



Global Economics Paper No: 205

Goldman Sachs Global Economics,
Commodities and Strategy Research
at <https://360.gs.com>

Why Doesn't Capital Flow to Where Returns Are Highest?

- There are considerable and persistent cross-country differences in the return on physical capital. These differences are positively correlated with *growth* in GDP per capita and negatively correlated with the *level* of GDP per capita (as standard theory would predict).
- Yet, despite the existence of large and persistent cross-country differences in the return on capital, investment does not flow from countries with low returns to countries with high returns.
- Understanding why this standard theoretical prediction is violated has important implications for long-term growth and convergence. It also has important implications for investors.
- We argue that other factors influencing savings and investment behaviour override the 'return chasing' capital flows. These factors include: inter-generational effects on aggregate savings behaviour, demographic differences and variation in the degree of financial development. We show that the first two of these factors have been important in driving 'uphill' capital flows (i.e., from fast-growing, high-return economies to slow-growing, low-return economies).
- The key insight for investors is that, with capital flows being driven by factors that—although rational from the perspective of the saver—are unrelated to return differentials, the opportunities for 'unconstrained' investors to invest where returns are highest are likely to be greater.

Important disclosures appear at the back of this document

Thanks to Dominic Wilson, Jan Hatzius,
Ben Broadbent, Francesco Garzarelli,
Timothy Moe, Jim O'Neill,
Loretta Sunnucks, Willem Buiter,
Patrick Honohan and Philip Lane

Kevin Daly

November 12, 2010

Contents

Summary	3
Section 1: Introduction	4
The Lucas Paradox: Why Doesn't Capital Flow from Rich to Poor Countries?	4
Returns <i>Are</i> Higher in Poor Economies, But Aggregate Capital Flows Are <i>Not</i> 'Return Chasing'	4
Intergenerational Savings Dynamics and Demographics Dominate 'Return Chasing' Flows	5
Investment Implications: Better Opportunities for 'Unconstrained' Investors	6
Section 2: Results and Analysis	7
Large and Persistent Differences in Rates of Return	7
Box 1: A Cross-Country Database of the Return on Physical Capital	9
Rates of Return Are Higher in Low-income, Fast-Growing Economies	11
Capital Flows do Not Respond to Differences in Rates of Return	12
Net Long-Term Capital Flows are Driven by Inter-Generational Savings Dynamics and Demographics	14
Section 3: Conclusions and Investment Implications	16
Investment Implications: Non-'Return Chasing' Flows Perpetuate Return Differentials	16
The Savings Glut and the High Global Equity Risk Premium	18
Bibliography	19

Summary

Standard economic theory predicts that emerging economies—with relatively low capital intensity, high rates of return and the prospect of higher income levels in the future—should save less than they invest and, therefore, run current account deficits (capital account inflows). Developed economies, meanwhile—with mature capital stocks and low internal rates of return—would typically be expected to save more than they invest and, therefore, to run current account surpluses (capital account outflows).

However, there has been no systematic pattern of capital flowing from rich to poor economies in the past 30 years and, from 2000 onwards, there have been sizeable capital flows in the opposite direction. While the size of these imbalances has shrunk since the onset of the financial crisis, capital continues to flow ‘uphill’ from poor economies to rich ones.

This phenomenon begs three questions: **(i) Are poor countries’ returns actually higher than rich ones?; (ii) Does capital flow from countries where returns are low to countries where returns are high?; and, (iii) If not, why not?**

Using a new database of rates of return on physical capital for the 12 largest economies in the world, covering more than three-quarters of global output, and spanning more than one-quarter of a century, we find that:

- **Rates of return on physical capital are significantly higher in poor economies than in rich economies** (to a degree that exceeds any reasonable premium for the additional riskiness of those returns).
- **Capital does *not* typically flow from low-return economies to high-return economies.**
- The existence of ‘uphill’ capital flows from poor countries with high returns to rich countries with low returns appears primarily to be due to differences in **demographics** between emerging and developed economies and **the effect of higher trend growth** on aggregate savings behaviour.

In a world without perfect capital mobility, ‘uphill’ capital flows from fast-growing, high-return economies to slow-growing, low-return economies contribute to and perpetuate the existence of cross-country return differentials. The key insight for investors is that, with capital flows being driven by factors that—although rational from the perspective of the saver—are unrelated to return differentials, the opportunities for ‘unconstrained’ investors (i.e., those who are in a position to take the other side of those flows) to invest where returns are highest are likely to be greater.

This does not, of course, imply that such investment would be right at any price—one can still overpay for the underlying assets that produce relatively high returns. But equity returns have also typically been higher in countries with relatively high returns on physical capital—consistent with the view that ‘uphill’ capital flows have led to underinvestment in EM *financial* capital (as well as physical capital). Moreover, we find little evidence that return differentials are typically reflected in stock market valuations, and our equity strategists do not believe that emerging market equities are overvalued today.

In past research we have emphasised the opportunities that the BRICs and other EM economies present for both portfolio and direct investment. The findings set out in this paper provide a new perspective on those opportunities, as they suggest a mechanism whereby (risk-adjusted) return differentials can and do persist.

We address three questions: (i) Are poor countries’ returns actually higher than rich ones?; (ii) Does capital flow from countries where returns are low to countries where returns are high?; and, (iii) If not, why not?

Rates of return on physical capital are significantly higher in poor economies than in rich economies but capital does not typically flow from low-return economies to high-return economies

With capital flows being driven by factors that are unrelated to return differentials, the opportunities for ‘unconstrained’ investors to invest where returns are highest are likely to be greater

Section 1: Introduction¹

The Lucas Paradox: Why Doesn't Capital Flow from Rich to Poor Countries?

Standard economic theory suggests that, in the absence of full capital market integration, rates of return should be higher in poor countries than in rich ones and that, reflecting these differences, capital should flow from rich to poor countries. In 1990 Robert Lucas, the Nobel prize-winning economist, posed the question “Why doesn't capital flow from rich to poor countries?”, and various explanations have since been proposed as to why this does not appear to be the case. The paradox can be usefully split into two distinct questions: “Are rates of return higher in poor countries?” and “Do capital flows systematically respond to differences in the rates of return?”, and proposed explanations typically address one of these two questions.

Capital does not flow from rich countries to poor countries as it 'should'

The first group of explanations refer to differences in *fundamentals* affecting the production structure of economies, which have the effect of reducing or even reversing rate of return differentials across rich and poor countries. One possibility is that differences in human capital fully counteract other factors driving differences in profitability. The second group of explanations relies on *international capital market imperfections*. For instance, it may be that badly-defined property rights in cross-border investments entirely offset the incentive to invest where returns are highest.²

Returns Are Higher in Poor Economies, But Aggregate Capital Flows Are Not 'Return Chasing'

Using a new database of ex-post rates of return on capital for the 12 largest economies in the world, covering more than three-quarters of global output, and spanning more than one-quarter of a century, we find considerable and persistent differences in ex-post rates of return on capital. The differences we find are unlikely to be due to measurement error: the data, described in Section 2, are based on national accounts data for the private non-financial sector (where profitability and capital stocks are most accurately measured), and have been adjusted for any differences in methodology that exist across countries. Nor can the differences be explained by the distinction between ex-post and ex-ante returns—we find evidence of predictability in the cross-country variation of ex-post returns—or by differences in the degree of risk attached to returns.

This means either rates of return are not higher in poor economies or capital does not flow to where returns are highest

Using panel-data analysis, we find that cross-country differences in rates of return are positively correlated with *growth* in GDP per capita and negatively correlated with the *level* of GDP per capita, as standard (neo-classical) theory would predict (Figure 1). However, we find no systematic response of overall cross-country capital flows to these differences (Figure 2). This failure does not appear to be due to the distorting effects of reserve accumulation. Within overall capital flows, we separately consider the response of net inflows of foreign direct investment, equity investment and bond investment—the sub-components that one would expect to be most strongly ‘return chasing’—but find no systematic response to differences in the return on capital here either.

We find that rates of return are higher in relatively poor economies but that capital does not flow to where returns are highest

Our findings imply a ‘yes’ in answer to the question of whether rates of return are higher in low-income countries but a strong ‘no’ to the question of whether capital flows systematically respond to differences in the rates of return.

-
1. This paper summarises and extends results contained in the PhD thesis of Daly (2010): “The Global Return on Capital, the Lucas Paradox and the ‘Savings Glut’”.
 2. Within the first group, Lucas (1990) proposes differences in human capital and externalities arising from differences in human capital (i.e., multi-factor productivity) as two such fundamental differences. Within the second group, Lucas (1990) suggests that badly-defined property rights in cross-border investments and monopoly control over trade in capital goods are two such imperfections (although, in his analysis, he goes on to reject these explanations). Other possibilities include a higher risk of default on poor country government debt (Gertler and Rogoff (1990)) and ‘home bias’ in investment related to asymmetric information (French and Poterba (1991)). The Lucas Puzzle is closely related to the Feldstein-Horioka (1980) analysis, which highlights the high cross-country correlation between investment and saving (implying imperfect capital mobility).

Intergenerational Savings Dynamics and Demographics Dominate 'Return Chasing' Flows

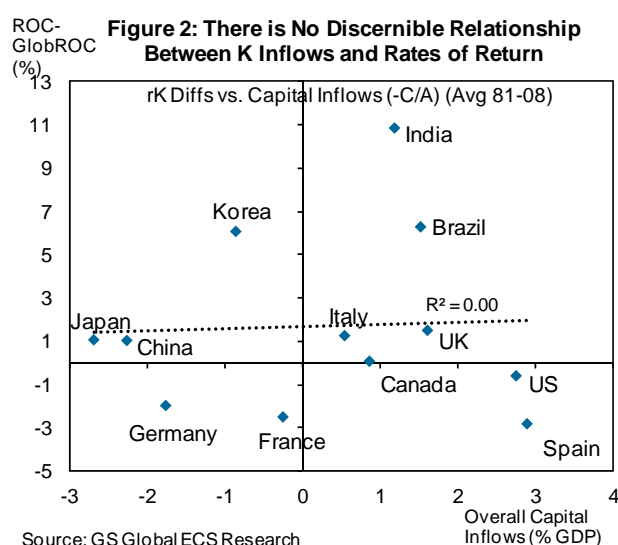
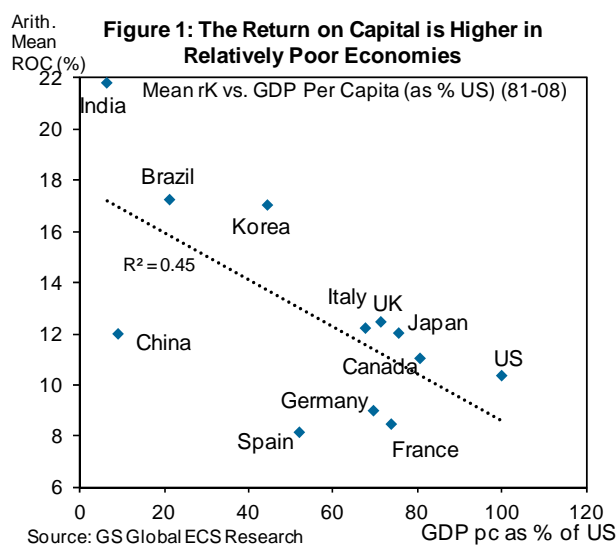
One can identify a number of alternative factors—i.e., other than differences in rates of return—that could be driving cross-country capital flows. An economy's current account is equal to its 'net' saving (saving less investment), so a tendency to save more across an economy will translate into pressure for current account surpluses and a flow of capital to other countries. Standard theory implies that it is the rate of return on capital that determines the equilibrium between those providing savings and those making investments. But other factors may induce some countries to save more than others:

- **Cross-country demographic differences:** Because people's savings behaviour varies throughout the different stages of their lives, the relative age structure of an economy can play an important role in determining their borrowing and lending to the rest of the world (see *GS Global Economics Paper No. 202*, August 12, 2010).
- **Higher trend growth can boost net saving:** One would typically expect rapidly growing economies to attract capital inflows but high trend growth can also boost net saving. In rapidly growing economies, the current generation of workers will typically earn much higher levels of income than the current generation of retirees will have done. Rapid growth can increase the aggregate level of saving in an economy if the savings of the (relatively rich) young cohorts is greater than the dissaving of (relatively poor) retirees.
- **Differences in financial development:** It is argued by some economists that low levels of financial development in emerging economies lead emerging market investors to seek more trustworthy savings vehicles in the mature financial markets of the developed world, leading to 'uphill' capital flows.
- **Cross-country differences in the degree of risk aversion:** Some countries may have a higher level of precautionary saving than others if future income is less certain. For instance, one suggestion is that the high household saving rates of emerging economies reflect a high level of individual risk, related to health costs, retirement and the financing of education, as a result of low levels of social protection.

An economy's current account is equal to its 'net' saving (saving less investment), so a tendency to save more across an economy will translate into pressure for current account surpluses and a flow of capital to other countries

Other factors may induce some countries to save more than others, such as demographic differences, the interaction between growth and savings dynamics, differences in risk aversion

We consider the effects of demographics, economic growth and financial development on net capital flows.³ We find strong evidence that higher trend growth results in capital outflows—consistent with the view that sustained



3. While other studies have considered the effects of these factors individually, to our knowledge this is the first time that these (potentially competing) effects have been evaluated alongside each other.

rapid income growth combines with intergenerational savings dynamics to create capital outflows from fast-growing economies. We also find some evidence that demographic differences play a role but no evidence that financial development is an important driver of net capital flows.

That capital flows ‘uphill’ from fast-growing, high-return economies to slow-growth, low-return economies is an important result and one that runs strongly counter to the standard theoretical prediction. It does not imply the absence of ‘return chasing’ flows. Rather, other determinates of saving and investment behaviour—driven by factors that are unrelated to differences in the return on capital—are overriding the incentive to invest where returns are highest.

Investment Implications: Better Opportunities for ‘Unconstrained’ Investors

There is a wide body of opinion that ‘uphill’ capital flows from emerging economies with high internal rates of return to developed economies with low rates of return played an important part in the formation of the 2007/2008 financial crisis (see, for instance, “The Savings Glut, the Return on Capital and the Rise in Risk Aversion”, *Global Economics Paper* No. 185, May 2009). If one subscribes to the view that the ‘savings glut’ had an important role in the formation of the financial crisis, then understanding why capital does not flow from countries with low rates of return to countries with high rates of return is key to understanding the formation of the financial crisis itself. Indeed, the ‘savings glut’ that preceded the 2007/08 financial crisis can be viewed as a special case of a much wider phenomenon, with the principal difference being that the emerging markets that are currently progressing through a period of rapid transition (in particular, the BRICs economies) are much larger than the transition economies of the past.

This also has important implications for investors: In a world without perfect capital mobility, ‘uphill’ capital flows from fast-growing, high-return economies to slow-growing, low-return economies contribute to and perpetuate the existence of cross-country return differentials. If capital were flowing in the ‘right’ direction, these flows would tend to smooth out return differentials over time. With capital flows that are driven by factors that—although rational from the perspective of the saver—are unrelated to return differentials, the opportunities for ‘unconstrained’ investors (i.e. those who are in a position to take the other side of those flows) to direct capital to where returns are highest are *likely* to be greater.

We emphasize ‘likely’ to be greater because one can still overpay for the underlying assets that produce relatively high returns. But equity returns have also typically been higher in countries with relatively high returns on physical capital—consistent with the view that ‘uphill’ capital flows have led to underinvestment in EM *financial* capital (as well as physical capital). Moreover, we find little evidence that return differentials are typically reflected in stock market valuations.

We view the market implications of this analysis to be primarily of a medium-to-long-term significance, rather than implying that EM equities are necessarily cheap today. However, it is also the case that our equity strategists currently view the majority of EM markets to be relatively good value.

In past research we have emphasised the opportunities that the BRICs and other EM economies present for both portfolio and direct investment. The findings set out in this paper provide a new perspective on those opportunities. It suggests a mechanism whereby (risk-adjusted) return differentials can and do persist.

We find strong evidence that higher trend growth results in capital outflows. We also find that demographics play a role

Equity returns have also typically been higher in countries with relatively high returns on physical capital

The findings set out in this paper provide a new perspective on the opportunities presented by the BRICs economies

Section 2: Results and Analysis

Large and Persistent Differences in Rates of Return

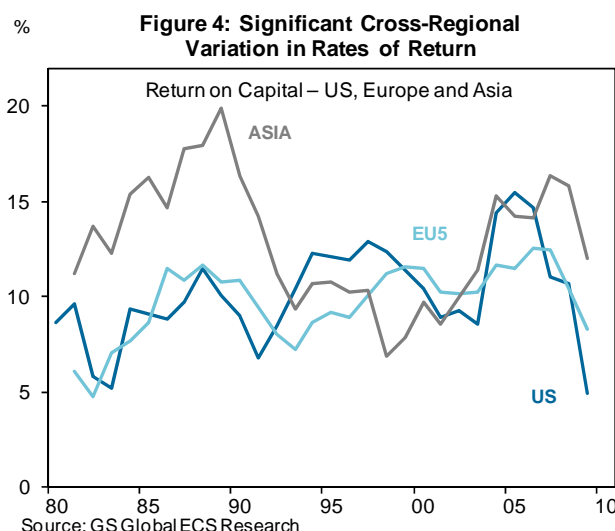
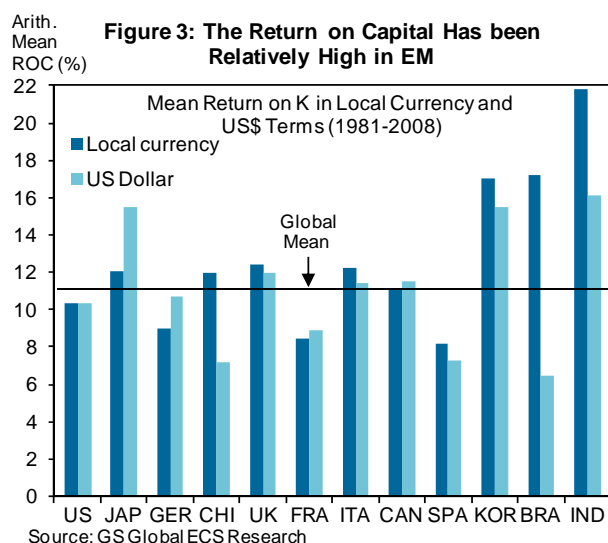
This section is structured as follows: first, we set out some ‘stylised facts’ regarding the behaviour of the cross-country rates of return; second, we explore some potential determinants of the return on capital, both within and across economies; third, we consider whether capital flows have been responsive to differences in rates of return; and, finally, we broaden the discussion to discuss other potential drivers of cross-country capital flows, such as demographics and relative financial development.

The core of our analysis is based on a new cross-country database of returns on physical capital, covering the 12 largest economies in the world and more than 75% of global GDP. The methodology underling the construction of the database is described in Box 1 on pages 9-10. Using this database, we find:

- **Large cross-country differences in rates of return:** Figure 3 displays the mean return on capital measure, r^K , for each country from 1981 and 2008. Figure 4 displays the rates of return on capital for Europe (Germany, UK, France, Italy and Spain), Asia (Japan, China, Korea and India) and the US. Table 1, meanwhile, sets out some summary results.⁴ In Column 1 of Table 1, we display the average return for each country over this 28-year period; in Column 2, the mean difference with the global capital-stock-weighted rate of return and, in Column 3, the ranking of the mean returns. The variation in mean cross-country returns has been substantial, from a high of 22% for India to a low of 8% for Spain. Even geographically-neighbouring countries saw substantially different rates of return: France’s return on capital averaged 4% less than Italy’s over the 28-year sample.⁵
- **The ranking of cross-country rates of return on capital has changed significantly over the 28-year sample.** In Asia, for instance, Japanese and Korean returns were very high in the 1980s but subsequently fell, while China’s ROC increased significantly in the 2000s. Figures A2-A4 in Box 1 provide a cross-country breakdown of the return on capital database. While we have made every effort to correct for differences in the measurement of

The core of our analysis is based on a new cross-country database of returns on physical capital

The variation in mean cross-country returns has been substantial



4. Note that the database of the rates of return on capital extends to the year 2009. However, we focus on the period up to 2008 because the crisis resulted in some sharp fluctuations in capital flows that, while worthy of analysis in their own right, are not the focus of our attention here.

5. Although a detailed analysis of the factors underlying each country’s ROC is beyond the scope of this paper, it is worth making the general point that, when ROCs are high, it is not always for ‘good’ reasons. In Italy, for example, there is evidence that ROCs have generally been high due to monopoly power and a lack of competition.

Table 1: Summary results for the return on capital (r^K), 1981-2008

	(Arith) Mean return	Diff. with Global (Mean)	Rank of Col 1 (High to Low)	Mean return (US Dollar) ¹	Correlation coeff. Ri- Rus, ExRate ²	Standard deviation of returns	Rank of Col 6 (Low to High)
US	10.4	-0.6	3	10.4	NA	2.4	3
Japan	12.1	1.1	6	15.5	0.13	3.5	7
Germany	9.0	-2.0	10	10.7	0.43	2.9	5
China	12.0	1.0	7	7.2	0.15	6.2	12
UK	12.5	1.5	4	12.0	0.14	3.9	9
France	8.5	-2.5	11	8.9	0.41	2.8	4
Italy	12.2	1.3	5	11.4	-0.20	1.7	1
Canada	11.0	0.1	8	11.5	0.16	3.9	8
Spain	8.1	-2.8	12	7.2	-0.05	2.2	2
Korea	17.0	6.1	3	15.5	-0.22	4.5	10
Brazil	17.2	6.3	2	6.5	-0.26	3.3	6
India	21.8	10.9	1	16.1	0.12	5.1	11
Whole sample	11.0				0.07	1.8	

Notes: ¹ US dollar returns for Brazil averaged over 1994-2008 only. ² Column 5 displays the pair wise correlations between the own-country rate of return relative to the US and the annual change in the real exchange rate versus the US from 1981 and 2008. Source: GS Global ECS Research

the return on capital across countries, there remains the potential for mis-measurement of the ROC *levels* (but less so for the sequential changes). In our statistical analysis later, we therefore account for the possibility that the ROC levels may be mis-measured.

- **Exchange rate changes matter but have not smoothed out the cross-country returns:** Exchange rate fluctuations matter for investors, with interest rate parity implying convergence in (ex-ante) rates of return only once expected exchange rate fluctuations are also taken into account. In Column 4 of Table 1, we set out average US-Dollar-denominated returns from 1981 to 2008 and, in Figure 3, we also compare mean returns in both local currency and US-Dollar terms. The currency denomination creates important differences in some cases over the 28-year period: Japanese returns have been significantly higher in US-Dollar terms than in local-currency terms, for instance, while Brazilian returns have been significantly lower. However, the difference in mean returns across countries (as measured by the cross-sectional standard deviation) is even higher in US-Dollar terms than in local-currency terms. Moreover, long-run exchange rate moves appear to be unrelated to rate of return differentials.

- **The cross-country differences in rates of return cannot be explained by differences in risk:** In Column 6 of Table 1, we display the volatility of returns as measured by their standard deviation over the sample.⁶ Figure 5 plots the mean results for r^K against their respective standard deviations. A positive relation exists between the mean and the volatility of returns, as theory would imply, but the relation is not strong (the R-squared is 0.28). Moreover, if exchange rate effects are also taken into account, the positive relation between mean and standard deviation disappears entirely. Nor do these differences appear to be due to cross-country variation in property rights: one of the advantages of using a return on capital measure based on reported profits (rather than 'top-down' estimates of the profits share) is that it is more likely to reflect the true return available to investors (because appropriated profits, by their nature, are unlikely to be reported in the national accounts).

In our statistical analysis we account for the possibility that the ROC levels may be mis-measured

The cross-country differences in rates of return cannot be explained by differences in risk

6. In most models of risk (such as the standard representative-agent asset-pricing model with constant-relative risk aversion (CRRA) preferences), the risk premium for an asset depends on the covariance of the asset's returns with the marginal utility of consumption (Lucas (1978)). But such a comparison is beyond the scope of this paper.

Box 1: A Cross-Country Database of the Return on Physical Capital

Using national accounts data, we have derived a database of the return on physical capital, r_t^K . The database, which is described in detail in Daly (2010), has the following main attributes: (i) It is comparable across economies; (ii) it covers the 12 largest economies in the world and more than three-quarters of the world's economy; and (iii) it covers more than a quarter of a century in every case (1981-2009), with significantly earlier starting dates for some economies. The economies covered in decreasing order of size are: the United States, Japan, Germany, China, UK, France, Italy, Canada, Spain, South Korea, Brazil and India.

Although previous studies have calculated the return on capital for individual countries or small groups of countries, there is little or no pre-existing work in deriving comparable rates of return for all of the major economies. Given a broad and comparable dataset, we can combine individual country ROC results into an estimate of the global ROC for the first time.

We have taken a number of steps to ensure comparability of the ROC measures across countries. For instance, we focus on non-financial corporations where the measurement of profits and capital stocks is most accurate and we have adjusted for differences in the treatment of imputed labour income of the self-employed across countries.

The ROC measures calculated are based on data sourced directly from the 12 national statistical agencies. Where official capital stock measures are not available, we have constructed our own estimates using data on investment flows, real investment prices and depreciation.

The return on capital measure, r_t^K , that we estimate is composed of yield on capital (net of depreciation but gross of corporate income taxes) and the capital gain, and it takes the following structure:

$$r_t^K = \frac{\Pi_t}{P_{t-1}^K K_{t-1}} + \left(\frac{P_t^K P_{t-1}^C}{P_{t-1}^K P_t^C} - 1 \right) \quad (1)$$

where r_t^K is the return on capital in period t , $\frac{\Pi_t}{P_{t-1}^K K_{t-1}}$ is the operating surplus net of depreciation in period t expressed as a ratio of the nominal net capital stock at the end of period $t-1$, $P_{t-1}^K K_{t-1}$, which is given by the product of the real capital stock, K_{t-1} , and the capital stock (at replacement cost) deflator, P_{t-1}^K . P_t^C is the household consumption deflator at time t . The first term in the RHS of equation (1) represents the net yield on capital, while the second term represents the real capital gain (loss) from holding a representative piece of capital from the start to the end of period t . r_t^K is expressed in percentage terms.

To understand why the calculation takes this form, consider a representative household in period $t-1$ facing the choice of consuming $P_{t-1}^K K_{t-1}$ or investing it in period t . If the household chooses to invest, it forgoes the consumption of $P_{t-1}^K K_{t-1}$. But the ex-post, additional return from doing so is given by $\frac{\Pi_t}{P_{t-1}^K K_{t-1}}$, the profits in period t as a fraction of the capital invested in period $t-1$, plus $\frac{P_t^K P_{t-1}^C}{P_{t-1}^K P_t^C} - 1$, the fractional change in real capital prices during the period t (as measured by the capital stock deflator deflated by the household consumption deflator). Moving the decision on by one period, the sum that the representative household can choose to invest or consume at the end of period t is then given by $(1 + r_t^K) P_{t-1}^K K_{t-1}$, while the sum at the end of period $t+1$ is given by $1 + r_{t+1}^K ((1 + r_t^K) P_{t-1}^K K_{t-1})$ and so forth.

Previous studies that have compared the return on capital across countries have typically ignored the capital gain element of the return on capital calculation, reporting instead the yield on capital as being the 'return on capital'. One important innovation of this database is that we have combined the yield and the capital gain (loss) to report correctly the national-accounts-based return on capital data.

cont' Box 1: A Cross-Country Database of the Return on Physical Capital

The national accounts inputs are inserted into this structure broadly as follows. The net yield on capital is given by:

$$\frac{\Pi_t}{P_{t-1}^K K_{t-1}} = \frac{NetOperatingSurplus_t^{PNFC}}{NomCapital_{t-1}^{PNFC}}$$

$$= \frac{(GVA_t^{PNFC} - L_t^{PNFC} - TP_t^{PNFC} - Kcons_t^{PNFC})}{NomCapital_{t-1}^{PNFC}} \quad (2)$$

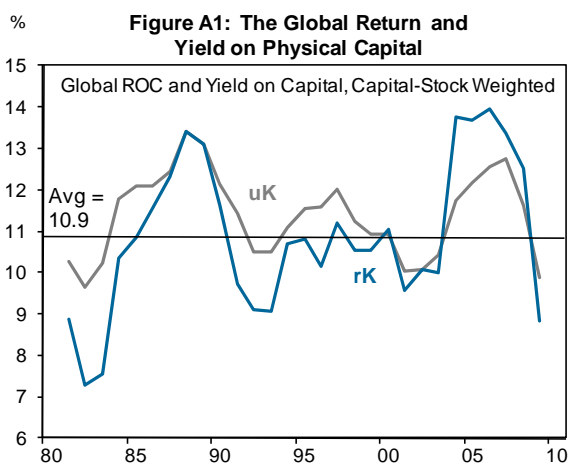
Where GVA = Gross Value Added or total resources, L = total compensation of employees, TP = taxes (less subsidies) on production, and $Kcons$ = capital consumption. The capital stock measure includes all physical, reproducible capital. The measure is net of past depreciation and is calculated at replacement cost. The real capital gain (loss) is calculated using the deflators

for the capital stock and household consumption deflator, as discussed previously.

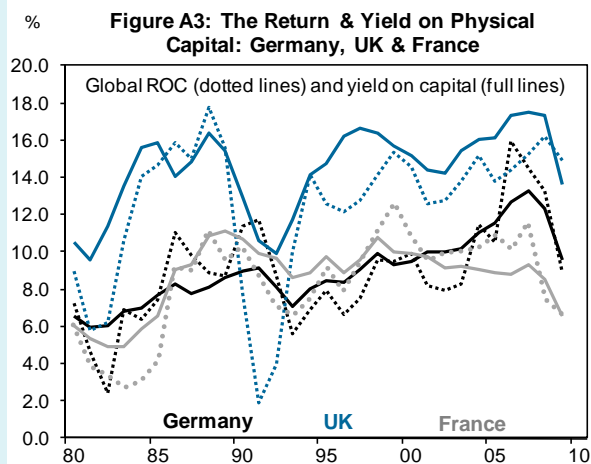
We also calculate a second return on capital measure, $r2_t^K$, that is net of corporation taxes (this is a useful addition because one would expect the convergence of post-tax returns rather than gross returns). This return on capital measure is equivalent to $r2_t^K$ but the post-tax yield on capital ($u2_t^K$) is given by:

$$u2_t^K = (1 - \tau_t)u_t = \frac{(GVA_t^{PNFC} - L_t^{PNFC} - TP_t^{PNFC} - Kcons_t^{PNFC} - Tcorp_t^{PNFC})}{Capital_{t-1}^{PNFC}} \quad (3)$$

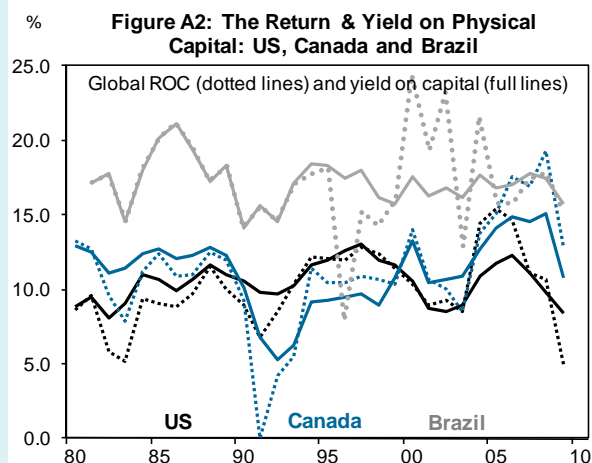
Figure A1 displays the global return and yield on capital measures for the world, while Figures A2-A4 provide breakdowns for America, Europe and Asia.



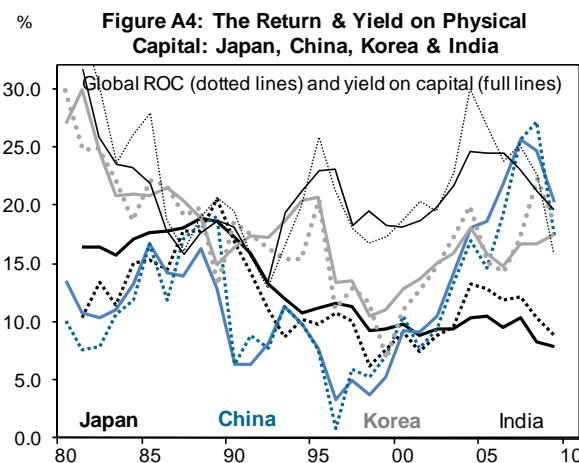
Source: GS Global ECS based on nat accts data



Source: GS Global ECS based on nat accts data



Source: GS Global ECS based on nat accts data



Source: GS Global ECS based on nat accts data

- **Rates of return began to converge in the 1980s but diverged again in the 2000s:** Figure 6 displays the cross-sectional standard deviations of both the yield on capital and the rate of return on capital—known as sigma convergence—from 1981 to 2009. There appears to have been considerable sigma convergence during the 1980s but, from the early 2000s, this trend went into reverse. This reversal coincided with the emergence of the ‘savings glut’ (with ‘uphill’ capital flows from large emerging markets with relatively high returns to advanced economies with relatively low returns) and with an increase in the global equity risk premium. In previous research we have argued that these developments are related, see “The Savings Glut, the Return on Capital and the Rise in Risk Aversion”, *Global Economics Paper* No. 185, May 2009.

Rates of return began to converge in the 1980s but diverged again in the 2000s

Rates of Return are Higher in Low-income, Fast-Growing Economies

Table 2 displays the results of a series of panel-data estimations of the relation between the return on capital, r^K , and a selection of explanatory variables. We find that:

- **Rates of return on capital are higher in rapidly-growing economies—strong growth boosts profitability.** Regression 2.1 suggests that there is a strong positive relation between the return on capital (r^K) and annual real GDP growth, with every one-percent rise in long-term growth boosting the ROC by 1.4ppt. This effect appears to operate via GDP per capita rather than population growth: Regression 2.2 implies a strong positive relation between ROCs and GDP per capita growth rates but none with population growth.
- **The return on capital is typically higher in poor countries.** Regression 2.3 implies a strong negative relation between the return on capital and the level of GDP per capita. Every 10ppt convergence with US GDP per capita has, all else equal, historically reduced the return on capital by close to one percent. Regression 2.4, meanwhile, suggests that there are no decreasing marginal returns to capital at a whole-economy level.
- The last two regressions include each of the variables to see how they interact, using both annual data (2.5) and five-year averages (2.6). GDP per capita *growth* appears more important in the regression using annual data (reflecting the importance of the cycle at this frequency) but the negative relation between *level* of GDP per capita and the ROC is more important using 5-year averages.

Rates of return on capital are higher in rapidly-growing economies and in poor economies

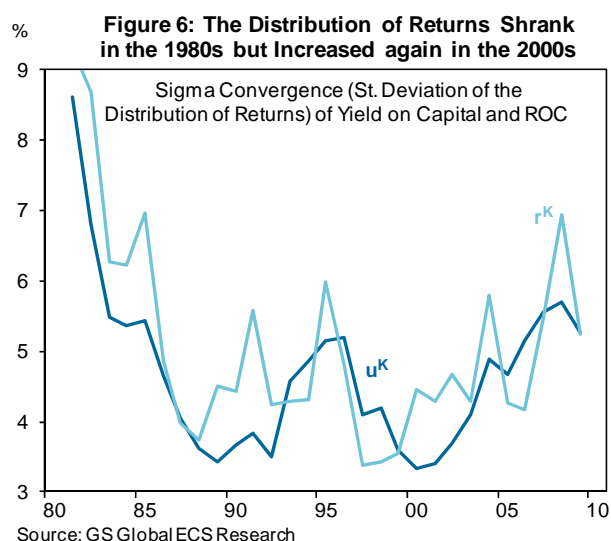
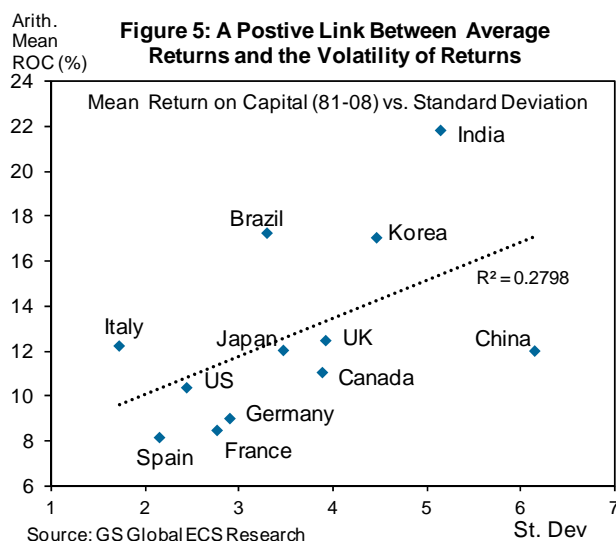


Table 2: Panel least squares regression results for return on capital

Dependent variable is ROC, 1981-2008

	(1)	(2)	(3)	(4)	(5)	(6)
Constant	1.74 (4.51)***	1.73 (4.49)***	3.9 (5.82)***	3.3 (3.31)***	3.8 (1.75)*	17.6 (2.90)***
ROC(-1)	0.77 (26.93)***	0.77 (24.16)***	0.78 (23.38)***	0.73 (15.28)***	0.74 (14.59)***	0.38 (2.25)
GDP growth (%yoy)	0.32 (6.63)***					
GDP per capita growth		0.32 (6.46)***			0.28 (3.70)***	-0.32 (-1.13)
Population growth		0.36 (1.37)			0.08 (0.19)	-0.84 (-0.81)
GDP per cap LEVEL			-0.02 (-3.05)***		-0.01 (-0.44)	-0.06 (-1.88)*
Capital-to- output ratio				0.00 (-0.07)	0.00 (-1.05)	-0.03 (-1.79)*
Adj R2	0.74	0.74	0.72	0.54	0.57	0.28
Frequency	Annual	Annual	Annual	Annual	Annual	5-year
N	324	324	324	203	203	40
DW	2.08	2.07	2.09	2.18	2.12	2.50

Notes: Total panel (balanced) observations before adjustments = 336, with the exception of (6) which is based on 5-year averages (from 1981 to 2008) and has a total panel before adjustments of 72 observations. T-statistics in parentheses. ***, **, * denote significance at the 1, 5 and 10 percent levels respectively. DW stands for Durbin-Watson statistic. Source: GS Global ECS Research

Capital Flows do Not Respond to Differences in Rates of Return

Economic theory implies that capital flows should respond to differences in rates of return, with countries with relatively low rates of return exporting capital to countries with relatively high rates of return. In Figure 2, we plotted the mean difference between country i 's rate of return and the global rate of return (based on the r^K measure for the years 1981-2008) against the average capital inflow (expressed as a percentage of GDP). Based on average data, there is no relation (either positive or negative), in contrast to the standard theoretical prediction.

The regressions set out in Table 3 explore the relation between capital inflows and relative rates of return more formally:

- **Capital does not flow to countries where returns are highest.** Regression 3.1 implies no relation between aggregate capital inflows (the negative of the current account balance) on the difference between the return on capital in country i and the global return on capital. Indeed, the coefficient has been negative (but not significant). Regression 3.3 carries out the same regression but using post-tax rather than pre-tax rates of returns, with similar results. The absence of a significant relation is robust to different lag structures in the rate of return differential and across time (splitting the 1981-2008 sample into two 14-year periods, we find no significant relation in either period). Separately, we find that return differentials do not 'cause' capital flows but that capital flows appear to 'cause' differences in rates of return (i.e., the existent of 'uphill' capital flows appears to perpetuate differences in rates of return).⁷

Capital does not flow to countries where returns are highest

7. In a Granger-Causality test (with two lags included), we cannot reject the hypothesis that rates of return differentials do not Granger-cause capital flows, but we do reject the hypothesis that capital flows do not Granger-cause rates of return differentials (at a 1% level of significance), suggesting that Granger causality runs from capital flows to rates of return differentials.

- **Private-sector capital flows (i.e., excluding reserve accumulation) also appear to be largely unresponsive to return differentials.** In the past year and a half, private sector capital flows into EM economies have increased significantly, offset by public sector reserve accumulation (a development we have highlighted in our FX research—see “The ‘Wall of Money’ to EM”, *FX Monthly Analyst*, October 2010). In general, however, we find that private sector capital flows have not been ‘return chasing’. Regressions 3.3-3.5 focus on the subcomponents of capital flows—foreign direct investment, net equity investment and net bond investment—where theory provides the strongest a priori expectation of a systematic response to return differentials. In each case the coefficient is positive—as theory would predict—but is not significant.

Private-sector capital flows (i.e., excluding reserve accumulation) also appear to be largely unresponsive to return differentials

- **The failure of capital to flow to where returns are highest is not due to mis-measurement of ROC levels.** Although we have taken care to ensure the cross-country comparability of our ROC measures, some scope for mis-measurement will always remain, particularly when comparing ROC levels. To account for the possibility of mis-measurement, Regression 6.5 repeats 6.2 but allows for country-specific fixed country effects. The results are very similar, implying that capital flows do not respond to relative increases in the return on capital over time. We have also run fixed-effect regressions for the other formulations with similar outcomes (results not shown).
- To preclude the possibility that our results are being distorted by cyclical effects, in Regression 3.6 we repeat Regression 3.2 using five-year averages. On this basis, we find a significant *negative* relation between capital flows and rates of return (i.e., countries with high returns typically *export* capital).

Countries with high returns have typically exported capital

Table 3: Panel least squares regression results for capital flows response (1981-2008)

Dependent variable	(1) Capital Inflow % GDP ¹	(2) Capital Inflow % GDP ¹	(3) Net FDI % GDP	(4) Net Equity % GDP	(5) Net Debt % GDP	(6) Capital Inflow % GDP ¹	(7) Capital Inflow % GDP ¹
Constant	0.00 (0.04)	0.01 (0.16)	-0.07 (-0.81)	-0.06 (-0.59)	0.52 (2.94)***	0.05 (0.58)	0.14 (0.41)
Lagged dependent variable	0.89 (30.31)***	0.89 (30.25)***	0.65 (14.68)***	0.37 (6.06)***	0.39 (6.59)***	0.79 (21.86)***	0.81 (5.51)***
($r^k_i - r^k_w$)	-0.01 (-0.64)						
($r^{2k}_i - r^{2k}_w$)		-0.02 (-1.00)	0.01 (0.42)	0.00 (0.02)	0.02 (0.32)	-0.03 (-0.93)	-0.19 (-2.12)**
Adj R2	0.74	0.74	0.41	0.12	0.14	0.75	0.39
Frequency	Annual	Annual	Annual	Annual	Annual	Ann/Fixed Effts	5-year
N	323	323	313	249	265	323	60
DW	1.64	1.64	2.04	2.06	2.13	1.61	1.92

Notes: Baseline total panel (balanced) observations before adjustments = 336, with the exception of (6) which is based on 5-year averages (from 1981 to 2005) and has a total panel of 50 observations. T-statistics in parentheses. ***, **, * denote significance at the 1, 5 and 10 percent levels respectively. DW stands for Durbin-Watson statistic. ¹ In order to make the interpretation of coefficients consistent across each of the regressions in Table 5, we use capital inflows (the negative of the current account balance) as the dependent variable.

Source: GS Global ECS Research

Net Long-Term Capital Flows are Driven by Inter-Generational Savings Dynamics and Demographics

Net capital flows are the difference between savings and investment and, in the standard theoretical model, cross-country differences in the rate of return determines the equilibrium between the two. But one can identify a number of alternative factors—i.e., other than differences in rates of return—that could be driving cross-country capital flows and overriding the incentive to invest where returns are highest.

These include:

- **Cross-country demographic differences:** In *GS Global Economics Paper* No. 202 (August 12, 2010), we found that demographic differences are an important driver of cross-country capital flows, as economies where a relatively high proportion of the population are of working age tend to save more than those with a high dependency ratio.
- **Higher trend growth may boost net saving.** Rapid growth could increase the aggregate level of saving in an economy if the savings of the (relatively rich) young cohorts is greater than the dissaving of (relatively poor) old cohorts, leading to higher net saving in rapidly-growing poor economies than in slow-growing rich economies. Mankiw, Romer and Weil (1992) have shown that savings ratios are positively correlated with growth, while Prasad, Rajan and Subramanian (2007) and Gourinchas and Jeanne (2008) find a negative correlation between capital inflows and growth.
- **Differences in financial development:** Caballero, Farhi and Gourinchas (2008a, 2008b) suggest that low levels of financial development in emerging economies lead emerging market investors to seek more trustworthy savings vehicles in the mature financial markets of the developed world, while Mendoza, Quadrini and Rios-Rull (2007) argue that low levels of financial development have a direct impact on savings behaviour.
- **Cross-country differences in the degree of risk aversion:** Cross-country differences in the degree of risk aversion could result in higher levels of precautionary saving in some economies than in others. Blanchard and Giavazzi (2005) argue that high household saving rates in China and other emerging economies reflect a high level of individual risk, related to health costs, retirement and the financing of education.

The first three factors can be measured directly and thus lend themselves to empirical analysis. As a measure of demographic cross-country heterogeneity, we use the difference between the working age population (15-65) as a share of the total population in country *i* relative to the (GDP-weighted) global average of the same ratio. To gauge the effect of growth on capital flows, we use a (Hodrick-Precott) trend of GDP per capita growth relative to the global equivalent. We use trend growth rather than annual growth in order to reduce the effect of domestic demand fluctuations on both growth and the current account. For financial development, we follow Mendoza et al (2007) in using the difference in the ratio of private-sector lending to GDP in country *i* relative to the global average. The fourth factor—cross-country heterogeneity in risk aversion—is not one that lends itself to easy statistical analysis (because there are no independent, cross-country measures of risk aversion).

In Table 4 we present panel-data analysis of the relation between capital inflows and each of these variables. Our findings suggest that:

- **Countries exhibit capital outflows when the working age population is relatively high.** Regression 4.1 suggests that there are net capital outflows when a relatively high proportion of the population is of working age but the coefficient just fails to be significant at the 10% threshold.

Other factors could be driving capital flows: demographic differences, the interaction between growth and savings dynamics, differences in financial development and differences in risk aversion

Countries exhibit capital outflows when the working age population is relatively high

We find a strong relationship between net outflows and high trend growth

Table 4: Panel least squares regression results for capital flows response (1981-2008)

Dependent variable	(1) Capital Inflow % GDP	(2) Capital Inflow % GDP	(3) Capital Inflow % GDP	(4) Capital Inflow % GDP	(5) Capital Inflow % GDP	(6) Capital Inflow % GDP
Constant	-0.08 (-0.79)	0.02 (0.17)	-0.06 (-0.57)	-0.01 (-0.06)	-0.02 (-0.26)	0.12 (0.37)
Lagged dependent variable	0.88 (23.18)***	0.88 (26.56)***	0.90 (25.37)***	0.89 (22.72)***	0.87 (22.61)***	0.73 (4.61)***
Demographics	-0.08 (-1.55)			-0.05 (0.95)	-0.07 (1.30)	-0.06 (-0.48)
Trend GDP Per Capita Growth		-0.10 (-2.14)**		-0.08 (1.65)*	-0.08 (1.86)*	-0.34 (2.57)***
Financial Development ($r2^k_i - r2^k_w$)			0.00 (-0.01)	0.00 (-0.36)		
				0.00 (-0.10)		
Adj R2	0.72	0.75	0.71	0.73	0.72	0.40
Frequency	Annual	Annual	Annual	Annual	Annual	5-year
N	259	259	259	259	259	60
DW	1.64	1.67	1.66	1.68	1.64	1.81

Notes: Total panel (balanced) observations before adjustments = 336, with the exception of (6) which is based on 5-year averages (from 1981 to 2005) and has a total panel of 50 observations. T-statistics in parentheses. ***, **, * denote significance at the 1, 5 and 10 percent levels respectively. 'Demographics' is the difference between the working age ratio in country i and the global working age ratio. 'Trend GDP pc growth' is the difference between the Hodrick-Precott trend of GDP pc growth and the global equivalent. Financial development is the difference in the ratio of private sector lending to GDP in country i relative to the global average. DW stands for Durbin-Watson statistic. Source: GS Global ECS Research

■ **There is a strong relationship between net outflows and high trend growth.** The size of the coefficient in Regression 4.2 suggests that every one-percent difference in trend growth is matched one-for-one by a 1%-of-GDP increase in capital outflows in the long run.

■ **There is no discernable link between capital flows and our measure of financial development** (Regression 4.3).

■ Regressions 4.4-4.7 explore how each of these variables interact when included together, based on annual data and five-year averages. In each case we find strong evidence that higher trend per capita growth results in capital outflows and weak evidence that a relatively high working age ratio results in capital outflows.

There is no discernable link between capital flows and our measure of financial development

To summarise the results of this section, we find that aggregate net capital flows do *not* respond to cross-country differences in rates of return. Rather than being 'return chasing', long-term net capital flows appear to be largely dictated by internal savings and investment dynamics (which, in turn, are driven by inter-generational savings dynamics and demographics).

Section 3: Conclusions and Investment Implications

The Lucas Paradox (1990), “Why doesn’t capital flow from rich to poor countries?”, can be split into two distinct questions: “Are rates of return higher in poor countries?” and “Do capital flows systematically respond to differences in the rates of return?”. Our results imply a ‘yes’ in response to the first of these questions and a clear ‘no’ to the second question:

- We find that differences in rates of return on capital have been substantial and predictable, and that rate of return differentials are positively related to *growth* in GDP per capita and negatively related to relative *levels* of GDP per capita.
- We find no systematic or consistent relation between rates of return and capital flows, either across countries or across time. Within the breakdown of the capital and financial accounts, we also find that net FDI inflows, net equity investment and net bond investment have been largely unresponsive to return differentials.

At the end of the previous section, we discussed some alternative explanations of the Lucas paradox, including demographic differences, the interaction between savings behaviour and economic growth, and variation in the degree of financial development. We find strong evidence that higher trend growth results in capital outflows and some evidence that demographic differences also play a role.

High net saving in fast-growing economies—irrespective of whether the causation flows from savings to growth or growth to savings—runs strongly counter to the predictions of standard economics and finance theory.

Investment Implications: Non-‘Return Chasing’ Flows Perpetuate Return Differentials

In a world without perfect capital mobility, ‘uphill’ capital flows from fast-growing, high-return economies to slow-growing, low-return economies contribute to and perpetuate the existence of cross-country return differentials. If capital were flowing in the ‘right’ direction, these flows would tend to smooth out return differentials over time.

The key insight for investors is that, with capital flows being driven by factors that—although rational from the perspective of the saver—are unrelated to return differentials, the opportunities for ‘unconstrained’ investors (i.e., those who are in a position to take the other side of those flows) to invest where returns are highest are *likely* to be greater.

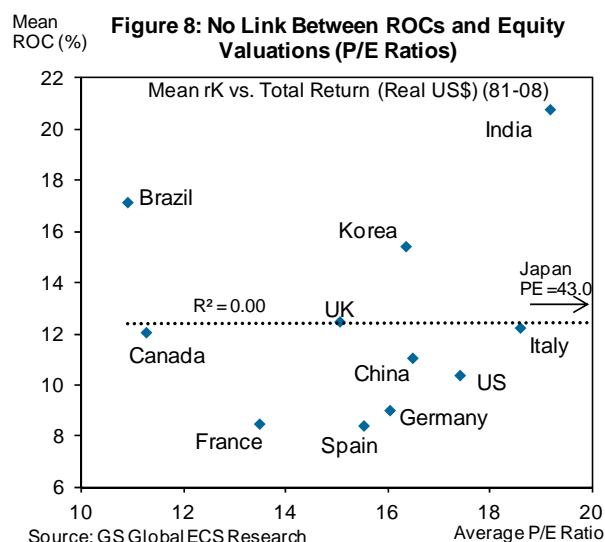
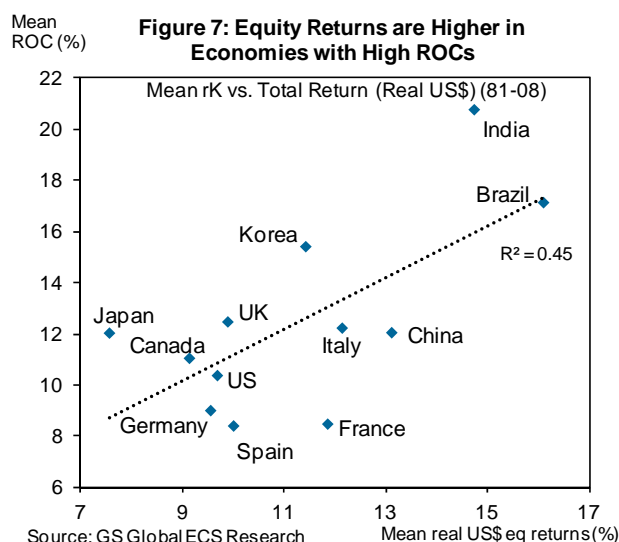
We emphasise ‘likely’ to be greater because one can still overpay for the underlying assets that produce relatively high returns. Focusing on the example of stock market investment, if it is the case that relatively high returns on physical capital are indicative of high prospective stock market returns, then the following two statements should also be true:

- **There is a link between returns on physical capital and stock market returns.** Figure 7 displays the average return on capital against average total equity returns (measured in real US\$). Just under half of the variability in average stock market returns is explained by rate of return differentials. Equity returns are much more volatile than the return on physical capital so the link on a year-to-year basis is less strong. Nevertheless, in a panel data regression using annual data, the return on capital is a significant predictor of absolute real equity returns and the difference between the return on capital in an individual country and the global rate of return on capital is also a significant predictor of the relative real equity returns.⁸

Rate of return differentials are positively related to growth in GDP per capita and negatively related to relative levels of GDP per capita

We find no systematic or consistent relation between rates of return and capital flows

In a world without perfect capital mobility, ‘uphill’ capital flows contribute to and perpetuate the existence of cross-country return differentials



- **Rate of return differentials are not already reflected in stock market valuations.** Figure 8 displays the average return on capital against the average price-to-earnings ratio for each country. Historically, there has not been a link between relatively high rates of return on capital and stock market valuations (the R-squared—the amount of variation in average P/E ratios that can be explained by the ROC—is zero). If one excludes Japan (whose average P/E ratio has been exceptionally high and may, therefore, be distorting the result), the R-squared is still only 0.02 using average data. In a panel data regression using annual data there is no significant relationship between P/E ratios and the return on capital, nor is there one between relative P/E ratios and return differentials.⁹

There is a link between returns on physical capital and stock market returns

In past research we have found that P/E ratios (and other common equity valuation metrics) are useful predictors of medium-term equity returns (see “Finding ‘Fair Value’ in Global Equities: Part II—Forecasting Returns”, *Global Economics Paper* No. 182, March 23, 2009). If we take account of differences in P/E ratios, does the return on physical capital remain a significant predictor of stock market returns? It appears that it does. In a joint regression, both the P/E ratio and return on capital differential are significant predictors of equity returns.

The analysis of the investment implications of high ROCs is only tentative at this stage and, in future research, we intend to delve more deeply into the relationship between the return on capital and equity returns. One issue is that the higher returns from EM markets may simply be compensating for the risk of significant events that occur infrequently. This is the so-called ‘Peso problem’ (see, for instance, Rietz (1988)), presented by differences in returns that appear unjustified over the duration of the sample but only because the risk insured against does not occur within the sample. Looking forward, if the ‘Peso problem’ explains the high EM returns of the past, the financial crisis may have nullified the logic for such a premium (because EM assets provided protection against a crisis that primarily affected advanced economies).

The findings set out in this paper provide a new perspective on the opportunities presented by the BRICs economies

We have emphasised the opportunities that the BRICs and other EM economies present for both portfolio and direct investment in previous research. The findings set out in this paper provide a new perspective on those opportunities, as it suggests a mechanism whereby (risk-adjusted) return differentials can and do persist.

8. Where the data are available, the sample for these regressions runs from 1981 to 2008. The main exceptions are China (where we have market returns data from 1994), Brazil (1995) and India (1991).

9. In the standard ‘neo-classical’ economics model, the ‘q ratio’ (the market value of capital/the replacement cost of capital) should be relatively high in countries where the return on capital is high—due to equity valuations discounting higher returns—and it is this market signal that encourages investment flows into countries with high ROCs. However, given that investment *hasn’t* flowed into countries with high ROCs, we do not find it surprising that q ratios do not appear to have been higher in these countries either.

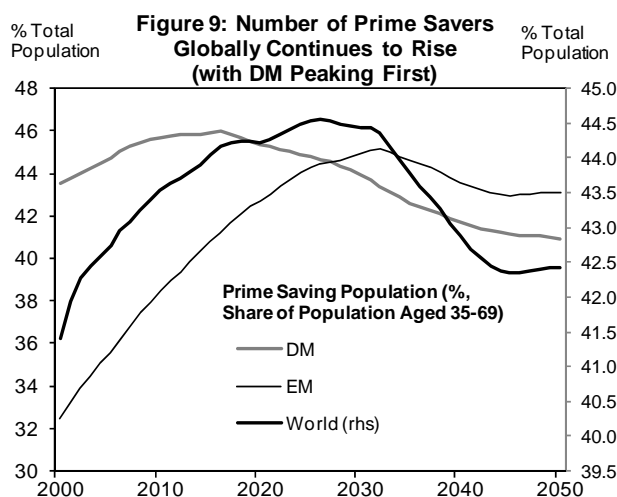
The Savings Glut and the High Global Equity Risk Premium

There is a large body of opinion that the macro imbalances we have outlined in this paper also played an important part in the formation of the financial crisis. According to this account, excessive saving in the emerging world held down real interest rates and facilitated a boom in credit. In previous research, we showed that the global economy was also characterised by rising returns on physical capital and increased equity risk premia in the years preceding the crisis, two features that the standard imbalances (or ‘savings glut’) story cannot easily account for. We argued that this was due to the skew in emerging market saving towards fixed income rather than equity investments (see “The Savings Glut, the Return on Capital and the Rise in Risk Aversion”, *Global Economics Paper* No. 185, May 27, 2009).

The integration of large, high-saving emerging markets resulted in (i) an increase in desired saving; (ii) an increase in the global effective labour supply (boosting the return on capital); and (iii) a rise in the ‘effective’ equity risk premium across the world. Given the ongoing rapid emergence of large EM countries and given that many EM countries have a high proportion of their populations in prime savings age, the structural factors underlying the ‘savings glut’ look likely to remain in place for some time (Figure 9, which is taken from *Global Paper* No. 202, illustrates this point).

This will make it more difficult to engineer a fundamental reversal of global imbalances—something we also argued in a recent *Global Economics Weekly* (“Seoul Food: The Search for Global Balance”, November 3, 2010). It also implies that the global ERP may remain elevated for some time (implying relatively high equity returns but not the super-high returns that would result from a period of prolonged ERP reduction).

Given the ongoing rapid emergence of large EM countries and that many EM countries have a high proportion of their populations in prime savings age, the structural factors underlying the ‘savings glut’ look likely to remain in place for some time



Bibliography

Blanchard, O., and F., Giavazzi, 2005, “Rebalancing Growth in China: A Three-Handed Approach”, *M.I.T. Department of Economics Working Paper Series*, Working Paper 05-32 November 25, 2005

Daly, K., 2010, “The Global Return on Capital, the Lucas paradox and the Savings Glut”, *PhD Dissertation*, Trinity College, Dublin

Daly, K. and B. Broadbent, 2009, “The Savings Glut, the Return on Capital and the Rise in Risk Aversion”, *Global Economics Paper* No. 185, May 27

Feldstein, M. and C. Horioka, 1980, “Domestic Saving and International Capital Flows”, *Economic Journal* 90: 314-329

French, K. and J. Poterba, 1991, “Investor Diversification and International Equity Markets”, *American Economic Review* 81, 222-226

Gertler, M., and K. Rogoff, 1990, “North-South Lending and Endogenous Domestic Capital Market Inefficiencies”, *Journal of Monetary Economics* 26, 245-66

Gourinchas, P. O., and O. Jeanne, 2008, “Capital Flows to Developing Countries: The Allocation Puzzle”, *NBER Working Paper* 13602

Goldman Sachs FX Monthly Analyst, “The ‘Wall of Money’ to EM”, October 2010

Lucas, R., 1978, “Asset Prices in an Exchange Economy”, *Econometrica*, Vol. 46, No. 6, 1429-1445

Lucas, R., 1990, “Why Doesn’t Capital Flow from Rich to Poor Countries?”, *American Economic Review*, 80: 92–96

Mankiw, G. N., Romer, D., and D. Weil, 1992, “A Contribution to the Empirics of Economic Growth,” *Quarterly Journal of Economics*, 107 (2), 407-38

Mendoza, E., Quadrini, V., and J-V Rios-Rull, 2007, “Financial Integration, Financial Deepness and Global Imbalances”, *NBER Working Paper* No. 12909, February 2007

Prasad, E., Rajan, R. and A. Subramanian, 2007, “Foreign Capital and Growth”, *NBER Working Papers*, No. 13619

Oppenheimer, P., Nielsen, A., and K. Daly, 2009, “Finding ‘Fair Value’ in Global Equities: Part II—Forecasting Returns”, *Global Economics Paper* No. 182, March 23

Rietz, T.A., 1988, “The Equity Risk Premium: A Solution,” *Journal of Monetary Economics*, 22, 117-131

Wilson, D. and S. Ahmed, 2010, “Current Accounts and Demographics: The Road Ahead”, *Global Economics Paper* No. 202, August 12

Wilson, D., Carlson, S., and R. Brooks, 2010, “Seoul Food: The Search for Global Balance”, *Global Economics Weekly*, November 3

GOLDMAN SACHS GLOBAL RESEARCH CENTRES

New York

Goldman Sachs & Co.
200 West Street, 4th Floor
New York, New York 10282, USA
Tel: +1 212 855 0346

Washington

Goldman Sachs & Co.
101 Constitution Ave, NW
Suite 1000 East
Washington, DC 20001
Tel: +1 202 637 3700

London

Goldman Sachs International
Peterborough Court
133 Fleet Street
London, EC4A 2BB, England
Tel: +44 (0)20 7774 1000

Frankfurt

Goldman Sachs & Co. oHG
MesseTurm
D-60308 Frankfurt am Main,
Germany
Tel: +49 (0)69 7532 1000

Moscow

Goldman Sachs OOO
14th floor, Ducat III
6, Gasheka Street
Moscow 125047
Russian Federation
Tel: +7-495-645-4000

Paris

Goldman Sachs Inc et Cie
2, rue de Thann
75017 Paris, France
Tel: +33 (0)1 4212 1341

Hong Kong

Goldman Sachs (Asia) L.L.C.
Cheung Kong Center,
68th Floor
2 Queen's Road Central
Hong Kong
Tel: +852 2978 1000

Tokyo

Goldman Sachs Japan Co, Ltd.
Roppongi Hills Mori Tower
47th Floor, 10-1, Roppongi 6-chome
Minato-ku, Tokyo 106-6147, Japan
Tel: +81 (0)3 6437 9960

Singapore

Goldman Sachs (Singapore) Pte.
1 Raffles Link, #07-01 South Lobby,
Singapore 039393
Tel: +65 6889 1000

South Africa

Goldman Sachs International
13th Floor, The Forum
2 Maude Street
Sandton 2196
South Africa
Tel: 27-11-303-2700

I, Kevin Daly, hereby certify that all of the views expressed in this report accurately reflect personal views, which have not been influenced by considerations of the firm's business or client relationships.

Global product; distributing entities

The Global Investment Research Division of Goldman Sachs produces and distributes research products for clients of Goldman Sachs, and pursuant to certain contractual arrangements, on a global basis. Analysts based in Goldman Sachs offices around the world produce equity research on industries and companies, and research on macroeconomics, currencies, commodities and portfolio strategy. This research is disseminated in Australia by Goldman Sachs & Partners Australia Pty Ltd (ABN 21 006 797 897) on behalf of Goldman Sachs; in Canada by Goldman Sachs & Co. regarding Canadian equities and by Goldman Sachs & Co. (all other research); in Hong Kong by Goldman Sachs (Asia) L.L.C.; in India by Goldman Sachs (India) Securities Private Ltd.; in Japan by Goldman Sachs Japan Co., Ltd.; in the Republic of Korea by Goldman Sachs (Asia) L.L.C., Seoul Branch; in New Zealand by Goldman Sachs & Partners New Zealand Limited on behalf of Goldman Sachs; in Russia by OOO Goldman Sachs; in Singapore by Goldman Sachs (Singapore) Pte. (Company Number: 198602165W); and in the United States of America by Goldman Sachs & Co. Goldman Sachs International has approved this research in connection with its distribution in the United Kingdom and European Union.

European Union: Goldman Sachs International, authorized and regulated by the Financial Services Authority, has approved this research in connection with its distribution in the European Union and United Kingdom; Goldman Sachs & Co. oHG, regulated by the Bundesanstalt für Finanzdienstleistungsaufsicht, may also distribute research in Germany.

General disclosures

This research is for our clients only. Other than disclosures relating to Goldman Sachs, this research is based on current public information that we consider reliable, but we do not represent it is accurate or complete, and it should not be relied on as such. We seek to update our research as appropriate, but various regulations may prevent us from doing so. Other than certain industry reports published on a periodic basis, the large majority of reports are published at irregular intervals as appropriate in the analyst's judgment.

Goldman Sachs conducts a global full-service, integrated investment banking, investment management, and brokerage business. We have investment banking and other business relationships with a substantial percentage of the companies covered by our Global Investment Research Division. **SIPC:** Goldman, Sachs & Co., the United States broker dealer, is a member of SIPC (<http://www.sipc.org>).

Our salespeople, traders, and other professionals may provide oral or written market commentary or trading strategies to our clients and our proprietary trading desks that reflect opinions that are contrary to the opinions expressed in this research. Our asset management area, our proprietary trading desks and investing businesses may make investment decisions that are inconsistent with the recommendations or views expressed in this research.

We and our affiliates, officers, directors, and employees, excluding equity and credit analysts, will from time to time have long or short positions in, act as principal in, and buy or sell, the securities or derivatives, if any, referred to in this research.

This research is not an offer to sell or the solicitation of an offer to buy any security in any jurisdiction where such an offer or solicitation would be illegal. It does not constitute a personal recommendation or take into account the particular investment objectives, financial situations, or needs of individual clients. Clients should consider whether any advice or recommendation in this research is suitable for their particular circumstances and, if appropriate, seek professional advice, including tax advice. The price and value of investments referred to in this research and the income from them may fluctuate. Past performance is not a guide to future performance, future returns are not guaranteed, and a loss of original capital may occur. Fluctuations in exchange rates could have adverse effects on the value or price of, or income derived from, certain investments.

Certain transactions, including those involving futures, options, and other derivatives, give rise to substantial risk and are not suitable for all investors. Investors should review current options disclosure documents which are available from Goldman Sachs sales representatives or at <http://www.theocc.com/publications/risks/riskchap1.jsp>. Transactions cost may be significant in option strategies calling for multiple purchase and sales of options such as spreads. Supporting documentation will be supplied upon request.

All research reports are disseminated and available to all clients simultaneously through electronic publication to our internal client websites. Not all research content is redistributed to our clients or available to third-party aggregators, nor is Goldman Sachs responsible for the redistribution of our research by third party aggregators. For all research available on a particular stock, please contact your sales representative or go to www.360.gs.com.

Disclosure information is also available at <http://www.gs.com/research/hedge.html> or from Research Compliance, 200 West Street, New York, NY 10282.

No part of this material may be (i) copied, photocopied or duplicated in any form by any means or (ii) redistributed without the prior written consent of The Goldman Sachs Group, Inc.

© Copyright 2010, The Goldman Sachs Group, Inc. All Rights Reserved.