The Risky Capital of Emerging Markets*

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Abstract

Emerging markets exhibit (1) high expected returns to capital and (2) large exposures to movements in US returns, measured by the 'beta' of the returns to the asset on the returns to its US counterpart. We document these facts in detail for two asset classes - stock market returns and the return to aggregate capital - and we provide further evidence from a third class - sovereign bonds. We use a series of endowment economies to explore whether consumption-based risk faced by a US investor can reconcile these findings. We find that long-run risk, i.e., risk due to fluctuations in economic growth rates, is a promising channel - our calibrated model implies return disparities at least 55% as large as those in the data. From the perspective of the US investor, fact (2), although not a sufficient statistic, is informative about the extent of long-run risk in foreign assets, and so about fact (1).

JEL Classification: O4, E22, F21, G12

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1 Introduction

The returns to capital in emerging markets are puzzlingly high. In the growth literature, this is deemed the 'Lucas Paradox' after the seminal paper of Lucas (1990), who points out that the data reveal substantial dispersion in the marginal product of capital - one measure of capital returns - despite the fact that neoclassical growth theory predicts return equalization across countries. A standard interpretation of this finding is that return differentials indicate a misallocation of capital across countries.[1] Lucas documents what appears to be an arbitrage opportunity on the part of international investors, who would seem able to earn assured excess returns through increased investments in poor countries. Similarly, the finance literature often points to emerging market stocks - the return to equity representing an alternative measure of the return to capital - as an attractive investment due to their high average returns and low correlations with US returns, again suggesting the existence of an untapped arbitrage opportunity.[2] In sum, the persistence of rate of return differentials across countries and asset classes remains a puzzle in several fields of economics.

In this paper, we (1) revisit the dispersion in international capital returns and (2) explore the role of one particular mechanism - namely, differences in their risk attributes - in reconciling these disparities. We begin by comprehensively documenting two key properties of the international returns to capital. First, there are substantial differences in average returns across countries and these disparities vary systemically with income: poor countries tend to offer higher returns than do rich. For example, the return differential between the US and a set of the poorest countries ranges from about 5.5% to about 10%, depending on the particular asset class and set of countries under study. Second, there is a strong relationship between a country's mean return on an asset and its exposure to a single common factor - namely, the return on a corresponding US asset. Specifically, countries that offer high average returns tend to have a high 'beta' on the return to a similar asset in the US. This is despite the fact that low-income countries actually tend to have lower correlations with US returns than do high income ones; however, the large degree of volatility in emerging markets compared to developed ones offsets their lower correlations and leads to higher levels of comovement in a beta (or covariance) sense. We show that low-income countries tend to be precisely the ones that exhibit both a high degree of comovement with the US and feature higher average returns.

We demonstrate these regularities in depth using two measures of the returns to capital: first, a version of the Lucas-style measure in which a unit of capital represents a claim on aggregate GDP, which we compute using macroeconomic data on country-level capital stocks,

[1]The development literature documents also finds high rates of return in low-income countries. See, for example, the comprehensive review in Banerjee and Duflo (2005).

[2]See Harvey (1995) and Bekaert and Harvey (1997) among others.

output, and relative prices across a broad set of 144 countries from 1950-2008. Our measurement approach takes the perspective of a US investor and takes into account the appropriate relative prices in order to infer the marginal return on an additional unit of a capital good invested abroad. Second, we use direct data on stock market returns, i.e., the return on equity, across 33 countries over the period 1988-2014.[3] We show that the properties of returns hold at various levels of aggregation - for individual countries, as well as for 'bundles', or 'portfolios', of countries grouped by level of income. Further, we show that return disparities are robust to a number of different measurement approaches, i.e., various measures of relative prices and the share of GDP paid to capital, and cannot be explained by differences in capital market openness. We draw on the analysis by Borri and Verdelhan (2012) to provide further evidence that a third asset class, sovereign bonds, displays similar patterns. We additionally use these data to show that substantial return differentials remain even after controlling for default risk and as one way of addressing exchange rate risk since these are bonds denominated in US dollars.

Next, we ask whether the risk-return tradeoff implied by asset pricing theory can reconcile these empirical regularities. Specifically, we take the perspective of a US investor and use a class of endowment economies to explore whether the dynamic properties of capital returns imply risk premia - and so return disparities - on par with those we measure in the data. To do so, it seems natural to begin with the traditional power-utility consumption-based capital asset pricing model (CCAPM). Here, we run into a well-known hurdle - for reasonable levels of risk aversion, covariances of returns with US consumption growth, a sufficient statistic for risk premia, are far too small to account for the cross-sectional return disparities that we measure. For example, parameterized to match the covariance of returns with US consumption growth, the CCAPM requires a coefficient of relative risk aversion of over 50 in order to best fit observed stock return differentials, and an order of magnitude higher to best fit real returns. In this light, international return differentials and the Lucas Paradox resemble the equity premium and other closely related asset pricing puzzles.

We proceed by investigating the role of long-run risks à la Bansal and Yaron (2004), i.e., risks due to persistent fluctuations in economic growth prospects. Our motivation for this approach is twofold: first, a recent literature, touched off by Aguiar and Gopinath (2007), has documented the importance of shocks to trend growth rates in accounting for the properties of business cycles in poor/emerging markets and in reconciling differences in the behavior of

[3]As pointed out by the literature, for example Gomme et al. (2011), although in theory there is a tight connection between the return to capital and the return to equity, they exhibit very different characteristics in the data. We will not take a stand on the precise source of differences between the two, but rather, simply use the two in conjunction to demonstrate the robustness of the facts we document and the explanation we explore across multiple asset classes. We discuss in more detail the tradeoffs in using the two measures in Section 2.1.

macroeconomic variables between these countries and developed ones.[4] Second, long-run risks have been shown to have important implications for asset prices, and have been able to resolve a number of 'puzzles' in the asset pricing literature, including the equity premium puzzle.[5] Thus, it seems natural to explore the extent to which heterogeneity in risk arising from volatile and uncertain economic growth prospects can reconcile international rate of return differentials.

We work with an international endowment economy along the lines of Colacito and Croce (2011), Colacito and Croce (2013), Lewis and Liu (2015), and Nakamura et al. (2012). A representative US investor is endowed with a stream of consumption and dividends, i.e., payouts from risky capital investments (either equity dividends or payouts to units of capital, depending on the measure of returns) in a number of regions (either individual countries or portfolios thereof) and a risk-free asset. Economic growth rates feature a small but persistent component, which manifests itself in both consumption growth and growth in dividend payments from invested capital. In each region, this component contains both a common 'global' piece and a region-specific idiosyncratic one.[6] Regions differ in their exposure to the common component. With recursive preferences of the Epstein and Zin (1989) form, the value of capital holdings responds sharply to persistent shocks that are global in nature. Regions that are more sensitive to these shocks represent riskier investments and so must offer higher risk premia to investors as compensation. Additionally, each region is exposed to both common and idiosyncratic transitory shocks (i.e., shocks that affect growth rates for only a single period), which may also lead to return differentials.

Quantifying the implications of long-run risks in our model is challenging for two reasons: first, we must disentangle common from idiosyncratic long-run shocks. In our framework, the former command risk premia for the US investor whereas the latter do not. Second, even having identified common shocks, we must separate those that affect long-run growth prospects from those that are purely transitory in nature. To understand the complication, consider the following: a natural way to identify long-run shocks would be to rely on moments in persistence in growth rates of cash flows; however, in our context, the observed persistence may be due to either common or idiosyncratic shocks, and these moments are not sufficient on their own to disentangle the two. Given this, it would seem that moments in the comovement of growth rates would serve to eliminate purely regional phenomena; in our context, however, comovement may arise due to both common long-run and short-run shocks, and again, these moments are

[4]We feature a more detailed literature review in the next section.

[5]Among others, see Bansal and Yaron (2004) and Hansen et al. (2008) for an examination of the equity premium puzzle; Malloy et al. (2009) for the value and size premia and other cross-sectional facts; Chen (2010) for the credit spread puzzle; and Colacito and Croce (2013) and Bansal and Shaliastovich (2013) for the forward premium puzzle in international currency markets.

[6]In other words, the persistent component of growth rates may be correlated across regions.

not sufficient to distinguish between the two. We demonstrate that failing to properly identify the various drivers of return dynamics may result in misleading conclusions regarding the true riskiness of international capital holdings and we find that, quantitatively, the bias could be substantial.

Lewis and Liu (2015) outline an empirical strategy designed to overcome a similar hurdle, and we proceed by adapting their approach to our setting. We employ moments in both the persistence and comovement of dividend growth rates and additionally draw on a key prediction of the model that directly links a country's beta on the US return to its required risk premium for a US investor - recall that fact (2) which we document above strongly supports this prediction in the data. In particular, both dividend growth rates and returns depend on both long-run and transitory shocks; however, where dividend growth rates and returns respond in an identical manner to transitory shocks, which affect current payments to capital but have no implications for future growth rates, returns respond more sharply to persistent long-run shocks. Intuitively, because long-lived shocks signify revisions in the long-run value of capital holdings, returns exhibit a higher degree of sensitivity to these shocks than do current payoffs. Countries that are more sensitive to the common long-run shock will have a more volatile response of returns and so exhibit greater comovement with the US return - namely, a higher beta. We exploit this fact and use the comovement of returns - i.e., the betas we found in our empirical work - relative to the comovement in dividend growth to infer the degree of common long-run risk. Thus, our empirical strategy directly links a country's beta on the US return to the extent of its sensitivity to the global component of long-run risk - the key factor in assessing the quantitative implications of our theory - and so to the required rate of return to a US investor. In other words, through the lens of the model, although not a sufficient statistic, it is precisely fact (2) - the high betas we find in emerging markets - that is informative about fact (1) - the high average level of returns.

Applying this methodology, we find that long-run risk can account for a significant portion of the large return disparities observed in the data, and more importantly, for the pattern of low income/high return vs high income/low return. In our benchmark specification, which features the US as well as a small number of income-sorted portfolios of countries, the parameterized model accounts for 66% of the spread in the required return to aggregate capital between the US and a portfolio of the poorest countries in the world and implies a spread in stock returns between the US and a set of emerging markets approximately equal to that in the data. Using the richness of the data on returns to aggregate capital, we are able to further disaggregate countries into bundles of five and ten portfolios, in which case the model implies return spreads between the US and the lowest income portfolio that are 61% and 62% of their values in the data, respectively. At the finest level of granularity, we parameterize the model at the individual country level for a set of 96 countries for which sufficient time-series data are available. The correlation between the model's predicted returns and the actual is 0.61, confirming the key role of long-run risk in driving return differentials. Moreover, at the country level, the model predicts a negative and statistically significant relationship between returns and income, where the slope amounts to 55% of that observed in the data.

Finally, to gain additional insights behind the risk-return relationship, we decompose predicted returns into their short- and long-run risk components. Foreign risk premia stemming solely from short-run risk are generally negative and are actually higher in rich countries than poor. Because period-by-period growth rates in foreign countries exhibit low comovement with US consumption growth, particularly so in poor countries, investments there actually serve as good hedges for short-run consumption growth risks. This pattern holds using both returns to aggregate capital and returns to equity. Hence, long-run risks would appear critical to reconciling the high returns from capital investments in poor countries observed in the data: these risks are systematically higher in poor countries and imply variation in returns across the income spectrum on par with the data. Thus, our findings suggest that long-run risks due to volatile economic growth rates are a promising avenue to reconcile what would appear to be puzzling return differentials.

The paper is organized as follows. After reviewing the related literature next, in Section 2 we describe our data sources and we document the stylized facts. In Section 3, we lay out a risk-based explanation of these facts. In Section 4, we conclude and discuss some directions for future research.

Related literature. Our paper relates to several branches of literature. The first documents large differences in returns to the aggregate capital stock between developed and developing countries, an observation initially made by Lucas (1990). A number of papers focus on measuring returns to aggregate capital. In fact, our measurement of returns to aggregate capital is based on Gomme et al. (2011) who outline a procedure for the US, and on Caselli and Feyrer (2007) and Hsieh and Klenow (2007), who do so across countries. These studies point out the importance of accounting for the large TFP differences across countries, as well as for systematic variation in relative prices of investment and consumption goods. Caselli and Feyrer (2007) find that after adjusting capital shares for non-reproducible factors and accounting for differences in the relative price of investment goods, capital returns are approximately equalized across countries in a single year, 1996. In contrast, when employing their measurement approach, we find large return differentials over long periods; this is the key difference in our analysis (for example, similar to their paper, we find essentially no pattern in returns in 1996).[7]

Our preferred approach to measure returns to aggregate capital relates closely to the methodology in Gomme et al. (2011) which aims to account for the properties of the return to aggregate capital and to equities simultaneously. We further examine returns to equities that we obtain from stock market data and we find systematic differences across rich an poor countries. Our results for stock market returns are reminiscent of the findings in Bekaert and Harvey (1997) that emerging market returns are on average higher, more volatile, and less correlated with those of developed. It is this last observation that has led researchers to study emerging equity markets in isolation in a attempt to find local (or country-specific) factors that can reconcile the high returns. In contrast, we show that it is the covariance, rather than correlation of returns with the US—or the returns beta—that is a key statistic that helps to reconcile the higher returns in emerging markets.

A second branch of literature relates the observation of higher returns to capital in poor relative to rich countries to the implied missing capital flows from the latter to the former (see Obstfeld and Taylor (2003), Prasad et al. (2007) and Reinhart and Reinhart (2008) for historical and recent patterns of capital flows across rich and poor countries). Relatedly, Gourinchas and Jeanne (2013) document that countries that invest and grow faster do not receive capital inflows—an observation that they term 'the allocation puzzle'—and that the pattern of capital flows is directly linked to the level of national savings. A number of potential explanations for the lack of capital flows exist. In particular, a large literature emphasizes differences in institutional quality across countries as an explanation for the observed differences in capital flows. In a comprehensive empirical study, Alfaro et al. (2008) point to differences in the quality of institutions across countries in determining flows of different types of capital (FDI, equity portfolio, and debt instruments). Kraay et al. (2005) and Tornell and Velasco (1992) argue that capital does not flow to developing countries due to a lack of enforcement of debt repatriation or property rights to capital holdings for international investors there. Stulz (2005) emphasizes that in developing countries the sovereign as well as corporate insiders pursue their own interests at the expense of outside investors. Edwards (1992) emphasizes the role that political variables in recipient countries play in driving FDI inflows. Ju and Wei (2006) argue for the importance of the quality of financial and property rights institutions in recipient countries in determining capital inflows. Papaioannou (2009) argues that institutional differences across countries can reconcile differences in flows of funds by banks. Recently, Gourio et al. (2014) link capital flows to expropriation risk.

[7] Alternative measures of the returns to capital in the literature yield similar findings to ours. Using statistics compiled directly from local national accounts data, Daly (2010) finds average returns in emerging markets exceeded those in developed markets over the period 1981-2008 by similar amount to what we document.

Other explanations include frictions in international capital markets that limit capital mobility as emphasized by Obstfeld (1993). Gertler and Rogoff (1990) and Gordon and Bovenberg (1996) analyze the effect of asymmetric information on cross-border lending and capital flows. Reinhart and Rogoff (2004) point to the effects of serial default in developing countries. Finally, Ohanian and Wright (2007) evaluate a number of potential explanations for the Lucas Paradox and find the explanatory power of each to be limited, as none reverse the standard forces pushing for return equalization. Gourinchas and Rey (2013) offer an even more comprehensive survey of the theoretical and empirical literatures that examines cross-border capital flows. We add to this literature by demonstrating that risk due to uncertain growth prospects seems to be a promising channel. We relate to this literature in that we propose a new potential explanation for the Lucas Paradox—one that builds on consumption growth risk for a global investor. To our knowledge, this is the first paper to propose such an explanation. In addition, we demonstrate that the consumption-growth risk can quantitatively account for a large portion of the return differentials across several different classes of assets—most notably aggregate capital as well as equities.

Our focus on long-run risks as a key source of risk premia builds on the insight of Bansal and Yaron (2004). More specifically, our modeling structure is closely related to Lewis and Liu (2015), Nakamura et al. (2012), Colacito and Croce (2011), and Colacito and Croce (2013). All of these papers find a significant role for shared long-run risk across countries, although they do not focus on heterogeneity (across rich and poor countries) in the exposure to this risk as we do. Additionally, our finding of more severe exposure to growth shocks by emerging markets relates our paper to Aguiar and Gopinath (2007) who demonstrate the important role of TFP growth rate volatility in driving observed aggregate dynamics in these countries. Relatedly, Naoussi and Tripier (2013) find that growth shocks play an even more important role in accounting for the behavior of macroeconomic variables in developing and Sub-Saharan African countries.

Lastly, there is a large literature that demonstrates the importance of global shocks in driving asset prices and flows as well as the behavior of key macroeconomic variables. Calvo et al. (1996) argue that the behavior of US interest rates drove capital flows to developing countries during the 1990s. Neumeyer and Perri (2005) and Uribe and Yue (2006) argue that US interest-rate shocks are of first-order importance in driving emerging market business cycles as they affect domestic variables mostly through their effects on country spreads. Rey (2015) and Miranda-Agrippino and Rey (2014) document a 'global financial cycle,' specifically, that US monetary policy is a key global factor that drives time-varying global risk aversion and aggregate volatility, which have strong implications for international risk premia. The authors argue that US monetary policy directly affects the leverage of global banks and consequently cross-border capital flows. Borri and Verdelhan (2012) show that foreign sovereign bonds exhibit significant comovement with US bonds, and similar to the stylized facts that we document, that higher bond betas are associated with higher excess returns. Longstaff et al. (2011) find that global factors can account for the majority of sovereign credit spread, while Colacito et al. (2014) show that there is substantial heterogeneity in the exposure to global shocks among the ten most traded currencies in the world.

Related to our measure of aggregate capital returns, Cooper and Priestley (2013) show that the world capital-output ratio has significant explanatory power for the cross-section of international stock returns. Papers that focus on quantity dynamics include Kose et al. (2003), who find that there is an important common factor in international business cycles, i.e., a 'World Business Cycle'. Burnside and Tabova (2009) find that about 70% of the cross-sectional variation in the volatility of GDP growth can be explained by countries' differing degrees of sensitivity to global factors and additionally, that low-income countries exhibit greater exposure to these factors. The key factors that the authors study include US GDP growth and interest rates, a number of commodity price indices, and the return on the US stock market. Our analysis differs from these papers in that we quantify the importance of global shocks in accounting for risk premia and therefore required returns across different assets in developed versus emerging markets.

2 The Returns to Capital: Stylized Facts

In this section, we describe our measures of the returns to capital and we establish a number of empirical properties of returns - namely, systematic relationships between average returns and level of income across countries as well as between average returns and the beta on the return of a corresponding US asset.

2.1 Measuring Returns

We use two alternative measures of the returns to capital. The first follows the growth literature in using macroeconomic data on the marginal product of capital and the relative price of investment goods to measure the return to the aggregate capital stock. The second uses stock market returns, which represent a direct measure of the returns to some piece of the capital stock, i.e., that which is publicly traded. Each of these measures has advantages and disadvantages. The first allows us to study a large set of countries over an extended period of time, whereas equity market data are available for a much smaller set of countries and span a shorter period (in large part because such markets did not exist for the majority of emerging markets until recent decades). Further, portfolio investments are one of several ways to undertake investments in emerging markets (for example, alternative vehicles include debt instruments and FDI, which have traditionally been larger than equity), and a focus only on equity returns may miss out on important margins. Relatedly, equity returns may give a non-complete picture of the properties of returns to many investments in emerging markets, since only a small fraction of the capital stock tends to be publicly listed. Moreover, stock market returns can reflect a number of additional forces, for example, the value of intangible capital, the effects of financial leverage, and more. Finally, the Lucas Paradox has typically been framed in the literature as a puzzle regarding the return to aggregate capital, for example in Caselli and Feyrer (2007) as well as in the seminal work by Lucas (1990), and we view tackling this particular measure as one of the main contributions of our paper. Nevertheless, stock market returns have the benefit of being an assumption-free measure and are less affected by concerns regarding tradability and other market frictions than our broader measure of the return to the entire capital stock. Moreover, the risk-based explanations that we explore are commonly applied to the US stock market and, given our focus on international capital returns, it is reasonablr to explore their implications for equity returns across countries. For these reasons, we demonstrate that the key facts that we document hold across both measures of returns.

Returns to aggregate capital. Our first measure of returns builds closely on Caselli and Feyrer (2007), Hsieh and Klenow (2007), and Gomme et al. (2011), extended to include an explicit international dimension. The world economy consisting of the US and J regions, where regions will correspond to countries, or 'bundles' of countries in our empirical analysis. As in these papers, the economy consists of both consumption goods and investment goods. We consider a US-based investor who decides whether to pursue an additional capital investment, either at home or abroad. He would purchase a unit of the investment good domestically and invest it either in the US or in some other region. The additional unit of capital represents a claim on some portion of the local income it generates. The payment received by the investor is the rental rate on capital, which represents the period payoff, or 'dividend' from this investment. A portion of the capital depreciates and so the investor is left with only a fraction of the unit at the end of the period, which would continue to hold some value. The return from this transaction in region j is:

$$R_{j,t} = \frac{D_{j,t}}{P_{I,t}} + (1 - \delta_{j,t}) \frac{P_{I,t+1}}{P_{I,t}}$$

where $D_{j,t}$ denotes the period payoff to a unit of capital, or dividends, $P_{I,t}$ the price of the investment good (in terms of the US consumption good, which serves as numeraire), and $\delta_{j,t}$ the time t rate of depreciation in region j.[8] We assume that investment goods are freely

[8] We will use country-time specific values of δ in our empirical implementation.

tradable across regions while consumption goods are at least in part not.[9] The law of one price then implies a common price for investment goods (hence, no region subscript). Because the price of consumption goods need not equate, the relative price $\frac{P_{I,t}}{P_{C,j,t}}$ may differ across regions. Although the assumption of freely traded capital goods is a clear simplification, it is motivated by the observation that relative price differences that are systematically related to income are largely driven by differences in the price of consumption goods, which tends to be higher in richer countries, whereas the price of investment goods shows no systematic relationship with income.[10] Our focus on a US-based investor stems in large part from the fact that many countries import a large share of their capital goods and that this is particularly the case in poor countries.[11] Moreover, the question we seek to answer is whether rate of return differentials necessarily point to an untapped arbitrage opportunity on the part of a single investor, and it seems a reasonable first pass to take the perspective of one based in the US.[12]

As shown in Caselli and Feyrer (2007), under the assumptions of constant returns to scale and competitive capital markets, the payout to a unit of capital is equal to the (price-adjusted) marginal product of capital:

$$D_{j,t} = \alpha \frac{P_{Y,j,t} Y_{j,t}}{K_{j,t}} \tag{1}$$

where α is the share of total income paid to capital and $P_{Y,j,t} Y_{j,t}$ is region j total income, evaluated in local prices. Putting the pieces together, the return on aggregate capital from region j in period t is given by,

$$R_{j,t} = \alpha \frac{P_{Y,j,t} Y_{j,t}}{P_{I,t} K_{j,t}} + (1 - \delta_{j,t}) \frac{P_{I,t+1}}{P_{I,t}} \tag{2}$$

which measures the return to capital - or more specifically, the marginal return to an additional unit of investment - as the number of consumption goods received compared to the number

[9] Similar assumptions have been made in the literature, see, for example, the setup in Section I.A. in Hsieh and Klenow (2007).

[10] See, for example, Hsieh and Klenow (2007), who point out that this fact is inconsistent with higher trade frictions in poor countries, but rather may stem from lower productivity of producing investment goods there. We will empirically explore variants of this approach that (1) take into account different levels of P_I across countries and (2) limit our analysis to countries classified as 'open' according to a number of measures so that trade frictions are presumably lower there. We show that our results do not depend on this assumption.

[11] For example, Burstein et al. (2013) document that 80% of the world's capital equipment was produced in just 8 countries in the year 2000; that the median import share of equipment in that year was about 0.75; and that the poorest countries in the world tend to import almost all their equipment. Mutreja et al. (2012) find similarly, and report a correlation between the import to production ratio for capital goods and income of -0.34 (they report, for example, that Malawi imports 39 times as much capital as it produces, and Argentina 19 times as much). Related facts are also in Eaton and Kortum (2001) and Kose (2002), who follow a similar approach in using US investment good prices to measure prices of imported capital goods in developing economies.

[12] A number of recent papers have taken a similar stance in assessing return differentials in international asset markets, for example, Lustig and Verdelhan (2007) in the case of high- versus low-inflation currencies and Borri and Verdelhan (2012) in the case of sovereign bonds.

given up.

The measure of returns in expression (2) builds on the insight of Caselli and Feyrer (2007), who show that accounting for differences in relative prices is key when measuring the cross-sectional dispersion in capital returns, and additionally that of Gomme et al. (2011), who point out the importance of changes in the relative price $P_{I,t}$ in driving the time series behavior of capital returns, at least in the US, and in particular, the contribution of this term to the volatility of returns. In one important regard, our measure is closer to that in Gomme et al. (2011) than in Caselli and Feyrer (2007): all prices are expressed in units of US consumption, not of region-specific output. The calculations in Caselli and Feyrer (2007) imply that the investor considers his return in units of output received per unit of output invested; here, as in Gomme et al. (2011), the investor considers units of consumption received per unit of consumption invested, and a corresponding adjustment must be made when mapping (2) to the data. A second departure from Caselli and Feyrer (2007) is in the cost of the original unit of the investment good: there, investors purchase investment goods locally, that is, in the region where they will be used in production; in our setup, the US investor purchases these goods domestically, no matter the location of production.[13]

To measure the quantities in equation (2) we use data from Version 8.0 of the Penn World Tables (PWT),[14] and to measure the relevant prices we rely on data from the US National Income and Product Accounts as reported by the Bureau of Economic Analysis (BEA). Our final sample consists of 144 countries over the period 1950-2009 (so returns are from 1950-2008).[15] For each country, the PWT directly reports real GDP valued at 2005 US dollars, which we will denote $P_{Y,US,2005}Y_{j,t}$, an estimate of the real-valued capital stock $K_{j,t}$ and country-time specific depreciation rates $\delta_{j,t}$. Recall that all prices in (2) are relative to US consumption, as that is the relevant tradeoff being made, and that relative prices may (and do) vary through time. To make this adjustment, we multiply the reported value of GDP by the relative price of output to consumption in the US, $\frac{P_{US,Y,t}}{P_{US,C,t}} = \frac{\frac{P_{US,Y,t}}{P_{US,Y,2005}}}{P_{US,C,t}}$ in each year t, where $P_{Y,US,2005}$ is normalized to 1. The result gives the value of year t GDP in region j in current units of US consumption, which is the object needed to measure $D_{j,t}$. The price index of US output $P_{US,Y,t}$ is constructed as nominal GDP divided by real GDP, with 2005 serving as the base year as noted. To construct the price index of consumption $P_{US,C,t}$, we divide nominal spending on non-durables and services by the corresponding real values. The ratio of these two series is then the relative price of interest. Data for these latter two computations are obtained from the BEA. It remains to specify a value for α, which we set to 0.3 across all regions following

[13] As discussed above, the majority of investment goods are produced in a small number of developed countries.

[14] See Feenstra et al. (2013) for detailed documentation.

[15] Countries need not be present for the entire period to be included. We describe the sample construction in Appendix A.

Gollin (2002), although with recent work by Karabarbounis and Neiman (2014) in mind, we explore the effects of using time-country specfic α's below.

Finally, to compute returns, we need the relative price of investment goods in the US. We compute this price as nominal private spending on investment in equipment and structures divided by the corresponding real values, again with data obtained from the BEA. Our approach to measuring the relevant relative prices follows closely that of Gomme et al. (2011). From an empirical point of view, a beneficial by-product of our focus on a US investor is the ability to measure the relevant prices using a widely used data source thought to be highly reliable.

Returns to equity. As a second measure of international capital returns, we examine stock market returns. To do so, we obtain quarterly country-level stock market returns denominated in US dollars from Morgan Stanley Capital International (MSCI). We deflate these using the US CPI. To ensure a clean comparison across countries, we limit the sample to countries classified as 'Developed' or 'Emerging' by MSCI, which have data available beginning in 1988 (this is the earliest date available for most emerging markets). We additionally include Argentina, which is classified as 'Frontier,' but has data back to 1988. Our final sample consists of a balanced panel of 33 countries over the period 1988-2014, 22 classified as developed (including the US) and 11 as emerging.[16]

Due to known problems with imputing dividend series from the return and price indices provided by MSCI, see, for example, the discussion and references in Rangvid et al. (2014), we follow these authors and use dividend data obtained from Datastream. Datastream reports quarterly dividend yields and price indices in US dollars for most of the countries in our sample, from which we can compute the level of dividends.[17] We deflate quarterly dividends using the US CPI and because of well-known seasonality in dividend payouts, we aggregate to an annual frequency.

There are a number of concerns regarding the data on returns and dividends, particularly in emerging markets. First, both series exhibit a handful of extreme outliers. As has been recognized in the literature, emerging stock markets are prone to extremely large short-term fluctuations, due, for example, to events such as currency crises, default episodes, movements in commodity prices etc.[18] Given our rather short time frame and small number of countries, even one of these episodes can have a large influence on the results (for example, over 100% returns within a single quarter or fluctuations in dividend growth rates exceeding 300% in a

[16] We provide further details on the data construction in Appendix A.

[17] Brazil and Switzerland are only available in local currency. For these countries, we convert dividends from local currency to US dollars using end of quarter exchange rates obtained from the Federal Reserve Bank of St. Louis FRED database.

[18] CITE

year). The dividend series are also subject to at least two other considerations: first we are only able to compute total dividends from the Datastream data, not dividends per share. To the extent that the number of firms in the Datastream index is changing, this may affect the resulting moments for reasons unrelated to changes in dividends per share, which is the object of interest. Second, countries may differ in terms of the dividend policy of firms - i.e., to what extent firms smooth dividends or decide to use retained earnings to finance increased investment rather than distribute profits to shareholders - and these differences may be independent of actual differences in the underlying fundamentals of firms. To address this concern we exclude observations where dividends fluctuate by more than 50% in a single year, roughly the 2% tails of the distribution. We accordingly do the same for stock returns, where we trim the 3% tails of returns in each country. We choose this more systematic approach, rather than take a stand on whether particular episodes represent outliers or not, given their relatively more frequent occurrence in emerging markets. Importantly, we show that the facts that we document are not sensitive to these choices and are even more pronounced when examining raw returns. Moreover, our "truncated" measurement approach tends to be conservative for our quantitative work, in the sense of generally leading to lower predicted returns from our model.

2.2 Stylized Facts

2.2.1 Returns to Aggregate Capital

Beginning with returns to the aggregate capital stock, Figure 1 illustrates our main stylized facts across the full set of 144 countries in our sample. The left hand panel plots the mean return to capital for each country over all available years for that country, denoted by R_j, where returns are computed year by year using expression (2), against the mean level of income over the same period, measured as (log) income per worker and denoted by y_j. The figure shows the first key fact: capital returns differ significantly around the world and despite a good deal of noise, there is a systematic relationship between returns and income, that is, returns are generally higher in poorer countries. The relationship between returns and income is negative and highly significant, both in a statistical sense and an economic one: each 10% reduction in income is associated on average with a 1.8% increase in mean returns.

Next, we compute each country's return beta by regressing the time-series of its returns on those in the US. The right-hand panel of Figure 1 plots mean returns against the resulting betas. The figure illustrates our second fact: there is a strong connection between a county's beta and its mean return - countries that exhibit a greater exposure to shocks that move US returns tend to be the same that offer high levels of average returns.

The puzzle we are after is why systematic return differences may persist between low re-

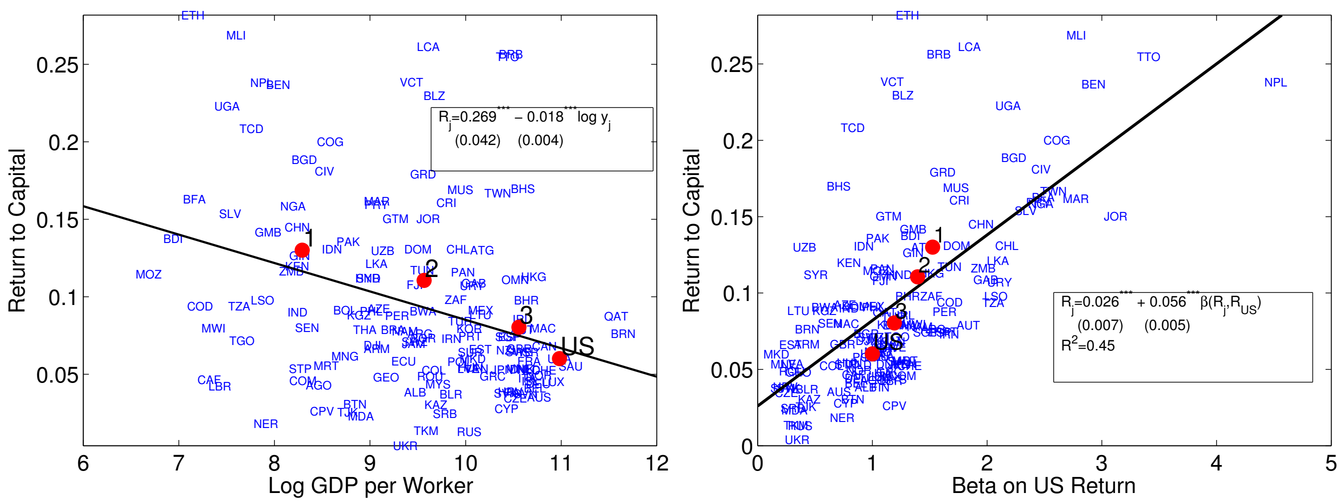

Figure 1: The Cross-Section of Capital Returns

turn/rich countries and high return/poor ones. To focus on the link between returns and income, we form 'bundles,' or 'portfolios,' of countries, grouped by levels of per-worker income. These portfolios, rather than individual countries, are the primary unit of the quantitative analysis and they correspond to the J regions to which we have been referring. Our approach here follows widespread practice in empirical asset pricing, which has generally moved from addressing variation in individual asset returns to returns on asset portfolios, sorted by factors that are known to predict returns. This procedure proves useful in eliminating asset-specific diversifiable risk, and so in honing in on the sources of return variation of interest. In our application, it serves to eliminate idiosyncratic factors that drive country-specific returns but are unrelated to countries' levels of economic development. Additionally, the portfolio approach also aids in eliminating measurement error in country-level variables. Further, we are able to expand the number of countries as data become increasingly available, enabling us to include the largest possible set of countries in our analysis. Lastly, there is an intuitive appeal to analyzing portfolios: by doing so, we are asking whether there are arbitrage opportunities for a US investor to go short in a portfolio of rich country capital assets and long in a portfolio of poor country ones, which is at the heart of the question we are after.

We perform our analysis first on 3 portfolios plus the US and we extend our analysis to 5 and 10 portfolios in our quantitative work (with the US always separate). We allocate countries into portfolios based on average income over the sample period. That is, we align average income with average returns with the interpretation being whether average, or expected, returns in the cross-section are systematically related to average income. Figure 1 overlays returns at the country-level with returns in our 3 portfolio grouping.[19] Portfolio 1 contains the poorest

[19]Appendix E lists the countries by portfolio and year in which they entered the PWT dataset.

set of countries and portfolio 3 the richest, with the US always kept apart, so that higher numbered portfolios are higher income and the US is last, a terminology which will remain consistent throughout the paper. The portfolios eliminate a good deal of the country-level variation in returns even within similar income groups and with respect to their betas, yet retain the systematic relationship between returns and income. We report the levels of average income, expected returns, and beta on the US return across portfolios in the top panel of Table 1, which shows average returns of 13% in portfolio 1 compared to 6% in the US, a spread of 7 percentage points and a beta as high as 1.5 in portfolio 1.

Table 1: The Return to Aggregate Capital

Returns					
Portfolio	log(income)	$\mathbb{E}[R_{j,t}]$	$\beta(R_{j,t}, R_{US,t})$	$\text{corr}(R_{j,t}, R_{US,t})$	$\text{std}(R_{jt})$
1	8.29	13.01	1.53	0.71	0.063
2	9.57	11.06	1.39	0.76	0.053
3	10.56	8.04	1.19	0.83	0.042
US	10.98	6.01	1.00	1.00	0.027
Dividend Growth Rates					
Portfolio			$\beta(\Delta d_{j,t}, \Delta d_{US,t})$	$\text{corr}(\Delta d_{j,t}, \Delta d_{US,t})$	$\text{std}(\Delta d_{j,t})$
1			0.47	0.18	0.083
2			0.49	0.21	0.074
3			0.60	0.31	0.064
US			1.00	1.00	0.026
GDP Growth Rates					
Portfolio			$\beta(\Delta y_{j,t}, \Delta y_{US,t})$	$\text{corr}(\Delta y_{j,t}, \Delta y_{US,t})$	$\text{std}(\Delta y_{j,t})$
1			0.18	0.06	0.081
2			0.23	0.10	0.071
3			0.45	0.26	0.059
US			1.00	1.00	0.023

Notes: The top panel of the table reports moments for returns to aggregate capital during the 1950-2008 period for three portfolios, sorted by mean income per worker, and the US. The middle panel reports moments for growth rates of dividends from aggregate capital during the same period. The last panel reports moments for income per worker during the same period.

Second moments. In addition to the first moment, returns across countries differ greatly in their second moments. First, Table 1 reports the correlation of returns in each portfolio with those in the US. Strikingly, these move in the opposite direction of the return betas and actually tend to be lower in poorer countries. However, betas are a composite of the correlation and standard deviation and the last column of the table shows that returns are much more volatile in poor and emerging markets - generally twice as high in the poorest two portfolios as in the

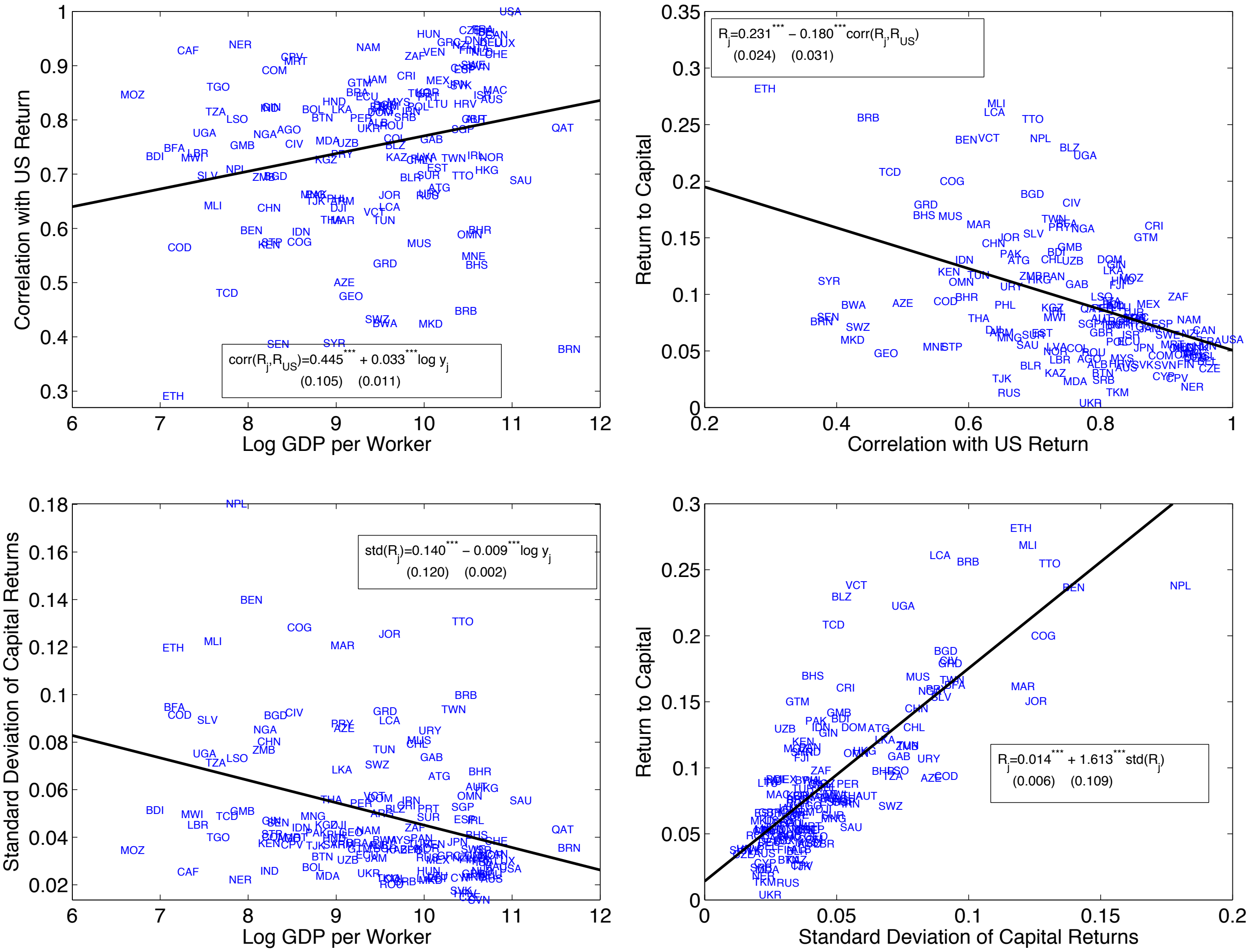

Figure 2: Aggregate Capital Returns - Correlations and Volatility

US. The extreme differences in volatility more than offset the pattern in correlations and are largely what drive the disparities in betas.

Figure 2 displays these patterns at the country level. In the top row, we plot correlations with US returns against income on left, and average returns against correlations on the right. Correlations are somewhat lower in low-income countries and lower correlations are associated with higher returns. The bottom row of 2 shows analogous plots using the standard deviation of returns. Here, the opposite emerges: low-income countries tend to exhibit higher return volatility, and the degree of return volatility is strongly positively related to the average level of returns. Again, what we learn is that, while low-income countries tend to be less correlated with the US, their high level of volatility more than offsets this pattern, leading them to have higher return betas.

Dividend growth rates. The center panel of Table 1 reports second moments of the growth rates of dividends as implied by expression (1). Comovement of dividend growth with that in the US, as measured by the beta of foreign dividend growth on US dividend growth, is lower in poorer countries, the opposite pattern to that in returns. The same pattern is true in terms of correlations. Finally, dividend growth is more volatile in lower-income countries, for example, portfolio 1 has three times the standard deviation of the US. The fact that low-income countries show (1) high comovement of returns but (2) low comovement of dividend growth, alongside (3) high levels of volatility, will all play a role in our quantitative analysis of risk-based explanations below.

From expression (1), dividend growth comes from changes in income, i.e., GDP, and changes in the capital stock. To get a sense of the role of each, the bottom panel of Table 1 reports the second moments of GDP growth rates across the portfolios. These display patterns similar to those in dividend growth - lower betas and correlations with US GDP growth in low-income countries and higher levels of volatility. Dividends clearly inherit much of the properties simply of GDP growth. This is not overly surprising, given the slow-moving nature of the capital stock, which does not tend to be very volatile at short frequencies, and suggests that fluctuations in payments to capital are largely driven by movements in aggregate GDP.

Alternative measurement approaches. There are a number of plausible variants on our measurement approach. First, we relax our assumption of a common price of investment goods. To do so, we use country-specific prices as reported in the PWT for all prices in equation (2). Loosely speaking, this corresponds to the return earned by a local investor - one who purchases capital goods in the local country and whose payoff is denominated in local consumption goods. This is the price adjustment made, for example, in Caselli and Feyrer (2007). We report the results across three portfolios in the second column of the top panel of Table 2 and we repeat the baseline values in the first column. Generally, the returns to each portfolio do not change much under this modification; while the dispersion in returns falls slightly, the differences between the returns on different portfolios and the US remain significant, both economically and statistically.[20] While this exercise is an informative check, notice that our theory prescribes our baseline measure due to our focus on a US investor, not domestic investors in each country.

Second, we use country-year specific capital shares, with an adjustment for the shares of non-reproducible capital, again in the spirit of Caselli and Feyrer (2007). To do so, we obtain data on the shares of payments to natural resources in GDP from the World Bank's World Development Indicators (WDI) database. We compute the reproducible capital share as one

[20]The US changes most, increasing about 2 percentage points simply from using PWT relative prices, rather than those from the BEA.

minus the labor share minus the natural resource (non-reproducible) share.[21] These data are available for 115 of our original 144 countries only over the period 1970-2008. We report the values in the second column of the bottom panel of Table 2 and we repeat the baseline calculation for the subset of countries and years in the first column for reference. During this limited time period and country sample, all returns are lower, which is mainly due to rising capital-to-output ratios around the world. After making the adjustment for shares of non-reproducible capital, returns in the three portfolios rise moderately, reaching the levels reported in the top panel. The differences in returns relative to the US remain large and statistically significant in both cases. Thus, while differences in α affect the magnitudes of returns, the message remains the same, with poorer countries exhibiting higher rates of return.

In the third column of the bottom panel of Table 2, we report returns using both country-specific prices and capital shares. Similar to the results with only country-specific prices, dispersion falls slightly relative to the second column, and particularly so among portfolios 1 to 3 (although as in column 2, the US shows the largest change). On the other hand, portfolios 1 to 3 continue to exhibit returns that are significantly different from those in the US, and so the main message does not change.

Finally, to understand better why we find significant differences in returns where others have not, perhaps most prominently Caselli and Feyrer (2007), we recompute returns for only the year 1996 - the year that those authors study - under our baseline approach and each alternative. In other words, we compute the dispersion in returns for a single cross-section rather than over the entire time-period. Under our baseline, the spread in returns in 1996 is much smaller than the average over the period, falling to less than 2% from almost 7%. Although the difference from the US remains statistically significant for portfolios 1 and 2, the magnitude is clearly much smaller. Using country-specific prices, statistical significance as well as the systematic pattern across portfolios disappears.[22] Similar patterns hold with country-specific α's and the combination of the two. Thus, under any of these approaches, differences across portfolios are significant - both economically and statistically - when the entire time-period is under examination, but the returns do not obey any particular pattern in a single year such as 1996.[23] What we conclude is that differences in the time periods is the primary

[21]It should be noted that payments to natural resources include oil rents, natural gas rents, coal rents, mineral rents, and forest rents, and whether or not these are truly 'non-reproducible' is unclear: consider, for example, an investment by Exxon-Mobil in a new oil well.

[22]Portfolio 3, which contains the richest countries in the world, enjoys very high returns in 1996 when computed in this fashion.

[23]We should note that one important reason why Caselli and Feyrer (2007) may have chosen to work with year 1996 is because the prices in the PWT 6.1 version that they use correspond to 1996—the benchmark year in PWT 6.1. Prices in PWT are obtained from the International Comparison Program (ICP), which collects prices of narrowly-defined and comparable consumer and capital goods across retail locations in a given year. The prices used outside of the benchmark years are interpolated, so they should be interpreted with caution.

reason why we find systematic cross-country differences where some other studies have not, in particular, our focus on returns over a longer time-period.[24] The risk-based explanations that we explore below are designed to account for these long-run differences, i.e., differences in expected returns over time, not those in any given year based on some particular realization of the stochastic processes that drive returns.

Table 2: Capital Returns - A Variety of Approaches

	1950-2008			1996		
Portfolio	Baseline	Country prices		Baseline	Country prices	
1	13.01***	11.94***		5.37**	3.32	
2	11.06***	10.44***		5.20*	5.89	
3	8.04***	9.30***		3.90	10.03**	
US	6.01	8.20		3.63	7.23	
	1970-2008			1996		
	Baseline	Country α's	Country prices & α's	Baseline	Country α's	Country prices & α's
1	9.59***	13.23***	12.85***	4.93**	8.36***	6.21
2	7.53***	12.50***	12.27***	3.97	8.11**	9.37
3	6.32**	9.04***	11.10***	3.67	6.55	14.17***
US	5.21	6.19	9.37	3.63	5.51	9.55

Notes: Table reports the returns to aggregate capital across portfolios under a number of measurement approaches. Baseline uses US prices from BEA. Country prices uses country-specific P_Y, P_I, P_C from PWT. Country α's uses country-year α from PWT and subtracts from α the share of payments to non-reproducible capital from WDI, dropping the countries that have negative α for at least one year. Country prices and α's uses country prices and country-year α as described above. Baseline and Country prices cover years from 1950 to 2008. Country α's and Country prices and α's cover years from 1970 to 2008. The portfolios include only countries for which data are available. Standard errors are reported in parentheses. Asterisks denote significance of difference from US values: *** difference significant at 99%, ** 95%, and * 90%.

Capital market frictions. An important consideration is that measured returns may differ systematically across countries due to the presence of frictions associated with foreign invest-

As noted earlier, we rely on an entirely different version of the PWT—8.0, where the price data were collected in year 2005. Moreover, in our baseline case, where we compute returns from the point of view of a US investor, we rely on price indices for consumption, investment and output for the US from the BEA, which samples prices annually, thus circumventing the problem of interpolated prices between ICP benchmarks. We do use GDP data (in current 2005 PPP prices) from the PWT, so the price of output of each country relative to the US in all years reflects the 2005 PPP adjustment. However, the capital stock in PWT 8.0 is expressed in the same unit; hence, PPP adjustments disappear when we compute dividends and therefore returns.

[24] We should note that the returns across portfolios over the last decade of the PWT data show some convergence compared to earlier periods. However, insufficient data are yet available to determine whether this is a temporary or more permanent change. For example, as we show below, stock return data continue to show substantial differences over recent periods (1988-2014).

ments in some countries. These capital market distortions may be explicit (ex. trading limits, taxes, etc.) or implicit—for example, Gourinchas and Jeanne (2013) posit that credit market imperfections, expropriation risk, bureaucracy, bribery, and corruption in poor countries may result in a 'wedge' between social and private returns to physical capital there. Such a wedge may imply that the US investor expects to receive only a fraction of the dividend and/or capital gains yield on investments in poor countries. Hence, in order to invest there, he would demand higher pre-wedge rates of return.

Measuring the types of frictions described above with the intent of adjusting realized returns is very difficult.[25] The existing literature, however, has made attempts to quantify these frictions, commonly referred to as capital controls, and to categorize countries according to their degree of 'capital account openness.' To understand whether systematic differences in openness can account for the observed return differentials in the data, we recompute returns using only the countries that have capital accounts classified as 'open.' The thought experiment is as follows: if differences in capital controls are the primary source of differences in returns to capital across countries, then returns should be at least approximately equalized among countries with open capital accounts.[26]

Chinn and Ito (2006), Quinn (2003), and Grilli and Milesi-Ferretti (1995) provide measures of capital account openness at the country-year level.[27] The first two indices provide continuous measures of openness, while the last is an indicator function. For each of the first two indices, we compute the median index value over the covered period and we define a country to be open in a given year if its index value exceeds this threshold. In the case of the Grilli/Milesi-Ferretti index, we define a country to be open in every year in the sample the indicator takes on the value of 1.

Having obtained definitions of openness, we turn to the three portfolios analyzed in the baseline case and examine only the countries that are considered open according to one of the three indices described above. The list of open countries according to each measure, classified by

[25]For example, Gourinchas and Jeanne (2013) impute the capital wedge for each country so as to match the discrepancy between actual investment rates in the data and those predicted by a one-sector deterministic neoclassical growth model with a capital tax and fixed world interest rate. The authors find that the imputed capital wedge is higher in poorer countries—an observation that is consistent with the existence of capital market distortions. As the authors note, however, the wedge is consistent with another mechanism: inefficiencies in producing investment goods in poor countries that distort the relative price of capital to consumption goods as argued by Hsieh and Klenow (2007).

[26]In an additional exercise, when considering stock returns, MSCI reports for a few countries and years returns both before and after withholding taxes. Using these to impute some measure of the effective tax rates, we find no significant relationship between the level of taxes and income.

[27]The Grilli/Milesi-Ferretti index covers 61 countries during the 1966-1995 period. Quinn (2003) covers a large number of countries during the 1950-2004 period. Chinn and Ito (2006) build on the work by Quinn (2003) and expand the country coverage to the majority of countries in the world as well as extend the time coverage to 2011.

portfolio, are reported in Appendix E. Notice that the number of open countries in portfolio 1 is significantly smaller than the number of open countries in portfolios 2 and 3. Thus, there is some evidence that poorer countries are characterized by more strict capital controls. In addition, there is considerable overlap across the different measures of openness, which is reassuring.

Table 3: Capital Returns - Open Countries

	Measure of Openness		
Portfolio	Chinn, Ito	Quinn	Grilli, Milesi-Ferretti
1	10.38***	12.39***	11.48***
2	8.74***	11.27***	10.28***
3	5.61	6.66	7.57**
US	5.22	6.06	5.85

Notes: Table reports the returns to capital across portfolios for economies that are characterized as open according to three indices: Chinn/Ito, Quinn, and Grilli/Milesi-Ferretti, respectively. Chinn/Ito and Quinn openness cutoff is median value in sample. Grilli/Milesi-Ferretti openness indicator is unity. Asterisks denote significance of difference from US values: *** difference significant at 99%, ** 95%, and * 90%.

Table 3 reports the returns in open countries, classified according to each of the three different measures, including the returns on aggregate US capital. The returns to capital for the US differ across columns due to the different time periods covered by each openness measure. Overall, portfolios 1 and 2 yield significantly higher rates of return to US investors, regardless of the measure of openness employed. Returns are monotonically decreasing across portfolios, as in the baseline. Portfolio 3 remains higher than the US, although the difference is somewhat narrower, and is statistically significant in only one case.[28] In sum, the negative link between level of income and returns to capital remains present among economies typically classified as 'open,' suggesting that capital control differences cannot fully account for the differences in returns between rich and poor countries.

2.2.2 Returns to Equity

In this section, we document the same facts using stock market returns. As discussed above, stock market data are only available for a smaller set of countries and shorter time period, and additionally measure returns only to publicly listed capital, which may not be a full picture of all the investment channels available to investors. On the other hand, equity returns are largely free from assumptions such as capital's share of income, the tradability of goods, etc., and in this sense, represent a clean measure of the return to at least some piece of the capital stock.

[28]Returns are even closer to our baseline as reported in Table 1 if we use the less conservative cutoff for openness in the Quinn database that corresponds to the cutoff used by Lustig and Verdelhan (2007).

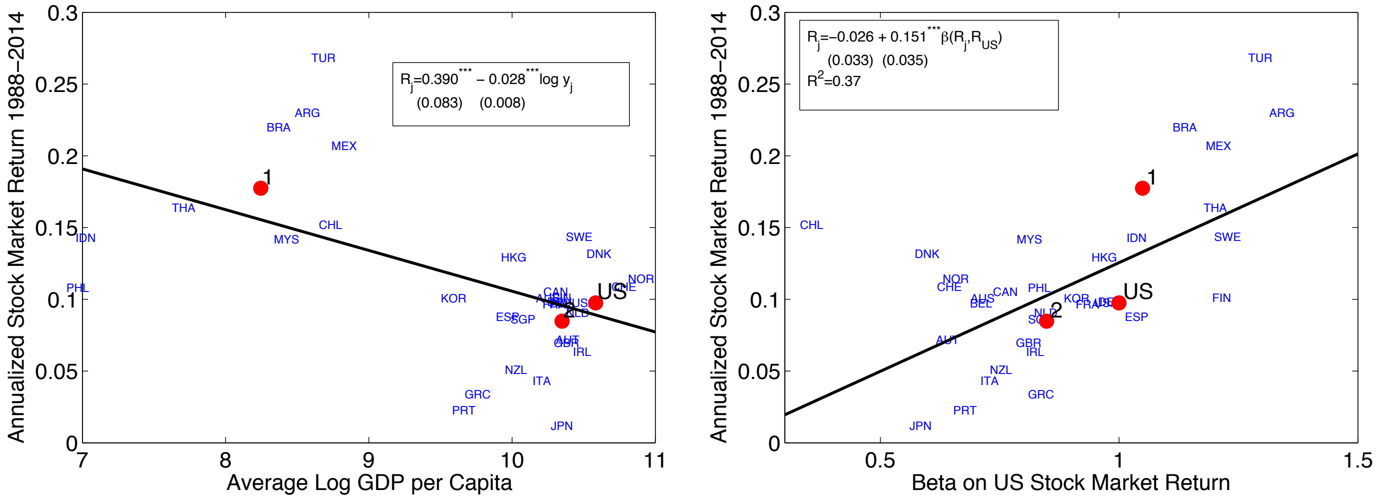

Figure 3: The Cross-Section of Equity Returns

Figure 3 replicates Figure 1 using stock market returns. The left-hand panel shows that expected equity returns exhibit a negative and significant relationship with mean income.[29] The right-hand panel shows that high return countries tend to be those that exhibit high betas on the US stock market return. An examination of the plot shows that countries clearly fall into two categories: high-income/low return, with South Korea representing the lower bound along the income dimension, and low-income/high return. We group countries into two portfolios according to this classification and overlay the graph with these portfolios. Additionally, we report the corresponding values in Table 4. At the portfolio level, the returns to equity exhibit similar patterns to the returns to aggregate capital: low-income countries feature higher mean returns and returns are strongly related to the beta on the US return.[30]

Next, analogous to Figure 2 above, Figure 4 illustrates the patterns in second moments for stock returns. Precisely the same regularities emerge: first, the correlation of returns with those in the US are actually lower in low-income countries and high correlation countries feature lower average returns. However, these patterns are reversed when examining the volatility of returns: low-income countries are extremely volatile and higher volatility is associated with higher mean returns. This latter finding is what primarily drives the strong relationships between average returns, betas, and income.

[29]Since the PWT data end in 2009, mean income here is measured using (log) GDP per capita from the World Bank World Development Indicators database over the period 1988-2014.

[30]For completeness, Appendix B shows these patterns hold using raw stock returns, i.e., including even extremely large outlying values of returns (either positive or negative). In fact, the patterns are even more pronounced.

Table 4: The Return to Equity Capital

Returns Income Level	$\mathbb{E}[R_{j,t}]$	$\beta(R_{j,t}, R_{US,t})$	$\text{corr}(R_{j,t}, R_{US,t})$	$\text{std}(R_{j,t})$
Low	17.74	1.05	0.42	0.333
High	8.47	0.85	0.55	0.199
US	9.75	1.00	1.00	0.130
Dividend Growth Rates Income Level		$\beta(\Delta d_{j,t}, \Delta d_{US,t})$	$\text{corr}(\Delta d_{j,t}, \Delta d_{US,t})$	$\text{std}(\Delta d_{j,t})$
Low		0.55	0.17	0.191
High		0.63	0.25	0.155
US		1.00	1.00	0.062

Notes: Table reports moments for returns to equity during 1988-2014 for 33 countries as described in Appendix A.

2.2.3 Sovereign Bonds

In this section, we provide some additional evidence of the robustness of these empirical regularities using data from a third asset class - sovereign bonds. We use data from Borri and Verdelhan (2012), who report credit spreads on sovereign bonds for 36 emerging markets. In line with our findings, they show that mean returns on emerging market sovereign bonds are significantly above US bond returns: the average difference is about 5.4% (see Table 6 in their paper).

Exchange rate risk and default risk. Examining sovereign bonds is useful for two additional reasons. First, they provide a direct way to control for exchange rate risk, since all the bonds under study are denominated in US dollars. The fact that spreads are above 5% suggests that exchange rate risk cannot account for a large portion of the differences in real returns that we observe. The argument is further supported by our findings in Table 2 that the returns to aggregate capital computed using local prices are marginally different from the baseline returns - namely, local investors whose returns are denominated in local consumption goods do not require significantly lower rates of return than do US investors, which suggests that exchange rate risk cannot account for the return differentials between rich and poor countries.

We can also use the sovereign data to control for default risk. Borri and Verdelhan (2012) sort countries into six portfolios along two dimensions: their probability of default based on credit ratings from Standard and Poor's and their betas on a single US bond (they use the Merrill Lynch US BBB corporate bond index). We summarize their findings in Table 5. Each row in the table shows the credit spreads for one level of default risk, for both high beta and low beta countries. Each column shows the credit spread for one level of beta across the various

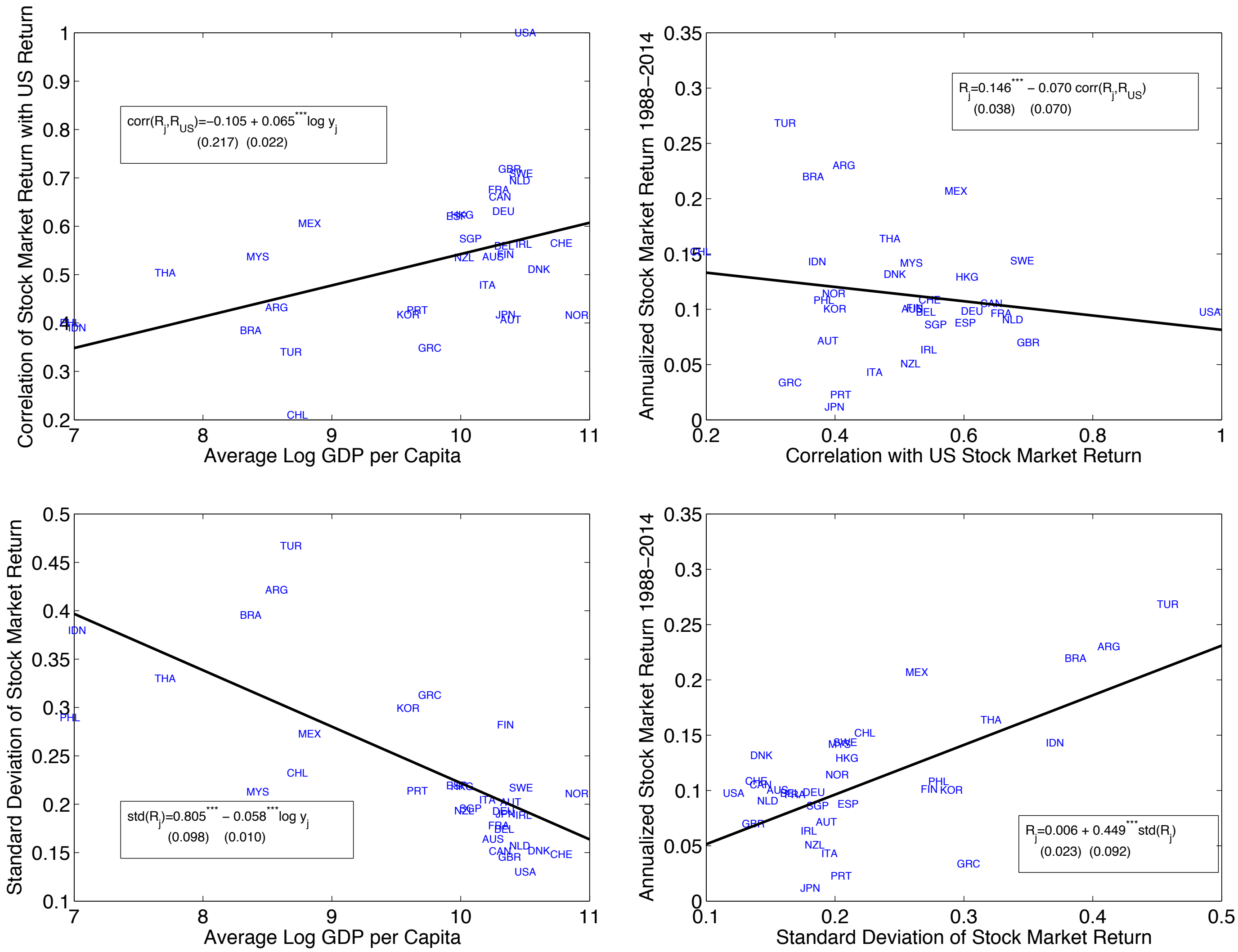

Figure 4: The Returns to Equity - Second Moments

default probabilities.

In the right-hand column, we calculate the difference in yields between high-beta and low-beta portfolios, conditional on the level of default, that is, within each specific default group. The differences are substantial, ranging from 4% to almost 7%. In the bottom row, we calculate the difference in yields between high and low default portfolios, conditional on the beta. The differences here are significant as well, ranging from about 3.5% to about 6.5%, but, if anything, are slightly smaller than those due to 'beta risk.' These results suggest that both beta risk and default risk are important in leading to return differentials across sovereign bonds. In our analysis, we focus on the latter, and note that return differentials remain large even after controlling for default risk.

Table 5: Emerging Market Sovereign Yields

Default Rating \ Beta	Low (0.4)	High (1.3)	Beta: High-Low
Low	3.01	7.03	4.02
Medium	5.62	10.15	4.53
High	6.54	13.50	6.96
Default: High-Low	3.53	6.47	

Notes: Table reports credit spreads for emerging markets. Countries are grouped by (i) default risk (each row represents a group) and (ii) beta on US BBB corporate bond index (each column represents a group). All data are from Borri and Verdelhan (2012).

3 Risk-Based Explanations

Thus far, we have documented two important empirical regularities of capital returns, measured across several different asset classes: first, low-income countries tend to offer high average returns and the gap remains under various measurement approaches, when limiting the analysis to countries with 'open' capital accounts, and when accounting for default risk and exchange rate risk. Second, average returns are strongly related to a country's beta on the US return. In this section, we explore the potential for a risk-based explanation - namely, the risk-return tradeoff implied by asset pricing theory - to reconcile these findings. To do so, we take the perspective of a US investor and use a class of endowment economies to explore whether the dynamic properties of capital returns imply risk premia - and so return disparities - on par with those that we measure in the data.

Consumption CAPM. We begin by examining the traditional power-utility consumption-based capital asset pricing model (CCAPM). In this setting, risk premia are determined by the covariance of returns to each asset with consumption growth of the investor. Taking this approach, we run into a well-known hurdle - for reasonable levels of risk aversion, these covariances are far too small to account for the cross-sectional return disparities that we measure. From this perspective, the dispersion in capital returns and the Lucas Paradox take on the familiar characteristics of a typical asset pricing puzzle.

To reach this result, consider a representative US investor with CRRA preferences

$$u\left(c_t\right) = \frac{c_t^{1-\gamma} - 1}{1-\gamma}$$

where γ is the coefficient of relative risk aversion (here also the inverse of the intertemporal elasticity of substitution).

Standard methods give the following Euler equations, one for each risky asset and one for the risk-free asset:

$$
\begin{aligned}
1 &= \mathbb{E}_t \left[M_{t+1} R_{j,t+1} \right] \; \forall \; j \\
1 &= \mathbb{E}_t \left[M_{t+1} R_{f,t+1} \right]
\end{aligned} \tag{3}
$$

where $M_{t+1} = \beta \left(\frac{C_{t+1}}{C_t} \right)^{-\gamma}$ denotes the investor's stochastic discount factor (SDF), $R_{j,t}$ the return on capital in region j as defined in equation (2), and $R_{f,t}$ the return on a risk-free bond. To simplify matters, we linearize the SDF around its unconditional mean as $\frac{M_{t+1}}{\mathbb{E}[M_{t+1}]} \approx 1 + m_{t+1} - \mathbb{E}\left[m_{t+1}\right]$ where $m_t = \log M_t$. Using the definition of m_t along with the unconditional expectation of (3) gives the standard covariance formula

$$
\mathbb{E}\left[R^e_{j,t}\right] = \gamma \text{cov}\left(\Delta c_t, R_{j,t}\right) \tag{4}
$$

which relates the mean excess return on an asset to the covariance of its returns with log consumption growth. The degree of risk aversion γ governs the strength of this relationship, that is, it determines how much additional compensation is demanded for each additional unit of covariance risk.

To assess the ability of the CCAPM to account for the patterns in international capital returns, it remains to construct the objects in equation (4). Mean excess returns are computed as the average of annual returns less the annual return on a 3 month treasury bond. US consumption is measured as real per-capita consumption of non-durables and services.[31] The covariance for each portfolio is calculated as the average covariance of the countries within that portfolio (recall that in our baseline approach, countries do not change portfolios).

The top panel of Table 6 reports the results for the returns to aggregate capital and the bottom panel for the returns to equity. First, we set a value for γ and evaluate the right hand side of (4). This is the excess return predicted by the CCAPM. We set $\gamma = 10$, which is towards the higher end of the range commonly deemed to be reasonable, and report the implied excess return $\widehat{r}^e$ in the third column of the table.[32] Across the two measures, excess returns range from a low of 0.10% to a high of 0.95%. Quantitatively, these are essentially negligible: the model generates excess returns orders of magnitude below the actual, and only a minimal spread between portfolios. Clearly, the CCAPM cannot rationalize the patterns of capital returns observed in the data, at least not for this level of risk aversion. It is in this sense that we argue that the "Lucas Paradox," i.e., the dispersion in capital returns around the

[31]Data on treasury returns are obtained from the Federal Reserve Bank of St. Louis FRED database. We follow the 'beginning-of-quarter' timing convention outlined in Campbell (2003) and compute consumption growth as the next period's consumption divided by the current period.

[32]See, for example, Mehra and Prescott (1985).

world, takes on the familiar characteristics of an asset pricing puzzle.

Table 6: Capital Returns: An Asset Pricing Puzzle

Returns to Aggregate Capital						$\widehat{r^e}$	
Portfolio	r^e	$\text{cov}\,(r, \Delta c)$	$\text{corr}\,(r, \Delta c)$	$\text{std}\,(r_t)$	$\gamma =$	10	480
1	11.79	0.00027	0.30	0.063		0.27	12.75
2	9.84	0.00019	0.25	0.053		0.19	8.97
3	6.82	0.00012	0.23	0.042		0.12	5.94
US	4.79	0.00010	0.31	0.027		0.10	4.94
Spread: 1-US	6.99	0.00016	−0.00	0.036		0.16	7.81
Returns to Equity						$\widehat{r^e}$	
Portfolio	r^e	$\text{cov}\,(r, \Delta c)$	$\text{corr}\,(r, \Delta c)$	$\text{std}\,(r_t)$	$\gamma =$	10	143
1	17.65	0.00095	0.20	0.399		0.95	13.59
2	8.30	0.00085	0.34	0.210		0.85	12.10
US	9.01	0.00070	0.43	0.134		0.70	9.92
Spread: 1-US	8.64	0.00026	−0.23	0.266		0.26	3.67

Notes: Table reports excess returns across portfolios, r^e, the covariance of returns with US consumption growth, and the predicted excess returns from the CCAPM model under two alternative levels of risk aversion.

Next, we ask what level of risk aversion is needed to best fit the observed levels of returns across portfolios? To answer this, we compute the slope of the line of best fit (with a constant term of zero) across portfolios, which is 480 for aggregate returns and 143 for equity returns. The predicted excess returns are reported in the last column of the table, which shows that to generate levels of returns on par with the data requires an unreasonably high level of risk aversion, no matter the measure of capital returns.[33]

Long-run risk. Next, we explore the potential for a long-run risk based explanation of the cross-sectional patterns in capital returns documented above. In particular, we ask whether differences in the extent of uncertainty in economic growth prospects account for the high return/low income vs. low return/high income pattern observed in the data. To answer this question in a quantitatively precise way, we work with a long-run risk model in the spirit of Bansal and Yaron (2004), and closely related to the setups in Colacito and Croce (2011), Colacito and Croce (2013), Lewis and Liu (2015), and Nakamura et al. (2012).[34] Specifically,

[33]Note, first, that the level of risk aversion required for aggregate returns is well above that for equity returns. This is because the covariance of aggregate returns with consumption growth is much lower than that of equity returns. The difference is largely due to the smoothness of the real series. Second, the results are not a consequence of our grouping procedure. For example, repeating the exercise at the country level gives a smallest level of risk aversion of about 105, still well above the reasonable range.

[34]The two other leading approaches to resolve the asset-pricing puzzles are: external habits (Campbell and Cochrane, 1999), and rare disasters (Barro, 2006; Gabaix, 2008). A model of rare disasters may, potentially, be complementary to our approach.

we follow these papers and place our representative investor in an international endowment economy in which both consumption and payments to capital experience shocks to trend growth rates. Each region (e.g., country or portfolio) is exposed to both global and idiosyncratic components that impact expected long-run growth rates in the economy. Regions differ in their exposure to the global shock process and in the characteristics of the idiosyncratic one. From the perspective of a US investor, only the former are risky and command a return premium.[35] A key challenge in measuring the quantitative importance of long-run risks is to empirically disentangle these two processes; after outlining our model and its implications for return differentials, we will propose an empirical strategy that does precisely that.

3.1 The Model

Preferences. Assume now that the representative US investor has recursive preferences à la Epstein and Zin (1989). The investor seeks to maximize lifetime utility

$$V_t = \left[(1-\beta)\, C_t^{\frac{\psi-1}{\psi}} + \beta \nu_t \left(V_{t+1}\right)^{\frac{\psi-1}{\psi}}\right]^{\frac{\psi}{\psi-1}}, \quad \nu_t\left(V_{t+1}\right) = \left(\mathbb{E}_t\left[V_{t+1}^{1-\gamma}\right]\right)^{\frac{1}{1-\gamma}}$$

where ψ denotes the intertemporal elasticity of substitution, γ measures risk aversion, β is the rate of time discount, and $\nu_t\left(V_{t+1}\right)$ is the certainty equivalent of period $t+1$ utility. Euler equations of the form in expression (3) continue to hold with the investor's SDF now given by

$$M_{t+1} = \beta^{\theta}\left(\frac{C_{t+1}}{C_t}\right)^{-\frac{\theta}{\psi}} R_{c,t+1}^{\theta-1}$$

where $\theta = \frac{1-\gamma}{1-\frac{1}{\psi}}$ and $R_{c,t+1}$ denotes the return on an asset that pays aggregate consumption as its dividend, or equivalently, the return to aggregate wealth.

Dynamics of consumption and dividends. Growth in each region is exposed to a number of transitory ('short-run') fluctuations, as well as to a small but persistent ('long-run') component that affects expected future growth prospects. The latter is comprised of two pieces: a shock to 'global' growth prospects that impacts all regions and a shock to region-specific idiosyncratic growth. Regions differ in their sensitivity to the global shock, as well as in the properties of their idiosyncratic process. Although only the former impact both consumption growth of the US-based investor and the menu of assets in which he can invest and so warrant

[35]In our model, a high degree of long-run risk in some particular region, i.e, volatile or highly persistent growth shocks, does not necessarily mean that the US investor demands a risk premium on his investment there; this is only the case if these shocks are global, in the sense that they affect the investor's SDF. Purely regional long-run shocks do not, and so they do not command significant risk premia.

a risk-premium, modeling the latter is key to ensure that we do not incorrectly label local long-run shocks as global and so overstate the implications for return differentials. Additionally, we allow for correlation in short-run shocks so that, first, we do not attribute all comovement to the global long-run shock, and second, so as to include a source of transitory risk and allow for a decomposition of return differentials into long- and short-run components. Disentangling the importance of these two sources of comovement is a second empirical challenge that we will need to address.

The presence of idiosyncratic shocks points to incomplete risk-sharing and can take several interpretations, for example, some form of market incompleteness, or complete markets with complete home bias à la Colacito and Croce (2011). We follow Lewis and Liu (2015) in not taking a stand on the precise market structure at work that leads to this outcome, but rather specify the consumption process directly and work with a general Euler equation, which holds for any level of market integration, and prices both domestic and foreign assets. The consumption process we measure in the data is an equilibrium outcome based on the true market structure and by working directly with consumption, we avoid having to explicitly specify trading protocols. Additionally, our approach is fairly general, in the sense that the perfect risk-sharing is nested in our framework, and would simply entail a finding of no significant idiosyncratic shocks when we take the model to the data.

The following system lays out the joint dynamics of US consumption and domestic and foreign dividends. We denote with an asterisk a representative foreign region, a convention we follow hereafter.

$$\begin{aligned}
\Delta c_{t+1} &= \mu_c + x_t + \eta_{t+1} \qquad (5)\\
x_{t+1} &= \rho x_t + e_{t+1}\\
\Delta d_{t+1} &= \mu_d + \phi x_t + \pi \eta_{t+1} + \mu_{t+1}\\
x^*_{t+1} &= \rho^* x^*_t + e^*_{t+1}\\
\Delta d^*_{t+1} &= \mu^*_d + \phi^* \left(\xi^* x_t + x^*_t\right) + \pi^* \eta_{t+1} + \pi^*_d \mu_{t+1} + \mu^*_{t+1}
\end{aligned}$$

A detailed description of the environment is as follows: turning first to the US, μ_c is the unconditional mean of consumption growth and x_t a time-varying, small but persistent component of the growth rate, so that the conditional expectation at time t of consumption growth in $t+1$ is $\mu_c + x_t$. The persistent component evolves according to an AR(1) process with persistence ρ and variance in the innovations σ^2_e. Consumption growth is also subject to purely transitory shocks η_{t+1} with variance σ^2_η. Dividend growth in the US has unconditional mean μ_d and a levered exposure to the persistent component of consumption growth, x_t, captured by ϕ. Intuitively, the higher the value of ϕ the more responsive are dividend growth rates to innovations in x. The transitory consumption shock η_{t+1} also influences the dividend process, with the magnitude of this relationship governed by π. This will generate some degree of 'short-run' risk due to period-by-period transitory fluctuations along the lines of that in the CCAPM model (or a model with no long-run risk) and enables us to assess the relative contributions of long- and short-run risk to return differentials. Dividend growth is also subject to a purely transitory shock μ_{t+1} with variance σ_{μ}^2. All shocks are i.i.d. and normally distributed.

The dynamics of foreign dividends are similar. Dividend growth has unconditional mean μ_d^* and a levered exposure to a small but persistent component of the growth rate, which is now composed of two pieces. First, there is an exposure to the US long-run shock x, with the degree of exposure governed by ξ^* (the US ξ is normalized to 1) and it is in this sense that x represents a 'global' shock. Additionally, there is a region-specific idiosyncratic long-run component x^*, which again evolves according to an AR(1) process with persistence ρ^* and variance in the innovations $\sigma_{e^*}^2$.[36] The exposure of foreign dividends to the global long-run shock is governed by both the degree of leverage, ϕ^*, and the sensitivity of the underlying x^* process, ξ^*.[37] We allow for transitory shocks to foreign dividend growth rates to be correlated with temporary shocks to US dividend growth rates μ_{t+1} and US consumption growth η_{t+1}. The strength of these relationships is captured by π_d^* and π^*, respectively. Lastly, each region is also subject to an idiosyncratic transitory shock μ_{t+1}^* with variance $\sigma_{\mu^*}^2$. As in the US, all shocks are i.i.d. and normally distributed.[38]

In short, our model is quite rich in terms of the dynamics of growth, allowing for both transitory and persistent fluctuations in growth rates, and common and idiosyncratic components of each. Each element plays a role in enabling us to accurately pin down the extent of shared long-run risks and to assess the implications for return differentials. Specifically, we will demonstrate that predicted returns from our model depend crucially on properly accounting for regional long-run shocks and distinguishing comovement that arises from long-run and short-run sources; failure to address these issues gives predicted returns that may be substantially biased (generally upward).

[36]We model the US x as directly influencing the foreign consumption process. Alternative approaches would be to explicitly include a world x and a US-specific one, or only region-specific x's with some correlation in their innovations. These approaches are all clearly related, and mainly involve a relabeling of the parameter governing the extent of comovement ξ^*.

[37]For purposes of computing risk premia, only the product of these two parameters will matter and so we will not need to separately identify them. In Section XXX, we use foreign consumption data to provide some evidence that the primary source of heterogeneity is in ξ^* rather than ϕ^*, suggesting that the high sensitivity of emerging markets to changing growth conditions features across a broader set of macroeconomic variables.

[38]We do not need to explicitly specify the foreign consumption process. However, a natural way that fits into our framework (and is symmetric with the US process) would be $\Delta c_{t+1}^* = \mu_c^* + \xi^* x_t + x_t^* + \pi_c^* \eta_{t+1} + \eta_{t+1}^*$. Then, $\sigma_{\mu^*}^2$ may include some variance coming from an exposure to local consumption shocks η_{t+1}^*. It is straightforward to prove that this distinction has no bearing on our results, in the sense that risk-premia do not depend separately on the two sources of variation.

Finally, our framework builds closely on those in a recent literature examining the role of long-run risks in an international context. For example, imposing symmetry in the parameters and a correlation of 1 in the long-run shock between the US and the foreign region, our setup can be mapped to that in Colacito and Croce (2011) (although they abstract from the short-run risk captured here by π and π^*). In our setting, the heterogeneity across regions, and in particular, their sensitivity to global long-run shocks, is critical in leading to return differentials.[39] The consumption dynamics we specify closely resemble those in Nakamura et al. (2012), which also feature heterogenous exposure to a common shock alongside country-specific ones and Lewis and Liu (2015), who allow for correlation in long-run shocks across countries. A key innovation in our approach is to analyze the asset pricing implications of assets from developed and emerging markets for a single US-based investor.

Risk premia. We solve the model and derive its asset return implications using standard approximation methods.[40] Risk premia (in excess of the risk-free rate) on the US and foreign capital assets are, respectively:

$$\begin{aligned} \mathbb{E}\left[r_t^e\right] &= \left(\phi - \frac{1}{\psi}\right)\left(\gamma - \frac{1}{\psi}\right)\frac{\kappa_{m,1}}{1-\kappa_{m,1}\rho}\frac{\kappa_1}{1-\kappa_1\rho}\sigma_e^2 + \gamma\pi\sigma_\eta^2 \\ \mathbb{E}\left[r_t^{e*}\right] &= \left(\tilde{\phi}^* - \frac{1}{\psi}\right)\left(\gamma - \frac{1}{\psi}\right)\frac{\kappa_{m,1}^*}{1-\kappa_{m,1}^*\rho}\frac{\kappa_1}{1-\kappa_1\rho}\sigma_e^2 + \gamma\pi^*\sigma_\eta^2, \end{aligned} \tag{6}$$

where $\tilde{\phi}^* \equiv \phi^*\xi^*$ is the overall sensitivity of foreign dividends to the common long-run shock. The parameter κ_1 is a constant of linearization that is endogenous and depends in a nonlinear way on the parameters of the US consumption process. Similarly, $\kappa_{m,1}$ and $\kappa_{m,1}^*$ are linearization constants that depend additionally on the parameters of the US and foreign dividend processes, respectively. The mean risk free-rate is given by:

$$\mathbb{E}\left[r_{f,t}\right] = -\log\beta + \frac{\mu}{\psi} + \frac{1}{2}\left(\frac{1-\gamma}{\psi} - \gamma\right)\sigma_\eta^2 + \frac{1}{2}\left(\theta - 1\right)\left(1 - \frac{1}{\psi}\right)^2\left(\frac{\kappa_1}{1-\kappa_1\rho}\right)^2\sigma_e^2 \tag{7}$$

Intuition. Equation (6) shows that excess returns are composed of two pieces, the first relating to long-run risks and the second to short-run. First, notice that setting $\gamma = \frac{1}{\psi}$, which is the case of CRRA preferences, eliminates the long-term component so that risk premia are determined only by the transitory comovement in consumption and dividend growth ($\pi\sigma_\eta^2$), which is 'priced' at γ. The same is true if $\sigma_e^2 = 0$, that is, there is no long-run risk in con-

[39] We do find that more developed countries feature stochastic processes more similar to the US than do developing ones. Colacito and Croce (2011) study the US and Britain.

[40] Because these techniques are widely used, we detail the steps in Appendix C.

sumption growth, or if $\rho = 0$, simply with an adjustment to reflect the additional variance σ_e^2, which would then be purely transitory in nature. Thus, both recursive preferences, i.e., the disentangling of γ and ψ, as well as the persistent and stochastic nature of growth rate shocks are necessary for risk premia to differ from the case with no long-run risk.

The sensitivity of dividends to changing global growth conditions, ϕ in the US and $\tilde{\phi}^*$ abroad, although not sufficient statistics, are key in determining risk premia. Intuitively, the higher this sensitivity, the riskier is the asset and the higher the associated risk premium. An important piece of our empirical work is to pin down the values of these parameters. In contrast, the idiosyncratic portion of the long-run shock abroad (x_t^*) does not enter the return equations anywhere. Because these shocks are by construction only regional, they do not enter the US investor's SDF and so are not risky from his perspective; in other words, idiosyncratic shocks are diversifiable and so do not garner risk premia. This does not mean that we can ignore these shocks, however; doing so may bias our estimates of the parameters of the model that do determine returns. We next outline an identification strategy that addresses this challenge, among others.

3.2 Identifying Long-Run Risks - Returns to Aggregate Capital

To derive the model's return implications and assess its ability to account for the cross-section of capital returns in the data, we must assign values to the parameters governing the consumption and dividend processes laid out in (5). We apply our model to assess both the returns to aggregate capital and the returns to equity. The consumption process is identical across these two measures. We assume that our specification of the dividend process applies to both, although we allow the parameter values to vary depending on the asset. As we noted above, there are a number of hurdles that we need to overcome. First, any empirical approach must disentangle global long-run shocks from purely idiosyncratic ones. As we have seen, these two sources of changing growth prospects have very different asset pricing implications; indeed only the first demands a risk premium. Despite this, the second will likely show up in moments that we would otherwise think are informative about global shocks and so must be accounted for. A second empirical challenge is in distinguishing global long-run and short-run shocks. Because both types of shocks generate comovement across regions, it is necessary to account for the latter when using otherwise informative moments regarding comovements to infer the extent of global long-run risk.

In this section, we outline our empirical strategy to address these difficulties. Our approach is closely related to that in Lewis and Liu (2015) and uses a combination of moments in comovements, persistence, and volatilities to infer the parameters of interest. Specifically, we demonstrate that moments of US consumption growth, dividend growth in each region, and the comovement of returns in each region with those in the US - closely related to the betas in Section 2 above - enable us to pin down all the necessary parameters of our model. For purposes of brevity, we focus primarily on identification of the parameters governing the return to aggregate capital. The strategy is very similar when examining equity returns.

Preferences and US consumption. We begin by assigning values to the preference parameters. We set $\gamma = 10$, $\psi = 1.5$, and $\beta = 0.99$, all standard values in the long-run risk literature. Our choice of β enables the model to approximately match the mean level of the risk-free rate.

Turning to the US investor's consumption process, we first assign a value to the persistence parameter ρ. This parameter is notoriously difficult to identify and rather than attempting to do so, we take guidance from the existing literature and set its value to 0.93.[41] This is reported as the mean estimate from annual US data in Ferson et al. (2013) and is quite close to the annual estimate from Bansal et al. (2012b) of 0.91.[42]

We determine the values of the remaining parameters of the US consumption process in order to match the unconditional mean, variance, and autocovariance of US consumption growth. Specifically, it is straightforward to derive the following expressions relating parameters to observable empirical moments from (5):

$$\begin{aligned} \mathbb{E}\left[\Delta c_t\right] &= \mu_c \\ \operatorname{cov}\left(\Delta c_t, \Delta c_{t+1}\right) &= \rho\frac{\sigma_e^2}{1-\rho^2} \\ \operatorname{var}(\Delta c_t) &= \frac{\sigma_e^2}{1-\rho^2} + \sigma_\eta^2 \end{aligned} \tag{8}$$

The mean growth rate is pinned down by its sample value. The autocovariance in consumption growth depends on the persistence in x, ρ, and the variance of x, $\operatorname{var}(x_t) = \frac{\sigma_e^2}{1-\rho^2}$. The total variance in consumption growth is the sum of the variance in x and the variance in the transitory component, σ_η^2. We use the latter two equations to solve for σ_e^2 and σ_η^2.

US dividends. We pin down the parameters of the US dividend process in a similar fashion. These include: the mean growth rate of dividends μ_d; the exposure to the persistent shock ϕ; the correlation with transitory consumption shocks, governed by π; and the volatility of the

[41] Because we are interested in the spread in returns between foreign regions and the US, another approach here would have been to choose ρ to match the mean US return. Our model prediction will be quite close to the actual return for the US, lending an additional degree of confidence in the value of ρ.

[42] Much of the long-run risk literature considers monthly decision frequencies and estimates parameters to match moments aggregated to the annual frequency. We abstract from this issue here and focus only on an annual model.

transitory shock, σ_μ^2. We set these to match the observed mean growth rate in dividends, the autocovariance of dividend growth relative to that of consumption growth, the covariance of dividend growth with consumption growth, and the variance of dividend growth. To see why these are informative moments, examine the equations in (9), which are straightforward to derive from (5):

$$
\begin{aligned}
\mathbb{E}\left[\Delta d_t\right] &= \mu_d \\
\sqrt{\frac{\operatorname{cov}\left(\Delta d_{t+1}, \Delta d_t\right)}{\operatorname{cov}\left(\Delta c_{t+1}, \Delta c_t\right)}} &= \phi \\
\operatorname{cov}\left(\Delta d_t, \Delta c_t\right) &= \phi \frac{\sigma_e^2}{1-\rho^2} + \pi \sigma_\eta^2 \\
\operatorname{var}(\Delta d_t) &= \phi^2 \frac{\sigma_e^2}{1-\rho^2} + \pi^2 \sigma_\eta^2 + \sigma_\mu^2
\end{aligned}
\tag{9}
$$

The mean growth rate μ_d is identified directly from its sample value. The leverage parameter ϕ is pinned down by the ratio of the autocovariance in Δd to that in Δc. This is intuitive: by capturing the exposure to the persistent shock x, ϕ influences the persistence of Δd. At the same time, common to any leverage adjustment, ϕ also affects the volatility of Δd relative to that of Δc in response to the same innovation in x. Thus, it is not only the autocorrelation that provides information on ϕ, but the autocovariance, which encodes both relative persistence and volatility in exactly the right combination.[43] With a value for ϕ in hand, it is straightforward to use the covariance of Δd with Δc to infer π. This covariance is composed of two parts: comovement through mutual dependence on x, and additionally through correlation in the transitory consumption shock. Knowing the value of ϕ, we can distinguish these two components and back out a value for π. Lastly, we use the total variance of Δd to infer a value for σ_μ^2. The variance is composed of three elements: a piece associated with volatility in x, with exposure to the transitory consumption shock, and with the dividend-specific shock. Knowing ϕ and π enables us to compute the first two components; it is then straightforward to back out σ_μ^2.

Foreign dividends. In our model, returns to both US and foreign assets are in large part driven by their exposure to the global persistent shock, governed by ϕ in the US and $\tilde{\phi}^*$ abroad. A seemingly natural way to identify $\tilde{\phi}^*$ would be to follow an approach analogous to the one used above to infer ϕ. Due to the presence of local long-run shocks (i.e., x^*), however, the ratio of the autocovariance of foreign dividend growth to that of US consumption does not deliver

[43] Note that this identification approach would pin down the correct value of ϕ were we to model the US process as the combination of a world x and US-specific one and so the implications for excess returns would be the same.

the true value of $\tilde{\phi}^*$. Indeed, assuming for the moment that $\rho^* = \rho$, we can derive the following equation from (5), which makes clear the difficulty:

$$\sqrt{\frac{\operatorname{cov}\left(\Delta d_{t+1}^*, \Delta d_t^*\right)}{\operatorname{cov}\left(\Delta c_{t+1}, \Delta c_t\right)}} = \tilde{\phi}^* \sqrt{1 + \frac{1}{\xi^{*2}} \frac{\sigma_{e^*}^2}{\sigma_e^2}} \tag{10}$$

This moment identifies the true $\tilde{\phi}^*$ only if $\sigma_{e^*}^2 = 0$, that is, only if there are no regional long-run shocks. Otherwise, relying on this moment gives a biased estimate of $\tilde{\phi}^*$, with the bias corresponding to the term in square root. This term is weakly larger than 1, implying that the estimate of $\tilde{\phi}^*$ is upwardly biased, which would tend to deliver a higher estimate of the risk premium. We show below that the quantitative impact of this bias can be substantial.

An analogous strategy where we could employ foreign consumption data and specify a foreign consumption process as in footnote 38 to use the ratio of the autocovariance of foreign dividends to foreign consumption growth is also not sufficient. This moment exactly identifies ϕ^*, but does not hold any information regarding ξ^* and therefore does not pin down $\tilde{\phi}^*$, as can be seen from the following expression:

$$\sqrt{\frac{\operatorname{cov}\left(\Delta d_{t+1}^*, \Delta d_t^*\right)}{\operatorname{cov}\left(\Delta c_{t+1}^*, \Delta c_t^*\right)}} \quad = \quad \phi^* \tag{11}$$

In other words, this ratio tells us the translation from persistence in local consumption growth to dividend growth, but does not identify how the local consumption process itself depends on the long-run shock. We will provide some evidence below that ϕ^* does not seem to differ much across countries, but rather, the dominant source of heterogeneity is in the values of ξ^*.

Finally, since x^* is orthogonal to x, it may seem that the comovement between domestic and foreign dividend growth would be an informative moment to identify the exposure of foreign dividends to the common component x. Although this moment is indeed unaffected by the foreign long-run shock x^*, because we allow for correlation in the transitory movements of dividend growth rates across countries, this single moment does not provide enough information to disentangle comovement due to long-run and short-run components. To demonstrate this fact, we can derive the following expression:

$$\operatorname{cov}\left(\Delta d_t^*, \Delta d_t\right) = \phi \tilde{\phi}^* \frac{\sigma_e^2}{1-\rho^2} + \pi^* \pi \sigma_\eta^2 + \pi_d^* \sigma_\mu^2 \tag{12}$$

The US parameters $\left(\phi, \sigma_e^2, \rho, \pi, \sigma_\eta^2, \sigma_\mu^2\right)$ are identified using US data as already described. However, even if we knew the value of π^*, which measures the exposure of foreign dividend growth to the transitory component of US consumption growth, the moment in (12) does not separately identify $\tilde{\phi}^*$ from π_d^*. Failure to account for the portion of the comovement of dividend growth rates that is due to temporary shocks - π_d^* - may bias the estimate of $\tilde{\phi}^*$. We show below that the magnitude of this bias can be substantial, and perhaps more importantly, is systemically related to income levels: it is negative for poorer regions and positive for richer. Thus, the presence of regional long-run shocks in conjunction with correlation in transitory movements in growth rates confounds a number of seemingly available identification approaches.

To overcome this challenge, we propose a strategy that builds on the insight of Lewis and Liu (2015), who face a related problem of having to distinguish correlations in persistent and transitory sources of risk across a few developed economies. Specifically, they show that, in addition to dividend growth comovement, the comovement of returns contains information that can be used to disentangle long-run from short-run correlations. Although our environment is not identical to theirs, the strategy we employ is very much in this spirit.

The six moment conditions that we use are given by:

$$
\begin{aligned}
\mathbb{E}\left[\Delta d_t^*\right] &= \mu_d^* && (13)\\
\operatorname{cov}\left(\Delta d_t^*, \Delta c_t\right) &= \tilde{\phi}^* \frac{\sigma_e^2}{1-\rho^2} + \pi^* \sigma_\eta^2 && (14)\\
\operatorname{cov}\left(\Delta d_t^*, \Delta d_t\right) &= \phi \tilde{\phi}^* \frac{\sigma_e^2}{1-\rho^2} + \pi^* \pi \sigma_\eta^2 + \pi_d^* \sigma_\mu^2 && (15)\\
\operatorname{cov}\left(\Delta d_{t+1}^*, \Delta d_t^*\right) &= (\phi^* \sigma_{e^*})^2 \frac{\rho^*}{1-\rho^{*2}} + \left(\tilde{\phi}^* \sigma_e\right)^2 \frac{\rho}{1-\rho^2} && (16)\\
\operatorname{var}\left(\Delta d_t^*\right) &= (\tilde{\phi}^*)^2 \frac{\sigma_e^2}{1-\rho^2} + \frac{(\phi^* \sigma_{e^*})^2}{1-\rho^2} + \pi^{*^2} \sigma_\eta^2 + \pi_d^{*^2} \sigma_\mu^2 + \sigma_{\mu^*}^2 && (17)\\
\operatorname{cov}\left(r_{m,t}^*, r_{m,t}\right) &= \frac{1}{\psi^2} \frac{\sigma_e^2}{1-\rho^2} + \pi^* \pi \sigma_\eta^2 + \pi_d^* \sigma_\mu^2 + \\
&\quad \frac{\kappa_{m,1}}{1-\kappa_{m,1}\rho} \frac{\kappa_{m,1}^*}{1-\kappa_{m,1}^*\rho} \left(1-\frac{1}{\psi}\right)\left(\tilde{\phi}^* - \frac{1}{\psi}\right) \sigma_e^2. && (18)
\end{aligned}
$$

We describe our empirical approach below, and we begin by noting that, because the κ's in (18) are nonlinear functions of the other parameters of the model, we employ a numerical fixed point procedure. We first use (13) to infer the mean dividend growth rate μ_d^* from its sample value. We then guess a candidate value for $\tilde{\phi}^*$. Using this guess and the set of US parameters, (14) pins down π^*. The use of this moment is intuitive. π^* measures the exposure of foreign dividend growth to temporary shocks to US consumption growth, while $\tilde{\phi}^*$ measures the exposure to persistent shocks. Given a value for $\tilde{\phi}^*$, the covariance of foreign dividend growth with US consumption growth is informative about π^*. With these values in hand, we next obtain π_d^* from (15). The intuition here is similar. The comovement of dividend growth across countries is governed by their exposure to common consumption shocks, both persistent and temporary, as well as by π_d^*, which measures the correlation in transitory shocks to dividend growth rates. Having already parameterized the first two sources of comovement, (15) pins down the last, π_d^*.

Given $\tilde{\phi}^*$, (16) shows that the autocovariance of foreign dividend growth pins down the parameter combination $\phi^* \sigma_{e^*}$ (for a given value of ρ^*). This expression decomposes the autocovariance of foreign dividend growth into its global and local components. Next, given $\tilde{\phi}^*, \phi^* \sigma_{e^*}^2, \pi^*, \pi_d^*$, (17) shows that the variance of foreign dividend growth pins down $\sigma_{\mu^*}^2$. Intuitively, after accounting for the variance in foreign dividend growth due to exposure to persistent consumption shocks as well as common transitory shocks in consumption and dividend growth, the remaining variance is due to idiosyncratic dividend-specific shocks. Finally, we construct the model-implied covariance of returns in expression (18) and iterate on the initial guess of $\tilde{\phi}^*$ until we match the empirical moment.

Notice why (18) is informative about $\tilde{\phi}^*$: both the comovement in dividend growth rates (15) and returns (18) depend on both types of common shocks, transitory and persistent. While the former enter both equations in an identical way, return comovement is more sensitive to common long-run shocks than is dividend comovement. Intuitively, a persistent shock leads to large revisions in asset valuations, since expected future growth prospects are changed, which serves to increase the comovement of asset returns *relative* to the comovement in period-by-period dividend growth rates. The higher is $\tilde{\phi}^*$, the greater is the response of foreign returns to the global shock and the higher is the comovement of returns relative to that in dividends. Because we neither target nor exactly match the US return variance (for example, for the returns to aggregate capital, our estimate is slightly higher than the empirical value, 0.035 vs. 0.027), the estimated covariances will not match the actual. To account for this discrepancy, we normalize both the model-implied and empirical covariance by the standard deviation of US returns, so that the precise moment we match is $\frac{\text{cov}\left(r_{m,t}^*, r_{m,t}\right)}{\text{std}(r_{m,t})}$. This moment is independent of the US variance and has the feature of being closely related to the betas from Section 2.

Our empirical strategy does not require us to separately identify $\sigma_{e^*}^2$ from ϕ^*, where the first governs the volatility of the persistent shock in the foreign region and the second the sensitivity of foreign dividend growth to this shock. Nor must we distinguish ϕ^* from ξ^*, that is, the precise source of the foreign dividend's exposure to the common long-run shock does not matter for risk premia.[44] Hence, our approach does not necessitate the use of any moments in consumption growth in the foreign region. We view this as a significant advantage of the strategy we propose, as we are able to circumvent certain data requirements. For example, alternative approaches that would require separate values of $\sigma_{e^*}^2$ and ϕ^* would likely require a consumption series for each country. Ideally, one would use the equivalent data on non-durables and services that we obtain from the BEA for the US. Unfortunately, such data do not exist in the cross-section of

[44] We prove these two results in Appendix C.

countries. At best, we could obtain total consumption series for each country from the PWT. Even if these data are a good proxy for the consumption series that we would need, for many countries, the series are quite short, rendering it problematic to compute reliable time series moments.[45] We should note, however, that to implement our (or likely any other) identification strategy, we require a value for ρ^*, a parameter that is highly difficult to estimate for the US, and more so in emerging markets for which data are significantly more limited. We begin by making the simple assumption that $\rho^* = \rho$.[46]

Table 7: Target Moments - 3 Portfolios

US Moments						
Consumption	$\mathbb{E}[\Delta c_t]$	$\text{cov}(\Delta c_{t+1}, \Delta c_t)$	$\text{std}(\Delta c_t)$			
	0.018	0.00023	0.021			
		$\text{corr}(\Delta c_{t+1}, \Delta c_t)$				
		0.50				
Dividends	$\mathbb{E}[\Delta d_t]$	$\sqrt{\frac{\text{cov}(\Delta d_{t+1}, \Delta d_t)}{\text{cov}(\Delta c_{t+1}, \Delta c_t)}}$	$\text{cov}(\Delta d_t, \Delta c_t)$	$\text{std}(\Delta d_t)$		
	-0.006	2.21	0.00018	0.026		
		$\text{corr}(\Delta d_{t+1}, \Delta d_t)$	$\text{corr}(\Delta d_t, \Delta c_t)$			
		0.28	0.60			
Foreign Moments						
Portfolio	$\mathbb{E}[\Delta d_t^*]$	$\text{cov}(\Delta d_{t+1}^*, \Delta d_t^*)$	$\text{cov}(\Delta d_t^*, \Delta c_t)$	$\text{std}(\Delta d_t^*)$	$\text{cov}(\Delta d_t^*, \Delta d_t)$	$\frac{\text{cov}(r_t^*, r_t)}{\text{std}(r_t)}$
1	-0.017	0.00122	0.00011	0.083	0.00032	0.041
2	-0.015	0.00156	0.00011	0.074	0.00033	0.037
3	-0.011	0.00075	0.00015	0.064	0.00040	0.032
		$\text{corr}(\Delta d_{t+1}^*, \Delta d_t^*)$	$\text{corr}(\Delta d_t^*, \Delta c_t)$		$\text{corr}(\Delta d_t^*, \Delta d_t)$	$\text{corr}(r_t^*, r_t)$
1		0.18	0.12		0.18	0.71
2		0.28	0.13		0.21	0.76
3		0.19	0.21		0.31	0.83

Notes: Table reports target moments for baseline parameterization. Consumption is measured as real per-capita consumption of non-durables and services. Consumption moments are computed over the period 1929-2008, the longest available from the BEA. Dividends are measured in exactly the same manner as described in (1). Portfolio moments are computed over the period 1950-2008 using data from PWT and US prices from BEA. The moments for each portfolio represent the mean values for the countries in that portfolio.

[45] Including durables is problematic since the connection to the marginal flow utility of consumption (i.e., to the agent's SDF), which in this case is likely very different than current consumption expenditures, is much more tenuous. Additionally, measurement error is likely a bigger concern for foreign consumption data. Moreover, it is worth pointing out that our approach does not have any counterfactual implications for the second moments of the empirical consumption process, since there are still free parameters we have not placed values on - for example, π_c^* and $\sigma_{\eta^*}^2$ in footnote 38.

[46] This assumption is standard in the literature, for example, in Lewis and Liu (2015), Colacito and Croce (2011) and Nakamura et al. (2012). We show below that our results are only negligibly affected by even large changes in this parameter.

Moments and Parameters. Table 7 reports the target moments for the 3 portfolio case. All measures are consistent with the procedure in Section 2.1. US consumption moments are computed using data on nondurables and services over the period 1929-2014, the longest available series from the BEA. Dividends are measured exactly as in that section using data from the PWT and BEA, as guided by expression (1). The moments for each portfolio represent the mean values for the countries in that portfolio (listed in Appendix E). This is where the portfolio approach proves useful: our hope is to cleanse country-specific idiosyncratic variation in the moments and isolate the variation that is related to the level of income. We provide further details on our empirical work in Appendix A.

In the top panel of Table 7, we display the moments in US consumption and dividend growth rates. The mean growth rate in consumption is about 2%, with a standard deviation of about 0.02 and an autocovariance of 0.00024, which together imply an autocorrelation of 0.50. These values are quite close to those found by other authors over similar time periods.[47] Turning to the portfolio moments, portfolios 1 and 2 display a high covariance of returns with those in the US (we report the covariances scaled by the standard deviation of US returns; as we noted above, correlations are actually ordered in the reverse direction, and the primary driver of the ordering of covariances that we find is higher return volatility in poorer countries). Dividend growth rates for these portfolios are more volatile as well. At the same time, these portfolios exhibit the lowest covariance of dividend growth rates with those in the US: these patterns jointly suggest relatively low contemporaneous correlations in transitory shocks with the US and high exposure to the global long-run shock. Similarly, the covariance of dividend growth rates with US consumption growth tends to increase with income across the portfolios, which again suggests that developed countries co-move more with the US at high frequencies.

Table 8: Parameter Values - 3 Portfolios

Preferences:	$\gamma = 10$ $\psi = 1.5$ $\beta = 0.99$					
Consumption:	$\rho = 0.93$ $\mu_c = 0.018$ $\sigma_e = 0.006$ $\sigma_\eta = 0.01$					
Portfolio	μ_d	ϕ ($\tilde{\phi}^*$)	π	π_d	σ_μ	$\phi^* \sigma_{e^*}$
1	−0.017	5.09	−1.16	−0.15	0.074	0.005
2	−0.015	4.20	−0.75	0.00	0.062	0.011
3	−0.011	2.85	0.35	0.29	0.056	0.008
US	−0.006	2.21	0.99	-	0.020	-

Notes: Table reports parameter values that match moments for baseline parameterization reported in Table 7.

We report the resulting parameter estimates (along with those assigned outside the model)

[47]See, for example, Bansal and Yaron (2004) and Bansal et al. (2012a).

in Table 8. The consumption parameters are relatively standard. Turning to the asset-specific parameters, the moments detailed above imply a greater exposure of poor countries to the global long-run shock, captured by a higher value of $\tilde{\phi}^*$. In contrast, the correlation of transitory shocks with the US (captured by π and π_d) is generally increasing in income, and, not surprisingly, is highest in the US. This parameter configuration implies that poor countries are more sensitive to the global long-run shock, even while allowing for richer countries to display the greater period-by-period comovement with the US observed in the data. It is precisely these two forces that our empirical strategy allows us to disentangle. Poor countries also experience more volatile idiosyncratic transitory shocks, captured by σ_μ, a property inherited from the ordering of overall dividend growth volatility seen above.[48] Next, we assess the implication of these cross-region differentials for capital returns, that is, do these patterns across income-sorted portfolios lead to expected return differentials of the order that we observe in the data?

3.3 Results

Baseline - returns to aggregate capital. We report our baseline results in the first two columns of Table 9. The table reports the expected return to capital in each portfolio, measured in the data as an average over the entire time period, r, and the expected return predicted by the model, $\hat{r}$, from equations (6) and (7) under the parameter configuration in Table 8. The model predicts returns that are very much in line with those in the data and that generally mimic the decreasing pattern across higher income portfolios. Predicted returns range from about 10.4% for the poorest portfolio, 1, to about 5.9% for the US, compared to 13% and 6% in the data. The predicted values for the intermediate portfolios 2 and 3 are 9.1% and 7.0%, respectively, compared to 11% and 8%. Across portfolios, the model predicts a mean level of returns of about 8.1%, slightly below, but in line with, the average of 9.5% observed in the data. Finally, and perhaps most importantly, the model predicts a spread in returns between portfolio 1 and the US of about 4.5%, which represents about 64% of the actual spread of 7%. In other words, given the parameter configuration in Table 8, long-run risk implies a return differential across income-sorted portfolios that almost two-thirds of the actual.

Our portfolio grouping in Table 9 classifies countries according to their mean income over the period. An alternative approach would be to 'rebalance' the portfolios by reclassifying countries in each year based on their rank in the income distribution within that particular year. We have also performed this exercise and for purposes of brevity, report the results in Appendix D. Our main findings are robust to this alternative.

[48] For completeness, we report the estimated value of $\phi^* \sigma_{e^*}$, although because we cannot separate the two components, this value is difficult to interpret in a meaningful way.

Table 9: Predicted vs. Actual Returns

3 Portfolios			5 Portfolios			10 Portfolios		
	$\widehat{r}$	r		$\widehat{r}$	r		$\widehat{r}$	r
1	10.34	13.01	1	10.80	14.37	1	12.12	16.38
2	9.13	11.06	2	10.59	10.88	2	9.46	12.37
3	7.04	8.04	3	8.59	11.39	3	9.76	10.27
US	5.89	6.01	4	8.14	10.06	4	11.09	11.37
			5	6.16	6.74	5	7.33	10.64
			US	5.89	6.01	6	9.83	11.98
						7	7.92	9.74
						8	8.33	10.39
						9	6.47	7.62
						10	5.92	5.99
						US	5.89	6.01
Average:	8.10	9.53		8.36	9.91		8.56	10.25
Spread: 1-US	4.45	6.99		4.90	8.36		6.23	10.37
Percent of actual	64			59			60	
corr($\widehat{r}, r$)	1.00			0.92			0.91	

Notes: Table reports the expected return to capital in each portfolio as measured in the data, r, and as predicted by the model, $\hat{r}$, from equations (6) and (7) under the parameter configuration in Tables 7, 16, and 17 for 3, 5, and 10 portfolio groupings, respectively.

Disaggregated portfolios. In our baseline analysis, we group countries into 3 income-based portfolios, along with the US. In the remainder of Table 9 we use the richness of our data to examine the implications of our model for more disaggregated groups of countries, specifically, groups of 5 and 10 portfolios (always along with the US). The middle panel reports the results across a 5-portfolio grouping, and the right-hand panel across 10 portfolios.[49] Not surprisingly, as we move to more disaggregated levels, the spread between the poorest countries in portfolio 1 and the US widens, going from about 7% to about 8% to about 10%. The increase is due to a rise in returns in portfolio 1 (the US, of course, remains the same). The model captures this feature of the data to a large extent, with the predicted spread also increasing, although not quite in-step with the actual, from 4.5% to 4.9% to 6.2%. The model accounts for about 60% of the observed spread with 5 and 10 portfolios, compared to 64% with 3. As we increase the number of portfolios, the correlation of predicted and actual returns becomes a useful statistic, which remains quite high even in the 10 portfolio case at 0.9. What we glean from Table 9 is that long-run risks play a quantitatively important role in driving return differentials across countries at different stages of development, and that this finding is not an artifact of our baseline choice of 3 portfolios: the model predicts returns that are in line with the data at

[49] We report moments and parameters for the 5 and 10 portfolio cases in Appendix F.

each of the levels of aggregation we examine (and indeed, as we show below, continues to hold significant explanatory power even at the country level).

Country-level analysis. Although the portfolio-based approach lends certain advantages, it is nonetheless worth exploring the implications of our model when the parameters are estimated to match moments of individual countries. To do so, we restrict our analysis to countries with sufficiently long time-series of available data. Our empirical strategy relies heavily on time-series moments and short samples are thus problematic. Consequently, we examine only countries for which data availability reaches back at least to 1961, so that at least approximately 50 years of data are available.[50] This gives us 96 countries on which we perform our analysis, still a large number, although less than the 144 we include in our portfolio analyses above. We parameterize the model country-by-country and compute predicted returns on this basis.[51]

We analyze the results in a number of ways. First, we simply ask: does the model predict a relationship between returns and income at the country-level that resembles the one we observe in the data? To answer this question, we regress country-level returns on income both in the data and as predicted by the model. We obtain a clear negative relationship between capital returns and income in the data: the line of best fit has a slope of -0.023, which is significant at the 99% level.[52] The model also predicts a negative relationship: the line of best fit has a slope of -0.013, about 55% the actual, and is significant at the 95% level. In this sense, even when parameterized at the country-level, the model can account for a significant portion (about 55%) of the average relationship between the returns to aggregate capital and income.

To get a sense of how the model predictions line up with actual returns on a country-level basis (similar to the correlations reported at the portfolio level above), we display in Figure 5 the predicted vs. actual values, along with the 45 degree line. If the model were a perfect fit to the data, each point would lie exactly on the line. Although there is a good deal of variation at the country level, as should be expected, the model predicts returns that are generally in line with the data: the correlation between the predicted and actual returns is quite high at about 0.61 and is significant at the 99% level. We view this as a strong confirmation of the explanatory power of our theory: the cross-sectional distribution of returns at the country-level is likely determined by a host of factors specific to each country; that our relatively parsimonious

[50]Countries tend to be added to the PWT in waves, so we are including here the original 1950 wave, and a second wave that spans 1960 and 1961. The next major wave of additions is not until 1970.

[51]We denote by 1 the countries included in the analysis in Appendix E, column 6, titled Ctry An. A handful of countries feature a configuration of moments that imply a negative σ^2_μ due to its residual nature. In order not to lose these countries, we set $\sigma^2_\mu = 0.05$, which is the average of the other countries. This choice makes very little difference to the results.

[52]This statistic is the same as in Figure 1, but the sample here contains only the subset of countries for which we have sufficient data to pass through the model.

theory predicts returns that are highly correlated with the empirical ones suggests that long-run risks indeed play a key role in leading to the variation in returns observed in the data.

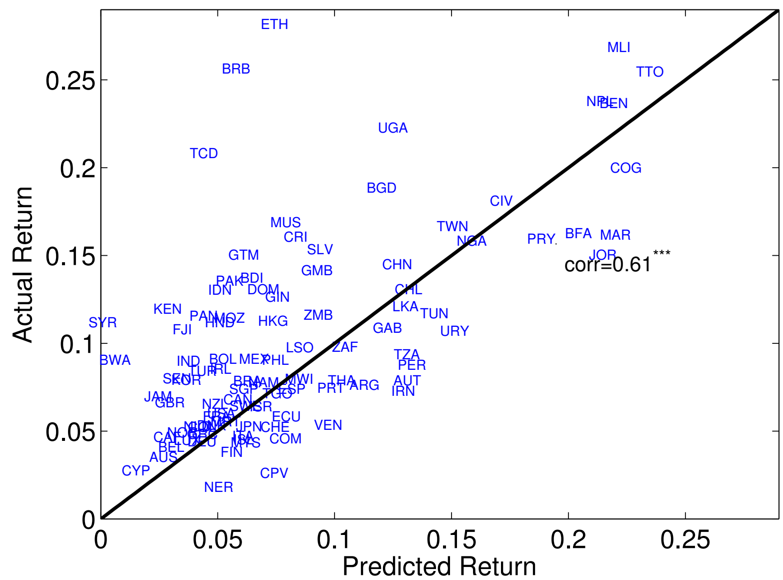

Figure 5: Country-Level Returns - Predicted vs. Actual

3.4 Returns to Equity

Our approach to analyzing stock market returns is quite similar. Moments in US consumption growth are exactly the same. We follow the literature and assign a value of $\phi = 3$ in the US (see, for example, Bansal and Yaron (2004) and many more). The remainder of the calibration follows exactly the strategy laid out above, simply employing moments from equity data, rather than aggregate capital. The top panel of Table 10 reports the target moments. Here, we use annual data for both returns and dividends. Even after trimming extreme outliers, the dividend data show very large differences in mean growth rates across countries. This may be due in part to the shortness of the time-series available and differences in dividend policies across countries unrelated to fundamentals. With this in mind, we make the admittedly rough adjustment of setting all mean growth rates to the US value of 0.02. This has very little effect on the results, since mean growth rates do not directly affect risk premia.[53]

The center panel of Table 10 reports the parameter estimates and the bottom panel the predicted mean returns. The model generates expected returns of 17.3% for the low-income countries and 8.4% for the US, representing a spread of 8.8 percentage points. The corresponding values in the data are 18.2% and 9.6%, so a spread of 8.6%; although the levels of returns

[53]For example, setting the growth rate of the low-income portfolio as high as 0.05 changes the risk premium there only negligibly.

Table 10: Predicted vs. Actual Stock Market Returns

Moments						
Portfolio	$\mathbb{E}[\Delta d_t^*]$	$\text{cov}\left(\Delta d_{t+1}^*, \Delta d_t^*\right)$	$\text{cov}\left(\Delta d_t^*, \Delta c_t\right)$	$\text{std}\left(\Delta d_t^*\right)$	$\text{cov}\left(\Delta d_t^*, \Delta d_t\right)$	$\frac{\text{cov}(r_t^*, r_t)}{\text{std}(r_t)}$
1	0.020	0.00812	-0.00002	0.191	0.00213	0.132
2	0.020	0.00655	0.00044	0.155	0.00254	0.087
US	0.020		0.00032	0.062		
		$\text{corr}\left(\Delta d_{t+1}^*, \Delta d_t^*\right)$	$\text{corr}\left(\Delta d_t^*, \Delta c_t\right)$		$\text{corr}\left(\Delta d_t^*, \Delta d_t\right)$	$\text{corr}\left(r_t^*, r_t\right)$
1		0.20	-0.01		0.17	0.35
2		0.25	0.21		0.25	0.43
US		0.54	0.44		1.00	1.00
Parameters						
Portfolio	μ_d	$\phi\ (\tilde{\phi})$	π	π_d	σ_μ	$\phi^* \sigma_{e^*}$
1	0.020	7.75	-14.14	0.20	0.131	0.021
2	0.020	3.68	1.88	0.48	0.127	0.028
US	0.020	3.00	0.83	-	0.055	-
Returns						
Portfolio	$\widehat{r}$	r				
1	17.27	18.24				
2	11.50	8.89				
US	8.44	9.60				
Average:	12.40	12.25				
Spread: 1-US	8.83	8.64				
% of actual	102					

Notes: Table reports target moments, calibrated parameters, and expected returns on equities as reported in the data, r and predicted by the model, $\hat{r}$. Consumption is measured as real per-capita consumption of non-durables and services. Consumption moments are computed over the period 1929-2008, the longest available from the BEA. Dividend data are from Datastream and returns data are from MSCI. Portfolio moments are computed over the period 1988-2014. The moments for each portfolio represent the mean values for the countries in that portfolio.

in the model are about 1% lower than the data, the model-implied spread between the poorest countries and the US is almost exactly that in the data. The higher-income countries exhibit an intermediate level of returns, both in the model and data, although here the model generates returns that are quite a bit higher than the data: 11.5% versus 8.9%. In sum, the long-run risk model leads to stock market returns across income groups very much in line with those in the data and perhaps most importantly, suggests risk premia on the order of those observed. Indeed, the model seems to fit equity returns more closely than aggregate returns; this may not be surprising, given that the LRR model was built with equity markets in mind.

3.5 Additional Exercises

Long-run vs short run risk. Expressions (6) and (7) show that we can express predicted returns to each asset in our model as the sum of three components: the risk-free rate, i.e., the level of returns in the absence of any risk, excess returns due to short-run risk, i.e., risk derived from period-by-period comovement between dividend and consumption growth, and excess returns due to long-run risk, i.e., risk derived from volatility in growth-rate regimes. In Table 11, we report the contribution of each source to the total predicted return.

Table 11: The Composition of Returns

Portfolio	Actual r	Predicted $\widehat{r}$	=	$\widehat{r}^f$	+	$\widehat{r}^e_{sr}$	+	$\widehat{r}^e_{lr}$
Returns to Aggregate Capital								
1	13.01	10.34		1.27		−0.25		9.32
2	11.06	9.13		1.27		−0.16		8.02
3	8.04	7.04		1.27		0.07		5.69
US	6.01	5.89		1.27		0.21		4.41
Returns to Equity								
1	18.24	17.27		1.27		−2.99		18.98
2	8.89	11.50		1.27		0.40		9.83
US	9.60	8.44		1.27		0.18		6.99

Notes: Table reports actual expected returns, r, and predicted expected returns from the model, $\hat{r}$, computed using parameters in Tables 8 and 10 for aggregate capital and equity, respectively. The predicted returns are decomposed into three components: risk-free rate, $\hat{r}^f$, short-run risk, $\hat{r}^e_{sr}$, and long-run risk, $\hat{r}^e_{lr}$ using expressions (6) and (7) in the text.

First, the risk-free rate is only about 1%, as in the data, and by construction, is constant across portfolios due to our focus on the US investor. Strikingly, excess returns to aggregate capital due to short run risk are negligible, ranging from about -0.2% to 0.1%. Negative values indicate a risk compensation: because transitory fluctuations in portfolios 1 and 2 are negatively correlated with US consumption growth, these assets actually represent good hedges for a US investor and so in the presence of only short-run risk, would provide lower returns than in the US. This is quite intuitive: period-by-period fluctuations in more developed countries are more correlated with those in the US, which implies higher risk premia in those countries, exactly opposite of the patterns actually observed in the data. However, the magnitude of the differences is quite small, with the US demanding 0.5% higher returns than portfolio 1 due to short-run risk. Thus, (more than) the entirety of the systematic return differentials predicted by our model is due to long-run risk. The last column in Table 11 shows that long-run risks command excess returns as high as 9.3% in portfolio 1 compared to about 4.4% in the US, leading to a return differential of about 5%. A similar message emerges from the analysis of equities. Perhaps most striking is the magnitude of the negative risk premium for emerging market equities, which amounts to nearly -3%.

These findings support the argument made at the outset of this section that a model without long-run risks, such as the standard CCAPM with power utility, struggles to account for the capital return differentials across rich and poor countries observed in the data. In this sense, the Lucas Paradox resembles the equity premium and other related asset pricing puzzles.

Alternative Identification Strategies. In this section, we perform several exercises meant to illustrate the important role played by various features of our model and identification strategy in accurately measuring the extent of long-run risks around the world. To do so, we return to the 3 portfolio case for aggregate capital and the 2 portfolio case for equities, and we parameterize the model under a number of alternative approaches discussed in Section 3.1. First, we parameterize the model ignoring region-specific idiosyncratic long-run shocks, i.e., under the naive assumption that $\sigma_{e^*} = 0$ (or alternatively, that $\rho^* = 0$). In this case, expression (10), i.e., the ratio of autocovariances in foreign dividend and US consumption growth gives an unbiased estimate of $\tilde{\phi}^*$. The third column of Table 12 reports the implied returns in the 3 foreign portfolios when following this alternative identification strategy (the US return does not change, since we are only changing assumptions regarding foreign idiosyncratic shocks). The first two columns report the actual returns and those predicted under our baseline approach. A comparison of the second and third columns shows that ignoring regional long-run shocks would lead to substantial bias in the results. As predicted by expression (10), returns are everywhere biased upward. The magnitude of this bias for aggregate capital ranges from 0.7% in portfolio 1 to 2.5% in portfolio 3. In the case of equities, the bias is even larger, especially for developed countries. Clearly, not accounting for idiosyncratic long-run shocks leads to significant bias under an approach that relies solely on autocovariance moments.

In contrast, the fourth column of Table 12 reports the predicted returns under the same assumption that there are no foreign persistent shocks, i.e. $\sigma_{e^*} = 0$, but following our baseline identification strategy. The predicted returns are nearly identical to those obtained from our benchmark approach, without restricting σ_{e^*} to zero. Notice that the last exercise is equivalent to a model where ρ^* is set to zero, and so also serves as a robustness exercise on the value of this parameter. In other words, under our empirical strategy, the results we obtain change only negligibly whether we account for local persistent shocks or not, and are robust to large changes in the persistence of those shocks (recall that the benchmark value of ρ^* is relatively high at 0.93). This robustness to the properties of regional long-run shocks is an attractive feature of our approach and is intuitive when examining our identification equations (13)-(18) and the expressions for predicted returns (6) and (7). Parameters of the foreign shock processes (ρ^*

Table 12: Predicted Returns - Alternative Empirical Strategies

Portfolio	r	$\widehat{r}$	$\sigma_{e^*}=0$ $\widehat{r}_{autocov}$	$\sigma_{e^*}=0$ $\widehat{r}$	$\widehat{r}_{\pi_d^*=0}$
Returns to Aggregate Capital					
1	13.01	10.34	11.00	10.35	8.68
2	11.06	9.13	11.99	9.16	9.18
3	8.04	7.04	9.54	7.05	10.47
Returns to Equity					
1	18.24	17.27	19.83	17.31	21.78
2	8.89	11.50	17.08	11.58	19.86

Notes: The first two columns of the Table report actual expected returns, r, and predicted expected returns from the model, $\hat{r}$, computed using parameters in Tables 8 and 10 for aggregate capital and equity, respectively. The third column, denoted by $\widehat{r}_{autocov}$ reports predicted expected returns when $\sigma_{e^*}=0$ and $\tilde{\phi}*$ satisfies expression (10); all remaining parameters satisfy moment conditions as in baseline. The fourth column, denoted by $\widehat{r}$ reports predicted expected returns when $\sigma_{e^*}=0$ and all remaining parameters satisfy moment conditions as in baseline. The fifth column, denoted by $\widehat{r}_{\pi_d^*=0}$ reports predicted expected returns when $\pi_d^*=0$ and all remaining parameters satisfy moment conditions as in baseline.

and $\sigma_{e^*}^2$) do not enter anywhere into the latter two, implying that they do not directly impact expected returns; their only effect is indirect by affecting $\kappa_{m,1}^*$, and so additionally our estimate of $\tilde{\phi}^*$ (through expression (c.5)). However, these indirect effects are quantitatively negligible.

Finally, we compute the predicted returns from our model under the assumption that there is no transitory comovement between dividend growth rates, i.e., $\pi_d^*=0$. Imposing this restriction implies that correlations in the dividend growth rates across countries are due only to exposure to the common long-run shock, and to their common dependence on the transitory consumption shock governed by π^* and π. In this case, the covariance of dividend growth rates with those in the US and with US consumption growth (expressions (15) and (14)) are clearly sufficient to tease out $\tilde{\phi}^*$. We report the results in the last column of Table 12. The implications are very stark: in the case of aggregate capital, portfolio 3 now yields the highest returns while portfolio 1 yields the lowest; in the case of equities, however, portfolio 1 continues to yield higher returns, but the difference between the portfolios is negligible. As discussed earlier, since period-by-period comovement between dividend growth in developed economies and the US is much higher than the corresponding comovement between less developed countries and the US, attributing this comovement only to persistent components results in developed countries' portfolios appearing to be riskier. Accounting for these short-run dividend correlations is key to properly measure the various sources of risk faced by the investor.

4 Conclusion

Emerging markets exhibit (1) high expected asset returns and (2) large exposures to movements in US returns, measured by the 'beta' of the returns to the asset on the returns to its US counterpart. We document these facts in detail for two asset classes - stock market returns and the real return to aggregate capital - and we provide further evidence from a third class - sovereign bonds. We use a series of endowment economies to explore whether consumption-based risk faced by a US investor can reconcile these findings. We find that long-run risk, i.e., risk due to fluctuations in economic growth rates, is a promising channel - our calibrated model implies return disparities at least 55% as large as those in the data and as much as the entirety, depending on the asset class. From the perspective of the US investor, fact (2), although not a sufficient statistic, is informative about the extent of long-run risk in foreign assets, and so about fact (1).

Key to our findings is that emerging markets not only feature large fluctuations in growth rates, but also that the shocks are systemically related across countries, i.e., these markets are highly exposed to global growth-rate shocks. We leave for future work a more detailed investigation into the sources of the differences in long-run risk that we measure. The implications of such an analysis would clearly be important in many dimensions; from the point of view of our analysis, in reducing required risk premia associated with investments in poor countries and so potentially attracting additional investment flows. Potential avenues of research include understanding the role that high dependence on the production and export of commodities, whose prices are known to be highly volatile, plays in generating volatility in emerging market macro aggregates. For example, Burnside and Tabova (2009) find a significant relationship between country growth rates and a number of commodity price indices—specifically crude oil, primary metals, and agricultural commodities. Additionally, examining the degree to which institutional differences across countries shape the ability to respond to external shocks may provide further insights into the mechanisms that result in high exposure of emerging markets to global shocks.

We have focused on consumption-based risk due to uncertainty regarding the payoffs to capital investments, both in the short- and long-run. By doing so, we have abstracted from a number of other sources of risk that may play a role in leading to return differences, for example, default risk or expropriation risk. Additionally, our model does not shed light on the fundamental source of long-run risk, i.e., changing prospects in technological progress, low frequency movements in relative prices, etc. Further work investigating these issues and their interaction with rates of return on capital around the world could be quite fruitful.

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For Online Publication: Appendix

A Data

Returns to aggregate capital. As described in the text, we use data on relative prices and US per-capita consumption from the BEA. We obtain data from the Penn World Tables Version 8.0 (PWT) to construct dividends in foreign countries. We exclude countries where insufficient data are available, with clear data errors, or that are large outliers. Altogether, these amount to 23 out of 167 countries, leaving us with the 144 used in the main text.

Due to the long time horizon that we analyze, some notes about the PWT country classification are in order. West Germany proxies Germany prior to the unification of East and West Germany. Data for Ethiopia for the period of 1970-1990 refer to the former territory of Ethiopia, including Eritrea. Czechoslovakia is not contained in PWT. Czech Republic and Slovak Republic are added in 1990. USSR is not contained in PWT. Russia, Azerbaijan, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Lithuania, Latvia and Moldova are added in 1990. Yugoslavia is not contained in PWT. Bosnia and Herzegovina, Croatia, Macedonia, Montenegro, Serbia and Slovenia are added in 1990.

We analyze portfolios of countries during the 1950-2008 period. Countries are added to the PWT in waves. In Appendix E we list the countries we use in our benchmark analysis, classified by the portfolio they fall into. In addition, we list the year the country was added to the PWT database and indicate the set of countries we analyze in the country-level exercises as well as those with open capital accounts. As described in the text, mean returns at the country level are computed as the time-series average for each country. To form portfolio returns, these are averaged across countries within each portfolio and through time. All moments for our empirical work are computed analogously, both at the country and portfolio level.

Returns to equity capital. As described in the the text, we obtain data from MSCI on quarterly returns denominated in US dollars. The data can be accessed at https://www.msci.com/end-of-day-data-search. We deflate these using the US CPI and limit the sample to countries classified as 'Developed' or 'Emerging' by MSCI, which have data available beginning in 1988 (this is the earliest date available for most emerging markets). We additionally include Argentina, which is classified as 'Frontier,' but has data back to 1988. Our final sample consists of a balanced panel of 33 countries over the period 1988-2014, 22 classified as developed (including the US) and 11 as emerging. The countries included are: Argentina, Australia, Austria, Belgium, Brazil, Canada, Switzerland, Chile, Germany, Denmark, Spain, Finland, France, Great Britain, Greece, Hong Kong, Indonesia, Ireland, Italy, Japan, Korea, Mexico, Malaysia, Netherlands, Norway, New Zealand, Phillipines, Portugal, Singapore, Sweden, Thailand, Turkey, and the US.

We obtain data on quarterly dividend yields and price indices for these same countries from Datastream. The majority of the series are reported in US dollars with the exception of Brazil and Switzerland. For these countries, we convert dividends from local currency to US dollars using end of quarter exchange rates obtained from the Federal Reserve Bank of St. Louis FRED database. We deflate quarterly dividends using the US CPI and because of well-known seasonality in dividend payouts, aggregate to an annual frequency. The return and dividend data cover the period 1988-2014. As a measure of income, we obtain data on real GDP per capita from the WDI and take the average for each country over this same period.

B Stylized Facts - Raw Equity Returns

Table 13: The Return to Equity Capital

Income Level	log(income)	$\mathbb{E}[R_{j,t}]$	$\beta(R_{j,t}, R_{US,t})$	$\text{corr}(R_{j,t}, R_{US,t})$	$\text{std}(R_{j,t})$
Low	8.25	17.73	1.26	0.46	0.437
High	10.35	8.31	1.04	0.65	0.254
US	10.58	8.84	1.00	1.00	0.156

Notes: Table reports moments for returns to equities. Returns data are from MSCI and are not truncated. Portfolio moments are computed over the period 1988-2014. The moments for each portfolio represent the mean values for the countries in that portfolio.

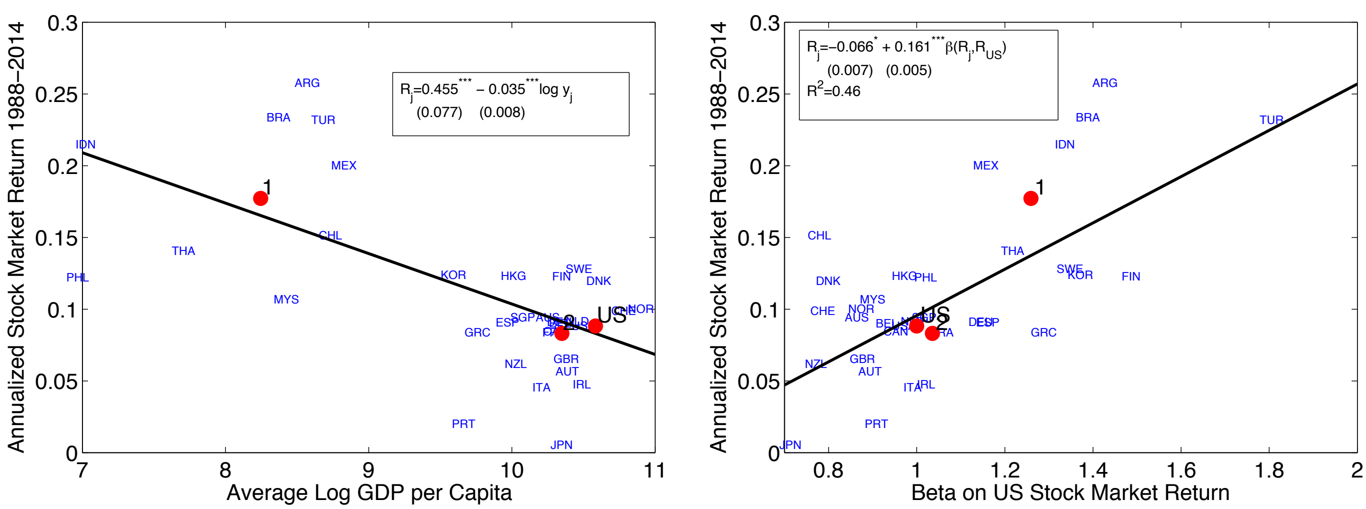

Figure 6: The Cross-Section of Capital Returns

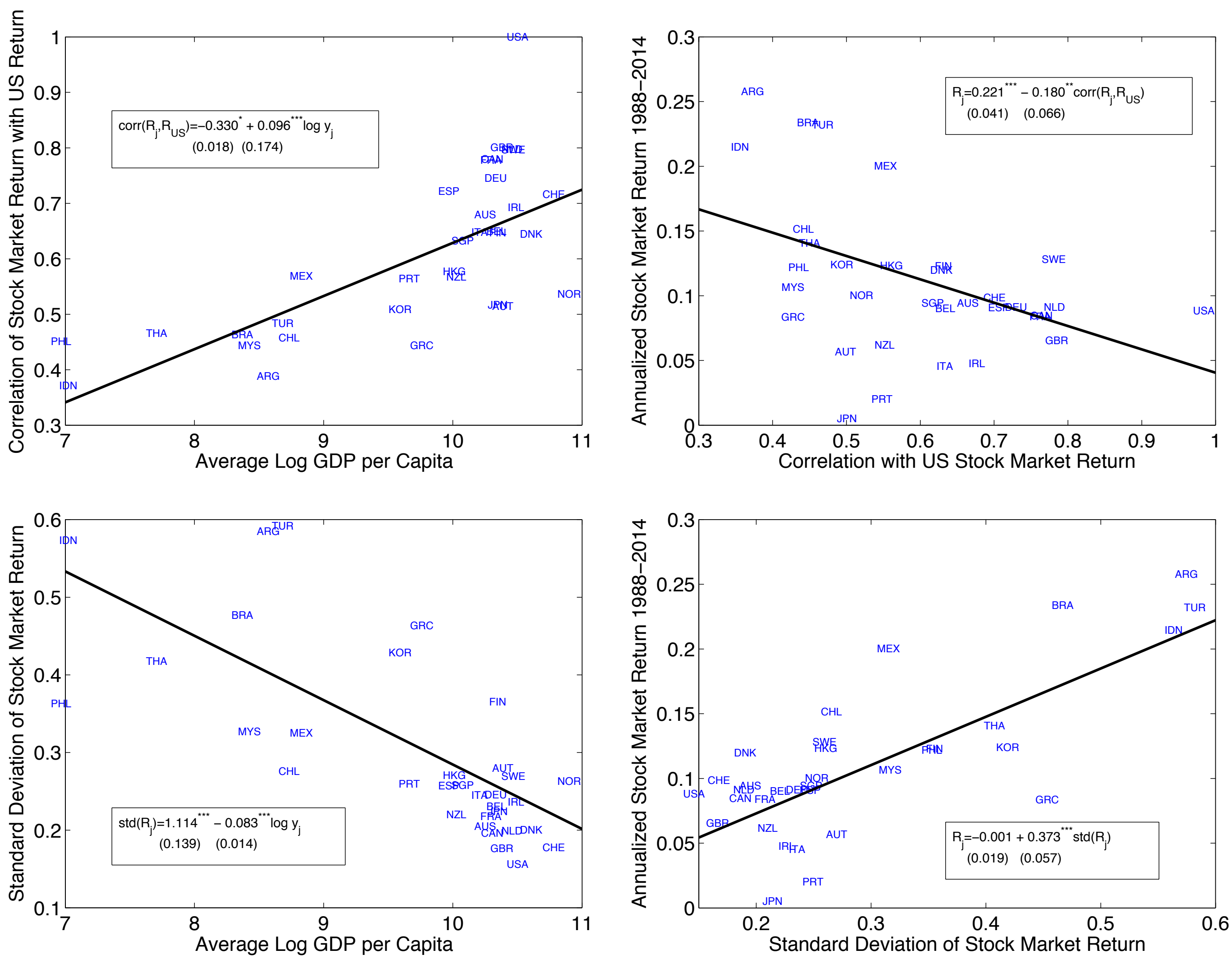

Figure 7: The Returns to Equity - Second Moments

C Model

Solution. We begin by writing the investor's SDF in logs as

$$m_{t+1} = \theta \log \beta - \frac{\theta}{\psi} \Delta c_{t+1} + (\theta - 1)\, r_{c,t+1} \tag{c.1}$$

Covariation with m_{t+1} will determine the risk premia on each asset. To characterize the SDF, we solve for the consumption return $r_{c,t+1}$, which we approximate as

$$r_{c,t+1} = \kappa_0 + \kappa_1 z_{t+1} - z_t + \Delta c_{t+1} \tag{c.2}$$

where $z_t = \log\left(\frac{P_t}{C_t}\right)$ is the log price-consumption ratio and the two κ's are constants of approximation that depend on the unconditional mean of z, $\overline{z}$: $\kappa_1 = \frac{\exp \overline{z}}{1+\exp \overline{z}}$ and $\kappa_0 = \log(1+\exp \overline{z}) - \overline{z}\kappa_1$. We similarly approximate returns to the US and a representative foreign asset as, respectively,

$$\begin{aligned} r_{m,t+1} &= \kappa_{m,0} + \kappa_{m,1} z_{m,t+1} - z_t + \Delta d_{t+1} \\ r^*_{m,t+1} &= \kappa^*_{m,0} + \kappa^*_{m,1} z^*_{m,t+1} - z^*_t + \Delta d^*_{t+1} \end{aligned}$$

where $z_{m,t} = \log\left(\frac{P_t}{D_t}\right)$ is the US log price-dividend ratio, which has unconditional mean $\overline{z}_m$, and the κ_m's depend on $\overline{z}_m$ in an analogous way to the κ's on $\overline{z}$ above (similar relationships hold for the foreign asset).

Given the endowment nature of the economy, we need find solutions for the price-consumption ratio and the price-dividend ratio for each asset in order to characterize returns. The state variables in the economy are the expected growth rates x_t and x^*_t, and these ratios are approximately linear in the states, i.e.,

$$\begin{aligned} z_t &= A_0 + A_1 x_t + A_2 x^*_t \\ z_{m,t} &= A_{m,0} + A_{m,1} x_t + A_{m,2} x^*_t \\ z^*_{m,t} &= A^*_{m,0} + A^*_{m,1} x_t + A^*_{m,2} x^*_t \end{aligned}$$

Substituting into the Euler equation (3), we can find

$$\begin{aligned} A_1 &= \frac{1-\frac{1}{\psi}}{1-\kappa_1\rho} \\ A_2 &= 0 \\ A_0 &= \frac{\log\beta + \left(1-\frac{1}{\psi}\right)\mu + \kappa_0 + \frac{1}{2}(1-\gamma)\left(1-\frac{1}{\psi}\right)\left(\sigma_\eta^2 + \left(\frac{\kappa_1}{1-\kappa_1\rho}\right)^2\sigma_e^2\right)}{1-\kappa_1} \end{aligned} \tag{c.3}$$

and for the US asset,

$$\begin{aligned} A_{m,1} &= \frac{\phi-\frac{1}{\psi}}{1-\kappa_{m,1}\rho} \\ A_{m,2} &= 0 \\ A_{m,0} &= \frac{\theta\log\beta - \gamma\mu + (\theta-1)(\kappa_0 + A_0(\kappa_1-1)) + \mu_d + \kappa_{m,0}}{1-\kappa_{m,1}} \\ &+ \frac{\frac{1}{2}(\pi-\gamma)^2\sigma_\eta^2 + \frac{1}{2}((\theta-1)\kappa_1 A_1 + \kappa_{m,1}A_{m,1})^2\sigma_e^2 + \frac{1}{2}\sigma_\mu^2}{1-\kappa_{m,1}} \end{aligned} \tag{c.4}$$

and lastly, for the foreign asset,

$$
\begin{aligned}
A^*_{m,1} &= \frac{\phi^* \xi^* - \frac{1}{\psi}}{1 - \kappa^*_{m,1} \rho} \\
A^*_{m,2} &= \frac{\phi^*}{1 - \kappa^*_{m,1} \rho^*} \\
A^*_{m,0} &= \frac{\theta \log \beta - \gamma \mu + (\theta - 1)\left(\kappa_0 + A_0\left(\kappa_1 - 1\right)\right) + \mu^*_d + \kappa^*_{m,0} + \frac{1}{2}\left(\kappa^*_{m,1} A^*_{m,2}\right)^2 \sigma^2_{e^*}}{1 - \kappa^*_{m,1}} \\
&+ \frac{\frac{1}{2}\left(\pi^* - \gamma\right)^2 \sigma^2_\eta + \frac{1}{2}\left((\theta - 1)\kappa_1 A_1 + \kappa^*_{m,1} A^*_{m,1}\right)^2 \sigma^2_e + \frac{1}{2}\pi^{*^2}_d \sigma^2_\mu + \frac{1}{2}\sigma^2_{\mu^*}}{1 - \kappa^*_{m,1}}
\end{aligned} \tag{c.5}
$$

Solving for mean excess returns entails finding the vectors of consumption parameters $\boldsymbol{A}$ and $\boldsymbol{\kappa}$ and the corresponding vectors of return parameters, $\boldsymbol{A_m}$ and $\boldsymbol{\kappa_m}$, both for the US and each foreign asset. This can be done following a simple iterative procedure. As an example, consider the consumption parameters. First, note that $\overline{z} = A_0$. Then, for a candidate value of $\overline{z}$, we can compute values for $\boldsymbol{\kappa}$. We can then compute the vector $\boldsymbol{A}$ using (c.3), which produces an updated value for $\overline{z}$. We then iterate until convergence. We use an analogous procedure to solve for the return parameters, both in the US and each foreign region. The mean risk-free rate depends only on consumption and preference parameters.

Identification. In this section, we prove that $\phi^* \sigma^2_{e^*}$, along with the parameters identified in equations (13)-(18) are sufficient to compute $\kappa^*_{m,1}$. Combining the expressions for $A^*_{m,1}, A^*_{m,2}$ and $A^*_{m,0}$ using (c.5) and letting $\tilde{\phi}^* \equiv \phi^* \xi^*$ as in the text gives the following expression for $A^*_{m,0}$:

$$
\begin{aligned}
A^*_{m,0} &= \frac{\theta \log \beta - \gamma \mu + (\theta - 1)\left(\kappa_0 + A_0\left(\kappa_1 - 1\right)\right) + \mu^*_d + \kappa^*_{m,0} + \frac{1}{2}\left(\frac{\kappa^*_{m,1}}{1-\kappa^*_{m,1}\rho^*}\right)^2 \left(\phi^* \sigma^*_e\right)^2}{1 - \kappa^*_{m,1}} \\
&+ \frac{\frac{1}{2}\left(\pi^* - \gamma\right)^2 \sigma^2_\eta + \frac{1}{2}\left((\theta - 1)\kappa_1 A_1 + \frac{\kappa^*_{m,1}}{1-\kappa^*_{m,1}\rho}\left(\tilde{\phi}^* - \frac{1}{\psi}\right)\right)^2 \sigma^2_e + \frac{1}{2}\pi^{*^2}_d \sigma^2_\mu + \frac{1}{2}\sigma^2_{\mu^*}}{1 - \kappa^*_{m,1}}
\end{aligned}
$$

Only $\tilde{\phi}^* \sigma^2_{e^*}$ appears in the expression. Because $\kappa^*_{m,1}$ is simply a nonlinear function of $A^*_{m,0}$, the same argument goes through.

D Rebalanced Portfolios for Returns to Aggregate Capital

As an alternative approach to classifying countries into portfolios, we return to our bundling procedure, and now group countries according to income on an annual basis. Specifically, we 'rebalance' our portfolios on an annual basis, i.e., classify countries in each year based on their rank in the income distribution within that particular year.[54] The main advantage of this approach is that it accounts for the changing place of countries as the income distribution evolves; the drawback is that it introduces a significant degree of turnover in the portfolios, i.e., many countries move in and out of each portfolio, particularly so at finer levels of disaggregation. From our point of view, we are most interested in the robustness of our results to this alternative grouping procedure. We report the results in Table 14.[55] Our results are robust to this alternative grouping procedure. Our model predicts a spread in returns between portfolio 1 and the US of between 4.5% and 5.3%, which accounts for between 60% and 74% of the spread in the data. These results are quite close to those obtained in our baseline approach above. The correlation of predicted and actual returns across portfolios ranges upward from a low of about 0.9.

Table 14: Predicted vs. Actual Returns - Annually Rebalanced Portfolios

3 Portfolios			5 Portfolios			10 Portfolios		
	$\widehat{r}$	r		$\widehat{r}$	r		$\widehat{r}$	r
1	10.36	12.08	1	10.82	12.98	1	11.23	14.89
2	8.58	10.22	2	9.88	10.82	2	10.39	10.90
3	6.91	7.56	3	7.99	10.17	3	9.59	10.48
US	5.90	6.01	4	7.34	8.48	4	10.18	11.15
			5	7.05	7.25	5	8.10	10.50
			US	5.90	6.01	6	7.91	9.86
						7	8.19	8.94
						8	6.50	8.00
						9	7.15	6.86
						10	6.95	7.63
						US	5.90	6.01
Average:	7.94	8.97		8.16	9.29		8.37	9.57
Spread: 1-US	4.46	6.07		4.92	6.97		5.33	8.88
Percent of actual	74			71			60	
corr($\widehat{r}, r$)	1.00			0.96			0.91	

E List of Countries

[54] This approach has been widely used in examining cross-sectional differences in returns. See, for example, Lustig and Verdelhan (2007).

[55] Moments and parameters estimates for this exercise are available upon request.

Country	3 Letter code	Init. year	Portfolio number 3 portf.	5 portf.	10 portf.	Ctry An.	α	Openness CI-2004	Q-2004	GMF-1995
Albania	ALB	1970	2	3	5	0	0	1	0	0
Angola	AGO	1970	1	2	3	0	0	0	0	0
Antigua/Barbuda	ATG	1970	3	4	8	0	0	1	0	1
Argentina	ARG	1950	2	3	5	1	1	1	0	1
Armenia	ARM	1990	2	2	4	0	1	1	0	0
Australia	AUS	1950	3	5	10	1	1	1	1	1
Austria	AUT	1950	3	5	9	1	1	1	1	1
Azerbaijan	AZE	1990	2	2	4	0	1	0	0	0
Bahamas	BHS	1970	3	5	9	0	1	0	0	0
Bahrain	BHR	1970	3	5	9	0	0	1	0	1
Bangladesh	BGD	1959	1	1	2	1	0	0	0	0
Barbados	BRB	1960	3	4	8	1	1	0	0	0
Belarus	BLR	1990	2	3	6	0	1	0	0	0
Belgium	BEL	1950	3	5	10	1	1	1	1	1
Belize	BLZ	1970	2	3	6	0	0	0	0	0
Benin	BEN	1959	1	1	2	1	1	0	0	0
Bhutan	BTN	1970	1	2	3	0	0	0	0	0
Bolivia	BOL	1950	1	2	3	1	1	1	1	1
Botswana	BWA	1960	2	3	5	1	1	1	0	0
Brazil	BRA	1950	2	2	4	1	1	1	1	0
Brunei	BRN	1970	3	5	10	0	0	0	0	0
Bulgaria	BGR	1970	2	3	5	0	1	0	1	0
Burkina Faso	BFA	1959	1	1	1	1	1	0	0	0
Burundi	BDI	1960	1	1	1	1	0	0	0	0
Canada	CAN	1950	3	5	10	1	1	1	1	1
Cape Verde	CPV	1960	1	2	3	1	0	0	0	0
Central Afr. Rep.	CAF	1960	1	1	1	1	1	0	0	0
Chad	TCD	1960	1	1	1	1	0	0	0	0
Chile	CHL	1951	2	3	6	1	1	1	1	0
China	CHN	1952	1	1	2	1	1	0	1	0
Colombia	COL	1950	2	3	6	1	1	1	1	0
Comoros	COM	1960	1	1	2	1	0	0	0	0
Congo, Dem. Rep.	COD	1970	1	1	1	0	0	0	0	0
Congo, Rep. of	COG	1960	1	2	3	1	0	0	0	0
Costa Rica	CRI	1950	2	3	6	1	1	1	1	1
Cote d'Ivoire	CIV	1960	1	2	3	1	1	0	0	0
Croatia	HRV	1990	3	4	8	0	1	1	0	0
Cyprus	CYP	1950	3	4	8	1	1	1	0	0
Czech Republic	CZE	1990	3	5	9	0	1	1	1	0
Denmark	DNK	1950	3	5	9	1	1	1	1	1
Djibouti	DJI	1970	1	2	4	0	1	1	0	1

Country	3 Letter code	Init. year	Portfolio number 3 portf.	5 portf.	10 portf.	Ctry An.	α	Openness CI-2004	Q-2004	GMF-1995
Dominican Rep.	DOM	1951	2	3	5	1	1	1	0	0
Ecuador	ECU	1951	2	2	4	1	1	1	1	1
El Salvador	SLV	1950	1	1	1	1	0	1	1	0
Estonia	EST	1990	3	4	7	0	1	1	0	1
Ethiopia	ETH	1950	1	1	1	1	0	0	0	0
Fiji	FJI	1960	2	3	5	1	1	0	0	0
Finland	FIN	1950	3	4	8	1	1	1	1	1
France	FRA	1950	3	5	10	1	1	1	1	1
Gabon	GAB	1960	3	4	7	1	0	0	0	0
Gambia, The	GMB	1960	1	1	2	1	0	1	0	1
Georgia	GEO	1990	2	2	4	0	1	1	0	0
Germany	DEU	1950	3	5	10	1	1	1	1	1
Greece	GRC	1951	3	4	8	1	1	1	1	0
Grenada	GRD	1970	2	3	5	0	0	0	0	0
Guatemala	GTM	1950	2	2	4	1	1	1	1	1
Guinea	GIN	1959	1	1	2	1	0	0	0	0
Honduras	HND	1950	1	2	4	1	1	1	0	1
Hong Kong	HKG	1960	3	5	10	1	1	1	1	1
Hungary	HUN	1970	2	4	7	0	1	1	1	0
Iceland	ISL	1950	3	5	10	1	1	1	0	0
India	IND	1950	1	1	2	1	1	0	1	0
Indonesia	IDN	1960	1	2	3	1	1	1	1	1
Iran	IRN	1955	2	3	6	1	1	1	0	0
Ireland	IRL	1950	3	5	9	1	1	1	0	1
Israel	ISR	1950	3	5	9	1	1	1	1	0
Italy	ITA	1950	3	5	9	1	1	1	1	1
Jamaica	JAM	1953	2	3	5	1	1	1	1	0
Japan	JPN	1950	3	4	8	1	1	1	1	0
Jordan	JOR	1954	2	3	6	1	1	1	0	0
Kazakhstan	KAZ	1990	2	3	6	0	1	0	0	0
Kenya	KEN	1950	1	1	2	1	1	1	1	0
Korea, Rep. of	KOR	1953	2	4	7	1	1	1	1	0
Kyrgyzstan	KGZ	1990	1	2	3	0	1	1	0	0
Latvia	LVA	1990	2	4	7	0	1	1	0	1
Lesotho	LSO	1960	1	1	2	1	1	0	0	0
Liberia	LBR	1964	1	1	1	0	0	1	0	0
Lithuania	LTU	1990	3	4	7	0	1	0	0	1
Luxembourg	LUX	1950	3	5	10	1	1	0	0	0
Macao	MAC	1970	3	5	10	0	1	1	0	0
Macedonia	MKD	1990	3	4	7	0	1	1	0	0
Malawi	MWI	1954	1	1	1	1	0	0	0	0

Country	3 Letter code	Init. year	Portfolio number 3 portf.	5 portf.	10 portf.	Ctry An.	α	Openness CI-2004	Q-2004	GMF-1995
Malaysia	MYS	1955	2	3	6	1	1	1	0	1
Mali	MLI	1960	1	1	1	1	0	0	0	0
Mauritania	MRT	1960	1	2	3	1	1	0	0	0
Mauritius	MUS	1950	2	4	7	1	1	1	0	0
Mexico	MEX	1950	3	4	8	1	1	1	1	0
Moldova	MDA	1990	1	2	3	0	1	0	0	0
Mongolia	MNG	1970	1	2	3	0	1	1	0	0
Montenegro	MNE	1990	3	5	9	0	0	1	0	0
Morocco	MAR	1950	2	2	4	1	1	0	0	0
Mozambique	MOZ	1960	1	1	1	1	1	0	0	0
Namibia	NAM	1960	2	3	5	1	0	0	0	0
Nepal	NPL	1960	1	1	1	1	0	0	0	0
Netherlands	NLD	1950	3	5	9	1	1	1	1	1
New Zealand	NZL	1950	3	4	8	1	1	1	1	1
Niger	NER	1960	1	1	2	1	1	0	0	1
Nigeria	NGA	1950	1	1	2	1	0	0	1	0
Norway	NOR	1950	3	5	10	1	1	1	1	1
Oman	OMN	1970	3	5	9	0	0	1	0	1
Pakistan	PAK	1950	1	2	3	1	0	0	0	0
Panama	PAN	1950	2	4	7	1	1	1	0	1
Paraguay	PRY	1951	1	2	4	1	1	1	0	0
Peru	PER	1950	2	2	4	1	1	1	1	1
Philippines	PHL	1950	1	2	4	1	1	1	1	0
Poland	POL	1970	2	3	6	0	1	1	1	0
Portugal	PRT	1950	2	4	7	1	1	0	1	1
Qatar	QAT	1970	3	5	10	0	0	1	0	1
Romania	ROU	1988	2	3	6	0	1	1	0	0
Russia	RUS	1990	2	4	7	0	1	0	1	0
S.Tome/Principe	STP	1970	1	1	2	0	1	1	0	0
Saudi Arabia	SAU	1970	3	5	10	0	0	1	0	1
Senegal	SEN	1960	1	1	2	1	1	0	1	0
Serbia	SRB	1990	2	3	6	0	1	1	0	0
Singapore	SGP	1960	3	4	8	1	1	1	1	1
Slovak Rep.	SVK	1990	3	4	8	0	1	1	0	0
Slovenia	SVN	1990	3	5	9	0	1	1	0	0
South Africa	ZAF	1950	2	3	6	1	1	0	1	0
Spain	ESP	1950	3	4	8	1	1	1	1	1
Sri Lanka	LKA	1950	2	2	4	1	1	1	1	0
St. Lucia	LCA	1970	2	3	6	0	0	1	0	0
St.Vincent/Gren.	VCT	1970	2	3	5	0	0	0	0	0
Suriname	SUR	1970	2	4	7	0	1	0	0	0

Country	3 Letter code	Init. year	Portfolio number 3 portf.	5 portf.	10 portf.	Ctry An.	α	Openness CI-2004	Q-2004	GMF-1995
Swaziland	SWZ	1970	2	3	5	0	1	0	0	0
Sweden	SWE	1950	3	5	9	1	1	1	1	1
Switzerland	CHE	1950	3	5	10	1	1	1	0	1
Syria	SYR	1960	1	2	4	1	0	0	0	0
Taiwan	TWN	1951	3	4	8	1	0	1	0	0
Tajikistan	TJK	1990	1	2	3	0	1	0	0	0
Tanzania	TZA	1960	1	1	1	1	1	0	0	0
Thailand	THA	1950	1	2	3	1	1	1	0	0
Togo	TGO	1960	1	1	1	1	0	0	0	0
Trinidad/Tobago	TTO	1950	3	4	8	1	0	0	0	1
Tunisia	TUN	1960	2	3	5	1	1	0	1	0
Turkey	TUR	1950	2	4	7	1	1	0	1	0
Turkmenistan	TKM	1990	2	3	5	0	0	0	0	0
Uganda	UGA	1950	1	1	1	1	0	1	1	0
Ukraine	UKR	1990	2	3	5	0	1	0	0	0
United Kingdom	GBR	1950	3	5	9	1	1	1	1	1
United States	USA	1950	4	6	11	1	1	1	1	1
Uruguay	URY	1950	2	4	7	1	1	1	1	0
Uzbekistan	UZB	1990	2	2	4	0	0	0	0	0
Venezuela	VEN	1950	3	4	7	1	1	0	1	0
Zambia	ZMB	1955	1	1	2	1	0	1	0	0

F Additional Tables

Table 16: Target Moments and Parameter Values, 5 Portfolios

Moments						
Portfolio	$\mathbb{E}[\Delta d_t^*]$	$\text{cov}\left(\Delta d_{t+1}^*, \Delta d_t^*\right)$	$\text{cov}\left(\Delta d_t^*, \Delta c_t\right)$	$\text{std}\left(\Delta d_t^*\right)$	$\text{cov}\left(\Delta d_t^*, \Delta d_t\right)$	$\frac{\text{cov}(r_t^*, r_t)}{\text{std}(r_t)}$
1	−0.016	0.00148	0.00014	0.084	0.00042	0.045
2	−0.016	0.00160	0.00005	0.078	0.00010	0.036
3	−0.016	0.00116	0.00014	0.077	0.00039	0.037
4	−0.013	0.00102	0.00015	0.070	0.00046	0.037
5	−0.011	0.00058	0.00015	0.060	0.00038	0.028
Parameters						
Portfolio	μ_d	$\tilde{\phi}^*$	π	π_d	σ_μ	$\phi^* \sigma_{e^*}$
1	−0.016	5.37744	−0.96821	−0.00010	0.074	0.00715
2	−0.016	5.33112	−2.07645	−0.57545	0.062	0.00846
3	−0.016	3.83740	−0.27666	0.14880	0.069	0.00918
4	−0.013	3.51331	0.01263	0.35320	0.061	0.00887
5	−0.011	2.39233	0.58129	0.27506	0.054	0.00715

Table 17: Target Moments and Parameter Values, 10 Portfolios

Moments						
Portfolio	$\mathbb{E}\left[\Delta d_t^*\right]$	$\operatorname{cov}\left(\Delta d_{t+1}^*, \Delta d_t^*\right)$	$\operatorname{cov}\left(\Delta d_t^*, \Delta c_t\right)$	$\operatorname{std}\left(\Delta d_t^*\right)$	$\operatorname{cov}\left(\Delta d_t^*, \Delta d_t\right)$	$\frac{\operatorname{cov}(r_t^*, r_t)}{\operatorname{std}(r_t)}$
1	−0.019	0.00138	0.00016	0.089	0.00041	0.049
2	−0.014	0.00161	0.00013	0.079	0.00043	0.041
3	−0.018	0.00107	0.00005	0.087	0.00009	0.033
4	−0.015	0.00208	0.00005	0.069	0.00009	0.038
5	−0.017	0.00114	0.00016	0.082	0.00042	0.033
6	−0.014	0.00116	0.00012	0.072	0.00037	0.041
7	−0.017	0.00113	0.00012	0.074	0.00041	0.035
8	−0.010	0.00091	0.00017	0.066	0.00052	0.039
9	−0.013	0.00069	0.00014	0.060	0.00037	0.029
10	−0.009	0.00047	0.00016	0.059	0.00039	0.027
Parameters						
Portfolio	μ_d	$\tilde{\phi}^*$	π	π_d	σ_μ	$\phi^* \sigma_{e^*}$
1	−0.019	6.45374	−1.33225	−0.18904	0.073	0.01000
2	−0.014	4.35358	−0.62409	0.19171	0.067	0.01123
3	−0.018	4.77576	−1.77650	−0.51733	0.078	0.00516
4	−0.015	5.65472	−2.24257	−0.62392	0.044	0.01100
5	−0.017	3.07385	0.30829	0.29047	0.074	0.01061
6	−0.014	4.66260	−0.90714	0.02476	0.062	0.00672
7	−0.017	3.46198	−0.25718	0.29270	0.065	0.00981
8	−0.010	3.55182	0.24894	0.42668	0.057	0.00783
9	−0.013	2.59247	0.32249	0.25836	0.053	0.00788
10	−0.009	2.23859	0.79737	0.28864	0.054	0.00631