THE RETURN TO CAPITAL IN CAPITAL-SCARCE COUNTRIES*

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Abstract

Capital flows from rich (capital-abundant) to poor (capital-scarce) countries fall short of what neoclassical theory predicts. In this paper, we use firm-level data to investigate the link between the marginal product of capital and financial rates of return across countries. Computed estimates from financial statement data show that capital-scarce countries display higher marginal products of capital. However, inflation-adjusted financial returns are roughly equal across capital-scarce and capital-abundant countries. The divergence between the marginal products of capital and financial returns implies that there may be little incentive for capital to flow to capital-scarce countries. We suggest that domestic capital-accumulation frictions such as sufficiently large capital adjustment costs can decouple financial rates of return from the marginal product of capital across countries.

Keywords: Marginal Product of Capital, Financial Returns, Lucas Paradox, Firm-Level Data

JEL classifications: E13, F49, G32, O16

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1 Introduction

The neoclassical model predicts that poor countries (capital-scarce) will have a higher rate of return to capital than rich countries (capital-abundant). Accordingly, scholars expend considerable effort trying to understand why capital does not flow from rich to poor nations (Lucas, 1990; Alfaro, et al., 2008; and Reinhart and Rogoff, 2004). An emerging body of empirical work based on national income accounts suggests that the neoclassical predictions about capital scarcity and higher rates of return do not hold up in the macro data. The marginal product of capital is apparently no higher in poor countries than it is in rich ones (Caselli and Feyrer, 2007, and Gourinchas and Jeanne, 2013). If recent empirical studies are accurate then it is unsurprising that capital does not flow from rich to poor countries; with equalized marginal products, it has little incentive to do so.

In this paper, we investigate the link between the marginal product of capital and financial rates of return in emerging and developed economies. In a one-sector neoclassical model, a firm's first-order condition states that the marginal product of capital (MPK_t) and the financial return (r_t) should differ only by the depreciation rate (δ), which is often assumed constant across countries ($r_t = MPK_t - \delta$). Therefore, theory predicts that high financial returns and high marginal products of capital should go hand in hand. If this link breaks down (i.e., if a high marginal product of capital does not turn into high financial returns), it is not clear that capital ought to flow to countries with high marginal products of capital.

Notwithstanding the significance of this first-order condition that lies at the heart of the Lucas Paradox, aggregate data pose limitations for testing its validity. In this paper, we use firm-level accounting and stock market data from a set of developed and emerging countries between 1997 and 2014 to examine the link between the marginal product of capital and financial returns. Much of the international macro literature imputes an aggregate marginal product of capital using calibration techniques. The imputations rely on underlying assumptions about functional form, such as technology, capital shares, and elasticities of substitution. The innovation in Caselli and Feyrer (2007) was to measure the aggregate return on capital using national income accounts instead of relying on calibration. In general, however, delivering the finding that marginal products of capital are essentially the same across rich and poor countries requires adjustments for (i) the capital per effective worker and a human capital externality (Lucas, 1990), (ii) non-reproducible capital and the price of capital goods (Caselli and Feyrer, 2007), or (iii) technology catch-up and distortions in saving and investment decisions (Gourinchas and Jeanne, 2013).

Our paper offers an alternative approach to measuring the return to capital using micro data. In contrast to previous literature about the return to capital that uses (i) calibrated estimates, or (ii) aggregate data, we directly compute rates of return at the firm level and aggregate them up to produce estimates of country-level rates of return. Inspite of the centrality of firm productivity in macroeconomic modelling, the link between accounting earnings and the macroeconomy remains relatively unexplored (Konchitchki and Patatoukas, 2014). The paper therefore contributes to a recent body of literature that uses firm-level accounting data to draw macroeconomic insights.

Our main finding is that the link between the marginal product of capital and the financial return, which is often assumed in the international capital flows literature, does not hold for a sample of developed and emerging countries between 1997 and 2014. Consistent with predictions from the neoclassical framework, the results show that firm marginal products of capital are indeed higher in emerging countries relative to their developed market counterparts. The evidence suggests an inverse correlation between marginal products of capital and per capita levels of output per worker. The pattern is robust to controlling for firm- and industry-specific effects and remarkably consistent across different sample periods and countries.

The neoclassical model also implies that the higher marginal product of capital should translate to higher financial returns in emerging markets. Contrary to this prediction, we find that inflation-adjusted financial returns are roughly equal between developed and emerging countries. The result is significant as it casts new light on the use of differences in the marginal products of capital to explain international capital flow patterns. The firm-level evidence using computed estimates suggests that the marginal product of capital might not be a valid proxy for financial returns. The divergence between marginal products of capital and investment returns is consistent with the capital wedge documented in Gourinchas and Jeanne (2013).

In addition, the results confirm the view that there is no prima facie evidence that international credit frictions play a major role in preventing capital flows from rich to poor countries (Caselli and Feyrer, 2007). If marginal product of capital differentials correctly translate to higher financial returns in emerging markets, then the shortfall in the capital flow to these countries points to international capital market frictions and investment barriers. However, if financial returns are equalized across developed and emerging countries, an alternative hypothesis may be that there is little incentive for capital to flow to less-developed countries.

To further explore this hypothesis, note that the firm's first-order condition that links the marginal product of capital and financial returns stems from the capital accumulation equation, which suggests that the capital stock tomorrow is the sum of capital stock today and the investment net of depreciation ($K_{t+1} = (1 - \delta)K_t + I_t$ such that K_t and I_t are the capital stock, and investment in period t, respectively). On the other hand, if a unit investment does not lead to a unit increase in the capital stock, the cross-country investment return and marginal product of capital patterns can differ. Although models with capital adjustment factors are widely used in the investment literature (see Cochrane, 1991; Hayashi, 1982; Abel and Blanchard, 1986), domestic capital accumulation frictions are relatively unexplored in the international capital flows literature. Jin (2012) is an exception as she uses a capital accumulation equation with adjustment costs from Abel (2003). However, Jin's empirical analysis focuses on the revealed comparative advantage using international capital flows rather than the measurement of marginal product of capital. In this paper, we show that capital accumulation frictions can help model the divergence between the investment returns and marginal product of capital patterns observed in the data between 1997 and 2014. We also show that the model with capital accumulation frictions provides an analytical framework that links cross-country differences in the relative price of capital and the capital wedge, explanations used to resolve the Lucas Paradox in the literature (Caselli and Feyrer, 2007; Gourinchas and Jeanne, 2013).

In large part, cross-country differences in capital accumulation processes have not been empirically explored in the capital flows literature because of data limitations.[1] With aggregate data, estimates of the aggregate capital stock are constructed from aggregate investment data (such as from the Penn World Tables) using the perpetual inventory method, which requires one to posit a capital accumulation process. Since this process is typically assumed to follow a model where a unit increase in investment leads to a unit increase in capital stock, the aggregate capital stock estimate itself implicitly relies on the assumption that the link between marginal product of capital and the investment return holds. A key advantage of the firm-level data we use in this paper is that unlike aggregate estimates, we can directly observe capital stock measures from accounting and market values. This allows us to directly compute the marginal product of capital and investment returns, and to empirically test the tightness of the link between the two.

The paper limits the analysis to listed firms in MSCI emerging and developed countries that have relatively well-established stock markets, which substantially reduces the number of countries in the sample. But, as Reinhart and Rogoff (2004) suggest, roughly 25 emerging markets account for the bulk of international financial flows. Therefore, the analysis of the firms in these countries can provide useful insights into the factors that drive international capital flows. We also restrict the period of analysis to the post-1996 period because of the

[1] It is important to note the extensive use of the implications of capital accumulation frictions within the international capital flows literature. For example, the cross-country differences in the relative price of capital introduced in Caselli and Feyrer (2007) and the capital wedge used by Gourinchas and Jeanne (2013) can both be derived within the neoclassical model using capital accumulation frictions.

limited availability of reliable firm-level data from emerging countries in the early 1990s.

Although firm-level data have many advantages, some drawbacks exist. For example, available firm-level data do not provide insight into the productivity of self-employed workers or informal sector firms. This is a significant drawback as these types of households and firms make up a large part of the economy in developing countries. Unlike aggregate data, firm-level market variables are also susceptible to market volatility. Since the period of analysis includes the global financial crisis (2007-2008), we control for year-specific effects and run a robustness test excluding these years. We suggest that despite these shortcomings, the firm-level data provide useful insights about the relationship between financial returns and firm productivity. The paper provides an alternative lens to complement existing literature that primarily uses macroeconomic data to perform aggregate analysis.

An important concern with using cross-country firm-level data is the difference in the accounting standards used to report data from different countries. For example, the definition of "assets" in the U.S. Generally Accepted Accounting Principles (U.S. GAAP) may differ from the definition in the International Financial Reporting Standards (IFRS). To minimize the effects of these differences, we use financial and accounting data from Worldscope Datastream. Datastream not only provides extensive accounting and market data on listed firms across countries but also aims to "provide the data in a manner that allows maximum comparability between one company and another, and between various reporting regimes" (Worldscope/Disclosure Partners, 1992). Thus, the numbers reported in the firm's annual/quarterly audit reports could differ from the numbers provided by Worldscope, which adjusts the data to make the definitions more comparable to their U.S. counterparts (Wald, 1999). Although Datastream takes extensive measures to increase firm comparability across countries, we further check for the effects of cross-country differences in accounting standards that may remain in the data, by running a robustness test restricted to firms from countries that adopt the IFRS. We find that the main results remain robust.

Other potential concerns include the overseas operations of the listed firms. Overseas subsidiaries are common among the major firms in both developed and emerging market countries and could influence the outcome of analysis. The globalization of firms also may increase the noise in the data. We further test the robustness of our results by looking at the cross-country patterns within industries that are less likely to have multinational firm presence (e.g., utilities). We find that the main findings remain intact within these industries.

Our paper relates to a vast international capital flows literature on the Lucas Paradox. Alfaro et al. (2008) sort the literature into two groups. The first group relies on differences in fundamentals that affect the production structure of the economy, such as technological differences, missing factors of production, government policies, and the institutions, to explain the paucity of capital flows to poor countries. The second group focuses on international capital market imperfections that stem from sovereign risk and asymmetric information (Stulz, 2005; Reinhart and Rogoff, 2004; Monteil, 2006; David et al., 2014). Much of the international macro and growth literature that uses cross-country marginal product of capital differences to explain international capital flow patterns relies on macroeconomic fundamentals and endowments that affect differences in productive efficiency to explain the Lucas Paradox (see Lucas, 1990, and King and Rebelo, 1993).

In their 2005 paper, Banerjee and Duflo outline an exhaustive list of methods used to calibrate the marginal product of capital in the development literature. Approaches include proxies for firm returns to capital using lending rates in the emerging countries that show extremely high risk-adjusted costs of borrowing in these countries. Caselli and Feyrer (2007) argue that interest rates may be poor proxies for the firm-level cost of capital in financially repressed/ distorted economies. Other method posit a production function and derive the expression for marginal product of capital. Using this approach, Lucas (1990) shows that adjusting for productivity differences lead marginal product of capital differences to fall substantially. Caselli and Feyrer (2007) take an alternative approach and directly measure marginal product of capital using national income accounts without assuming the production function. Their results show that the return to capital is roughly equal between emerging and developed countries once we adjust for the relative price of capital, and complementary factors of production such as land.

The findings in this paper are closely related to Gourinchas and Jeanne (2013), Banerjee and Duflo (2005), and Chirinko and Mallik (2008). Although the approaches differ, all of these papers investigate the role of domestic capital frictions on marginal product of capital differences. Hsieh and Klenow (2008) and Alfaro, et al. (2008) also study domestic capital market imperfections (i.e., the misallocation of capital within countries). However, these analyses focus on aggregate total factor of productivity (TFP) and institutional quality differences across countries rather than return differences. This paper adds to the literature by examining the impact of domestic capital frictions on the relationship between the marginal product of capital and financial investment returns. The paper is also related to the extensive literature on measurement of real returns in the economy. The efforts to correctly measure the real return in the economy at a macro level involve improving the measurement of income and capital shares in production (see Gollin, 2002; Karabarbounis and Neiman, 2013; and Jorda et al., 2017).

The paper proceeds as follows. In section 2, we introduce the basic neoclassical model and its predictions about the relationship between the marginal product of capital and financial investment returns, and explain the empirical methodology. Section 3 describes the firm-level data used in the analysis and presents summary statistics. We analyze the cross-country marginal product of capital and investment return patterns in section 4 and investigate an alternative model that can explain the divergence between the two patterns in section 5. Section 6 concludes.

2 A Benchmark Model and the Empirical Methodology

In this section, we present a simple neoclassical model to fix ideas and motivate the empirical analysis. Following that we describe the empirical methodology.

2.1 A Benchmark Neoclassical Model

To fix ideas, in this section we introduce a neoclassical one-sector model with perfectly competitive factor markets. This simple, benchmark model delivers useful predictions and illustrates the first order condition that we use to motivate the empirical analysis. We also consider a brief extension to a multi-sector setting.

2.1.1 One-Sector Model

Consider a neoclassical one-sector economy where the representative firm faces competitive factor and goods markets. The production function is given by $Y_t = F(K_t, L_t)$ where the firm chooses capital, investment, and labor ($\{K_t, I_t, L_t\}_{t_0}^{\infty}$) to maximize the net present value of future cash flows, taking the interest rate as given:

$$\max_{\{K_t, I_t, L_t\}_{t_0}^{\infty}} \sum_{t \geq t_0} \frac{1}{R_t}(Y_t - I_t - w_t L_t) \tag{1}$$

The capital accumulation process is defined as $K_{t+1} = G(K_t, I_t) = (1-\delta)K_t + I_t$, and the aggregate investment return between period t_0 and t is $R_t = (1+r_t)(1+r_{t-1})...(1+r_{t_0})$. Y_t is the period output of the representative firm, and w_t is the exogenously determined wage. Note that there is no capital rental market in this economy, as the firms own the capital used in production. R_t is the aggregate compounded investment return from period t_0 to t, and δ is the depreciation rate of the physical capital, which is assumed constant. The first-order conditions yield:

$$\begin{aligned} 1 + r_t &= \left(F_1(K_t, L_t) + \frac{G_1(K_t, I_t)}{G_2(K_t, I_t)} \right) G_2(K_{t-1}, I_{t-1}) \\ &= F_1(K_t, L_t) + 1 - \delta \end{aligned} \tag{2}$$

and,

$$F_2(K_t, L_t) = w_t \tag{3}$$

for all periods $t > t_0$. It is evident from equation (2) that the key determinant of the relationship between the period marginal product of capital ($F_1(K_t, L_t)$) and the investment return (r_t) is the capital accumulation equation ($G(K_t, I_t)$). Thus, if friction exists in the capital accumulation process, then the cross-country investment return and marginal product of capital patterns may diverge.

To illustrate, assume a constant return to scale Cobb-Douglas production function ($Y = AK^{\alpha}L^{1-\alpha}$), such that $y_t = \frac{Y_t}{L_t}$ and A is total factor of productivity or productive efficiency. Note that if alpha is the measured capital share in income, $MPK = \alpha\frac{y_t}{k_t}$ holds for neoclassical production functions of any functional form in a one-sector setting with perfect competition. The Cobb-Douglas production function serves as a simple example. The capital share of output (α) is assumed less than unity. Since we also assume that all firms in the economy share an identical production function, the output per unit of labor should be identical across all entities.

$$\begin{aligned} F_1(k_t) &= \alpha A^{\frac{1}{\alpha}} y_t^{\frac{\alpha-1}{\alpha}} \\ &= \alpha \frac{y_t}{k_t} \end{aligned} \tag{4}$$

It follows from equations (2) and (4) that both the period investment return and marginal product of capital should decline with increases in the output per unit of labor. With these simplifying assumptions, the model predicts that firm-level marginal products of capital and investment returns should be inversely correlated with the aggregate output per unit of labor.

2.1.2 Multisector Model

Consider a multi-sector neoclassical economy that produces J final goods and a capital good. The production function for firms that produce a final good i is given by $Y_t = F^i(K_t, L_t)$ where the firm chooses level of capital, investment, and labor ($\{K_t, I_t, L_t\}_{t_0}^{\infty}$) to maximize the net present value of future cash flows:

$$\max_{\{K_t, I_t, L_t\}_{t_0}^{\infty}} \sum_{t \geq t_0} \frac{1}{R_t^N}(P_{1,t}Y_t - P_{K,t}I_t - w_t L_t) \tag{5}$$

The capital accumulation process of the firm is defined as $K_{t+1} = G(K_t, I_t) = (1-\delta)K_t + I_t$, and the aggregate investment return between period t_0 and t is $R_t = (1+r_t)(1+r_{t-1})...(1+r_{t_0})$. Note that R_t^N in the equation (5) is the aggregate nominal investment return, such that $R_t^N = (1+r_t^N)(1+r_{t-1}^N)...(1+r_{t_0}^N)$. The real investment return (r_t) is defined as $1+r_t = \frac{1+r_t^N}{1+\pi_t}$, where π_t is inflation in period t. The first-order condition for producers of good i yields:

$$\begin{aligned} 1 + r_t &= \left(\frac{P_{1,t}}{P_{K,t}} F_1^i(K_t, L_t) + \frac{G_1(K_t, I_t)}{G_2(K_t, I_t)} \right) G_2(K_{t-1}, I_{t-1}) \\ &= \frac{P_{1,t}}{P_{K,t}} F_1^i(K_t, L_t) + 1 - \delta \end{aligned} \tag{6}$$

for all periods $t > t_0$.

$\frac{P_{1,t}}{P_{K,t}} F_1^i(K_t, L_t)$ is the price adjusted marginal product of capital introduced in Caselli and Feyrer (2007). In their paper, Caselli and Feyrer show that adjusting for the cross-country difference in the price of capital significantly reduces marginal product of capital differences between developed and developing economies. However, this cross-country difference in the relative price of capital does not affect the relationship between the price-adjusted marginal product of capital($\frac{P_{1,t}}{P_{K,t}} F_1^i(K_t, L_t)$) and the real return($r_t$)-the two only differ by a constant δ. Therefore, if the price-adjusted marginal product of capital is higher in emerging market countries, the real investment return ought also be higher.

Further, if capital is efficiently allocated within the economy, r_t should be identical for all firms within the economy and thus, $\frac{P_{j,t}}{P_{K,t}} F_1^j(K_t, L_t) = \frac{P_{1,t}}{P_{K,t}} F_1^i(K_t, L_t)$. Therefore, if for any sector i, $\frac{P_{1,t}}{P_{K,t}} F_i^K(K_t, L_t)$ is higher in emerging market countries relative to developed ones, the price-adjusted marginal product of capital for all final goods should be higher in emerging market countries.

Firm-level data allow us to test these implications at a more granular level than aggregate data. The next section describes how we map the theoretical predictions to the firm-level accounting and stock market data.

2.2 Mapping the Theory to Firm-Level Data

In this subsection, we describe the methodology to estimate marginal products of capital and investment returns used in the empirical analysis. To map the two variables of interest from the theory to the data, we use accounting and financial measures of profitability with some modifications to better align the measures with the economic definitions described in the benchmark model.

From equation (4), the marginal product of capital is equal to $\alpha \frac{y_t}{k_t}$, or in the multi-sector case, $\alpha \frac{P_y y_t}{P_k k_t}$. Given that α is the capital share of output, this expression suggests that the marginal product of capital is the ratio between the portion of earnings that accrue to capital holders (in the model simply the firm), and firm assets. The empirical estimations use return on assets (ROA) as a measure of the marginal product of capital as follows:

$$ROA_{f,i,c,t} = \frac{EBITDA_{f,i,c,t}}{MVA_{f,i,c,t-1}} \tag{7}$$

$EBITDA_{f,i,c,t}$ is the earnings before interest, tax, depreciation, and amortization, and measures the income that accrues to capital holders or the firm f in industry i in period t in country c. We use this measure of earnings rather than net income since the model assumes that the firm owns all of its capital assets, and, therefore, there are no interest costs. In the analysis, we further adjust this measure of income for extraordinary gains/costs. The adjustment is necessary as these costs/gains are often unrelated to business operations, and they can increase the volatility of earnings by inflating or deflating the income from the operations.

$MVA_{f,i,c,t}$ is the current market value of the firm's assets[2] and is defined as $MVA_{f,i,c,t} = Debt_{f,i,c,t} + MV_{f,i,c,t}$. $Debt_{f,i,c,t}$ is the book value of debt, and $MV_{f,i,c,t}$ is the market value of equity for the firm f in industry i in period t in country c. Poterba (1998) uses a similar measure to estimate the return to tangible capital at an aggregate level. This measure differs from the standard accounting ROA, which uses the book value of the assets in the denominator as the measure of capital. Although this ratio is widely used in finance and accounting[3], assets on the balance sheet are measured at the acquisition cost. As the market value of an asset can change over time (e.g., the value of buildings or land may appreciate or depreciate), the value of assets on financial statements may not correctly reflect current values. Therefore, we replace the denominator of the indicator with the sum of the book value of debt and market value of equity. As total assets necessarily equal the sum of liabilities and equity, this measure ought to provide a more accurate estimate of the replacement value of an asset in period $t-1$ under perfect capital markets.[4] The value of assets at the end of

[2]This is also the replacement value of the asset based on the q-theory of investment.

[3]See Eisenberg et al. (1998), Guenther and Young (2000), Chaney et al. (2004), Bowen et al. (2008).

[4]Debt also enters financial statements at a historical cost, and the interest rate on debt may differ across time. However, the income used in the analysis is income before interest. Therefore, even if debt is refinanced at a "current" rate of interest, it should not affect the ROA measure used in the analysis.

period $t-1$ is used in the denominator as a measure of what the firm owns entering period t. This is the capital employed during period t to generate the income $EBITDA_{f,i,c,t}$. Due to a time period mismatch between the numerator and denominator, we adjust the $MVA_{f,i,c,t-1}$ for inflation using the consumer price inflation (CPI) index.

We can rewrite the capital accumulation equation as $1-\delta = \frac{K_{t+1}-I_t}{K_t}$. Then, if investment efficiency holds,

$$r_t = \frac{\alpha Y_t - I_t + K_{t+1} - K_t}{K_t} \tag{8}$$

Note that this is the rate of return equation commonly used in finance to assess the profitability of an investment [5]. It measures the investment return that capital owners can receive by purchasing one unit of capital at time t and selling it at time $t+1$.

Using equation (8) as the benchmark, we derive the following expression to measure the investment return:

$$IRR_{f,i,c,t} = \frac{EBITDA_{f,i,c,t} + [\Delta MVA_{f,i,c,t} - \Delta BVA^{Adj}_{f,i,c,t}]}{MVA_{f,i,c,t-1}} \tag{9}$$

$\Delta MVA_{f,i,c,t}$ is the change in the market value of assets, $(MVA_{f,i,c,t} - MVA_{f,i,c,t-1})$. $\Delta BVA^{Adj}_{f,i,c,t} = \Delta BVA_{f,i,c,t} + depreciation_{f,i,c,t}$, such that $\Delta BVA_{f,i,c,t}$ is the change in the book value of assets. $\Delta BVA^{Adj}_{f,i,c,t}$ measures the current value of gross investments by firms. Recall that a historical-cost approach is used to measure assets on the balance sheet that are recorded at acquisition prices. Therefore, while balance sheet assets do not reflect the current market value of aggregate capital, the gross change in assets measures the capital investment of firms at current market (acquisition) prices.

This definition is similar to a period investment return measure used by Fama and French (1999) for the U.S. stock market. In their paper, this estimate is termed the "internal rate of return on value" and is used as the measure of the required rate of return by investors, or more precisely, an estimate of investor earnings during the sample period through passive investment in all corporate securities as they enter the sample. We note that this measure of investment does not include a significant portion of the research and development (R&D) spending by the firm. Due to accounting conservatism and uncertainty about the success of the R&D activity, R&D spending is considered a cost rather than an asset and is, thus, expensed. However, this should not affect the measurement of $IRR_{f,i,c,t}$ as the spending is reflected in the $EBITDA_{f,i,c,t}$. We also adjust the investment return for inflation across different countries. It is important to note that equations (7) and (9) apply in both the

[5] See Gordon (1974), Salamon(1985), Fama and French(1999), Graham and Harvey(2001)

single- and multi-sector cases. Further, we estimate the value of the capital assets using market prices. In turn these market values of capital assets imply that the observed values are adjusted for differences in the relative price of capital goods across countries. Therefore if the market value for capital assets is higher in emerging markets relative to developed markets, the market value firm assets will reflect this higher price of capital goods.

3 The Data and Summary Statistics

Financial and market data used to calculate the firm-level marginal product of capital and investment return are from Worldscope Datastream. Datastream is a preferred source of data for the cross-country comparison because it not only provides extensive accounting and market data on listed firms across countries, but it also aims to "provide the data in a manner that allows maximum comparability between one company and another, and between various reporting regimes" (Worldscope/Disclosure Partners, 1992). These adjustments by Worldscope help minimize the potential bias from the cross-country differences in accounting standards.

Although Datastream takes extensive measures to increase the accounting comparability across countries, we further check for the effects of cross-country differences in accounting standards by running a robustness test restricting the analysis to the countries that adopted IFRS. Since the mid-2000s there has been increasing attempt led by Euro-zone countries to unify accounting standards across countries. These efforts led to formation of the International Accounting Standards Board (IASB), whose explicit goal is "to develop an internationally acceptable set of high quality financial reporting standards" (Barth et al. 2008). Although the United States is yet to adopt IFRS, the standards were adopted by EU countries by 2005 and a majority of MSCI developed and emerging countries by 2011 (the Appendix provides a list). Many other countries that have yet to adopt IFRS have announced their plans for convergence in the near future. For example, India's Ministry of Corporate Affairs released a road map for convergence with the IFRS, and all Indian companies whose securities traded in a public market other than the SME Exchange, will be required to use IFRS by 2017. These efforts may lead to even greater data comparability going forward facilitating firm-level research. In this paper, we test that the main results remain robust to the cross-country differences in accounting standards.

The countries used in the analysis are MSCI emerging and developed countries that have relatively well-established stock markets.[6] Exchange floors in developing countries are

[6] Saudi Arabia is dropped from the sample due to the limited availability of firm-level data in early 2000s.

often very new (e.g., Laos opened its stock exchange in 2011, Syria in 2009, and Somalia in 2012), and in many cases Datastream does not carry data on the firms traded on these exchanges as the market capitalization of these countries is small (e.g., the Maldives Stock Exchange had only five firms listed as of 2008). Some developing countries do not have a national stock exchange (e.g., Angola, Brunei). Restricting the analysis to MSCI emerging and developed countries reduces the countries in the sample, but as Reinhart and Rogoff (2004) point out, roughly 25 emerging markets account for the bulk of the financial flows. Therefore, analyzing the marginal product of capital and the investment returns of the firms in the MSCI developed and emerging country sample can provide useful insights into factors that drive international capital flows.

The period of analysis is 1997 to 2014. A longer period may be preferred for the analysis as it provides more reliable estimates of return on assets (ROA) and internal rates of return (IRR) patterns. But unlike macroeconomic aggregate data, which date back to mid-1900s, firm level data for emerging countries are often unavailable before 1995. Even though the estimation period used in the paper is relatively short compared with papers that use macroeconomic data, the period after 1995 is characterized by a large volume of international capital investment following a series of trade and financial liberalization programs undertaken since the mid-1980s. Therefore, the period post-1990 is especially relevant for answering questions related to the marginal product of capital, investment returns, and the observed patterns of international capital flows. A major drawback, however, is that the sample period includes the global financial crisis, which was characterized by high levels of volatility in both earnings and market values. Thus, in the empirical analysis, we control for time fixed-effects and also run a robustness check excluding the crisis period.

Within the Worldscope dataset, we exclude firm-years with missing market value, assets, liabilities, depreciation, EBITDA, or extraordinary gains/cost. We also exclude balance-sheet insolvent firm-years where total liabilities exceed total assets. As period $t-1$ asset values are used to calculate the period t ROA and IRR, firm-years without debt and market value from the previous year are also excluded from the sample. The remaining data are winsorized at 1% and 99% by country to control for the outliers, following accounting practice.[7]

To adjust for industry-specific effects, we sort the firms into the 48 Fama-French indus-

[7]Some of the major outliers in the sample are due to merger/acquisitions. Consider a listed firm that merged with another (listed or unlisted) firm in January 2000. The ROA_{2000} will be the ratio between the post-merger EBITDA and the pre-merger asset value, and the indicator will be inflated. Major mergers are highly uncommon, but they can upwardly bias the results. For robustness, we repeat the analysis without winsorization, and the results remain unchanged.

tries.[8] Firms in the financial sector are dropped from the analysis as the paper focuses on the real economy. To test for the robustness of the empirical results to changes in the industry classification schemes, we repeat the exercise using the two-digit Standard Industry Classification (SIC) codes. After these exclusions, the main analysis uses 334,471 firm-years from 42 countries. Table 1 provides summary statistics for the raw data.

3.1 Summary Statistics

Table I shows a large variation in sample sizes across countries. The United States has the largest sample size with 68,438 firm-years, followed closely by Japan with 52,501 firm-years. The sample size is the smallest for Colombia, which has only 365 firm-years. Industry diversity also differs across countries; all 44 Fama-French (FF) industries are observed in Canada, Japan, the United Kingdom, and the United States. In contrast, only 23 FF industries are observed in Hungary. Purchasing power parity (PPP)-adjusted real GDP[9], population, employment, and average hours worked per employed are from the Penn World Tables 9.0. In this paper, we use GDP per capita as the measure of output per unit labor, and we check the robustness of the results using GDP per employed and GDP per hours worked. Consumer price indices are from the World Bank database.

Table I also provides summary statistics for the return on assets (ROA) and internal rates of return (IRR) estimates across countries. The bottom of the table reports unweighted averages of ROA and IRR for MSCI developed and emerging market countries. On average, MSCI developed and emerging market countries have an ROA of 9.2% and an IRR of 8.3% between 1997 and 2014. While this pattern is consistent with the benchmark model ($r = MPK - \delta$), two notable patterns emerge from the data. First, emerging market countries have a higher ROA, but lower IRR compared with developed countries. This pattern holds for both average and median values and suggests that a potential explanation for the Lucas Paradox may lie in the gap between investment return and marginal product of capital. Second, among developed countries, the average IRR is higher than the average ROA, in contrast to the implications of the benchmark model. This is likely due to the right skewness in the distribution of investment returns, illustrated in Figure I. The figure shows that compared with the ROA distribution (Figure Ia), which is almost perfectly symmetric across the mean, the IRR distribution (Figure Ib) is skewed to the right. Indeed, even for developed countries,

[8]The actual number of industries used in the analysis is 44, as four financial industries are dropped from the sample.

[9]A detailed discussion about the construction of the PPP adjusted GDP is available on Feenstra et al. (2015)

the median ROA is higher than the median IRR.[10]

Figure II shows two-way plots between firm-level ROA and IRR against the log of per capita GDP (PCGDP). The figure includes the best-fit line with a 95% confidence interval for the mean trend. Figure II(a) shows a steep downward sloping line of best-fit with a very narrow confidence interval, suggesting a negative correlation between ROA and the log(PCGDP). On the other hand, the Figure II(b), which shows the two-way plot for the IRR and the log(PCGDP), depicts an upward sloping line of best-fit with a wide confidence interval suggesting a potential deviation between the cross-country marginal product of capital and the financial return patterns. While this positive mean-trend contradicts the predictions of the neoclassical model, it is consistent with the uphill international capital flows pattern documented in Prasad et al. (2007).

Although the two-way plots are revealing, firm-specific factors may drive the observed patterns. Firms in emerging countries may be more risky and may face greater financial constraints relative to their peers in the developed markets. To delve deeper, we control for firm- and industry-specific factors in the following sections.

4 Cross-Country Marginal Products of Capital and Investment Returns

4.1 The Return on Assets and Per Capita GDP

To formally assess the relationship between aggregate output per unit of labor and firm-level profitability (return on assets), we estimate the following benchmark specification:

$$ROA_{f,i,c,t} = \alpha + \beta_1 log(PCGDP)_{c,t} + \beta_2 D_t + \beta_3 F_i + \gamma \boldsymbol{X}_{f,i,c,t} + \epsilon_{f,i,c,t} \quad (10)$$

$ROA_{f,i,c,t}$ is the return on assets (ROA) for a firm f in industry i in country c in period t, and $PCGDP_{c,t}$ is the purchasing power parity adjusted real GDP per capita in country c in period t in 2011 U.S. dollars (USD) that we use as a proxy for labor productivity. Note that we repeat the exercise using labor productivity which reduces the sample of countries. The benchmark regressions use GDP per capita as a proxy for labor productivity. D_t and F_i are time and industry dummies to control for global macroeconomic shocks and industry-specific effects. $X_{f,i,c,t}$ is the vector of firm-specific factors, which include size (the log of the book

[10] A third pattern observed is the negative mean ROA for Australia. This is due to the significant underperformance of the metal mining industry during and after the financial crisis; excluding the metal mining companies (SIC 2-digit code: 10), Australia's mean ROA turns positive.

value of assets denominated in USD, adjusted for inflation using the CPI index), leverage (the book debt to asset ratio), and the equity price-to-book ratio. The set of firm-specific controls come from Fama and French (1992) to proxy for alternative firm-level risks.

Standard errors are clustered at the country-year level to control for the firm-level error correlation within the country-year groups.[11] We do not include country fixed effects in the benchmark regression due to the relatively limited time dimension of the dataset (less than 20 years). The Appendix presents regression results with country clusters and with country fixed effects. The main findings remain robust.

Table II reports the results from the benchmark regression specification. Column (1) shows the results for the MSCI developed and emerging countries between 1997 and 2014. The coefficient on per capita GDP is negative and statistically significant at the 1% level. Consistent with the predictions of the neoclassical model, the result suggests that the firm-level ROA (our proxy for the marginal product of capital) is negatively correlated with income per capita during our sample period and holds for firms in both MSCI developed and emerging countries after controlling for firm-, industry-, and time-specific effects. In other words, as the model predicts, firm ROA falls with increases in the proxy for labor productivity. This finding also suggests that if, on average, the first-order condition that equates the marginal product of capital and the investment return holds, then investment returns should also be negatively correlated with per capita GDP.

Column (1) shows that, on average, firm-level ROA declines with increases in per capita GDP but the specification is silent about how the pattern varies within the sample. For example, does the relationship between firm-level ROA and per capita GDP change when we examine high-productivity firms with an above-average return on assets? Quantile regressions make up for this shortcoming of the ordinary least squares benchmark by modeling the relationship between the specified percentile of the response variable and the control variables (i.e. the median quantile regression portrays the relationship between the median marginal product of capital and the predictor variables). Also note the quantile regressions take on particular importance when analyzing the differences between internal rates of return (IRR) and the return on assets, owing to the high level of skewness observed in the distribution of the IRR in Figure I.

Columns (2) through (4) show that the coefficient on per capita GDP is consistently statistically significant across the 25th, 50th, and 75th percentiles. The coefficient is the most negative for firms in the 75th percentile of ROA, and there is little difference in the coefficients between the 25th and the 50th percentiles. This finding suggests that the effect

[11] The errors are clustered by country-year rather than country due to the limited number of country clusters.

of the changes in the aggregate output per unit labor is most acutely apparent for the most productive firms in the economy.

As stated in the data section, the period of analysis includes the global financial crisis, during which financial systems went through substantial stresses. We repeat the exercise in column (1) for the 2011 to 2014 post-financial crisis period. Owing to the short period of analysis, the values are susceptible to skewness from market volatility, but the regression results presented in column (5) confirm the findings in column (1). Columns (6) and (7) check for the effect of the cross-country differences in the accounting standards. Column (6) repeats the regression in column (5) using firms from the countries that adopted the International Financial Reporting Standards (IFRS) during the post-financial crisis period, and column (7) shows the results using firms in MSCI EU countries between 2006 and 2014[12]. Greece is excluded in the post-financial crisis (2011-2014) and in the 2005 to 2014 EU samples because of the Greek government-debt crisis that severely affected its stock market and firm performance between 2011 and 2013. The results presented in columns (5) through (7) of Table II show that the negative relationship between per capita GDP and the firm-level return on assets is surprisingly consistent across time, and is robust to cross-country differences in accounting standards.

Figure III(a) examines the relationship between the return on assets and per capita GDP by industry with year fixed effects. We estimate the following industry-by-industry regression for each of the 48 Fama-French industries (44 excluding financial industries) using the base sample of firms in the MSCI developed and emerging countries between 1997 and 2014.

$$ROA_{f,c,t} = \alpha + \beta_1 log(PCGDP_{c,t}) + \beta_2 D_t + \gamma \boldsymbol{X}_{f,c,t} + \epsilon_{f,c,t} \tag{11}$$

Figure III(a) shows that the negative coefficient on per capita GDP is remarkably consistent across industries. In other words, across industries, a negative relationship exists between per capita GDP and the firm-level return on assets-our measure of the marginal product of capital. The figure plots industry-by industry point estimates with whiskers that represent the 95% confidence intervals. Points to the left of the zero line line have a statistically significant negative coefficient at the 5% level, and those with points to the right of the zero have a statistically significant positive coefficient. There is a statistically significant decline in firm-level returns on assets with increases in per capita GDP in almost all 44 non-financial Fama-French industries. Forty industries have statistically significant negative coefficients for per capita GDP, and only one industry (aircraft manufacturing) has a statistically significant positive coefficient. The coefficient is most negative for defense and medical/pharmaceutical

[12]The European Union officially adopted IFRS starting 2005.

industries, both of which require high levels of human and physical capital.

Estimating year-by-year regressions, Figure IV(a) shows that the observed results are also consistent across time. The figure visually depicts the results for the following estimating equation using the base sample:

$$ROA_{f,i,c} = \alpha + \beta_1 log(PCGDP_c) + \beta_2 F_i + \gamma \boldsymbol{X}_{f,i,c} + \epsilon_{f,i,c} \tag{12}$$

In the figure, yearly point estimates and confidence intervals (whiskers) all lie below zero between 1997 and 2014, suggesting a statistically significant negative coefficient for all years in the sample. The incline of the negative slope is steep during the financial crisis (2007-2010) and early-2000 recession but slowly flattens in recovery periods. Conversely, the negative slope is relatively flat during the Asian financial crisis (1997) and slowly increases as the Asian tigers move out of their deep recessions.

The results in this section show that consistent with the neoclassical model, the marginal product of capital is higher in countries with low per capita GDP. In the next subsection, we repeat the exercises using investment returns (or the IRR).

4.2 Internal Rates of Return and Per Capita GDP

To test for the validity of the firm first-order condition described in equation (2), we use the following regression specification:

$$IRR_{f,i,c,t} = \alpha + \beta_1 log(PCGDP_{c,t}) + \beta_2 D_t + \beta_3 F_i + \gamma \boldsymbol{X}_{f,i,c,t} + \epsilon_{f,i,c,t} \tag{13}$$

The predictor variables in the equation are identical to those in the benchmark regression specification, equation (10), but the dependent variable is now the internal rate of return ($IRR_{f,i,c,t}$). As in equation (10), firm-level factors, such as size, leverage, and the price-to-book ratio, control for the firm-specific characteristics, and industry and time dummies control for industry- and time-specific effects. If the neoclassical relationship between the firm investment return and marginal product of capital holds, then the internal rate of return should also be inversely correlated with per capita GDP.

Table III presents the results. Column (1) reports the results for the MSCI developed and emerging countries between 1997 and 2014. Despite the statistically significant negative relationship with marginal product of capital observed in the previous subsection, the coefficient on per capita GDP is not statistically significant when controlling for firm- and industry-specific factors. This result implies that the cross-country marginal product of capital and investment return patterns do not necessarily mirror each other-as the neoclassical model predicts. The finding also suggests that even accurate measures of marginal products of capital may not explain patterns of international capital flows, as the marginal product of capital may itself be an inaccurate proxy for investment returns.

As Lucas (1990) suggests, if investment returns are inversely correlated with per capita GDP, capital ought to flow from developed to emerging countries and any deficiencies in these flows imply international financial market frictions. However, the results in column (1) suggest that the investment returns are roughly equal across developed and emerging countries. Therefore, an incentive may not exist for capital to flow to emerging markets, since opportunities that deliver similar investment returns also exist within developed economies. The result also suggests that a potential resolution to the Lucas paradox lies in the within-country gap between marginal products of capital and investment returns.

As in the previous subsection, we run a quantile regression to identify the within-sample heterogeneity in response to changes in per capita GDP. Given the large rightward skewness in the data from the summary statistics in Figure I, this analysis is particularly important for internal rates of return. Compared with the results in Table II, the quantile regression results in Table III vary more across percentiles. The regression results presented in columns (2),(3), and (4) show that the coefficient on per capita GDP is positive and statistically significant at the 5% level for the bottom 25th percentile and statistically insignificant for firms in the 50th and 75th percentile. The estimates suggest that even the best-performing firms within emerging countries cannot successfully translate their higher marginal products of capital to higher investment returns. A potential resolution to the Lucas paradox may therefore lie in macroeconomic factors that affect all firms within emerging economies.

Column (5) presents the results for the post-financial crisis period and reaffirms the divergence between the marginal product of capital and the investment return patterns observed in column (1). The coefficient on $PCGDP$ is statistically insignificant, which implies that the investment return in developed countries is statistically indifferent from that in emerging countries during the sample period. Column (6) repeats the regression in column (5) using only the firms that adopted IFRS accounting standards during the period, and documents that the cross-country pattern observed in column (5) is robust to cross-country differences in the accounting standards. Column (7) repeats the exercise in column (1) using the MSCI EU countries and finds that $PCGDP$ is statistically insignificant.

Figure III(b) shows the results for the following specification to check for any variation in cross-country internal rate of return patterns across industries. We run industry-by-industry regressions with year fixed effects to examine whether the negative correlation between return on assets and per capita GDP also holds for internal rates of return by industry:

$$IRR_{f,c,t} = \alpha + \beta_1 log(PCGDP_{c,t}) + \beta_2 D_t + \gamma \boldsymbol{X}_{f,c,t} + \epsilon_{f,c,t} \tag{14}$$

The results confirm the aggregate pattern observed in Table III. Unlike Figure III(a), Figure III(b) point estimates and confidence intervals lie on/cross over the zero line and the coefficient estimate is statistically insignificant in the regression. In particular, the coefficient on per capita GDP is statistically insignificant in 42 out of 44 industries. Only the defense industry has a statistically significant negative coefficient. This pattern for cross-industry firm-level IRR estimates contrasts sharply with Figure III(a), in which 40 industries have a statistically significant negative coefficient, and confirms the finding that the cross-country investment return pattern diverges from the marginal product of capital pattern.

Figure IV(b) displays the results for the following estimating equation to check for annual variation in the cross-country internal rates of return pattern with industry fixed effects:

$$IRR_{f,i,c} = \alpha + \beta_1 log(PCGDP_c) + \beta_2 F_i + \gamma \boldsymbol{X}_{f,i,c} + \epsilon_{f,i,c} \tag{15}$$

Unlike Figure IV(a), in which all point estimates lie below zero, Figure IV(b) shows coefficient estimates both above and below zero. Between 1997 and 2014, the coefficient on $PCGDP$ is statistically insignificant or positive and significant for 10 years. For eight years, the coefficient is negative and significant; four of the eight years occur around the financial crisis (2006-2008, and 2010). The negative slope is also the steepest during this period (2006 and 2007). The patterns once again confirm that the negative correlation between the marginal product of capital and per capita GDP does not necessarily translate to a negative correlation with investment returns.

The empirical results in this section document a divergence between the cross-country investment returns and the marginal product of capital patterns-a finding that is surprisingly robust across different sets of countries and time periods. In the following subsection, we check the impact of cross-country differences in employment and taxes to further confirm the robustness of the results documented thus far.

4.3 Additional Tests and Robustness Checks

4.3.1 Output per worker

In the previous two subsections, we used per capita GDP as the measure of output per unit labor. While this is a widely used measure of labor productivity (see Banerjee and Duflo, 2005; Gourinchas and Jeanne, 2013), the literature also uses alternative measures.

In this section, we check the robustness of the results using an alternative measure of labor productivity: output per worker. Output per worker is estimated using $PEGDP_{c,t}=\frac{GDP_{c,t}}{Emp_{c,t}}$. $Emp_{c,t}$ is the total number of employees and self-employed in country c, in time t. The measure considers only the fraction of the population directly involved in production. This measure, which is used in Caselli and Feyrer (2007), is potentially more precise relative to $PCGDP_{c,t}$, but coverage in the data is less reliable, especially for developing countries.[13]

To further check the robustness of the results in sections 4.1 and 4.2, we replace $log(PCGDP_{c,t})$ in the benchmark regressions with $log(PEGDP_{c,t})$. Table IV presents the regression results. Columns (1) and (2) confirm the negative relationship between output per unit labor and firm-level ROA observed in section 4.1. The coefficient on per worker GDP is negative and significant in the main sample (column 1) and in the countries that adopted IFRS during the post-financial crisis period (column 2). Columns (3) and (4) reinforce the findings on cross-country investment return patterns presented in section 4.2. The coefficient on per worker GDP is statistically insignificant in the main sample (column 3) and in the countries that adopted IFRS during the post-financial crisis period (column 4). The empirical results presented in this section confirm the findings of section 4.1 and 4.2, and show that the results hold across different measures of labor productivity. The findings strengthen the argument that within-country inefficiencies in resource allocation may explain the shortfall in international capital flows from rich to poor countries.

4.3.2 Tax-adjusted income

Previous sections use EBITDA as a measure of capital owner earnings to calibrate firm ROAs and investment returns. This approach is consistent with the benchmark neoclassical model, but corporate tax rates can also affect firm decisions and economic behavior. Corporate tax rates tend to be lower in emerging markets relative to developed countries, which suggests that tax rate differences are an unlikely friction in the international flow of capital. For robustness, we calibrate the firm-level tax-adjusted ROA and investment returns using the

[13]Yet another measure of output per unit labor is output per hour worked ($PHGDP_{c,t}$ $\frac{GDP_{c,t}}{AHW_{c,t}*Emp_{c,t}}$). $AHW_{c,t}$ is the average annual hours worked by persons employed, and $Emp_{c,t}$ is the fraction of the employed population in country c in time t. $PHGDP_{c,t}$ is frequently used as a measure of labor productivity in the macroeconomics literature (see Freeman, 1988; O'Mahony and Boer, 2002; Prescott, 2004) and is an even more precise measure than output per worker, as it measures the labor input by hour. However, lack of reliable hourly data substantially reduces its use. For example, China had to be dropped from the sample because of a lack of data, and some major assumptions are made to interpolate missing values. For completeness, we repeat the estimations of the benchmark regression specification using $PHGDP_{c,t}$ as a measure of output per unit labor in the Appendix, and the results remain robust. When regressed against ROA, not only does $log(PHGDP_{c,t})$ have a negative and statistically significant coefficient, but the incline of its slope is also steeper relative to $log(PEGDP_{c,t})$. The measure, however, has a statistically insignificant positive coefficient when regressed against IRR.

three-year average income tax rate. We exclude firm-years with tax rates exceeding 100% and use the three-year average income tax rate rather than an annual income tax rate to smooth large variations in tax rates.[14] For completeness, we run a regression with annual income tax rate for the main sample and the results remain unchanged.[15]

The tax-adjusted measures of ROA and IRR reduce the size of the sample, as firm-years without three-year average tax-rate data are dropped from the sample. Therefore, the cross-country pattern is estimated using 122,465 firm-years across 42 countries, in contrast to 334,471 firm-years in the main sample. Table IV presents the results using the tax-adjusted ROA and IRR. Columns (5) and (6) confirm the inverse relationship between $log(PCGDP_{c,t})$ and the marginal product of capital. The coefficient is negative and statistically significant in the main sample (column 5) and in countries that adopted IFRS during the post-financial crisis period (column 6). Column (7) and (8) on the other hand show that the $log(PCGDP_{c,t})$ is a statistically insignificant predictor of investment returns in the base sample.

These findings corroborate the evidence about the differences between the cross-country marginal product of capital patterns and the investment return patterns observed in sections 4.1 and 4.2 and remain robust across alternative specifications. A significant gap exists between the cross-country marginal product of capital pattern and the investment return pattern, suggesting that an explanation for the shortfall in international capital flows may lie in understanding the factors that drive the gap. In the following section we propose a modification to the traditional neoclassical model, as a potential explanation for the gap between marginal product of capital and investment returns.

5 Explaining the Divergence between Marginal Products of Capital and Investment Returns

5.1 Domestic Capital Accumulation Frictions

The empirical patterns documented in the previous sections show that while a statistically significant negative relationship exists between GDP per capita and the marginal product of capital, no such relationship exists between GDP per capita and investment returns. This finding suggests that differences in the marginal product of capital across countries do

[14]This modification is necessary as $EBITDA_{f,i,c,t}$ used in the analysis excludes extraordinary gains/losses. Thus, any major fluctuations in tax rate caused by unusual event can bias the corporate tax-adjusted ROA and IRR.

[15]An alternative expression for tax-adjusted income is $EBITDA_{f,i,c,t} - Tax_{f,i,c,t}$, where $Tax_{f,i,c,t}$ is the income tax on firm f. However, this estimate is heavily affected by the capital structure of a firm.

not necessarily translate into corresponding differences in investment returns, and the link assumed between marginal products and investment returns appears not to hold.

In this section, we turn our attention to the nature of the capital accumulation process that governs the relationship between the marginal product of capital and the investment returns. We discuss the implications introducing adjustment costs and connect this to the Lucas Paradox.

Consider the benchmark one-sector model introduced in section 2.1. Cochrane (1991) shows that the following holds in this one-sector setting:

$$\begin{aligned} 1 + r_t &= \left(F_1(K_t, L_t) + \frac{G_1(K_t, I_t)}{G_2(K_t, I_t)} \right) G_2(K_{t-1}, I_{t-1}) \\ &= \frac{F_1(K_t, L_t)}{p_{t-1}^{k_t}} + G_1(K_t, I_t) \frac{p_t^{k_{t+1}}}{p_{t-1}^{k_t}} \end{aligned} \tag{16}$$

$p_t^{k_{t+1}}$ is the price of installed capital in period $t+1$ in measured in period t output. The process follows from the fact that $G_2(K_t, I_t)$ is the marginal rate of transformation of a consumption good in period t to installed capital in period $t+1$. Therefore in equilibrium, the price of an installed capital in period $t+1$ in period t output is

$$p_t^{k_{t+1}} = \frac{1}{G_2(K_t, I_t)} \tag{17}$$

and $\frac{F_1(K_t, L_t)}{p_{t-1}^{k_t}}$ is a price corrected measure of marginal product of capital. With a standard capital accumulation equation, $p_t^{k_{t+1}} = 1$ for all t, which suggests that buying a unit of period t installed capital costs a unit of period $t-1$ consumption good; therefore cross-country differences in the price of installed capital are perfectly correlated with cross-country differences in the price of output. However, if friction exists in the capital accumulation process, the relative price of capital can diverge from a unity. In the benchmark model in section 2, the relative price of capital difference played a role in the multiple-sector case. The above equation suggests that when there are cross-country differences in capital accumulation processes, relative price differences can also create a wedge in a single-sector case.

In the benchmark model without adjustment costs, $G_1(K_t, I_t) = 1 - \delta$, the investment return and the marginal product of capital differ only by a constant depreciation rate, δ. However, with adjustment costs, $G_1(K_t, I_t)$ is no longer constant, and is a function of level of capital (K_t) and investment (I_t). This divergence between the marginal product of capital and the investment return is consistent with the capital wedge in Gourinchas and Jeanne (2013). There, investors receive only a fraction of gross return owing to the capital wedge caused by distortion in the market, and this capital wedge-adjustment substantially reduces the cross-country variation in returns across developed- and emerging-market countries. Gourinchas and Jeanne (2013) suggest that the source of the capital wedge may be taxes, corruption, and capital market frictions, among other factors. Using a capital accumulation friction, we explicitly depict how a within-country capital market friction can generate the capital wedge introduced in Gourinchas and Jeanne (2013).

The capital accumulation friction also affects the multi-sector model. In the multi-sector model with a capital adjustment factor,

$$\begin{aligned} 1 + r_t &= \left(\frac{P_{j,t}}{P_{K,t}} F_1(K_t, L_t) + \frac{G_1(K_t, I_t)}{G_2(K_t, I_t)} \right) G_2(K_{t-1}, I_{t-1}) \\ &= \frac{P_{j,t}}{P_{K,t} * p_{t-1}^{k_t}} F_1(K_t, L_t) + G_1(K_t, I_t) \frac{p_t^{k_{t+1}}}{p_{t-1}^{k_t}} \end{aligned} \quad (18)$$

With the capital accumulation friction, the relative price of capital has two components: the cross-country differences in the capital accumulation process ($p_{t-1}^{k_t}$), and the cross-country differences in price of capital relative to price of good j ($\frac{P_{K,t}}{P_{j,t}}$).

The price of capital used in Caselli and Feyrer (2007) is from PWT, which is compiled using the United Nations International Comparisons Program (ICP) price data. The ICP specifically states that the reported price includes "import duties and other product taxes actually paid by the purchaser, the costs of transporting the asset to the place where it will be used, and any charges for installing the asset so it will be ready for use in production." The transportation/installation costs are some of the most commonly cited sources of the capital accumulation friction. Therefore, the explanation from the ICP is consistent with the $\frac{P_{K,t} * p_{t-1}^{k_t}}{P_{j,t}}$ adjustment used in the above equation.

In the next section, we use a capital accumulation process with adjustment costs commonly used in the investment theory literature and empirically test its validity using firm-level data.

5.2 Capital Accumulation with Quadratic Adjustment Costs

The benchmark neoclassical model assumes capital accumulation without adjustment costs, where a unit increase in investment leads to a unit increase in capital stock. In this section, we introduce a modified capital accumulation equation with an adjustment cost factor, which accounts for installation costs and/or potential synergistic gains with the existing capital stock.

We assume the following modified capital accumulation condition:

$$\text{Capital accumulation:} \quad K_{t+1} = G(K_t, I_t) = (1-\delta)K_t + I_t + \beta \frac{I_t^2}{K_t} \tag{19}$$

The process commonly used in the investment literature yields the traditional capital accumulation equation if we set $\beta = 0$. The adjustment term, which is quadratic in investment, accounts for the nonlinear costs incurred in the installation process.[16] Moreover, the adjustment costs are inversely proportional to the size of the existing capital stock, as firms are less affected by the reallocation of resources when they have a large capital base. Chirinko(1993), Gilchrist and Himmelberg (1995), and Jin (2010) assume quadratic adjustment costs, while Chocrane (1991) assumes a cubic adjustment cost. In this paper, we use a quadratic adjustment cost term. The results, however remain robust even with a cubic adjustment cost.

The investment theory literature assumes that β is negative, as it is the cost incurred in the installation process. However, extensive research in the finance literature studies potential synergies in corporate mergers. Here, the fact that the value of the combined firm can exceed the sum of assets in the individual firms suggests that a unit investment can lead to a greater than one-unit increase in the aggregate capital stock. Therefore, we are agnostic about placing restrictions on the sign of β. If $\beta < 0$, then a unit of investment leads to a less than one unit increase in the aggregate capital stock (a friction). If $\beta > 0$, a unit of investment leads to a greater than one-unit increase in the aggregate capital stock (a synergy).

With the above-modified capital accumulation model, the following relationship holds between the price-adjusted marginal product of capital and investment return:

$$1 + r_t = \frac{F_1(K_t, L_t)}{p_{t-1}^{k_t}} + \left(1 - \delta + \beta \left(\frac{I_t}{K_t}\right)^2\right) \frac{p_t^{k_{t+1}}}{p_{t-1}^{k_t}} \tag{20}$$

With the additional quadratic term, the investment return now depends not only on the marginal product of capital but also the investment-capital ratio. This implies that the cross-country investment return pattern may deviate from the marginal product of capital pattern depending on the sign and the magnitude of β.

In the following section, we test the validity of this modified capital accumulation equation using firm-level data.

[16]This assumption implies, for example, that large investments will increase installation costs, as firms need to set aside more resources for the installation.

5.3 Empirical Analysis

Note that we can rewrite the capital accumulation process with adjustment costs as:

$$\frac{K_{t+1} - K_t}{K_t} = -\delta + \frac{I_t}{K_t} + \beta \left(\frac{I_t}{K_t} \right)^2$$

The modified equation includes a higher-order investment-capital ratio to describe the capital accumulation process.

To test the validity of the quadratic capital adjustment cost, we first define the following two variables:

$$IK_{f,i,c,t} = \frac{\Delta BVA^{Adj}_{f,i,c,t}}{MVA_{f,i,c,t-1}} \tag{21}$$

$$MK_{f,i,c,t} = \frac{\Delta MVA_{f,i,c,t}}{MVA_{f,i,c,t-1}} \tag{22}$$

$IK_{f,i,c,t}$ is the ratio between change in book value of an asset adjusted for depreciation and the market value of an asset. $MK_{f,i,c,t}$ measures the growth rate of a firm's capital stock at market price. Also, note that there is a quadratic adjustment cost term, the square of investment to capital ratio ($IK^2_{f,i,c,t}$). Both ratios are further adjusted for inflation in the respective countries. If the benchmark model without adjustment costs holds, then $MK_{f,i,c,t}$ should be independent of $IK^2_{f,i,c,t}$. As in the previous sections, following accounting practice, we winsorize the $IK_{f,i,c,t}$, $IK^2_{f,i,c,t}$ and $MK_{f,i,c,t}$ at the 1% level by country.[17] Table V provides summary statistics for the two variables. It shows that the unweighted averages and the median for $MK_{f,i,c,t}$ are smaller in emerging market countries relative to their developed peers, despite the higher levels of $IK_{f,i,c,t}$. This suggests that the effect of adjustment costs, $IK^2_{f,i,c,t}$, on the capital accumulation process, $MK_{f,i,c,t}$, may depend on the relative level of development.

As stated earlier, $\Delta BVA^{Adj}_{f,i,c,t}$ does not include investment in research and development (R&D), as R&D costs are considered expenses on financial statements. This does not affect the measurement of $IRR_{f,i,c,t}$ as both expenses and investment are deducted from the period income, but it may lead to a downward bias in the estimate of $IK_{f,i,c,t}$ by underestimating the level of investment in R&D intensive industries. In contrast, the market value of assets, $MVA_{f,i,c,t-1}$, includes the value of the intangible assets in the firm, as the market observes the outcome of R&D activities. However, if the omitted R&D expense is the sole driver of the observed gap, then $IK^2_{f,i,c,t}$ may not have statistical significance in the regression analysis as the effect of omission on $MK_{f,i,c,t}$ should be linear; in other words, omitted R&D

[17] For robustness, we repeat the exercise without winsorization and the results remain unchanged.

investment may affect the level of $IK_{f,i,c,t}$, but it should not affect the curvature of the capital accumulation process.

Another related concern is that while R&D activities conducted by the firm are considered an expense (thus, not included in the book value of asset), patents purchased from external firms are considered capital and are included in the firm's asset account at market value. This differential treatment of intangible assets can potentially create a bias by inflating the investment level of firms that conduct extensive M&A activities relative to those that focus on in-house research. To address this issue, we use the following definition of investment-to-capital ratio to check for the robustness of the results:

$$CapexIK_{f,i,c,t} = \frac{Capex_{f,i,c,t}}{MVA_{f,i,c,t-1}} \tag{23}$$

$Capex_{f,i,c,t}$ measures capital expenditure of firm f in industry i in period t in country c. Capital expenditure is the total amount of investment in fixed assets, such as plant and machinery, and excludes current assets and intangible assets. Therefore, the measure is shielded from the differential treatment of the intangible assets described above.

We run the following specification to incorporate the impact of adjustment costs in the capital accumulation process:

$$MK_{f,i,c,t} = \alpha + \beta_1 D_t + \beta_2 F_i + \eta_1 IK_{f,i,c,t} + \eta_2 IK^2_{f,i,c,t} + \gamma X_{f,i,c,t} + \epsilon_{f,i,c,t} \tag{24}$$

Column (1) of Table VI shows that $IK^2_{f,i,c,t}$ is positive and statistically significant between 1997 and 2014. This finding suggests that the aggregate capital estimates, which rely on a linear capital accumulation process, require modification. Column (2) confirms the result in column (1) and shows that the quadratic adjustment term is statistically significant and continues to hold even when the sample is reduced to countries with IFRS accounting standards.

To further test the robustness of the result, we replace $IK_{f,i,c,t}$ with $CapexIK_{f,i,c,t}$. Column (3) of Table VI shows that results remain unchanged; the quadratic adjustment factor remains positive and statistically significant between 1997 and 2014. This result further strengthens the view that the capital adjustment process is non-linear with respect to the investment-to-capital ratio. Column (4) shows that the result continues to hold for MSCI developed and emerging market countries that adopted IFRS accounting standards during the post-financial crisis period.

We also test whether the effect of the adjustment term is homogeneous across countries by including an interaction effect between the capital adjustment factor and the level of development ($IK^2_{f,i,c,t} * log(PCGDP_{c,t})$). To control for industry- and time-specific effects, we run the regression using industry and time fixed effects. In addition, we include firm-specific factors. The results in column (5) show that the effect of the adjustment term is not homogeneous. $IK^2_{f,i,c,t}$ is negative and statistically significant, suggesting a friction in a capital accumulation process. However, the interaction between $IK^2_{f,i,c,t}$ with log per capita GDP in the regression specification is positive and statistically significant during the sample period. The results remain robust for $CapexIK_{f,i,c,t}$. This suggests that while most emerging market countries may suffer from capital accumulation friction, the effect slowly dissipates as the economy develops. The result is not however statistically significant when sample is restricted to countries that adopted IFRS accounting standards in the post-financial crisis period. This may be due to the limited number of observations and a high correlation between $IK^2_{f,i,c,t}$ and $IK^2 * log(PCGDP)_{f,i,c,t}$ in the post-crisis period.

6 Conclusion

According to textbook neoclassical theory, if two countries share identical production functions, and trade in capital is free and competitive, new investment will occur only in the poorer country since the marginal return to capital should be higher in economies with less capital (owing to the law of diminishing returns). However, as Lucas points out in his seminal 1990 paper, observed capital flows from developed to developing countries fall short of what should be observed according to the theory.

In this paper, we use firm-level data to show that higher marginal products of capital in emerging countries do not translate into higher financial returns in emerging countries. We suggest that the marginal product of capital patterns do not mirror investment return patterns because of cross-country differences in capital accumulation efficiency. Sufficiently large capital adjustment costs can decouple the cross-country financial returns pattern from the marginal product of capital. This finding also suggests that a key explanation for the pattern of international capital flows may indeed be domestic rather than international frictions that affect the capital accumulation process. Thus, what matters is not only factors that affect productive efficiency but also those that affect capital accumulation efficiency.

This paper differs methodologically from most others in the literature in that it uses firm-level data instead of aggregate data to explain cross-country differences in return and marginal product of capital. Firm-level data have an advantage over macroeconomic data in that they allow direct computation of marginal products of capital and the financial returns. Future research using data that encompasses unlisted firms and self-employed workers may help increase our understanding of domestic capital market frictions.

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Table I: Summary Statistics (1997-2014)

This table presents summary statistics for the firm-level return on assets (ROA) and internal rates of return (IRR) estimates across MSCI developed and emerging market countries within the sample. The table also presents number of firm-years and Fama-French industries by country.

		Firm-years	Fama-French	ROA			IRR		
			Industries	Mean	Median	SD	Mean	Median	SD
Australia	AUS	14,839	43	(0.001)	0.020	0.183	0.185	0.007	0.922
Austria	AUT	1,147	28	0.098	0.098	0.069	0.065	0.042	0.275
Brazil	BRA	1,450	35	0.093	0.097	0.072	0.060	0.042	0.278
Belgium	BEL	3,250	38	0.139	0.124	0.108	0.102	0.052	0.354
Canada	CAN	12,624	44	0.065	0.084	0.139	0.131	0.037	0.626
Chile	CHL	2,080	30	0.107	0.099	0.085	0.062	0.025	0.303
China	CHN	20,090	43	0.062	0.052	0.061	0.146	0.012	0.577
Colombia	COL	365	24	0.132	0.119	0.093	0.062	0.007	0.365
Czech Republic	CZE	436	24	0.145	0.134	0.098	0.040	0.021	0.254
Denmark	DNK	1,890	36	0.085	0.092	0.087	0.071	0.032	0.342
Finland	FIN	1,929	36	0.094	0.097	0.070	0.088	0.061	0.313
France	FRA	8,621	42	0.087	0.087	0.076	0.067	0.042	0.303
Germany	DEU	9,039	42	0.080	0.088	0.095	0.063	0.040	0.345
Greece	GRC	3,643	37	0.072	0.069	0.075	0.120	(0.015)	0.823
Hong Kong	HKG	11,342	41	0.063	0.064	0.118	0.150	0.011	0.749
Hungary	HUN	423	23	0.104	0.109	0.094	0.002	(0.025)	0.333
India	IND	17,621	43	0.113	0.104	0.087	0.058	(0.029)	0.459
Indonesia	IDN	3,826	37	0.111	0.099	0.105	0.072	(0.019)	0.489
Ireland	IRL	782	26	0.075	0.084	0.079	0.137	0.065	0.551
Israel	ISR	3,189	40	0.068	0.076	0.103	0.083	0.034	0.425
Italy	ITA	3,141	36	0.079	0.082	0.064	0.030	0.020	0.229
Japan	JPN	52,501	44	0.081	0.077	0.059	0.055	0.027	0.244
Malaysia	MYS	11,428	41	0.090	0.088	0.085	0.044	0.015	0.317
Mexico	MEX	1,470	35	0.107	0.102	0.071	0.066	0.040	0.292
Netherlands	NLD	2,120	39	0.095	0.097	0.063	0.084	0.063	0.305
New Zealand	NZL	1,380	35	0.087	0.100	0.100	0.082	0.060	0.330
Norway	NOR	2,260	33	0.075	0.086	0.108	0.087	0.039	0.454
Peru	PER	986	26	0.155	0.137	0.127	0.157	0.074	0.510
Philippines	PHL	1,706	33	0.095	0.089	0.101	0.110	0.022	0.527
Poland	POL	3,053	40	0.085	0.084	0.094	0.073	0.011	0.473
Portugal	PRT	812	30	0.090	0.086	0.063	0.037	0.018	0.194
Russia	RUS	1,869	35	0.148	0.123	0.137	0.040	(0.014)	0.476
Singapore	SGP	7,146	43	0.085	0.082	0.090	0.068	0.013	0.407
South Africa	ZAF	3,621	40	0.126	0.123	0.118	0.105	0.058	0.422
South Korea	KOR	16,905	42	0.091	0.093	0.113	0.068	0.018	0.391
Spain	ESP	1,883	36	0.090	0.087	0.062	0.077	0.049	0.268
Sweden	SWE	4,761	42	0.040	0.072	0.130	0.092	0.037	0.500
Switzerland	CHE	2,936	33	0.084	0.087	0.064	0.096	0.070	0.302
Thailand	THA	5,740	40	0.116	0.109	0.095	0.125	0.055	0.386
Turkey	TUR	2,907	36	0.108	0.091	0.106	0.016	(0.047)	0.566
United Kingdom	GBR	18,822	44	0.066	0.086	0.106	0.085	0.037	0.489
United States	USA	68,438	44	0.063	0.081	0.112	0.110	0.048	0.535
Total		334,471	44	0.092	0.092	0.094	0.083	0.028	0.421
MSCI Developed		234,852		0.078	0.084	0.093	0.089	0.039	0.411
MSCI Emerging		99,619		0.108	0.101	0.096	0.075	0.013	0.434

Table II: The Relationship Between Firm-Level Returns on Assets and Per Capita GDP

This table presents the regression results from the benchmark regression specification. Size is the inflation-adjusted book value of the firm's assets in U.S. dollars, and leverage is the ratio between the book value of liabilities and assets. Price-to-book measures the ratio between the market and the book value of the firm's equity. Time fixed effects and industry fixed effects for the 48 Fama-French industries are included in all regressions. Robust standard errors are reported in the parenthesis. Column (1) shows the results for the MSCI developed and emerging countries in the sample between 1997 and 2014. Columns (2) through (4) show quantile regression results for the 25th, 50th, and 75th percentiles, and column (5) presents the result for post-financial crisis periods. Column (6) repeats the regression in column (5) using firms from the countries that adopted the International Financial Reporting Standards (IFRS) post-financial crisis, and column (7) shows the results using firms in MSCI EU countries between 2006 and 2014 (Greece is excluded from the sample of EU countries because of its debt crisis).

$$ROA_{f,i,c,t} = \alpha + \beta_1 log(PCGDP)_{c,t} + \beta_2 D_t + \beta_3 F_i + \gamma \boldsymbol{X}_{f,i,c,t} + \epsilon_{f,i,c,t}$$

$ROA_{f,i,c,t}$ is the return on assets (ROA) for a firm f in industry i in country c in period t, and $PCGDP_{c,t}$ is the purchasing power parity adjusted real GDP per capita in country c in period t in 2011 U.S. dollars. D_t and F_i are time and industry dummies to control for global macroeconomic shocks and industry-specific effects. $X_{f,i,c,t}$ is the vector of firm-specific factors. (*), (**), and (***) refer to the 10%, 5%, and 1% levels of significance, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	ROA	ROA	ROA	ROA	ROA	ROA	ROA
	97-14	97-14 (25th)	97-14 (50th)	97-14 (75th)	11-14	11-14 (IFRS)	06-14 (EU)
log(PCGDP)	-0.0218***	-0.0113***	-0.00981***	-0.0138***	-0.0176***	-0.0277***	-0.0287***
	(0.00220)	(0.00198)	(0.00256)	(0.00234)	(0.00451)	(0.00445)	(0.00549)
log(size)	0.0141***	0.0141***	0.00757***	0.00200***	0.0138***	0.0197***	0.0145***
	(0.000636)	(0.000527)	(0.000455)	(0.000410)	(0.00145)	(0.00192)	(0.000754)
Leverage	-0.0443***	-0.0246***	-0.0345***	-0.0608***	-0.0463***	-0.0366***	-0.0278***
	(0.00386)	(0.00294)	(0.00426)	(0.00467)	(0.00666)	(0.0120)	(0.00578)
Price-to-Book	-1.75e-05**	-0.000230**	-0.000115	-2.47e-05***	-1.95e-05	-5.24e-05***	-6.48e-05***
	(7.63e-06)	(0.000112)	(9.69e-05)	(5.34e-06)	(1.22e-05)	(1.92e-05)	(2.31e-05)
Constant	0.163***	-0.000293	0.116***	0.280***	0.105**	0.129***	0.223***
	(0.0221)	(0.0208)	(0.0272)	(0.0241)	(0.0441)	(0.0462)	(0.0539)
Observations	334,471	334,471	334,471	334,471	87,775	35,204	34,084
R-squared	0.139	0.112	0.119	0.059	0.144	0.200	0.134
Time FE	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y

Table III: The Relationship Between Firm-Level Internal Rates of Return and Per Capita GDP

This table presents the regression results from the benchmark regression specification. Size is the inflation-adjusted book value of the firm's assets in U.S. dollars, and leverage is the ratio between the book value of liabilities and assets. Price-to-book measures the ratio between the market and the book value of the firm's equity. Time fixed effects and industry fixed effects for the 48 Fama-French industries are included in all regressions. Robust standard errors are reported in the parenthesis. Column (1) shows the results for the MSCI developed and emerging countries in the sample between 1997 and 2014. Columns (2) through (4) show quantile regression results for the 25th, 50th, and 75th percentiles, and column (5) presents the results for post-financial crisis periods. Column (6) repeats the regression in column (5) using firms from the countries that adopted the International Financial Reporting Standards (IFRS) post-financial crisis, and column (7) shows the results using firms in MSCI EU countries between 2006 and 2014 (Greece is excluded from the sample of EU countries becuase of its debt crisis).

$$IRR_{f,i,c,t} = \alpha + \beta_1 log(PCGDP_{c,t}) + \beta_2 D_t + \beta_3 F_i + \gamma \boldsymbol{X}_{f,i,c,t} + \epsilon_{f,i,c,t}$$

$IRR_{f,i,c,t}$ is the internal rate of return (IRR) for a firm f in industry i in country c in period t, and $PCGDP_{c,t}$ is the purchasing power parity-adjusted real GDP per capita in country c in period t in 2011 U.S. dollars. D_t and F_i are time and industry dummies to control for global macroeconomic shocks and industry-specific effects. $X_{f,i,c,t}$ is the vector of firm-specific factors. (*), (**), and (***) refer to the 10%, 5%, and 1% levels of significance, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	IRR	IRR	IRR	IRR	IRR	IRR	IRR
	97-14	97-14 (25th)	97-14 (50th)	97-14 (75th)	11-14	11-14 (IFRS)	06-14 (EU)
log(PCGDP)	-0.00289	0.0235**	0.0108	-0.0142	0.0300	0.0245	-0.00620
	(0.0184)	(0.0117)	(0.0124)	(0.0169)	(0.0208)	(0.0259)	(0.0619)
log(size)	0.00262	0.0212***	0.0112***	0.000110	0.000562	-0.000693	0.0108***
	(0.00234)	(0.00144)	(0.00134)	(0.00162)	(0.00343)	(0.00433)	(0.00201)
Leverage	-0.125***	0.117***	-0.0442***	-0.270***	-0.0911***	-0.118***	-0.103***
	(0.0183)	(0.0126)	(0.0129)	(0.0208)	(0.0311)	(0.0404)	(0.0196)
Price-to-Book	0.000213**	2.15e-05**	0.000462***	0.0140***	0.000103	0.000421**	0.000277***
	(8.43e-05)	(1.03e-05)	(5.32e-06)	(0.00173)	(8.70e-05)	(0.000166)	(5.86e-05)
Constant	0.109	-0.706***	-0.206	0.458***	-0.334	-0.222	0.141
	(0.181)	(0.118)	(0.129)	(0.171)	(0.211)	(0.235)	(0.653)
Observations	334,471	334,471	334,471	334,471	87,775	35,204	34,084
R-squared	0.064	0.019	0.044	0.003	0.037	0.019	0.126
Time FE	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y

Table IV: Robustness Checks: Output per Worker and Tax-Adjusted Income

This table presents the robustness test results for the baseline sample of firms in MSCI developed and emerging market countries. Size is the inflation-adjusted book value of firm assets in U.S. dollars, and leverage is the ratio between the book value of liabilities and assets. Price-to-book measures the ratio between the market and the book value of the firm's equity. Time fixed effects and industry fixed effects for the 48 Fama-French industries are included in all regressions. Robust standard errors are reported in the parenthesis. Columns (1) through (4) show the regression result when output per unit labor is measured using purchasing power parity adjusted GDP per employed. Columns (5) through (8) present regression results from tax-adjusted ROA and IRR. (*), (**), and (***) refer to the 10%, 5%, and 1% levels of significance, respectively.

Variables	(1) ROA 97-14	(2) ROA 11-14 (IFRS)	(3) IRR 97-14	(4) IRR 11-14 (IFRS)	(5) ROA 97-14	(6) ROA 11-14 (IFRS)	(7) IRR 97-14	(8) IRR 11-14 (IFRS)
log(PEGDP)	-0.0203***	-0.0300***	-0.00491	0.0296				
	(0.00273)	(0.00609)	(0.0206)	(0.0305)				
log(PCGDP)					-0.00543***	-0.00311*	-0.0132	0.0220
					(0.00167)	(0.00177)	(0.0225)	(0.0213)
log(size)	0.0138***	0.0197***	0.00269	-0.000658	-0.00352***	-0.00356***	-0.00511**	-0.0119***
	(0.000655)	(0.00192)	(0.00238)	(0.00432)	(0.000276)	(0.000465)	(0.00260)	(0.00281)
Leverage	-0.0435***	-0.0354***	-0.125***	-0.119***	-0.0368***	-0.0317***	-0.0909***	-0.0911***
	(0.00388)	(0.0121)	(0.0184)	(0.0410)	(0.00246)	(0.00436)	(0.0221)	(0.0218)
Price-to-Book	-1.77e-05**	-5.29e-05***	0.000213**	0.000422**	-0.000240***	-0.00230***	0.00396***	0.0319***
	(7.69e-06)	(1.93e-05)	(8.43e-05)	(0.000166)	(7.56e-05)	(0.000335)	(0.00146)	(0.00377)
Constant	0.167***	0.175***	0.132	-0.297	0.196***	0.176***	0.226	-0.0940
	(0.0294)	(0.0650)	(0.217)	(0.301)	(0.0176)	(0.0186)	(0.216)	(0.222)
Observations	334,471	35,204	334,471	35,204	122,465	10,128	122,465	10,128
R-squared	0.135	0.199	0.064	0.019	0.119	0.125	0.113	0.164
Time FE	Y	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y

Table V: Capital Accumulation Frictions and Investment-Capital Ratios

This table presents summary statistics for firm-level capital growth rates and investment-to-capital ratios across MSCI developed and emerging market countries within the sample.

		Firm-years	MK			IK		
			Mean	Median	SD	Mean	Median	SD
Australia	AUS	14,839	0.330	0.014	1.234	0.139	0.057	0.488
Austria	AUT	1,147	0.064	0.019	0.337	0.093	0.070	0.190
Brazil	BRA	1,450	0.055	0.017	0.344	0.087	0.067	0.179
Belgium	BEL	3,250	0.115	0.034	0.423	0.147	0.104	0.220
Canada	CAN	12,624	0.228	0.032	0.865	0.155	0.081	0.386
Chile	CHL	2,080	0.081	0.023	0.336	0.118	0.089	0.206
China	CHN	20,090	0.198	0.049	0.636	0.112	0.071	0.181
Colombia	COL	365	0.114	0.030	0.360	0.187	0.126	0.265
Czech Republic	CZE	436	(0.001)	(0.027)	0.249	0.104	0.089	0.171
Denmark	DNK	1,890	0.077	0.011	0.401	0.087	0.059	0.202
Finland	FIN	1,929	0.076	0.018	0.389	0.079	0.054	0.185
France	FRA	8,621	0.080	0.024	0.376	0.096	0.067	0.181
Germany	DEU	9,039	0.064	0.014	0.415	0.079	0.058	0.212
Greece	GRC	3,643	0.152	(0.033)	0.939	0.095	0.062	0.225
Hong Kong	HKG	11,342	0.276	0.035	1.056	0.175	0.091	0.507
Hungary	HUN	423	0.011	(0.033)	0.389	0.117	0.095	0.246
India	IND	17,621	0.109	(0.008)	0.533	0.163	0.110	0.250
Indonesia	IDN	3,826	0.143	0.006	0.630	0.172	0.103	0.324
Ireland	IRL	782	0.169	0.056	0.677	0.104	0.071	0.254
Israel	ISR	3,189	0.104	0.013	0.512	0.082	0.056	0.236
Italy	ITA	3,141	0.050	0.003	0.338	0.092	0.059	0.212
Japan	JPN	52,501	0.025	(0.013)	0.282	0.049	0.043	0.124
Malaysia	MYS	11,428	0.055	(0.002)	0.378	0.096	0.070	0.211
Mexico	MEX	1,470	0.077	0.030	0.335	0.113	0.099	0.178
Netherlands	NLD	2,120	0.083	0.029	0.396	0.089	0.064	0.197
New Zealand	NZL	1,380	0.081	0.012	0.409	0.086	0.055	0.240
Norway	NOR	2,260	0.153	0.029	0.624	0.134	0.081	0.320
Peru	PER	986	0.153	0.041	0.550	0.148	0.093	0.259
Philippines	PHL	1,706	0.137	0.015	0.582	0.121	0.075	0.284
Poland	POL	3,053	0.123	0.002	0.580	0.133	0.085	0.307
Portugal	PRT	812	0.058	0.006	0.271	0.109	0.068	0.214
Russia	RUS	1,869	0.082	0.014	0.491	0.192	0.147	0.261
Singapore	SGP	7,146	0.096	0.006	0.489	0.110	0.074	0.250
South Africa	ZAF	3,621	0.117	0.026	0.561	0.139	0.095	0.345
South Korea	KOR	16,905	0.120	0.020	0.495	0.138	0.094	0.284
Spain	ESP	1,883	0.099	0.035	0.374	0.110	0.069	0.227
Sweden	SWE	4,761	0.154	0.035	0.618	0.100	0.056	0.277
Switzerland	CHE	2,936	0.073	0.029	0.373	0.057	0.044	0.168
Thailand	THA	5,740	0.118	0.026	0.446	0.106	0.078	0.191
Turkey	TUR	2,907	0.101	0.010	0.612	0.187	0.131	0.257
United Kingdom	GBR	18,822	0.133	0.015	0.647	0.107	0.060	0.296
United States	USA	68,438	0.138	0.029	0.621	0.089	0.059	0.231
MSCI		334,471	0.111	0.017	0.514	0.117	0.078	0.249
MSCI Developed			0.119	0.021	0.527	0.103	0.065	0.253
MSCI Emerging			0.102	0.011	0.497	0.133	0.094	0.243

Table VI: Capital Accumulation Frictions and Investment-Capital Ratios

This table presents baseline regression results for firm-level capital growth rates across MSCI developed and emerging market countries within the sample. Size is the inflation-adjusted book value of the firm's assets in U.S. dollars, and leverage is the ratio between the book value of liabilities and assets. Price-to-book measures the ratio between the market and the book value of the firm's equity. Time fixed effects and fixed effects for the 48 Fama-French industries are included in all regressions. Standard errors are reported in parenthesis.

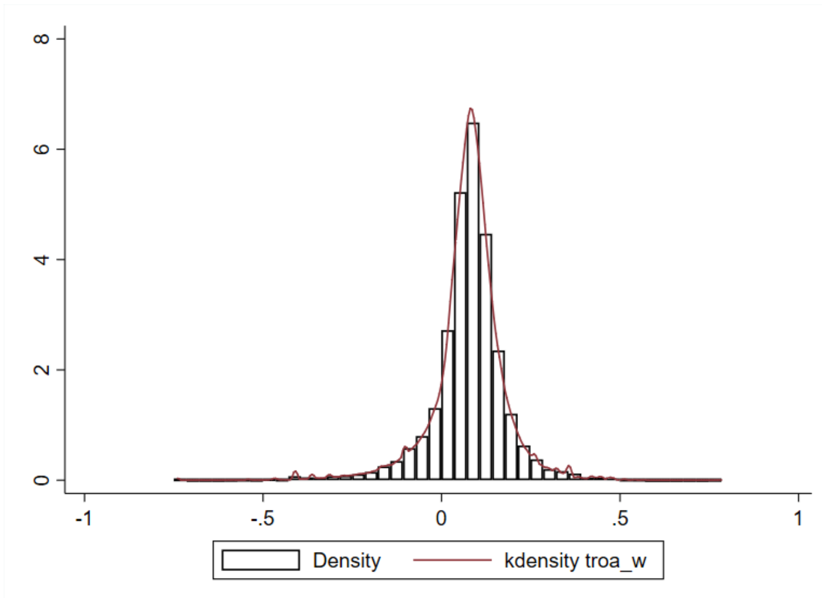
$$MK_{f,i,c,t} = \alpha + \beta_1 D_t + \beta_2 F_i + \eta_1 IK_{f,i,c,t} + \eta_2 IK^2_{f,i,c,t} + \gamma X_{f,i,c,t} + \epsilon_{f,i,c,t}$$
$$MK_{f,i,c,t} = \alpha + \beta_1 D_t + \beta_2 F_i + \eta_1 IK_{f,i,c,t} + \eta_2 IK^2_{f,i,c,t} + \eta_3 IK^2_{f,i,c,t} * log(PCGDP_{c,t}) + \gamma X_{f,i,c,t} + \epsilon_{f,i,c,t}$$

$PCGDP_{c,t}$ is the purchasing power parity adjusted real GDP per capita in country c in period t in 2011 US dollars. D_t and F_i are time and industry dummies to control for global macroeconomic shocks and industry-specific effects. $X_{f,i,c,t}$ is the vector of firm-specific factors: size, price-to-book and leverage. (*), (**), and (***) refer to the 10%, 5%, and 1% levels of significance, respectively.

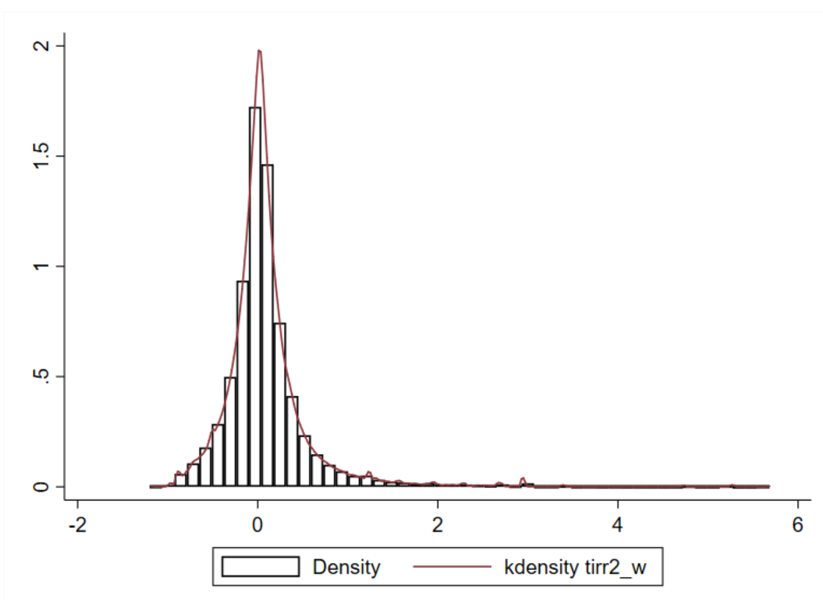
Variables	(1) MK 97-14	(2) MK 11-14 (IFRS)	(3) MK 97-14	(4) MK 11-14 (IFRS)	(5) MK 97-14	(6) MK 11-14 (IFRS)	(7) MK 97-14	(8) MK 11-14 (IFRS)
IK	1.152***	1.031***			1.164***	1.039***		
	(0.0251)	(0.0429)			(0.0243)	(0.0468)		
IK^2	0.200***	0.200***			-0.382*	-0.672		
	(0.0159)	(0.0288)			(0.197)	(0.711)		
$capexIK$			1.148***	0.531*			1.206***	0.560*
			(0.122)	(0.284)			(0.110)	(0.295)
$capexIK^2$			2.924***	4.419***			-6.187***	-0.0165
			(0.410)	(1.070)			(2.150)	(15.25)
$IK^2 * log(PCGDP)$					0.0552***	0.0816		
					(0.0195)	(0.0680)		
$capexIK^2 * log(PCGDP)$							0.893***	0.411
							(0.226)	(1.448)
log(size)	-0.00961***	-0.0171***	-0.00143	-0.00389	-0.00994***	-0.0173***	-0.00180	-0.00393
	(0.00244)	(0.00531)	(0.00241)	(0.00422)	(0.00244)	(0.00538)	(0.00240)	(0.00430)
Leverage	-0.0692***	-0.0524	-0.0814***	-0.0811	-0.0681***	-0.0522	-0.0782***	-0.0811
	(0.0177)	(0.0410)	(0.0203)	(0.0492)	(0.0175)	(0.0408)	(0.0199)	(0.0491)
Price-to-Book	0.000257**	0.000543**	0.000232**	0.00116*	0.000257**	0.000543**	0.000232**	0.00116*
	(0.000101)	(0.000211)	(0.000104)	(0.000677)	(0.000101)	(0.000211)	(0.000104)	(0.000678)
Constant	0.0688	0.106	0.0854*	0.0951	0.0742	0.109	0.0879*	0.0948
	(0.0456)	(0.0964)	(0.0464)	(0.106)	(0.0453)	(0.0976)	(0.0459)	(0.106)
Observations	334,471	35,204	327,107	34,394	334,471	35,204	327,107	34,394
R-squared	0.412	0.428	0.109	0.096	0.413	0.428	0.110	0.096
Time FE	Y	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y

Figure I: The Return on Assets and Internal Rates of Return

This figure plots the distribution of firm-level return on assets and internal rates of return for the entire sample. Histogram is plotted in density units, and the k-density line estimates density function $f(x)$ of the respective variable.



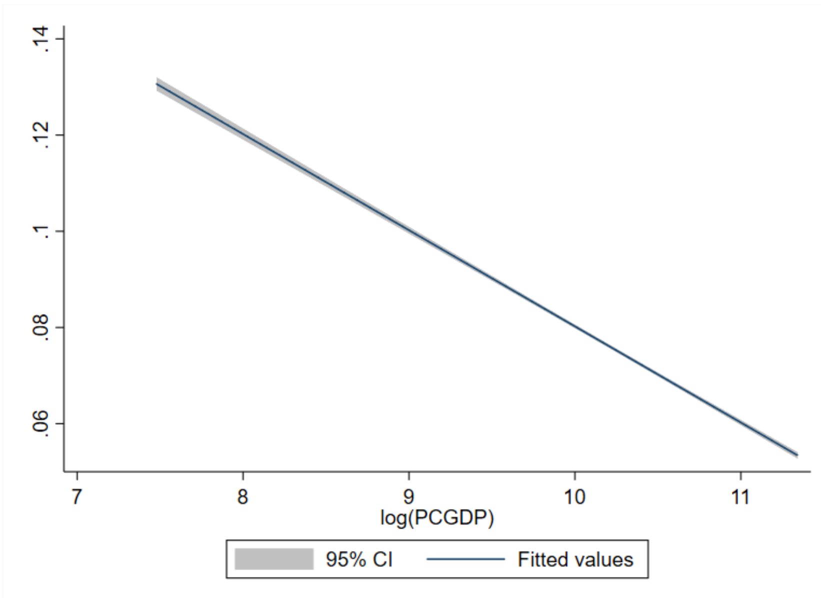
(a) Return on Assets (ROA)



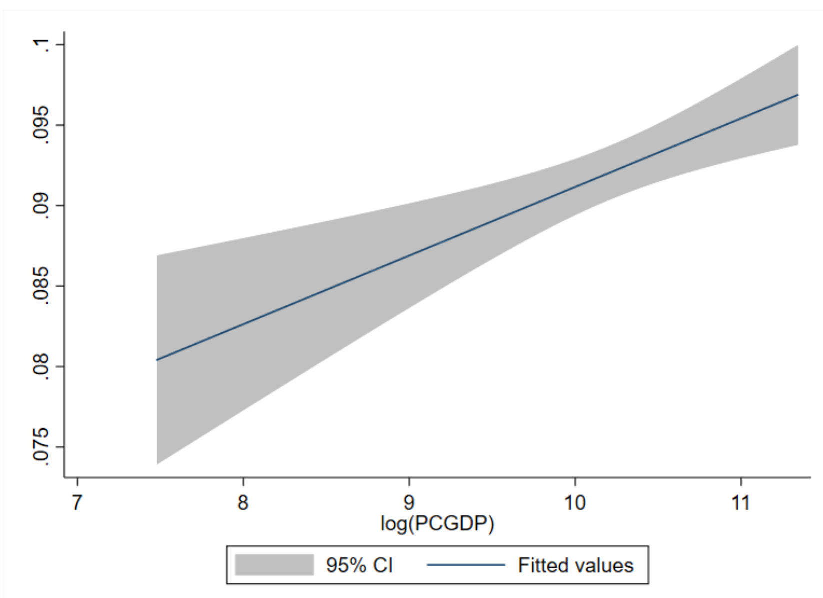
(b) Internal Rate of Return (IRR)

Figure II: The Return on Assets, Internal Rates of Return, and Per Capita GDP

This figure plots the best-fit line and 95% confidence interval of firm-level return on assets and internal rates of return for the entire sample against log of purchasing power parity (PPP)-adjusted real per capita GDP.



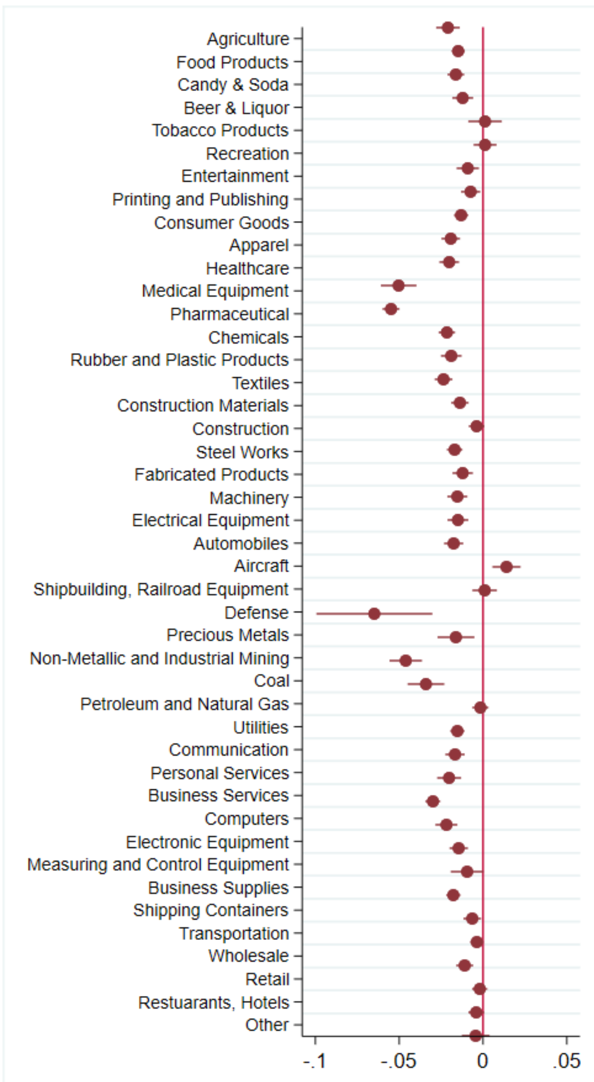
(a) Return on Assets and log(PCGDP)



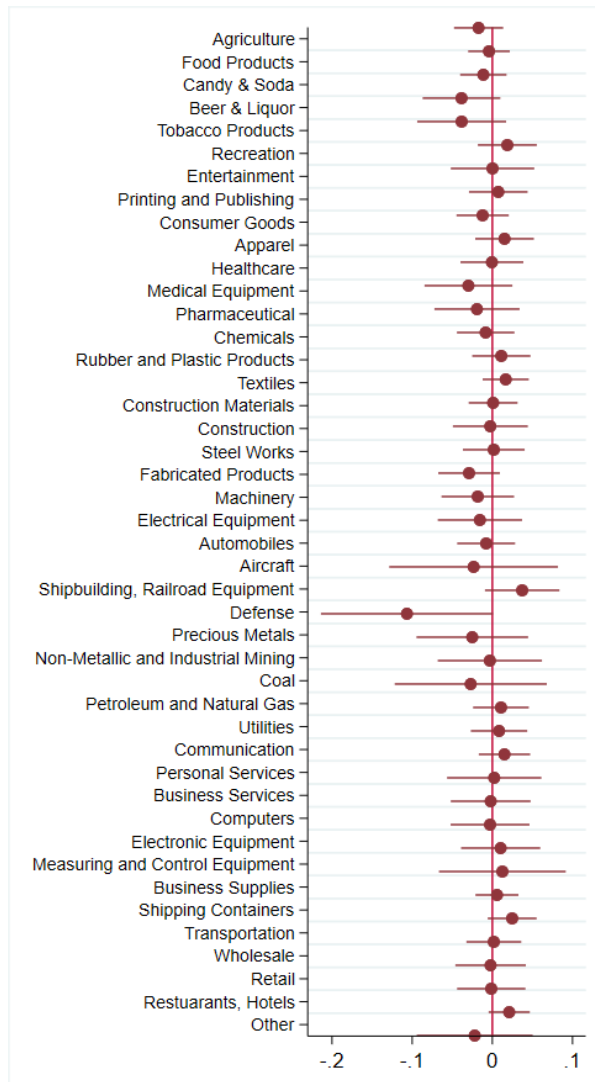
(b) Internal Rates of Return and log(PCGDP)

Figure III: The Return on Assets, Internal Rates of Return, and Per Capita GDP Across Industries

This figure plots industry-by-industry coefficients on per capita GDP for each of the 48 Fama-French industries (44 excluding financial industries) using the entire sample of firm-years in MSCI developed and emerging market countries. Panel (a) plots the coefficients for the return on assets and panel (b) for internal rates of return. The figure presents coefficient point estimates and whiskers that represent the 95% confidence intervals by industry. Appendix Tables A.3 and A.5. provide the regression results.



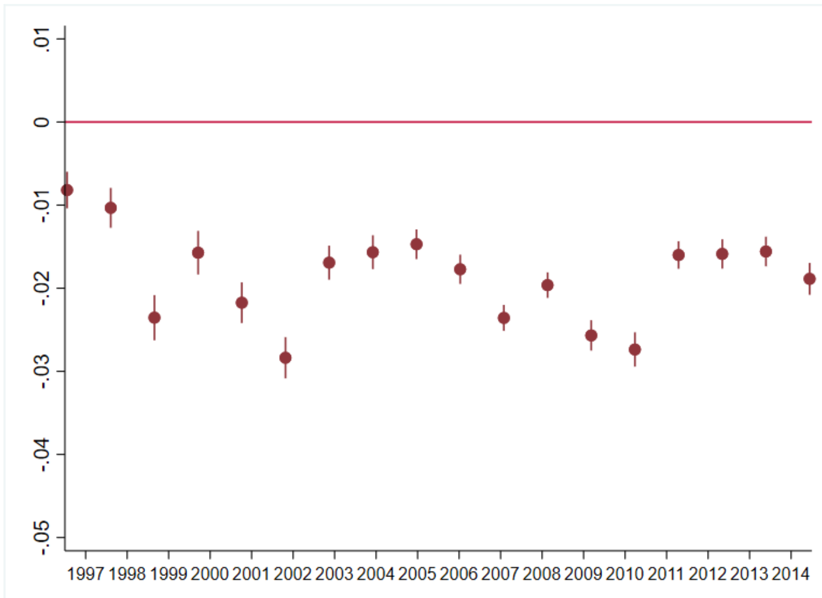
(a) Return on Assets



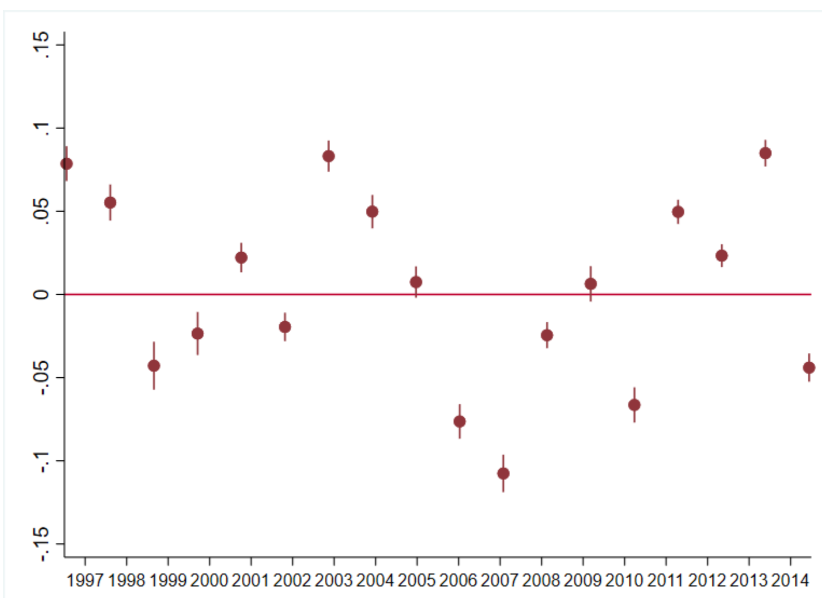
(b) Internal Rates of Return

Figure IV: The Return on Assets, Internal Rates of Return, and Per Capita GDP Across Time

This figure plots yearly regression coefficients on per capita GDP for each year between 1997 and 2014 using the entire sample of firm-years in MSCI developed and emerging market countries. Panel (a) plots the coefficients for the return on assets and panel (b) for internal rates of return. The figure visually presents coefficient point estimates and whiskers that represent the 95% confidence intervals by year. Appendix Tables A.4 and A.6. provide the regression results.



(a) Return on Assets



(b) Internal Rates of Return

A Online Appendix

Figure A.1: Countries with IFRS Standards

MSCI developed and emerging market countries in the sample are highlighted in red and green. Countries colored in red had adopted IFRS accounting standard by 2017.

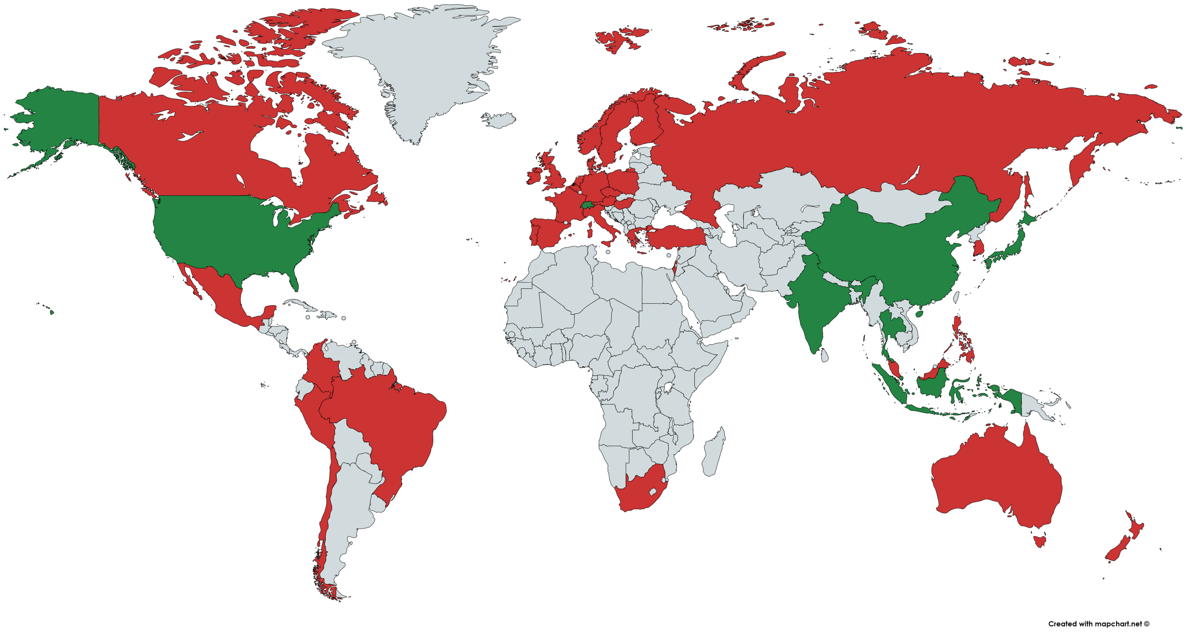


Table A.1: Summary of Variables

The table summarizes variables used in the analysis. Macroeconomic variables are from Penn World Table 9.0. and firm-level data are from Worldscope Datastream.

Variable	Description	Equations	Data Code	Data Source
Macro				
GDP	Output-side real GDP at chained PPPs (in mil. 2011US$)		Real GDP (rgdpo)	Penn World Tables 9.0.
Population	Population (in millions)		Population (pop)	Penn World Tables 9.0.
Employed	Number of persons engaged (in millions)		Number of employed (emp)	Penn World Tables 9.0.
$PCGDP_{c,t}$	Purchasing power parity (PPP) adjusted real per capita GDP	$\frac{GDP}{Population}$		Penn World Tables 9.0 and own calc.
$PEGDP_{c,t}$	Purchasing power parity (PPP) adjusted real per employed GDP	$\frac{GDP}{Employed}$		Penn World Tables 9.0 and own calc.
Firm				
$EBITDA_{f,i,c,t}$	Earnings before interest, tax, depreciation, and amortization before extraordinary items		Sum of EBITDA after extraordinary items (WC18198) and extraordinary cost (WC01254) minus extraordinary credit (WC01253)	Datastream and own calc.
$MV_{f,i,c,t}$	Market value of equity		Market Value (WC08001)	Datastream
$Debt_{f,i,c,t}$	Book value of debt		Total Liabilities (WC03351)	Datastream
$BVA_{f,i,c,t}$	Book value of assets		Total Assets (WC02999)	Datastream
$depreciation_{f,i,c,t}$	Depreciation and amortization		Depreciation/Depletion/Amortization (WC01151)	Datastream
$Capex_{f,i,c,t}$	Capital expenditure		Capital Expenditure (WC04601)	Datastream
$MVA_{f,i,c,t}$	Market value of assets	$Debt_{f,i,c,t} + MV_{f,i,c,t}$		Datastream and own calc.
$\Delta BVA^{adj}_{f,i,c,t}$	Change in asset net of depreciation	$\Delta BVA_{f,i,c,t} + depreciation_{f,i,c,t}$		Datastream and own calc.
$ROA_{f,i,c,t}$	Return on Assets	$\frac{EBITDA_{f,i,c,t}}{MVA_{f,i,c,t-1}}$		Datastream and own calc.
$IRR_{f,i,c,t}$	Financial Return	$\frac{EBITDA_{f,i,c,t}+[\Delta MVA_{f,i,c,t}-\Delta BVA^{Adj}_{f,i,c,t}]}{MVA_{f,i,c,t-1}}$		Datastream and own calc.
$MK_{f,i,c,t}$	Change in market value of assets	$\frac{\Delta MVA_{f,i,c,t}}{MVA_{f,i,c,t-1}}$		Datastream and own calc.
$IK_{f,i,c,t}$	Investment-to-Capital Ratio	$\frac{\Delta BVA^{Adj}_{f,i,c,t}}{MVA_{f,i,c,t-1}}$		Datastream and own calc.
$CapexIK_{f,i,c,t}$	Capex-to-Capital Ratio	$\frac{Capex_{f,i,c,t}}{MVA_{f,i,c,t-1}}$		Datastream and own calc.

Table A.2: Accounting Standards and IFRS Adoption Dates

This table presents the accounting standard and IFRS adoption date for MSCI developed and emerging market countries in the analysis.

Country	Accounting Standard	IFRS Adoption Date
Australia	IFRS	2005
Austria	IFRS	2005
Belgium	IFRS	2005
Brazil	IFRS	2010
Canada	IFRS	2011
Chile	IFRS	2010
China	Chinese Accounting Standards	NA
Colombia	IFRS	2015
Czech Republic	IFRS	2005
Denmark	IFRS	2005
Finland	IFRS	2005
France	IFRS	2005
Germany	IFRS	2005
Greece	IFRS	2005
Hong Kong	IFRS	2005
Hungary	IFRS	2005
India	India accounting standards	NA
Indonesia	Indonesian national GAAP	NA
Ireland	IFRS	2005
Israel	IFRS	2008
Italy	IFRS	2005
Japan	Japanese Accounting Standards	NA
Malaysia	IFRS	2017
Mexico	IFRS	2012
Netherlands	IFRS	2005
New Zealand	IFRS	2007
Norway	IFRS	2005
Peru	IFRS	2012
Philippines	IFRS	2005
Poland	IFRS	2005
Portugal	IFRS	2005
Russia	IFRS	2012
Singapore	Singapore Financial Reporting Standards (SFRS)	NA
South Africa	IFRS	2011
South Korea	IFRS	2011
Spain	IFRS	2005
Sweden	IFRS	2005
Switzerland	Swiss GAAP	NA
Thailand	Thai Accounting Standards	NA
Turkey	IFRS	2005
UK	IFRS	2005
US	US GAAP	NA

Table A.3: The Relationship Between Industry Returns on Assets and Per Capita GDP

This table presents the regression results from industry-by-industry regression for each of the 48 Fama-French industries (44 excluding financial industries). Size is the inflation-adjusted book value of the firm's asset in U.S. dollars, and leverage is the ratio between the book value of liability and assets. Price-to-book measures the ratio between the market and the book value of the firm's equity. Time fixed effects are included in the regression but are not reported. (*), (**), and (***) refer to the 10%, 5%, and 1% levels of significance, respectively.

Fama-French Industries	log(PCGDP)	log(size)	Leverage	Price-to-Book	Observations	R-squared
Agriculture	-0.0216***	0.0144***	-0.0623***	-0.000257	4,145	0.091
Food Products	-0.0161***	0.00657***	-0.0858***	-0.000247**	9,753	0.099
Candy & Soda	-0.0183***	0.00901***	-0.0477***	-0.000215	2,141	0.107
Beer & Liquor	-0.0119***	0.00471***	-0.0437***	-0.00135**	2,757	0.083
Tobacco Products	0.000411	0.00711***	-0.0691***	-0.000392*	481	0.180
Recreation	0.000403	0.00994***	-0.0929***	-7.86e-05***	2,990	0.090
Entertainment	-0.0125***	0.0140***	-0.0237***	-0.000106	5,172	0.063
Printing and Publishing	-0.0111***	0.00853***	-0.0466***	-0.000476***	3,756	0.087
Consumer Goods	-0.0144***	0.00861***	-0.0826***	-0.00101**	7,320	0.085
Apparel	-0.0216***	0.00817***	-0.135***	-0.000403**	4,111	0.128
Healthcare	-0.0302***	0.0122***	0.00433	-0.00145***	3,151	0.120
Medical Equipment	-0.0625***	0.0280***	-0.0382***	-3.76e-05***	5,590	0.228
Pharmaceutical Products	-0.0537***	0.0239***	-0.0441***	-1.92e-05	10,888	0.255
Chemicals	-0.0221***	0.0109***	-0.0899***	-3.62e-05	12,388	0.098
Rubber and Plastic Products	-0.0209***	0.00723***	-0.0901***	-0.000512**	3,533	0.095
Textiles	-0.0254***	0.00860***	-0.0837***	-0.000709***	5,259	0.098
Construction Materials	-0.0143***	0.00765***	-0.0904***	-0.000395***	13,180	0.086
Construction	-0.00482*	0.00564***	-0.0661***	-1.84e-05	17,799	0.044
Steel Works	-0.0164***	0.00676***	-0.0981***	-0.000666***	10,213	0.121
Fabricated Products	-0.0107***	0.00829***	-0.0955***	-0.00567***	1,530	0.116
Machinery	-0.0155***	0.00752***	-0.0590***	-0.000510**	14,777	0.062
Electrical Equipment	-0.0151***	0.00925***	-0.0462***	-0.000918*	5,411	0.068
Automobiles	-0.0174***	0.00795***	-0.0727***	-0.000159***	8,900	0.076
Aircraft	0.0133***	0.00158	-0.0273**	-0.000165	1,190	0.067
Shipbuilding, Railroad Equipment	0.00106	-0.000131	-0.0910***	-0.00286	867	0.090
Defense	-0.0681***	0.00945***	-0.103***	-0.00526**	325	0.170
Precious Metals	-0.0302***	0.0371***	-0.0142	2.92e-05***	5,036	0.254
Non-Metallic and Industrial Mining	-0.0517***	0.0317***	-0.00443	-0.000109**	5,832	0.336
Coal	-0.0390***	0.0276***	0.0286	-1.69e-06	1,902	0.268
Petroleum and Natural Gas	-0.00564**	0.0223***	-0.00982	-0.000152	11,754	0.225
Utilities	-0.0161***	0.00901***	-0.0503***	-2.87e-05	9,841	0.091
Communication	-0.0221***	0.0171***	-0.0403***	-8.48e-06	9,283	0.183
Personal Services	-0.0255***	0.0159***	-0.0155*	-0.000646**	3,370	0.103
Business Services	-0.0348***	0.0186***	0.000422	-6.66e-06	36,652	0.129
Computers	-0.0252***	0.0149***	-0.0400***	-7.47e-05	8,760	0.117
Electronic Equipment	-0.0188***	0.0164***	-0.0248***	-3.49e-05	15,711	0.100
Measuring and Control Equipment	-0.0147**	0.0144***	-0.0405***	-0.000162*	4,433	0.093
Business Supplies	-0.0185***	0.00536***	-0.108***	-1.78e-05***	5,242	0.121
Shipping Containers	-0.00843***	0.00594***	-0.0940***	-0.000352	1,665	0.092
Transportation	-0.00412*	0.00300***	-0.0463***	-1.67e-05	12,377	0.029
Wholesale	-0.0145***	0.0110***	-0.0687***	-2.05e-05	17,701	0.071
Retail	-0.00449*	0.00761***	-0.0601***	-3.90e-05	17,253	0.056
Restaurants, Hotels	-0.00506**	0.00318***	-0.0298***	-1.91e-05	7,915	0.022
Other	-0.0196***	0.0170***	-0.0287***	-0.000309*	2,117	0.136

Table A.4: The Relationship Between Firm-Level Returns on Assets and Per Capita GDP, By Year

This table presents the regression results of year-by-year analysis using the firm-level ROA of MSCI developed and emerging market countries in the sample. Size is the inflation-adjusted book value of the firm's assets in U.S. dollars, and leverage is the ratio between the book value of liability and assets. Price-to-book measures the ratio between the market and the book value of the firm's equity. Industry fixed effects are included in the regression but are not reported. (*), (**), and (***) refer to the 10%, 5%, and 1% levels of significance, respectively.

	log(PCGDP)	log(Size)	Leverage	Price-to-Book	Observations	R-squared
1997	-0.0103***	0.00657***	-0.0376***	-1.27e-05*	11,701	0.084
1998	-0.0129***	0.00810***	-0.0372***	-0.000100***	12,081	0.091
1999	-0.0271***	0.0110***	-0.0543***	-2.99e-05**	13,588	0.132
2000	-0.0196***	0.0117***	-0.0367***	-6.81e-05	14,348	0.139
2001	-0.0265***	0.0137***	-0.0401***	-0.000246***	15,990	0.168
2002	-0.0329***	0.0154***	-0.0451***	-4.50e-06	16,742	0.178
2003	-0.0198***	0.0161***	-0.0512***	-2.59e-05	17,543	0.152
2004	-0.0184***	0.0151***	-0.0513***	6.75e-08	17,796	0.150
2005	-0.0171***	0.0152***	-0.0447***	-0.000251***	18,433	0.168
2006	-0.0209***	0.0165***	-0.0348***	-2.34e-05	19,892	0.179
2007	-0.0259***	0.0150***	-0.0357***	-2.42e-05	21,530	0.168
2008	-0.0217***	0.0127***	-0.0382***	-1.84e-05*	22,130	0.141
2009	-0.0273***	0.0174***	-0.0781***	-0.000701***	22,184	0.160
2010	-0.0286***	0.0148***	-0.0314**	-0.000128**	22,012	0.156
2011	-0.0171***	0.0134***	-0.0386***	-2.57e-05**	22,502	0.141
2012	-0.0170***	0.0145***	-0.0521***	-4.17e-05***	22,348	0.141
2013	-0.0170***	0.0138***	-0.0550***	-7.82e-06	21,856	0.148
2014	-0.0201***	0.0134***	-0.0411***	-5.86e-05	21,795	0.151

Table A.5: The Relationship Between Industry Internal Rates of Return and Per Capita GDP

This table presents the regression results from industry-by-industry regression for each of the 48 Fama-French industries (44 excluding financial industries). Size is the inflation adjusted book value of the firm's assets in U.S. dollars, and leverage is the ratio between the book value of liability and assets. Price-to-book measures the ratio between the market and the book value of the firm's equity. Time fixed effects are included in the regression but are not reported. (*), (**), and (***) refer to the 10%, 5%, and 1% levels of significance, respectively.

Fama-French Industries	log(PCGDP)	log(size)	Leverage	Price-to-Book	Observations	R-squared
Agriculture	-0.0193	0.0220***	-0.115***	0.00126	4,145	0.096
Food Products	-0.00521	0.00380	-0.160***	0.00191	9,753	0.064
Candy & Soda	-0.0105	-0.00378	-0.0609	-0.000281	2,141	0.092
Beer & Liquor	-0.0391	0.00725*	-0.197***	0.0203***	2,757	0.141
Tobacco Products	-0.0401	0.0169	-0.0407	0.00378**	481	0.109
Recreation	0.0195	-0.00146	-0.157***	8.66e-05	2,990	0.063
Entertainment	-0.00125	0.00556	-0.124***	0.000736	5,172	0.042
Printing and Publishing	0.00659	0.00192	-0.130***	0.000959	3,756	0.096
Consumer Goods	-0.0126	0.00815**	-0.204***	0.00799**	7,320	0.093
Apparel	0.0131	0.00398	-0.202***	0.00822***	4,111	0.108
Healthcare	-0.00594	0.00561	-0.184***	0.00835**	3,151	0.077
Medical Equipment	-0.0342	0.00909	-0.149***	0.000337***	5,590	0.101
Pharmaceutical Products	-0.0197	0.0131**	-0.171***	0.000378	10,888	0.091
Chemicals	-0.0113	0.00907**	-0.117***	0.000140	12,388	0.084
Rubber and Plastic Products	0.00925	0.00463	-0.161***	0.00270	3,533	0.092
Textiles	0.0143	0.00337	-0.104**	0.00478*	5,259	0.072
Construction Materials	-0.000676	0.00870***	-0.127***	0.00762***	13,180	0.116
Construction	-0.00234	-0.00581	-0.0767**	0.000519*	17,799	0.088
Steel Works	-0.00179	0.00765	-0.117***	0.00626***	10,213	0.121
Fabricated Products	-0.0288	0.0166**	-0.288***	0.0467***	1,530	0.208
Machinery	-0.0200	0.00807**	-0.112***	0.00558**	14,777	0.124
Electrical Equipment	-0.0179	0.0129**	-0.135***	0.00389	5,411	0.097
Automobiles	-0.0128	0.00773**	-0.131***	0.000583**	8,900	0.103
Aircraft	-0.0189	-0.00912*	-0.0826	0.000554	1,190	0.160
Shipbuilding, Railroad Equipment	0.0345	0.00954	-0.363***	0.0652***	867	0.325
Defense	-0.114**	0.0226*	-0.346**	0.0579***	325	0.212
Precious Metals	-0.0247	0.00490	-0.163**	0.000292***	5,036	0.120
Non-Metallic and Industrial Mining	-0.00374	0.00780	-0.340***	0.000895	5,832	0.120
Coal	-0.0228	0.00103	-0.275**	-1.09e-05	1,902	0.110
Petroleum and Natural Gas	0.0105	0.00158	-0.291***	0.00332***	11,754	0.109
Utilities	0.00757	-0.00103	-0.0897***	0.000185	9,841	0.081
Communication	0.0158	-0.00248	-0.0694**	6.89e-05*	9,283	0.128
Personal Services	0.00147	0.00252	-0.150***	0.0106**	3,370	0.079
Business Services	-0.00338	0.00532	-0.100***	7.53e-05	36,652	0.080
Computers	-0.00347	0.00390	-0.135***	0.00164***	8,760	0.114
Electronic Equipment	0.0101	0.00173	-0.164***	0.000328	15,711	0.135
Measuring and Control Equipment	0.0114	0.00470	-0.103**	0.000756	4,433	0.119
Business Supplies	0.00214	0.00685**	-0.141***	0.000475***	5,242	0.123
Shipping Containers	0.0238	0.00355	-0.0967*	0.00513	1,665	0.106
Transportation	0.00168	0.000402	-0.127***	0.000245**	12,377	0.091
Wholesale	-0.00218	6.98e-06	-0.107***	0.000234	17,701	0.051
Retail	-0.00279	0.00423	-0.129***	0.00107**	17,253	0.066
Restaurants, Hotels	0.0245*	-0.00803**	-0.0795***	0.000388*	7,915	0.070
Other	-0.0187	0.00621	-0.202***	0.000884**	2,117	0.074

Table A.6: The Relationship Between Firm-Level Internal Rates of Return and Per Capita GDP, By Year

This table presents the regression results of year-by-year analysis using the firm-level IRR of MSCI developed and emerging market countries in the sample. Size is the inflation-adjusted book value of the firm's assets in U.S. dollars, and leverage is the ratio between the book value of liability and assets. Price-to-book measures the ratio between the market and the book value of the firm's equity. Industry fixed effects are included in the regression but are not reported. (*), (**), and (***) refer to the 10%, 5%, and 1% levels of significance, respectively.

	log(PCGDP)	log(Size)	Leverage	Price-to-Book	Observations	R-squared
1997	0.0772***	0.00276	-0.0793***	9.05e-05*	11,701	0.044
1998	0.0506***	0.0143***	0.0255	0.00171***	12,081	0.067
1999	-0.0360***	-0.0204***	-0.445***	0.000587***	13,588	0.088
2000	-0.0282***	0.0147***	-0.0791***	0.000479	14,348	0.031
2001	0.0183***	0.0115***	-0.0256	0.000952***	15,990	0.038
2002	-0.0200***	0.00197	0.0131	0.000163*	16,742	0.084
2003	0.0851***	-0.0103***	-0.300***	0.000236	17,543	0.072
2004	0.0500***	-0.0102***	-0.212***	2.98e-05	17,796	0.041
2005	0.0104**	0.00431**	-0.0953***	0.000737	18,433	0.033
2006	-0.0809***	0.0134***	-0.180***	0.000954***	19,892	0.057
2007	-0.109***	0.00664***	-0.280***	0.000543**	21,530	0.086
2008	-0.0264***	-0.00146	0.148***	5.85e-05	22,130	0.028
2009	0.00370	0.0354***	-0.363***	0.00967***	22,184	0.062
2010	-0.0705***	-0.00360	-0.145**	0.00123**	22,012	0.046
2011	0.0528***	-0.0128***	0.0189	9.51e-05	22,502	0.035
2012	0.0248***	0.0110***	-0.0477***	0.000267***	22,348	0.034
2013	0.0787***	0.00653***	-0.165***	3.82e-05	21,856	0.090
2014	-0.0437***	-0.00154	-0.170***	0.000500	21,795	0.025

Table A.7: Fixed Effect Analysis: Return on Assets and Internal Rates of Return

The table reports regression result with country and firm fixed-effects for the base sample. Columns (1) and (4) replicate the results reported in column (1) of Table 2 and 3, respectively, and the other four columns show the result with country or firm fixed effects. Size is the inflation-adjusted book value of the firm's assets in U.S. dollars, and leverage is the ratio between the book value of liability and assets. Price-to-book measures the ratio between the market and the book value of the firm's equity. Time fixed effects are included in all regressions. Standard error is reported in the parenthesis. (*), (**), and (***) refer to the 10%, 5%, and 1% levels of significance, respectively.

Variables	(1) ROA 97-14	(2) ROA 97-14	(3) ROA 97-14	(4) IRR 97-14	(5) IRR 97-14	(6) IRR 97-14
log(PCGDP)	-0.0218***	-0.0316***	-0.0450***	-0.00289	-0.0256	0.0662***
	(0.00220)	(0.00889)	(0.00207)	(0.0184)	(0.0744)	(0.00777)
log(Size)	0.0141***	0.0148***	0.0191***	0.00262	0.00257	-0.0777***
	(0.000636)	(0.000573)	(0.000577)	(0.00234)	(0.00197)	(0.00268)
Leverage	-0.0443***	-0.0508***	-0.0796***	-0.125***	-0.114***	-0.0611***
	(0.00386)	(0.00389)	(0.00214)	(0.0183)	(0.0168)	(0.0102)
Price-to-Book	-1.75e-05**	-1.47e-05**	4.12e-06	0.000213**	0.000209**	0.000344***
	(7.63e-06)	(6.83e-06)	(3.24e-06)	(8.43e-05)	(8.24e-05)	(0.000106)
Constant	0.163***	0.224**	0.347***	0.109	0.403	0.369***
	(0.0221)	(0.0935)	(0.0203)	(0.181)	(0.772)	(0.0758)
Observations	334,471	334,471	334,471	334,471	334,471	334,471
R-squared	0.139	0.168	0.037	0.064	0.068	0.070
Firm FE	N	N	Y	N	N	Y
Country FE	N	Y	-	N	Y	-
Industry FE	Y	Y	-	Y	Y	-
Time FE	Y	Y	Y	Y	Y	Y

Table A.8: Country Clustered Errors: Return on Assets and Internal Rates of Return

The table report regression result for the main sample when errors are clustered at a country level. Size is the inflation-adjusted book value of the firm's assets in U.S. dollars, and leverage is the ratio between the book value of liability and assets. Price-to-book measures the ratio between the market and the book value of the firm's equity. Time fixed effects and industry fixed effects for the 48 Fama-French industries are included in all regressions. Standard errors are reported in the parenthesis. (*), (**), and (***) refer to the 10%, 5%, and 1% levels of significance, respectively.

	(1)	(2)	(3)	(4)
Variables	ROA	ROA	IRR	IRR
	97-14	11-14	97-14	11-14
log(PCGDP)	-0.0218***	-0.0176*	-0.00289	0.0300**
	(0.00739)	(0.00890)	(0.00719)	(0.0122)
log(size)	0.0141***	0.0138***	0.00262	0.000562
	(0.00218)	(0.00285)	(0.00164)	(0.00233)
Leverage	-0.0443***	-0.0463***	-0.125***	-0.0911***
	(0.0110)	(0.0127)	(0.0131)	(0.0126)
Price-to-Book	-1.75e-05***	-1.95e-05	0.000213***	0.000103
	(6.26e-06)	(1.23e-05)	(7.68e-05)	(8.55e-05)
Constant	0.163**	0.105	0.109*	-0.334***
	(0.0696)	(0.0850)	(0.0630)	(0.122)
Observations	334,471	87,775	334,471	87,775
R-squared	0.139	0.144	0.064	0.037
Time FE	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y

Table A.9: Robustness Check: log(PCGDP) vs. log(PEGDP) vs. log(PHGDP)

This table reports regression results using different measures of output per capita. PCGDP is GDP per capita, PEGDP is GDP per employed, and PHGDP is GDP per hour employed. Size is the inflation-adjusted book value of the firm's assets in U.S. dollars, and leverage is the ratio between the book value of liability and assets. Price-to-book measures the ratio between the market and the book value of the firm's equity. Time fixed effects and industry fixed effects for the 48 Fama-French industries are included in all regressions. Standard errors are reported in the parenthesis. (*), (**), and (***) refer to the 10%, 5%, and 1% levels of significance, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	ROA	IRR	ROA	IRR	ROA	IRR
	97-14	97-14	97-14	97-14	97-14	97-14
log(PCGDP)	-0.0218***	-0.00289				
	(0.00739)	(0.00719)				
log(PEGDP)			-0.0203***	-0.00491		
			(0.00273)	(0.0206)		
log(PHGDP)					-0.0292***	0.00307
					(0.00136)	(0.0153)
log(size)	0.0141***	0.00262	0.0138***	0.00269	0.0150***	0.00179
	(0.00218)	(0.00164)	(0.000655)	(0.00238)	(0.000602)	(0.00202)
Leverage	-0.0443***	-0.125***	-0.0435***	-0.125***	-0.0447***	-0.123***
	(0.0110)	(0.0131)	(0.00388)	(0.0184)	(0.00405)	(0.0177)
Price-to-Book	-1.75e-05***	0.000213***	-1.77e-05**	0.000213**	-1.54e-05**	0.000198**
	(6.26e-06)	(7.68e-05)	(7.69e-06)	(8.43e-05)	(6.94e-06)	(7.99e-05)
Constant	0.163**	0.109*	0.167***	0.132	0.0316***	0.0805
	(0.0696)	(0.0630)	(0.0294)	(0.217)	(0.0111)	(0.0654)
Observations	334,471	334,471	334,471	334,471	314,381	314,381
R-squared	0.139	0.064	0.135	0.064	0.154	0.059
Time FE	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y