focusing on physical and intangible capital. We use place of incorporation for the country definition.[7]

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 located 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.[8]

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 overcome the sample size constrain, 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. In particular, we use the most detailed classification, the 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.

[7] For robustness check, we also consider defining the location of firm as the location of headquarter and results are similar.

[8] 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.

When estimating the parameters per region, we exclude the countries estimated individually so that they do not dominate the values. Hence, for 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 such as Canada, China, Japan, India, Australia are selected out. In Africa, Egypt and Zimbabwe are excluded because the hyperinflation generates inconsistent meaure of firm-level capital. The two Sub-regions *Northern Africa* and *Sub-Saharan Africa*are merged as *Africa* for sufficient observations inside the 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, Gahana, 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 Measurement

4.1.1 Physical Capital

The initial physical capital stock, K^P_{i0}, is given by net property, plant, and equipment (data item PPENT). The capital depreciation rate, δ^K_{it}, is the amount of depreciation (data item DP) divided by the beginning of the period capital stock.[9] 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^P_t) as $K^P_{t+1} = K^P_t(1-\delta_t)\frac{P^P_{t+1}}{P^P_{t+1}} + I_{t+1}$. Following Belo et al. (2022) we infer physical capital investment from the the law of motion of capital by inverting the previous law of motion of physical capital equation and solving for investment (accounting for inflation). This procedure guarantees that the investment and physical capital data are consistent with the law of motion for physical capital in the model.

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) and using the perpetual inventory method as follows:

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

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

[9] If the depreciation rate is greater than 1, we impute the rate as 1.

We set organization capital investment to be equal to 30% of SG&A expenditures following Peters and Taylor (2017). To implement the law of motion in equation (17) we must choose an initial stock and a depreciation rate. Using the perpetual inventory method, we set the initial stock to:

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

in which $I^I_{J,0}$ is the firm's investment in organization capital in the first year in the sample, and $\pi^K_{\text{Ind}(j)}$ is the average price growth rate, in the industry, in each country. We let $g^K_{\text{Ind}(j)}$ be industry-specific and set it equal to the average growth rate of the SG&A investments in that industry. We consider the first 2-digits of NAICS industry code to classify the industry in each country. As for the intangible depreciation rate, δ^I, we use 20% following the (Eisfeldt and Papanikolaou, 2013). Once we have the initial capital stock, we iterate forward using the appropriate 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 beginning of the period corresponding intangible capital stock I^I_t/K^I_t.

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 presents 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 analysis (country and region level) includes on average 17,069 firms per year whose sales represents 34.10% of the world GDP in 2020. The main equity markets represent the bulk of those numbers, with our 18 countries including and average of 13,698 firms per year whose sales represent 28.23% of world GDP in 2018. Furthermore, our main country has a diverse set of large equity markets, with countries per capital GDP in 2020 ranging from \$1,849 for India to \$58,148 for US. In Table 2 we present the regional statistics as an average of individual countries inside the region. A per country view for the regions is reported in Table A.1 in the Appendix. In this table we can observe that our regional analysis has even more diversity, with per capital GDP ranging from 1,447 for Pakistan to \$105,581 for Luxembourg.

In order to maximize the sample size for adjustment cost parameter estimation, we tailor the starting date to the country/region specific data availability. Column (1) of each table reports the starting point for each sample. The end date is always 2020.

4.3 Preview of the Firm Level Data

Table 3 and 4 reports 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 minimal 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/hiring 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 there is at least some independent variation in the shadow prices, and hence the market values, of the different capital inputs in the data.

5 Estimation Results

This section reports the main empirical findings. Subsection 5.1 reports the parameter estimates and model fit. In subsection 5.2 we display the estimates and model fit of the model assuming physical capital only. Subsection 5.3 discusses the model-implied firm value decomposition.

5.1 Parameter Estimates and Model Fit

For major equity markets Table 5, columns (1) and (2), reports the adjustment costs parameter estimates of the model. The estimates are all positive, and are statistically significant, which implies that we cannot reject the hypothesis that these inputs are subject to positive adjustment costs. Furthermore, while there is a large heterogeneity across countries, overall the adjustment cost parameters of intangible capital are higher than the physical. The cross country average adjustment cost for physical capital is $\theta_P = 3.42$ while the intangible adjustment averages $\theta_I = 11.56$.

There is higher across countries dispersion on the estimates of the adjustment cost of intangible than on the adjustment cost of physical capital. The standard deviation of the physical capital estimates across countries is 1.63, with estimates ranging from 0.42 for Japan to 7.08 for USA. The across countries standard deviation of the intangible capital estimates is 6.54, while this implies that there is a wide variability in this cost, there appears to be a regional patterns. The estimate of θ_I is relatively low in the European countries – like France (8.08), Germany (10.02) and the U.K. (9.14) – but high in North American countries like the United States (16.84) and Canada (12.07). The picture is less clear for Asia, with the estimates being low in Japan (2.63), South Korea (4.24) , Hong Kong (7.11) and Singapore (7.61), and high in China, India and Taiwan.

The model fit is good, both in the cross-sectional and in the time-series dimensions. Table 5 shows that the cross sectional R^2 is high, with an average of 66% across countries, even tough the model estimation does not explicitly targets this moment. The average time-series R^2 is 24%. In terms of average valuation ratio errors, the model scaled mean absolute error (m.a.e./$\overline{\text{VR}}$) is quite low, about 23% on average . Thus, the model is able to explain about 80% of the portfolio-level observed valuation ratios (the remaining 22% reflect, for example, measurement and misspecification errors).

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. One important reason behind the good performance of the model is the country specific adjustment cost parameter estimate. Columns (7) to (9) displays the model fit if we assume that the adjustment costs for all countries is equal to the estimates for the US ($\theta_P = 7.08$ and $\theta_I = 16.84$). The estimated R^2 is negative for a wide range of countries, implying that the sample average provides a better fit. This should come at no surprise as the adjustment cost, specially for intangible capital varies so much across countries.

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 and for most regions we can reject the hypothesis that these parameters are zero. The exception is the physical capital adjustment cost estimate for Northern Africa and Eastern Europe. The patterns are similar to the ones in the main equity markets. The intangible capital is consistently more costly to adjust than the physical capital. The across region average adjustment cost parameter for physical capital is 3.64 while for intangible capital is 12.66. There is higher across region dispersion on the adjustment parameter for intangible with standard deviation equal to 4.52 while the deviation of physical is 2.08.

The model fit is also good across regions. Table 5 shows that the cross sectional R^2 is high, with an average of 62% across regions and the time-series R^2 of 31%. In terms of average valuation ratio errors, the model scaled mean absolute error (m.a.e./$\overline{\text{VR}}$) is quite low, about 22% on average across regions. North Europe have particular good fit, with cross sectional R^2 above 81 and time-series above 37. Again, columns (7) to (9) display the model fit when we assume US parameters, the fit declines significantly.

Overall, the estimation results show that adjustment costs of the inputs vary across countries and regions, specially for intangible capital. Furthermore, once we assume the country/region specific adjustment cost parameters, the Q-model fits the firm level data very well.

5.2 Physical Capital Only Model

To help understand the fit of the model and the relative importance of the various capital inputs for firm valuation, Tables 7 and 8 reports the parameter estimates and model fit across a restricted version of the model where we use physical capital only. To provide a meaningful comparison of the model fit in terms of R^2, we use the same set of firms in the estimation (the sample used for the estimation of the baseline model), and the observed valuation ratio of each firm is the same.

The standard one-physical-capital input model is a natural benchmark. Comparing the adjustment cost estimated in the single capital input to the one in Table 5, we observe that the estimated adjustment cost parameter of physical capital is significantly larger, with an across country average of 11.25 and dispersion of 4.67. These results imply that the estimates of physical capital adjustment are likely capturing some of the intangible capital adjustment. The model fit results displayed in columns (3) to (5) show that the eliminating intangible capital significantly hinders the performance of the Q model. While the model fits decently for some countries, like Canada and Australia, the fit is significantly worst when compared to the baseline that includes intangible capital.

The per region estimation of the physical capital only model presented in Table 8 tell a similar story, with higher physical capital adjustment cost parameters and worst fit. Overall, these results point out the importance of the inclusion of intangible capital inputs for the good performance of the model. Hence, in the next sub-section we discuss the market value of intangible and physical capital.

5.3 The Value of Intangible and Physical Capital

The parameter estimates allow 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, for each firm and in each year, the values of $q_{it}^P \frac{K_{it+1}^P}{A_{it+1}}$ and $q_{it}^I \frac{K_{it+1}^I}{A_{it+1}}$, that is, the model-implied scaled value of each capital input. We then substitute these values in equations (8) to (9) to compute, in each year, the share of the firm's value attributed to each capital input (input-shares)[10]

To characterize the data in a comprehensive yet parsimonious manner, we summarize the properties of the firm-level input-shares in the economy by compute in each year and for each input, the cross-sectional median input-shares, and report the time series mean of these input-shares for each input, properly adjusted to add up to 100%.[11]

Table 9 column (1) shows that intangible capital is an important determinants of firms' market values across all countries. The across country average market share of intangible capital is 53.15% . There is significant heterogeneity across countries on this value, with the cross country dispersion of 9.78. While USA sits on top of the intangible market share, with about 67.38% of the market valuation coming from it, South Korea is on the bottom with 35.69. Large economies, like UK and China have above average intangible capital market shares, with respectively 64.37% and 63.05%. Since all the value is split between physical and intangible, the remaining market valuation is attributed to physical capital. Figure 1visualize the intangible market share across all countries in our sample. The darkness of color illustrates the magnitude of intangible market share. As shown in Figure 1, the Nothern 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.

[10] Note that, with this procedure, the input-shares add up to 100% by construction. This does not mean that the model explains the entire variation of the firm's value without any error. Thus, our analysis here provides a decomposition of the firm value that is explained by the model.

[11] An adjustment is required here because if we compute directly the cross-sectional median share of each input and report the time-series mean of these input-shares, the sum of the shares does not add to 100% because the medians are not additive. Thus, we proceed as follows. First, in each year, we compute the median scaled value of each input (for example, for physical capital, this corresponds to the cross sectional median of $q_{it}^P \frac{K_{it+1}^P}{A_{it+1}}$), then we compute the implied median total firm value as the sum of the median value of each input, and finally we compute the corresponding input-shares as the ratio of the median scaled values of each input as a fraction of the total median firm value. We then report the time-series mean of this measure for each input.

Turning to the analysis across regions the results reported in Table 10 column (1), show that the importance of the intangible capital is present also for those countries. The cross region average is 53.61%. Overall, this analysis shows that the intangible capital inputs are important determinants of firms' market values across the world. Next we discuss the magnitude and importance of relative adjustment costs in these share estimates.

5.3.1 Implied Adjustment Costs

To assess whether the model fits the data with economically reasonable parameter values, and also to better understand the relatively high importance intangible capital inputs for firm value, we use the parameter estimates to characterize the implied adjustment costs of each input. Thus, to understand the firm value decomposition estimates, here we evaluate the economic magnitude of the adjustment costs of the two inputs across the major economies and regions.

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:

$$\frac{CP_{it}}{Y_{it}} = \frac{\frac{\theta_P}{2}\left(\frac{I^P_{it}}{K^P_{it}}\right)^2 K^P_{it}}{Y_{it}} \tag{19}$$

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

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 6.24% of annual sales. This cost is, for most major equity markets, higher than the adjustment costs for physical capital, which average about 2.22% of sales. China stands out as having the highest adjustment cost of intangible capital, followed by US. For physical capital, US and European countries UK topping the list.

Table 10 shows the numbers for regions, with cross region average intangible capital adjustment cost at 5.25% 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 1.67% 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 they contribute not only for production but also allow the firm to 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 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) shows the book share of intangible capital. Compared to the 53.15% average cross country market share, the cross country average book share is for the major equity markets, about 34.85%. China stands out with a 21.02% book share of intangible capital versus a 63.05% 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 67.38% and in the UK 56.16% to 64.37%).

From the quantity channel, if the book share is high, we shall witness the high market share. This is true for United Kingdom and developed European countries. From the valuation channel, if the intangible capital investment is costly, we also witness the high market share. This is true for East Asia. The intangible investment cost θ_I is highest in China, in our whole sample. On the other hand, the adjustment cost parameter of intangible capital is very low in Japan. As the result, we observe that the difference between book and market value of intangible capital is very high in China, but relatively low in Japan (book at 38.52% and market at 48.15%). We also observe this fact in South Korea where the adjustment cost parameter of intangible capital is also small positive number.

6 Risk-Premium of Intangible Capital

Intuitively, the productivity of the capital inputs should not be perfectly correlated, so the valuation of physical capital and the valuation of intangible capital have a differential exposure toward aggregate productivity shocks (the source of systematic risk in the economy in most equilibrium neoclassical models of the firm). On the other side, the duration of physical capital and that of intangible capital are different, so the valuations have different exposure toward the common discount rate shock. Overall, the valuation of physical capital and that of intangible capital can have different composition of risk premiums.

We observe the cyclical fluctuation in firm investment, especially the investment rate of physical capital. Naturally, the composition of firm valuation has cyclical fluctuation. As such, the fluctuation in composition of firm valuation implies the time-varying risk-loading toward the common productivity shock and discount rate shock. If the investors know the true model in 13, she can decompose the firm valuation in each time period, to obtain the time-varying composition of risk premiums. In other words, the share of intangible capital in the firm valuation would help investors predict the expected return for a specific firm.

The estimation in Table 5 and Table 6 allows us to trace the time-varying risk-premium across firms using the market-share of intangible capital, which is a "deep firm-characteristics". Table 11 tests whether the intangible capital generates different amount of risk-premium, compared with the physical capital. Formally, we use Fama-Macbeth 2nd step regression, and the Pooled OLS regression to estimate the risk premium from the intangible capital.

$$r^e_{i,t} = a + \lambda \times \mu_{I,t-1} + \gamma \times \vec{Z}_{i,t-1} + e_{i,t}. \tag{21}$$

As illustrated in Table 11, the estimate of coefficients λ is statistically positive as 0.072 in the Annual cross-sectional regressions. Quantitatively, as the market share of intangible capital μ_I increases by 1%, the anual expected return increases by 0.072%. The estimated risk-premium of intangible capital λ is particularly high for the firms locating in Asia, as illustrated in Column (5) and Column (8) of Table 11.

7 Conclusion

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 24% and a cross-sectional R^2 of 65%. For the region estimation, the model also has good explanatory power, with an cross region average time-series R^2 of 30% and a cross-sectional R^2 of 61%.

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. The model performs well in explaining both cross-sectional and time-series variation in firms' market values across major equity markets, with a time-series R^2 of 24% and a cross-sectional R^2 of 66%. The model also performs well for regions with an average cross region average time-series R^2 of 31% and a cross-sectional R^2 of 62%.

We find that the importance of the intangible capital for firm value varies across countries and regions and is substantial, ranging from 35.60% to 67.38%. 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 allowing firms to extract some rents as compensation for the cost of adjusting the inputs. The adjustment cost of intangible capital is higher and more volatile than physical capital. Furthermore, for intangible capital the adjustment cost estimates are heterogeneous across countries and this heterogeneity is important to produce a good model fit. The characterization of the adjustment cost function of each input for different countries and regions can be useful to guide future research with models featuring intangible capital in international finance and economics.

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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 (1)	Firms (2)	$\frac{Y}{GDP}$ (%) (3)	$\frac{VA}{GDP}$ (%) (4)	Per Capita (USD) (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 (7) to (9) 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_K		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)	(9)
Australia		2.54	11.20	2006	0.58	0.31	0.24	-3.81	-2.06	0.48
	s.e.	[0.37]	[0.80]	2004	0.59	0.25	0.24			
Canada		3.37	12.07	2006	0.90	0.42	0.21	-1.91	-1.23	0.44
	s.e.	[0.26]	[0.78]	2000	0.90	0.44	0.20			
China		4.29	31.87	2006	0.19	-0.03	0.31	-0.81	-0.41	0.36
	s.e.	[0.91]	[3.29]	2001	0.16	0.07	0.32			
France		4.94	8.08	2007	0.63	0.12	0.23	-5.62	-2.89	0.54
	s.e.	[0.75]	[0.69]	2007	0.63	0.12	0.23			
Germany		4.64	10.02	2006	0.73	0.18	0.26	-1.41	-0.92	0.46
	s.e.	[1.23]	[1.27]	2006	0.73	0.18	0.26			
Hong Kong		2.31	7.11	2006	0.72	0.28	0.26	-12.84	-4.56	0.81
	s.e.	[0.37]	[0.69]	2002	0.82	0.26	0.27			
India		4.41	19.43	2006	0.73	0.19	0.28	0.81	0.11	0.30
	s.e.	[0.46]	[1.28]	2001	0.89	0.30	0.29			
Indonesia		4.58	14.26	2006	0.82	0.41	0.22	0.74	0.31	0.24
	s.e.	[0.59]	[1.44]	2000	0.92	0.49	0.26			
Israel		2.35	9.45	2008	0.46	0.08	0.26	-9.93	-3.75	0.59
	s.e.	[0.32]	[0.69]	2008	0.46	0.08	0.26			
Japan		0.42	2.63	2006	0.20	0.07	0.18	-125.41	-36.92	1.34
	s.e.	[0.42]	[0.39]	2000	0.28	0.07	0.18			
Malaysia		2.35	12.30	2006	0.70	0.20	0.19	-3.08	-1.96	0.38
	s.e.	[0.55]	[1.08]	2002	0.74	0.21	0.18			
Poland		3.44	4.54	2007	0.77	0.23	0.28	-34.04	-4.76	0.90
	s.e.	[0.66]	[0.50]	2007	0.77	0.23	0.28			
Singapore		1.21	7.61	2006	0.62	0.23	0.25	-38.64	-8.38	0.96
	s.e.	[0.37]	[0.55]	2002	0.70	0.23	0.24			
South Korea		1.13	4.24	2006	0.56	0.28	0.13	-56.45	-18.62	0.87
	s.e.	[0.25]	[0.45]	2000	0.66	0.32	0.20			
Taiwan		3.67	15.70	2006	0.77	0.13	0.18	-0.83	-0.69	0.24
	s.e.	[0.41]	[0.92]	2001	0.84	0.21	0.19			
Thailand		3.33	11.60	2006	0.74	0.24	0.23	-3.25	-0.75	0.36
	s.e.	[0.57]	[1.26]	2000	0.81	0.35	0.24			
UK		5.42	9.14	2006	0.83	0.47	0.19	-1.35	-0.64	0.36
	s.e.	[0.55]	[0.73]	2000	0.88	0.45	0.21			
USA		7.08	16.84	2006	0.87	0.59	0.17	0.87	0.59	0.17
	s.e.	[0.68]	[0.89]	2000	0.91	0.55	0.18			
Summary of Point Estimation, Model Fitness										
	Average	3.42	11.56		0.66	0.24	0.23	-16.50	-4.86	0.54
	S.E.	1.63	6.54		0.20	0.15	0.05	30.74	8.92	0.30

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 (1)	θ_I (2)	(3)	XS-R^2 (4)	TS-R^2 (5)	$m.a.e./\overline{VR}$ (6)	XS-R^2 (7)	TS-R^2 (8)	$m.a.e./\overline{VR}$ (9)
Southern Asia		3.10	19.43	2006	0.94	0.62	0.17	0.82	0.46	0.19
	s.e.	[0.47]	[0.99]	2006	0.94	0.62	0.17			
South-eastern Asia		2.72	13.68	2006	0.43	0.13	0.25	-0.15	-0.22	0.33
	s.e.	[0.80]	[1.53]	2000	0.43	0.13	0.25			
Western Asia		5.19	20.05	2006	0.12	0.09	0.23	0.16	0.06	0.23
	s.e.	[0.98]	[2.11]	2004	-0.83	-0.08	0.26			
Eastern Europe		0.66	4.80	2009	0.48	0.10	0.22	-22.90	-6.05	0.76
	s.e.	[0.30]	[0.48]	2009	0.48	0.10	0.22			
Northern Europe		3.28	12.57	2006	0.81	0.37	0.24	-0.36	-0.30	0.36
	s.e.	[0.50]	[0.74]	2000	0.85	0.36	0.26			
Southern Europe		2.68	11.64	2006	0.71	0.40	0.25	-0.52	-0.32	0.39
	s.e.	[0.53]	[0.90]	2004	0.73	0.41	0.25			
Western Europe		4.62	11.40	2006	0.58	0.19	0.27	-0.96	-0.44	0.37
	s.e.	[0.78]	[1.12]	2002	0.66	0.21	0.29			
Africa		8.36	11.86	2006	0.65	0.42	0.20	-0.90	0.21	0.24
	s.e.	[0.98]	[0.89]	2006	0.65	0.42	0.20			
L.Amer. & Carib.		2.17	8.51	2006	0.84	0.50	0.17	-4.36	-2.84	0.52
	s.e.	[0.35]	[0.91]	2000	0.86	0.49	0.21			
Summary of Point Estimation, Model Fitness										
	Average	3.64	12.66		0.62	0.31	0.22	-3.24	-1.05	0.38
	S.E.	2.08	4.52		0.24	0.18	0.03	7.08	1.98	0.17

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	7.05	0.66	-2.25	-1.30	0.47	10.20
Canada	7.61	0.51	-1.38	-1.12	0.44	7.33
China	16.40	0.86	-1.97	-1.23	0.46	6.70
France	15.38	1.03	-1.53	-1.81	0.45	10.66
Germany	15.58	0.93	-0.32	-0.74	0.38	10.10
Hong Kong	7.33	0.45	-0.53	-0.55	0.39	3.76
India	12.37	0.94	-2.36	-1.38	0.52	2.27
Indonesia	12.34	0.73	-0.69	-0.49	0.35	2.88
Israel	7.59	0.74	-4.47	-2.34	0.52	8.88
Japan	6.56	0.44	-3.41	-2.10	0.33	2.25
Malaysia	11.25	0.49	-0.07	-1.13	0.31	3.46
Poland	8.59	0.54	-2.60	-0.50	0.42	2.22
Singapore	6.53	0.37	-0.59	-0.76	0.38	3.02
South Korea	5.61	0.35	-3.94	-1.61	0.27	1.32
Taiwan	12.37	0.51	-1.90	-1.74	0.35	4.50
Thailand	10.27	0.52	-1.18	-0.71	0.34	4.45
UK	15.68	0.82	-1.16	-1.00	0.41	11.08
USA	24.03	1.25	-1.20	-1.07	0.42	20.59
Summary of Point Estimation, Model Fitness, Adjustment Cost						
Average	11.25		-1.75	-1.20	0.40	6.43
S.E.	4.67		1.21	0.53	0.07	4.72

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	11.60	1.21	-0.55	-0.67	0.34	2.87
South-eastern Asia	6.90	1.05	-2.17	-0.71	0.46	2.35
Western Asia	15.01	0.86	-2.08	-1.03	0.37	7.58
Eastern Europe	3.68	0.66	-6.94	-1.70	0.41	2.01
Northern Europe	14.35	1.00	-1.24	-1.18	0.49	11.22
Southern Europe	9.54	0.68	-0.94	-0.56	0.42	4.57
Western Europe	14.99	0.98	-1.09	-0.85	0.40	8.64
Africa	24.05	1.38	-4.37	-0.93	0.40	6.90
L.Amer. & Carib.	7.25	0.40	-0.57	-0.86	0.35	2.54
Summary of Point Estimation, Model Fitness, Adjustment Cost						
Average	11.93		-2.22	-0.94	0.40	5.41
S.E.	5.70		2.01	0.32	0.05	3.12

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	54.76	9.17	4.13	33.47
Canada	35.72	5.27	3.55	16.99
China	63.05	17.64	1.77	21.02
France	65.22	8.02	4.00	57.01
Germany	61.47	7.34	3.51	48.70
Hong Kong	59.31	4.44	1.32	44.34
India	54.42	3.77	0.85	27.12
Indonesia	40.62	4.95	1.09	18.95
Israel	61.87	5.24	3.20	44.60
Japan	48.15	1.50	0.17	38.52
Malaysia	47.71	4.83	0.76	24.02
Poland	45.94	2.49	0.98	34.78
Singapore	54.81	3.73	0.63	36.63
South Korea	35.60	1.93	0.29	22.78
Taiwan	52.33	6.07	1.53	26.88
Thailand	43.95	6.07	1.62	23.56
UK	64.37	6.88	4.17	56.16
USA	67.38	13.01	6.41	51.81
Summary of Market Share, Adjustment Cost, Book Share				
Average	53.15	6.24	2.22	34.85
S.E.	9.78	3.84	1.69	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	39.75	4.60	0.82	13.27
South-eastern Asia	49.31	4.75	0.88	23.47
Western Asia	53.48	5.58	2.39	24.86
Eastern Europe	42.97	1.70	0.21	30.32
Northern Europe	70.78	8.67	2.98	54.79
Southern Europe	56.65	6.57	1.41	34.64
Western Europe	60.89	8.13	3.05	45.05
Africa	59.80	4.11	2.56	36.06
L.Amer. & Carib.	48.85	3.16	0.72	30.33
Summary of Market Share, Adjustment Cost, Book Share				
Average	53.61	5.25	1.67	32.53
S.E.	9.08	2.13	1.02	11.50

Table 11: Firm-level stock return predictability regressions

The table below reports the estimation results from stock return predicatability regressions of the form:$r^e_{i,t+1} = a + \lambda \times \mu_{I,t} + e_{i,t+1}$, in which the $r^e_{i,t+1}$is the firm-level firms's compounded annual excess stock return in the next fiscal year., $\mu_{I,t}$ is the available market share of intangible capital calculated using the parameters from Table 5 and Table 6. The sample is from Jan 2006 to Dec 2018. 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 variables are winsorized with [5%,95%], by year and country (region) in Table 5 and Table 6. Columns (1) report 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 the set of firm-level variables related with cross-section anomalies**.** Columns (3) to (4) report the estimated slope coefficientes in the previous equation obtained by pooled OLS regressions. Column (3) includes the industry, the country, and year fixed effects. Column (4) includes the set of set of variables related with cross-section anomalies. In Columns (3)-(4), the standard error of pooled OLS regression is clustered at the firm-level and year-level. Columns (5)-(7) reports the estimation reasults per major region using the identical specification and methods with Column (1). Columns (8)-(10) reports the estimation reasults per major region using the identical specification and methods with Column (3). Columns (5) and (8) **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 (6) and (8) **North America** uses the subsample of firms located in North America, with homecountry as Canada or U.S.; Columnd (7) and (10) **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, 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					
	Cross-sectional		Pooled		Cross-sectional			Pooled		
	(1)	(2)	(3)	(4)	(5) Asia	(6) N.Amer.	(7) Europe	(8) Asia	(9) N.Amer.	(10) Europe
MarketShare	0.072***	0.068***	0.0858**	0.0960***	0.076***	0.054***	0.053***	0.109**	0.112***	0.158***
-Intangible	(0.016)	(0.015)	(0.0304)	(0.0278)	(0.025)	(0.020)	(0.012)	(0.0409)	(0.0338)	(0.0352)
Anomaly	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SIC-2 FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	-	-	Yes	Yes	-	-	-	Yes	Yes	Yes
Obs.	11954	11954	152248	152248	7490	1679	2048	96211	20733	26005
Adj-R^2	0.118	0.253	0.055	0.067	0.292	0.217	0.284	0.081	0.076	0.076

B Figures

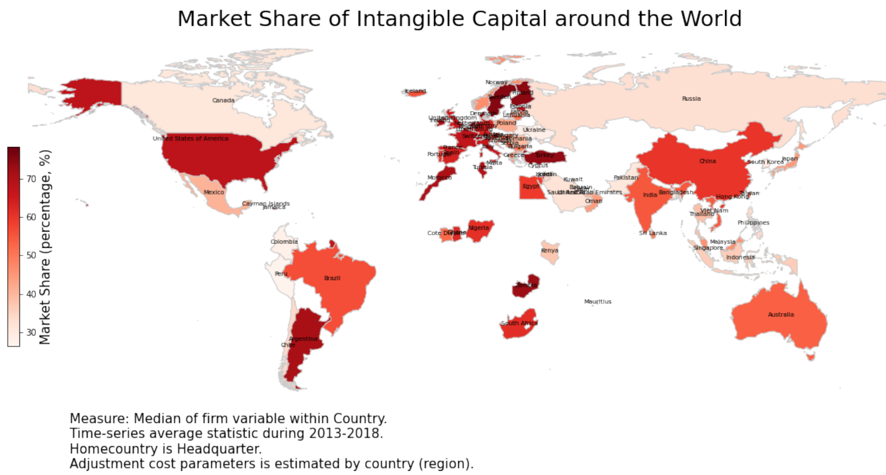

Figure 1: Contribution of Intangible Capital in Firm Value across Globe

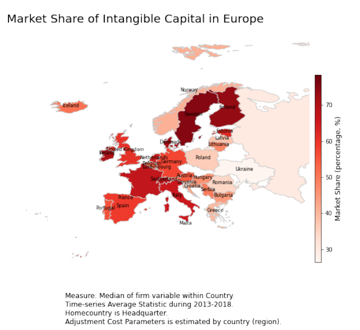

Figure 1: (a) Europe

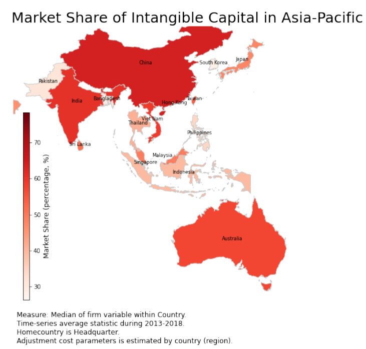

Figure 1: (b) Asia-Pacific

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 14. The statistic for the 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 2013 to the year 2018, 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.

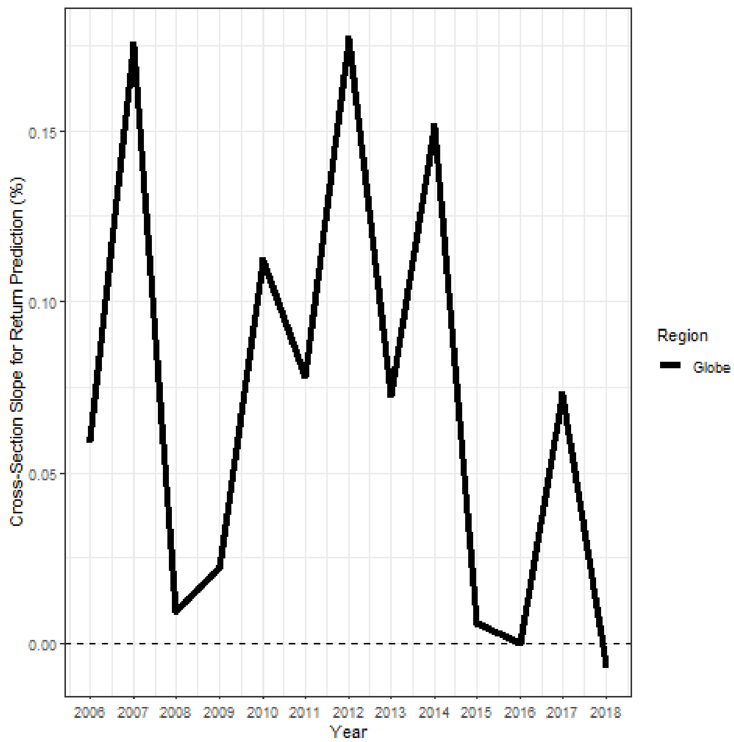

Figure 2: Fama-Macbeth Regression Slope

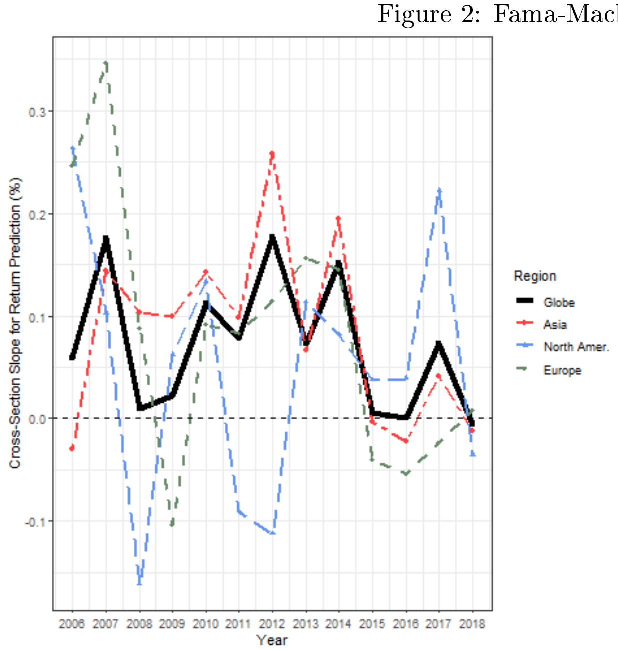

Figure 2: (a) Major Regions

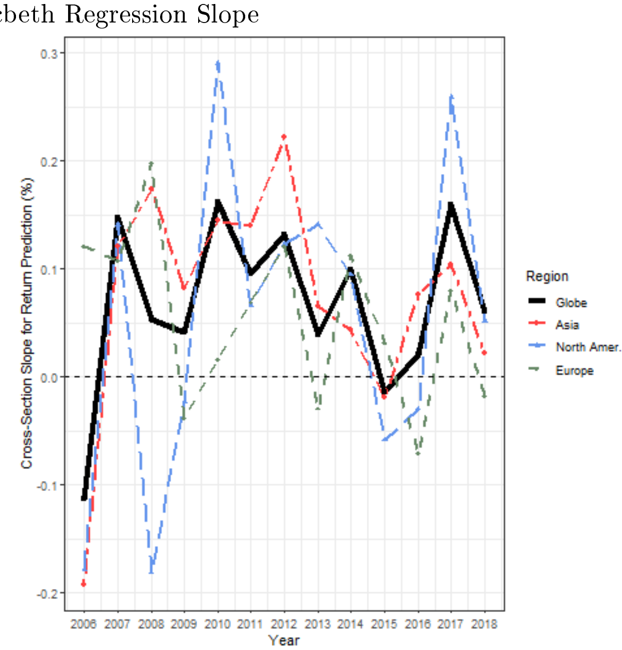

Figure 2: (b) Anomaly Controlled

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 2plots the slope of cross-section slope for Columns (5)-(7) in Table 11, using the benchmark sample during 2006-2018: 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 2plots the cross-section slope, after including the anomaly control.

C Additional Tables

Table 12: 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 12: 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 13: 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 13: 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 14: Capital Accounting: Share of Intangible

	Market Share	Adjustment Cost		Book Share
	Market μ_I	c_I (% sales)	c_P (% sales)	Book $\overline{\mu}_I$
Morocco	60.56	7.03	3.82	43.56
Tunisia	62.48	1.82	2.69	42.47
Cote Divoire	50.66	5.42	1.73	25.69
Ghana	52.68	6.24	2.55	30.45
Kenya	40.04	5.39	3.60	25.21
Mauritius	78.00	3.73	5.64	38.26
Nigeria	54.03	3.88	1.27	30.35
South Africa	66.24	4.00	2.18	46.36
Zambia	85.89	4.42	9.83	30.73
Argentina	72.12	0.72	2.08	64.40
Brazil	60.12	2.73	1.14	41.00
Cayman Islands	50.16	4.57	1.48	29.17
Chile	39.06	3.70	0.57	21.67
Colombia	29.99	2.26	0.90	15.27
Jamaica	72.96	5.08	0.72	56.05
Mexico	46.66	4.09	0.66	27.96
Peru	26.63	2.96	0.61	14.25
Bangladesh	33.13	5.88	0.77	9.75
Sri Lanka	51.46	9.78	0.73	20.01
Pakistan	35.38	2.61	0.92	12.03
Philippines	37.33	7.03	2.30	16.75
Viet Nam	55.88	4.19	0.67	28.79
United Arab Emirates	45.91	11.28	6.07	19.35
Bahrain	38.82	9.00	8.99	21.65
Cyprus	50.32	8.51	2.95	24.01
Jordan	40.42	7.08	0.76	16.72
Kuwait	47.31	9.55	8.25	21.66
Oman	48.12	12.67	6.18	19.89
Palestine	52.84	10.80	2.34	26.77
Qatar	27.23	11.75	29.39	8.95
Saudi Arabia	38.17	8.84	1.75	12.85
Turkey	77.88	2.81	2.39	37.62

Table 14: 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	64.45	7.40	1.61	40.41
Greece	48.92	5.34	0.83	26.23
Croatia	48.84	4.29	0.86	28.58
Italy	66.98	7.91	1.87	45.68
Malta	34.24	10.98	3.12	17.40
Portugal	64.61	6.16	1.64	42.57
Serbia	55.42	4.32	0.67	31.68
Slovenia	44.77	1.53	1.09	27.09
Bulgaria	51.85	2.75	0.15	36.80
Hungary	52.20	2.02	0.37	38.13
Romania	47.56	3.78	0.19	31.73
Russia	37.82	1.05	0.59	27.49
Ukraine	37.90	0.81	1.18	28.16
Denmark	74.16	10.46	2.15	54.17
Estonia	65.16	4.48	0.87	45.76
Finland	76.68	6.73	1.82	59.06
Ireland	71.43	10.05	2.98	55.02
Iceland	54.30	7.25	6.89	36.80
Lithuania	52.02	4.16	1.30	34.76
Latvia	53.00	6.45	1.84	27.18
Norway	50.09	6.70	4.29	27.14
Sweden	77.74	10.46	3.32	63.05
Austria	59.27	7.10	2.55	40.42
Belgium	58.95	6.30	2.63	38.89
Switzerland	68.33	9.74	2.61	53.36
Luxembourg	43.82	4.79	2.92	27.17
Netherlands	65.66	7.56	3.31	51.35

Table 15: Firm-level stock return predictability regressions - Major Regions

The table below reports the estimation reasults for each major regions using the identical specification in Column (2) and Column (4) in Table 11. Estimation excludes the set of variables related with cross-section anomalies. Definitions of major regions are identical with Table 11. The table below reports the estimation reasults by each major regions using the Method of pooled OLS regressions and the identical specification in Column (3) and Column (4) in Table 11. Columns (1)-(3) reports the time-series average slope from the Cross-sectional regressions. Newey-West 3 lagged standard errors are reported. Columns (4) -(6) reports the slope from the Pooled OLS regressions. The standard error of OLS regression is clustered at the firm-level and year-level. 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.

	Cross-sectional			Pooled OLS		
	(1) Asia	(2) North Amer.	(3) Europe	(4) Asia	(5) North Amer.	(6) Europe
MarketShare	0.083***	0.051*	0.082***	0.0899*	0.0764*	0.126***
-intangible	(0.028)	(0.030)	(0.031)	(0.0420)	(0.0422)	(0.0383)
Anomaly Controlled	No	No	No	No	No	No
SIC-2 FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	-	-	-	Yes	Yes	Yes
Obs.	7490	1679	2048	96211	20733	26005
Adj-R^2	0.151	0.053	0.129	0.065	0.065	0.065

Table 16: Firm-level stock return predictability regressions - Rest of World

The table below reports the estimation reasults for the Rest of World using the Fama-Macbeth cross-sectional regressions and the identical specification in Column (1) and Column (2) in Table 11. Columns (1)-(3) have identical specification with the Columns (5)-(7) in in Table 11. Columns (4)-(6) exclude the set of variables related with cross-section anomalies**.** Column (1) and (4) **Latin America** uses the subsample of firms located in countries of Latin America and the Caribbean; Column (2) and (5) **Africa** uses the subsample of firms located in countries of Sub-Saharan Africa and Northern Africa. Column (3) and (6) **Australia** uses the subsample of firms located in Australia. P-value of t-stat are indicated using * for $p<0.10$, ** for $p<0.05$, *** for $p<0.010$.

	(1) L. Amer.	(2) Africa	(3) Aus.	(4) L. Amer.	(5) Africa	(6) Aus.
MarketShare	0.089**	0.178***	−0.032	0.096***	0.028	0.021
-intangible	(0.042)	(0.029)	(0.028)	(0.019)	(0.020)	(0.045)
Anomaly	Yes	Yes	Yes	No	No	No
SIC-2 FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	276	246	291	276	246	291
Adj-R^2	0.400	0.429	0.333	0.156	0.115	-0.008

Table 17: Firm-level stock return predictability regressions - Rest of World

The table below reports the estimation reasults for the Rest of World using the Method of pooled OLS regressions and the identical specification in Column (3) and Column (4) in Table 11. Columns (1)-(3) has identical specification with the Columns (8)-(10) in in Table 11. Columns (4)-(6) exclude the set of variables related with cross-section anomalies. Definition of regions is identical with Table 16 P-value of t-stat are indicated using * for $p<0.10$, ** for $p<0.05$, *** for $p<0.010$.

	(1) L. Amer.	(2) Africa	(3) Aus.	(4) L. Amer.	(5) Africa	(6) Aus.
MarketShare	0.0676	0.0717*	0.0704	0.0898	0.0623*	0.102
-intangible	(0.0553)	(0.0377)	(0.0741)	(0.0603)	(0.0332)	(0.0741)
Anomaly	Yes	Yes	Yes	No	No	No
SIC-2 FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	3145	2688	3464	3145	2688	3464
Adj-R^2	0.215	0.102	0.061	0.212	0.095	0.045