Return to Capital: Evidence from firm level data of non-financial firms

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1. Introduction

According to the textbook neoclassical theory, if two countries produce the same good with identical production function, and trade in capital good is free and competitive, new investment will only occur in the poorer country since marginal return to capital should be higher in economies with less capital (due to law of diminishing return). However, as Lucas pointed out in his seminal paper in 1990, observed capital flow from developed to developing countries fall short of what should be seen according to the theory. Why doesnt capital flow from developed to developing countries? Also, on the flip side, why does any capital flow from developing to developed countries?

It should be noted here that there are in fact two parts to this paradox: 1) do developing countries really have higher return to capital?; and 2) if so then what deters capital from flowing? The first questions the premise of the paradox, and the latter asks for solution of the paradox assuming the premise is true. Both questions have generated an extensive literature on international finance.

This paper attempts to examine the first question, i.e. the premise of the Lucas Paradox, by empirically measuring the return-to-capital from the firm level data. Thus far most attempts to address the first question has focused on the country level return as in Lucas (1990) or Caselli and Feyrer (2007). Hsieh and Klenow (2009) uses microdata in manufacturing establishment in China, India, and US to measure misallocation of capital in emerging markets but doesn't measure return to capital within the establishments. Country level data is comprehensive in its coverage of countries and is easily accessible, but it ignores variation in the return within country, which has been documented empirically in various papers (ex: Banerjee, 2004). This paper differs from others in the literature in that it looks at returns from investable firms (typically med- to large- size firms) instead of the entire economy. In the presence of information asymmetry (Portes and Rey, 2005) and the absence of institutional framework (Alfaro, et al, 2005) in emerging markets, self-employed workers and mom & pop store owners are unlikely recipients of international investment, despite the fact that they are major players in the many emerging economies.[1]. Thus sample size restrictions

[1]Gollin (2002) show that as much as $75-80\%$ of manufacturing workers are self employed in Bangladesh

should provide more realistic estimate of the return to capital from international investment in the presence of capital market imperfections.[2]

To analyze the firm-level data, I use modified internal rate of return calculation introduced by Fama and French (1999). In this paper, Fama and French estimated internal rate of return of non-financial firms treating the entire non-financial corporate sector as an investment project. The rate of return is found setting initial market value of the industry equal to the discounted present value of the net cash flows post-entry. This method is not only straightforward and relatively easy to compute, but also make adjustments for survivor bias that is often associated with high returns in emerging countries. To check the robustness of the result, Fama and French complement internal rate of return with time weighted average of annual return. Time weighted average of annual return does not adjust for survivor bias but provides information about the consistency of the returns, as it weighs all years equally. I replicate both results for all countries in the sample as the period of interest (1995-2013) includes both Asian and Global Financial Crisis, which can skew the results.

Advantage of this approach is that it does not require assumptions about depreciation rate or capital share in production. Instead, discounted cash flow (DCF) approach assumes fair valuation of asset by market, which is standard in the finance literature. Under this assumption, capital stock used in the calculation takes into account not only the fixed, reproducible asset, but also non-produced assets(ex:land), and intangibles that are often left out when calculating capital stock from macroeconomic investment series.

In my analysis, I find that inflation adjusted return to capital is in fact higher for developed vs. emerging countries when controlling for survivor bias–this result hold under both discounted cash flow and time weighted return analysis.Although this finding contradicts the implications of the simple economic model, it is consistent with capital flow observation made by Prasad, Rajan and Subramanian (2007). Prasad, et al showed that "not only is capital not flowing from rich to poor countries in quantities the neoclassical model would predict–a paradox pointed by Lucas (1990), but in the last few years, it has been flowing from poor to rich countries". Finding here suggests that the outflow of capital from emerging countries over this period may be justified by the higher average returns of investable firms in developed countries.

Why then does medium-to large-size firms in emerging market have lower return to capital vs. their peers in developed markets? For detailed analysis, I decompose return to capital into two parts: asset turnover[3], and capital share in production. Under the standard

and Nigeria compared to less than 2% in US

[2]If we assume perfect capital mobility within country, return should equilibrate within, and the return from firm level data can be used as a proxy for country wide return. Thus, interpretation of the numbers presented in the paper should defer based on assumptions about the existence of capital market frictions. In this paper, I assume the presence of capital market friction within based on works by Banerjee, 2004, etc.

[3]In this paper, I do not differentiate the effect of output capital price ratio $\frac{p_y}{p_k}$ and output capital ratio

model, such decomposition shouldn't create any issue as capital share is assumed constant across countries. This assumption has been empirically confirmed by Gollin(2002). However, I show that without adjustment for self-employed workers, emerging country firms have higher capital share. This is to be expected as emerging countries tend to have lower average wages vs. developed countries due to abundance of unskilled labour, and is consistent with findings from Elias (1992).

With downward sloping capital share, the upward slope in return must due to higher asset turnover ratio in developed countries relative to emerging. In the multi-sector world, upward trend in relative value can be observed when there is product specialization across countries. To check for specialization, I run two sample t-test on sector composition of developed and emerging countries. I also re-run the return regression against GDP per capita omitting the industries that are exclusive to emerging or developed countries. Both t-test and the regression result suggests that the specialization across product is not the main cause behind the counter-intuitive upward slope. This only leaves the latter option: specialization within product. This finding is consistent with Schott (2004), which showed using US trade data that unit value of the final product increases with GDP per capita and skill abundance (population share attaining secondary or higher education) when goods are sourced from both high and low wage countries, providing support for within product specialization.

2. Methodology

Consider a standard neoclassical model with constant return to scale Cobb-Douglas type production function. Then aggregate production per capita can be expressed as:

$$y = Ak^{\alpha} \tag{1}$$

such that k is capital per worker and α is capital share in production, which should be between 0 and 1. From the above production function Lucas derived the following expression for marginal product of capital (MPK):

$$\begin{aligned} MPK &= \frac{\partial y}{\partial k} && (2)\\ &= A\alpha k^{\alpha-1} && (3)\\ &= A^{\frac{1}{\alpha}}\alpha y^{\frac{\alpha-1}{\alpha}} && (4) \end{aligned}$$

Under free and perfectly competitive capital market, return to capital (q) equals marginal product of capital and equation (4) can be simplified further:

$$q = A^{\frac{1}{\alpha}}\alpha y^{\frac{\alpha-1}{\alpha}} = \alpha\frac{y}{k} \tag{5}$$

$\frac{y}{k}$. Instead, I refer to an aggregate $\frac{p_y y}{p_k k}$ as the value of output relative to capital, or asset turnover. Asset turnover in accounting refers to sales to book ratio, which measures the efficiency with firms use capital to generate sales

From the above expression for q, one can make the following inferences: if countries produce the same good with the same constant returns to scale production function,

- the logarithmic plot between return and output per capita should be downward sloping as
$$ln(q) = ln(A^{\frac{1}{\alpha}}\alpha) + \frac{\alpha - 1}{\alpha} ln(y) \tag{6}$$
, and
- return to capital(q) should be high in poor countries, and low in rich countries

In empirical macroeconomics, GDP per capita is typically used as a proxy for output per capita, and return to capital is derived by estimating level of capital stock (via perpetual inventory method), capital share in output, growth rate with varying assumptions about depreciation rate. In this paper I calculate return to capital from firm level data using both time and money weighted approach from Fama and French (1999). Money-weighted approach place more weight on periods with large asset size, and time weighted approach puts equal weight on all periods within the period of analysis. Both approaches have pros and cons, but money weighted approach tend to be preferred method of measurement by investors as it more accurately reflects the cash return that investors receive. However, considering the 1) limited availability of the firm data in mid-1990s (thus, the data in 2000s may be over-weighed in money weighted calculation), and 2) series of financial crisis during the period of analysis (Asian Financial Crisis in 1997, Global Financial Crisis 2008, etc), the result from money weighted approach alone may provide skewed or incomplete representation of the development that occurred in the period. Thus, money weighted return is supplemented with time weighted return to check the robustness of the return.

2.1. Internal Rate of Return (Money Weighted Average)

Internal rate of return (IRR) calculation introduced in Fama and French (1999) are as follows:

$$IV_0 = \sum_{t=1}^{T} \frac{X_t - I_t}{(1+i_v)^t(1+\pi_t)^t} + \sum_{t=1}^{T} \frac{FS_t - FBV_t}{(1+i_v)^t(1+\pi_t)^t} + \frac{TV_T}{(1+i_v)^T(1+\pi_t)^T} \tag{7}$$

$$IC_0 = \sum_{t=1}^{T} \frac{X_t - I_t}{(1+i_c)^t(1+\pi_t)^t} + \sum_{t=1}^{T} \frac{FS_t - FBC_t}{(1+i_c)^t(1+\pi_t)^t} + \frac{TV_T}{(1+i_c)^T(1+\pi_t)^T} \tag{8}$$

- IV_0 is aggregate initial market value;
- IC_0 is aggregate initial book value;

- X_t is aggregate cash earnings (earnings before tax, interest and depreciation) for year t for firms in the sample in year t-1;
- I_t is aggregate gross investment (net change in the book value plus depreciation) of these firms;
- FS_t is terminal market value of firms that leave the sample in year t;
- FBV_t is the market value of firm that enter the sample at year t;
- FBC_t is the book value of firm that enter the sample at year t;
- TV_T is the terminal market value of firms that exist at the end of the sample period

The first term in the equation (7) gives current return from asset net of investment, second term adjusts for the survivor bias, and the last term gives an estimate of the future return from today's investment. i_v calculated using the equation (7) is the return to capital that non-financial firms can expect. Note that in the earnings calculation, depreciation is added back in to X_t; this adjustment is necessary to ensure that the DCF calculation yields return to capital and not a interest rate[4] Main assumption that is implicit in this method is that the market value is discounted present value of the future cash flows, a standard assumption in finance literature. I also assume fair valuation of asset by market. Although this is another standard assumption in the finance literature, I check for the robustness of the result by comparing return from equation (7) with that from equation (8), which values assets at historic prices. Valuation of assets at historic price gives a very conservative valuation of assets and thus return from equation (8) should provide an upper bound for the i_v estimate.

2.2. Time Weighted Average of Annual Return

Internal rate of return method described in the above section is straight forward, and makes adjustments for survivor bias that is often associated with high return in emerging countries. However, the downside of this method is that is there isn't always a plausible solution to the DCF problem. Also, the returns may be heavily influenced by periods of crisis (1997 Asian Financial Crisis, and 2008 Global Financial Crisis). To measure the consistency of the relative performance between developed and emerging countries, I calculate time weighted return by taking the geometric average of the following equation[5]:

$$r_{b,t} = \frac{X_t - I_t + TV_t}{TV_{t-1}(1+\pi_t)} - 1 \tag{9}$$

[4] $1 + R = q + (1 - \delta)$, such that R is gross interest rate, q is return to capital, and δ is depreciation rate.

[5] The terminal value used to calculate the annual return in (10) is not market value but book value. Thus, the future return from current investment at the end of the estimation period, is not reflected in the geometric average.

such that π_t above is an inflation rate during the period t. Although this method does not adjust for the survival bias during the period of analysis, it is relatively insulated from the effect of periodic shocks as it weighs all periods equally.

3. Data

3.1. Data Source and Definitions

Financial and market data used to calculate the return to capital is obtained from Worldscope Datastream. Worldscope has different coverage criteria for different group of countries. It provides complete coverage of listed firms for developed, advanced emerging and few emerging countries with relatively developed financial systems (as of 2006, this included: Malaysia, Indonesia, Thiland, China, Taiwan, and Philippines), but has stringent coverage criteria for firms from other countries[6]. This differential treatment between developed and emerging countries makes it particularly suitable data source for this paper as it screens out firms in emerging countries that are viewed "non-investable". It is also a very good source for international financial data comparison as it makes adjustments to the financial data to make definitions more comparable across countries.[7] PPP adjusted GDP per capita in constant international dollar (measure of output per capita) and annual growth rate of GDP implicit deflator (measure of inflation rate) are both from the World Bank.

The definition of capital stock and market capital used in the paper are roughly in line with those used by Fama and French (1999). Capital stock (IC_0, FBC_t, BC_{t-1}) and market capital (FS_t, TV_T) only include debt that pays explicit interest (long-term debt and short-term debt) and net investment are defined as change in book capital between year t and t-1. Non-interest paying liabilities are excluded from the book value as " X_t is net of implicit interest payment", and "non-interest paying liabilities are often the result of intercorporate

[6]Companies need to meet one or more of the following criteria to be included in Worldscope Coverage:

- Broker estimates equal to or greater than five
- Market capitalization equal to or greater than 100 million U.S. dollars
- Company belongs to the FTSE ALL World, Dow Jones Global, MSCI World, MSCI EMF, S&P Global, S&P/Citigroup
- Company has an ADR that is listed on the NYSE, ASE or NASDAQ or a sponsored ADR that trades over the counter (we need the non-U.S. identifier and ADR identifier).
- Companies included in EASDAQ or EURO.NM
- Non U.S. company which has a listing on the NYSE, ASE or NASDAQ.

[7]Worldscope to "enhance the comparability of the financial data of companies from different countries and industries and across time periods." (Worldscope Database Datatype Definitions Guide, 2003).

financial intermediation". Only definition of X_t differs slightly from Fama and French in that it is earnings before interest, tax and depreciation. Although tax rate is one of the major factors affecting the net capital returns, for economic return comparison I am interested in the performance of the industry net of tax.

Within each country, I exclude firm years with missing market value, book value, or EBIT (earnings before interest and tax). I further exclude firm years with negative book value (usually within a year or two before de-listing), or negative sales (occurs rarely in the sample, but sometimes observed due to technicality in accounting). Financial sector is excluded in the analysis as the paper focuses on the return from real economy. Standard Industry Classification (SIC) code was used to sort the firms into industries, following the convention of US Securities and Exchange Commission (SEC). For cross-industry comparison, I also exclude countries with no listed firm in 1995 for the specified industry.

3.2. Sample Choice and Estimation Period

The major drawback of this approach is that it significantly reduces the sample size and the time horizon of analysis. Few developing countries do not have national stock exchange (ex: Angola, Brunei), or their exchange floor is very new (ex: Laos opened its stock exchange in 2011, Syria in 2009, and Somalia in 2012). Also, market capitalization in many developing is so small that Datastream does not carry data on the firms traded on the exchange (ex: Maldives Stock Exchange had only five firms listed as of 2008). Thus, I restrict my analysis to MSCI emerging and developed countries that have relatively well established stock markets. Although this substantially reduces the size of the sample, as Reinhart and Rogoff (2004) pointed out "roughly 25 'emerging markets' accounts for the bulk of the financial flows". Therefore, the MSCI emerging countries should provide a good estimate of a return to capital that can be expected from the popular investment destinations amongst non-developed countries. Table 1 shows the MSCI list of developed and emerging countries used in the analysis. Printed in red are the countries whose financial data were unavailable until after 1995. Therefore, these countries had to be omitted from the analysis. Taiwan was omitted due to absence of GDP(PPP adjusted, constant international dollar) data.

The estimation period that is used in the analysis is 1995-2013. Longer period would be more favorable as it provides more reliable estimates of expected returns, but unlike macroeconomic aggregate data, which goes back to mid-1900s, firm level data form emerging countries is often unavailable pre-1995.[8] Thus, the estimation period used in the paper is substantially shorter vs. the other papers in the literature. However, between 1995 and 2013, world experienced a large increase in international capital investment following financial liberalization programs undertaken since the mid-1980s; thus, the paper should provide

[8] "Worldscope offers comprehensive annual history from the late 1980s for firms in developed markets, and from the early 1990s for firms in emerging markets." (Thomson Worldscope Fundamentals)

Table 1: MSCI list of Developed and Emerging countries as of 2015

Developed	**Emerging**
Australia	Bangladesh
Austria	Brazil
Belgium	Chile
Canada	China
Denmark	Colombia
Finland	Czech Republic
France	Egypt
Germany	Greece
Hong Kong	Hungary
Ireland	India
Israel	Indonesia
Italy	Malaysia
Japan	Mexico
Netherlands	Peru
New Zealand	Philippines
Norway	Poland
Portugal	Qatar
Singapore	Russia
Spain	South Africa
Sweden	South Korea
Switzerland	Taiwan
United Kingdom	Thailand
United States	Turkey
	United Arab Emirates

useful insight about international capital return in the era of trade and financial liberalization.

4. Results

To test the implications of the standard neoclassical model, I regress real return to capital for investable-size firms on the PPP adjusted constant international dollar GDP per capita obtained from World Bank database. If assumptions of the model is valid, the regression should show downward slope among developed and emerging countries, as capital share (α) is less than one.

Contrary to the predictions of the model, Figure 1 shows that relationship between real return to capital and PPP adjusted GDP per capita is in fact positive for both money weighted and time weighted average return to capital (the slope is statistically significant at 1%). This trend is also observed in the return to capital calculated using historic price (shown in Appendix A). This finding suggests that return on capital for investable-size firms is in fact higher in developed countries vs. emerging countries. Although this finding contradicts the implication of the neoclassical model, it is consistent with the capital flow observation made by Prasad, Rajan and Subramanian (2007). Prasad, et al showed that "not only is capital not flowing from rich to poor countries in quantities the neoclassical model would predict- a paradox pointed by Lucas (1990), but in the last few years, it has been flowing from poor to rich countries." Finding here suggests that the outflow from emerging countries over this period may be justified by higher average return of investment-size firms in developed countries.

The result shown in Figure 1 and 2 suggests that the return relationship among emerging and developed countries does not fit the trend described by the standard neoclassical model. What, then, is causing this gap between standard model and empirical results? In the following subsections, I empirically test some of the assumptions of the standard model to explain the gap between the implications of the model and the empirical results.

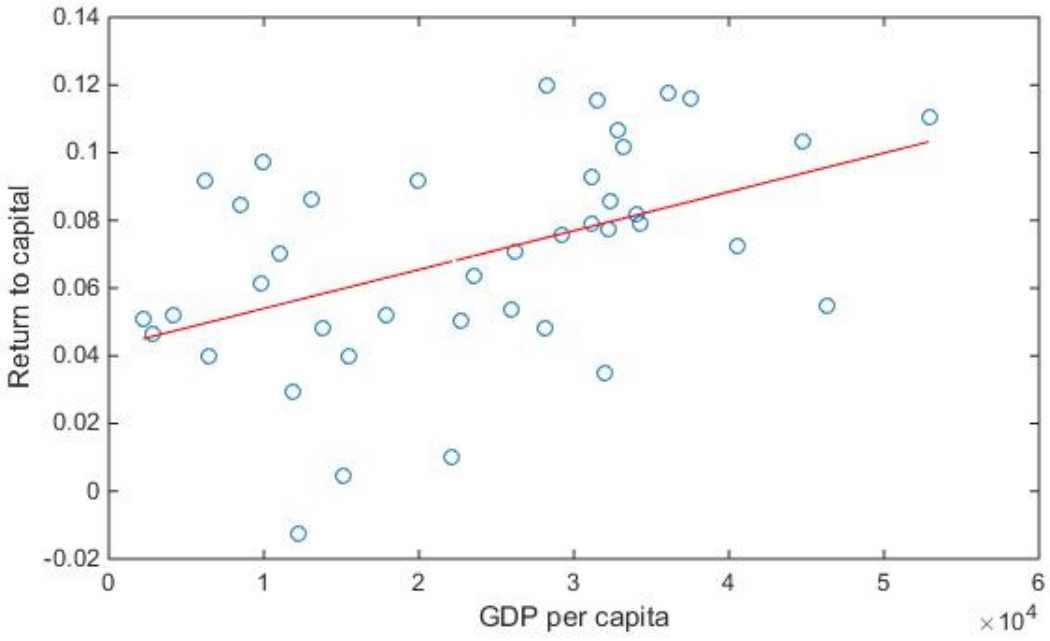
For the analysis, I divide the return to capital expression(refer to equation 5) into capital share in production (α), and value of output relative to capital, which I will hence forth refer to as asset turnover ($\frac{y}{k}$)[9]. Under the standard model, this separation should not create any issues as α is assumed constant across countries. [10]

[9]I borrow the term turnover-ratio from accounting literature to refer to the relative value of output with respect to capital. In accounting, the term refers to ratio between sales and book value and measures efficiency with which capital generates output

[10]This division between asset turnover and capital share should also hold in the modified model introduced by Caselli and Feyrer (2007). Caselli, et al pointed out that standard models are potentially biased because they ignore the cross-country difference in relative price between capital and output. Thus they suggest a

Figure 1: Base Case: Return to capital vs. GDP per Capita

(a) Fama French Money Weighted Return



(b) Geometric Average of Time-Weighted Return

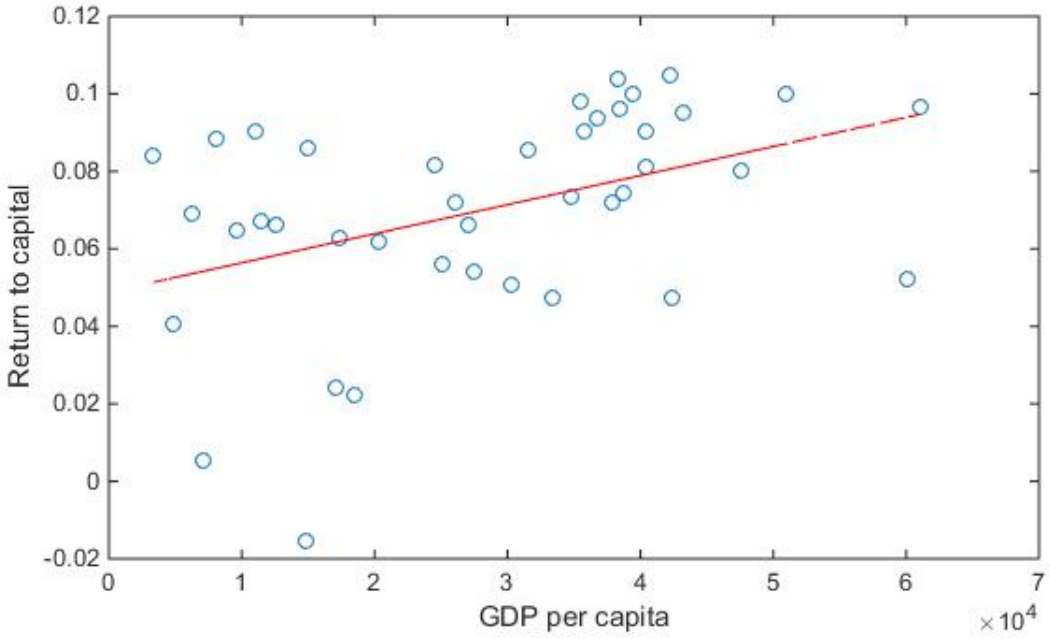
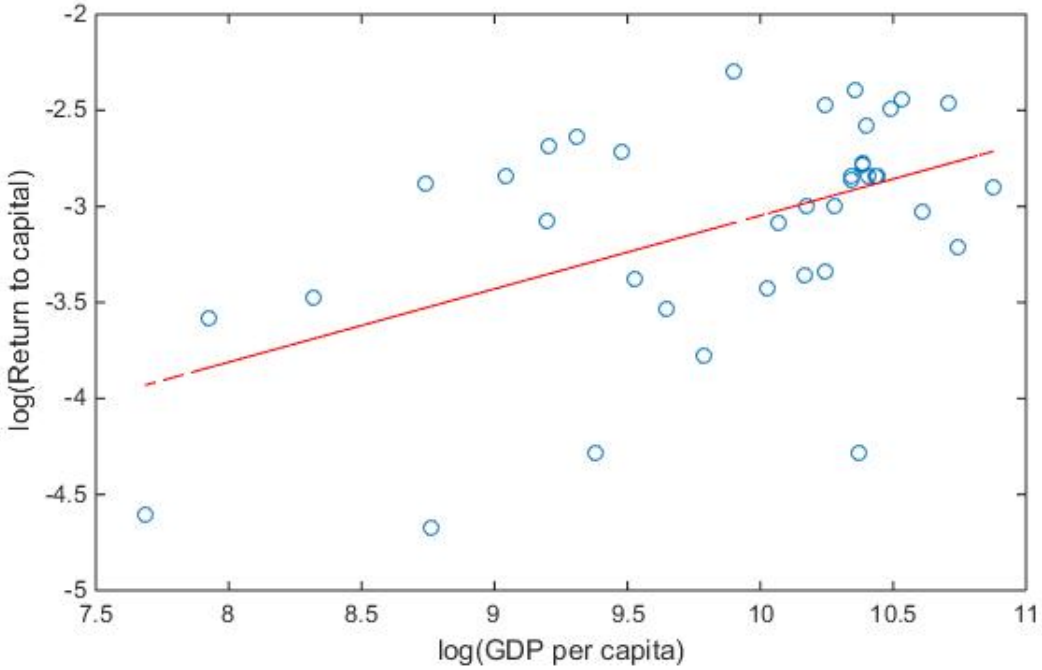


Figure 2: log(Return to capital) vs. log(GDP per Capita)



4.1. Capital Share in Production

If the aggregate upward slope in Figure 1 is driven by technological difference, which results in different capital/labor share in producing identical good, α should increase with output. However, the upward sloping α directly contradicts not only with the model, but

multi-sector model such that equation (6) is replaced by the following equation:

$$1 + r_{Global} = q\frac{p_y}{p_k} + (1 - \delta) \tag{10}$$

Keeping in mind that $q = \alpha\frac{y}{k}$ and using the fact that α is the capital share of total income they further establish the following equality:

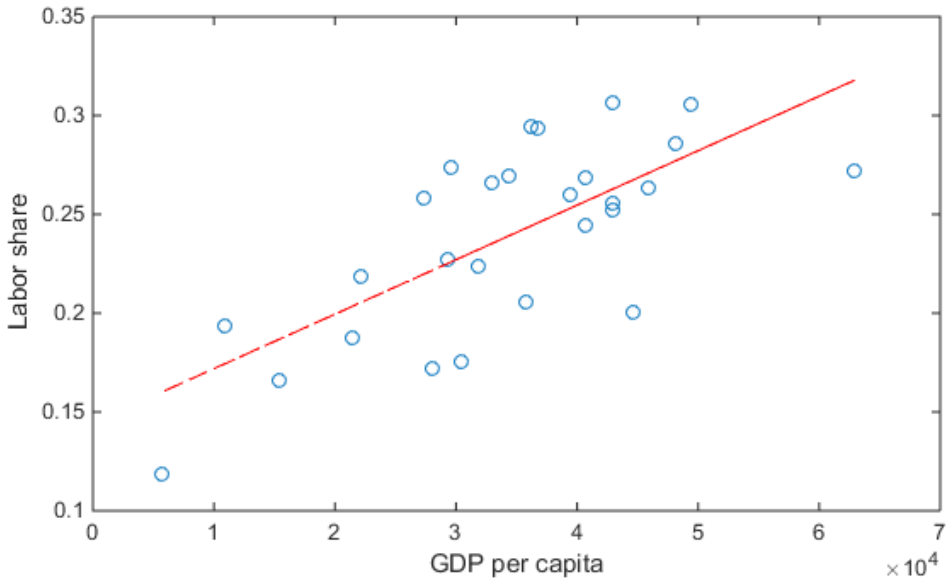
$$\alpha = \frac{p_y q k}{p_y y} \tag{11}$$

$$\frac{p_y}{p_k} q = \alpha \frac{y p_y}{k p_k} \tag{12}$$

Caselli and Feyrer refer to $q\frac{p_y}{p_k}$ as the price adjusted return to capital and find that price correction substantially alters return to capital trend between developed and emerging countries. As the price of capital relative to the price of consumption good is higher in poor countries, after the price correction, return to capital is roughly equalized across countries. In this paper, I do not attempt to differentiate the price ratio from output to capital ratio as I do not have data on sub-parts. Also, any attempt to do so may lead endogeneity problem unless all firms are price takers in the respective industry.

also the finding of Gollin (2002). Using macroeconomic data, Gollin showed that adjusting for self-employeed workers the labor shares$(1-\alpha)$ in production is consistent not only across time but also across countries. However, this paper derive return using accounting/market data of listed firms, which are typically mid-to large-size. Without adjustment for self-employment, labor shares have often been found to have lower values in developing countries than in industrial countries (ex: Elias, 1992). Figure 3 shows the labor share found using UN National Accounts Statistics for year 2010, which verifies this observation.[11] The data is available for only 27 countries in the sample, but the regression show that there is a clear upward trend (slope is significant at 1% level). Since labor share is $1-\alpha$, the upward sloping labor share depicted in Figure 3 suggests downward sloping α, which is opposite of the observed result.

Figure 3: Labor Share in Production: 2010



4.2. Asset Turnover

With downward sloping α, the upward slope of the return must be driven by difference in the value of output relative to capital in each country. This however, then leads to yet another question: why does the output to capital ratio differ? The standard model described in the previous section assumes production of identical goods in both developed and emerging countries. Is there a potential bias caused by the heterogeneity in output good produced

[11]Labor share is found by taking compensation share of the output in 2010.

Table 2: Sectoral Composition Based on Book Value: Two Sample t-test

	1996			2013		
	Developed	**Emerging**	**p_value**	**Developed**	**Emerging**	**p_value**
Agriculture, Forestry and Fishing	0.023	0.009	0.529	0.006	0.019	0.069
	(0.062)	(0.015)		(0.007)	(0.029)	
Mining	0.081	0.091	0.839	0.111	0.143	0.508
	(0.112)	(0.168)		(0.144)	(0.152)	
Construction	0.052	0.061	0.702	0.049	0.070	0.312
	(0.072)	(0.038)		(0.061)	(0.062)	
Manufacturing	0.481	0.537	0.396	0.440	0.380	0.296
	(0.194)	(0.213)		(0.204)	(0.162)	
Transportation, Communications, Electric, Gas and Sanitary service	0.244	0.252	0.894	0.287	0.314	0.609
	(0.149)	(0.234)		(0.167)	(0.175)	
Wholesale Trade	0.041	0.038	0.764	0.023	0.032	0.406
	(0.037)	(0.039)		(0.027)	(0.043)	
Retail Trade	0.050	0.035	0.371	0.046	0.048	0.898
	(0.052)	(0.038)		(0.036)	(0.044)	
Service	0.057	0.046	0.585	0.051	0.038	0.251
	(0.054)	(0.061)		(0.030)	(0.040)	

among emerging and developed countries?

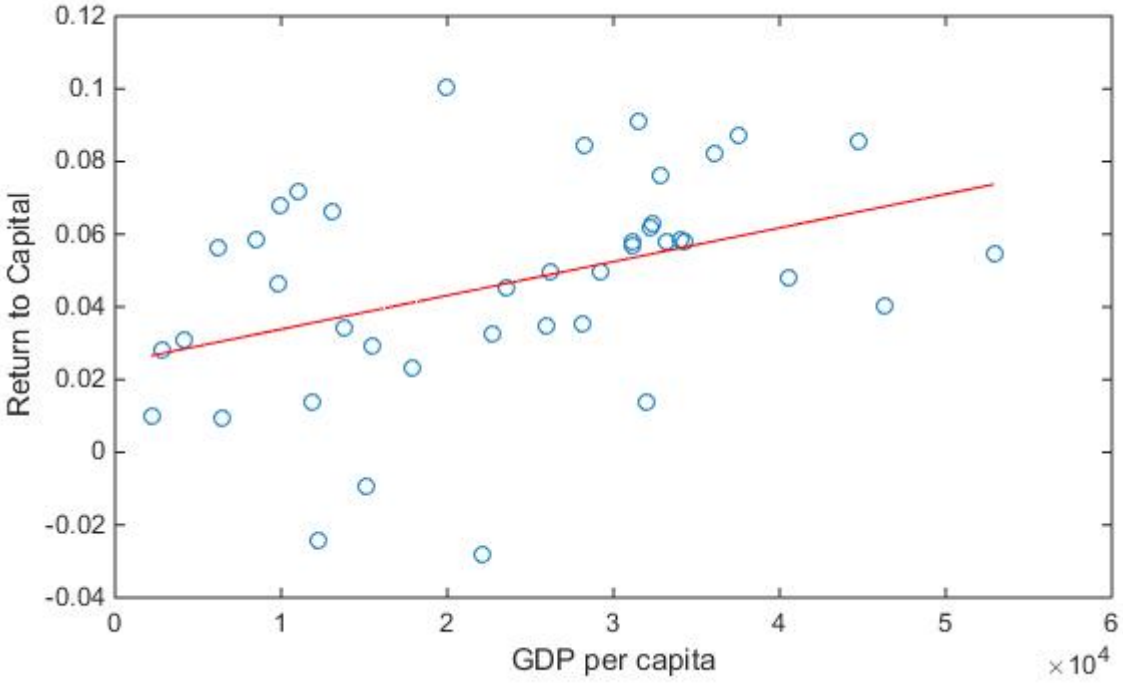
I first test for the product specialization among developed and emerging countries by re-running the Figure 1 regression excluding the 4-digit SIC codes that appear only among developed or emerging countries. This eliminate approximately 160 4-digit SIC sectors. Note that the sectors being excluded doesn't suggest that there is no productive activity in the respective sector in emerging or developed countries. Rather, it suggests that there is no listed firm whose main activity is in the specified SIC sector. Excluding them however should show relative returns in the sectors that are strictly shared among the developed and emerging countries in the sample. Figure 4 shows that the upward trend is still statistically significant at 1% even after the exclusion.

The above regression suggests that the upward sloping return is primarily driven by the sectors that are shared between the developed and emerging countries. For robustness, I also perform cross-sectional industry composition analysis. Detailed breakdown of industry is desirable, but this can lead to a small sample problem within an industry. Thus, I use 2-digit SIC industry division to sort firms into 8 industries: Agriculture, Forestry and Fishing; Mining; Construction; Manufacturing; Transportation, Communications, Electric, Gas and Sanitary service; Wholesale Trade; Retail Trade; Services. Although this is a very crude breakdown, it should still provide some insight about the composition effect on the aggregate return.

Table 2 shows the two sample t-test result on the industry composition of developed and emerging countries in 1996 and 2013. The test result doesn't reject null hypothesis that de-

Figure 4: Adjusting for Exclusive Industries: Return to capital vs. GDP per Capita

(a) Internal Rate of Return



(b) Geometric Average of Time-Weighted Return

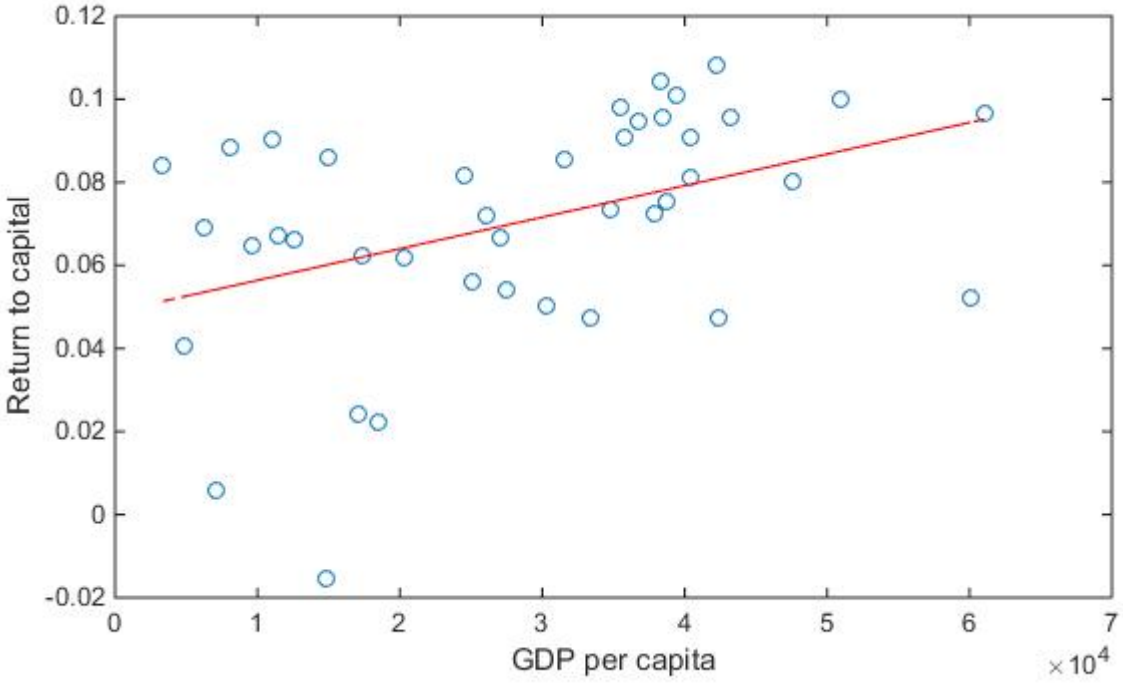


Table 3: Average Industry Return Comparison: Two Sample t-test

	Developed	**Emerging**	**p-value**
Agriculture, Forestry and Fishing	0.122	0.120	0.994
	(0.594)	(0.550)	
Mining	0.154	0.201	0.804
	(0.486)	(0.546)	
Construction	0.072	-0.019	0.053*
	(0.143)	(0.083)	
Manufacturing	0.087	0.032	0.000***
	(0.039)	(0.043)	
Transportation, Communications, Electric, Gas and Sanitary service	0.064	0.032	0.031**
	(0.031)	(0.058)	
Wholesale Trade	0.056	-0.009	0.301
	(0.178)	(0.143)	
Retail Trade	0.080	0.002	0.070*
	(0.109)	(0.143)	
Service	0.025	0.133	0.317
	(0.075)	(0.504)	
Overall	0.083	0.052	0.001***
	(0.025)	(0.032)	

veloped and emerging countries have similar industry structure. I also looked at the industry composition of EBIT for the robustness of the result and the null hypothesis still held in all sectors. This contradicts Gollin(2002), which showed that there is substantial differences in sectoral composition across countries using data on 41 countries from 1992 U.N. National Account Statistics, but his dataset included countries like Burkina Faso, Rwanda, Botswana, whereas my sample is restricted to developed and emerging countries. Thus, variation in the composition should be significantly reduced.

This leaves only one possibility: difference in return within industry. This observation is further confirmed by the two sample t-test on average sector returns of developed and emerging countries (Table 3). Within-sector heterogeneity in return is in-line with observations made by Schott (2004), which showed that contrary to traditional trade theory, most goods are not specialized across countries. Schott showed using US import data that: 1) contrary to traditional trade theory, most goods are not specialized across countries (specialization occurs within industry not across), and 2) unit values within each product are higher for goods originating from capital and skill abundant countries, when goods are sourced from both high and low wage countries. The latter observation by Schott is especially significant considering the modification to the standard model made by Caselli and Feyrer (2007). Using weighted average of final good domestic prices and capital good prices, Caselli and Feyrer suggested that adjusting for the lower price of output goods relative to capital in emerging countries substantially reduce average return to capital observed in the poor countries. If price of output and capital are differs across countries, higher per unit price should lead to larger sales and larger asset turnover ($\frac{p_y y}{p_k k}$) in developed countries, which is consistent with what is shown in Figure 1.

Given the upward sloping asset turnover and downward sloping profit margin(α), the kink observed in the return to capital graph can be attributed to the trade-off between asset turnover and profit margins that occur with increase in GDP. This potentially relates the finding of this paper to the literature on middle income growth trap. Relatively low return to capital in middle income countries should lead to low international investment, which further leads to stagnant growth.

5. Conclusion

In this paper, I investigated the Lucas Paradox using the firm level data. The result shows that for investable-size firms (which are usually medium to large scale), the return to capital is in fact higher in developed countries vs. emerging countries, primarily due to difference in the relative value of output with respect to capital. As the capital share decrease with increase in GDP per capita, the result suggests trade-off between asset turnover and profit margin with increase in output per capita for developed and emerging countries.

The firm level data has advantage over macroeconomic data in that it allows direct measurement of capital that is used to generate income. However, it restricts the analysis to mid-to large-size firms that are listed in the stock market. One may argue that the return found using only the firm level data is biased upward as it doesn't include self-employed workers, or mom-and-pop stores. This is a plausible argument, but the sample restriction may not necessarily be a major drawback in the analysis of Lucas Paradox, which deals with international capital flows. Although self-employment accounts for a large fraction of the emerging countries' output, it isn't a popular international investment destination. Thus, when estimating the return from international investment, it may be better to look at returns at firm-level.

Although Worldscope attempts to maximize the comparability of data among companies by normalizing differences in terminology, language, etc, the difference in accounting standard across countries may still bias the results. There is not only a cross-country difference in accounting standard but also a time variation (ex: Financial Accounting Standards Board amended employers' accounting for Defined Benefit Pension and Other Post-retirement Plans in 2006). However, in order to argue that upward slope is driven by difference in accounting standards, we have to argue that emerging countries have more conservative accounting standards (tends to under-estimate net income and overestimate liabilities) vs. developed countries, which seems unlikely.

6. References

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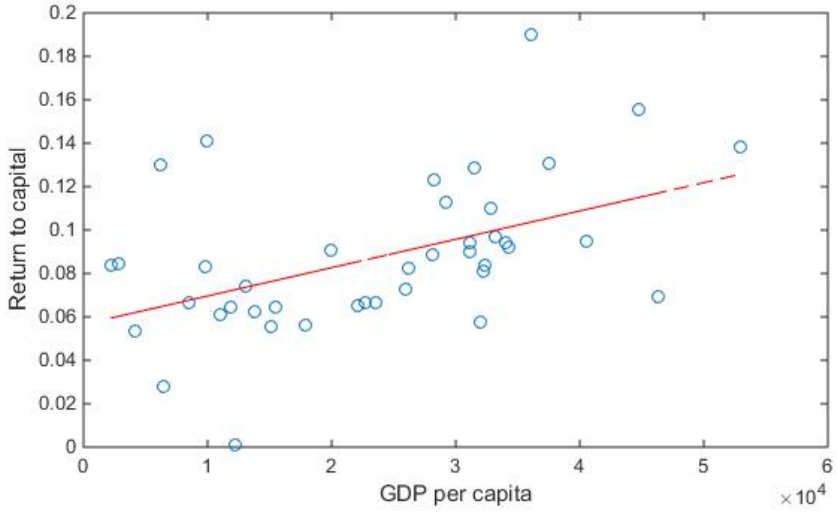
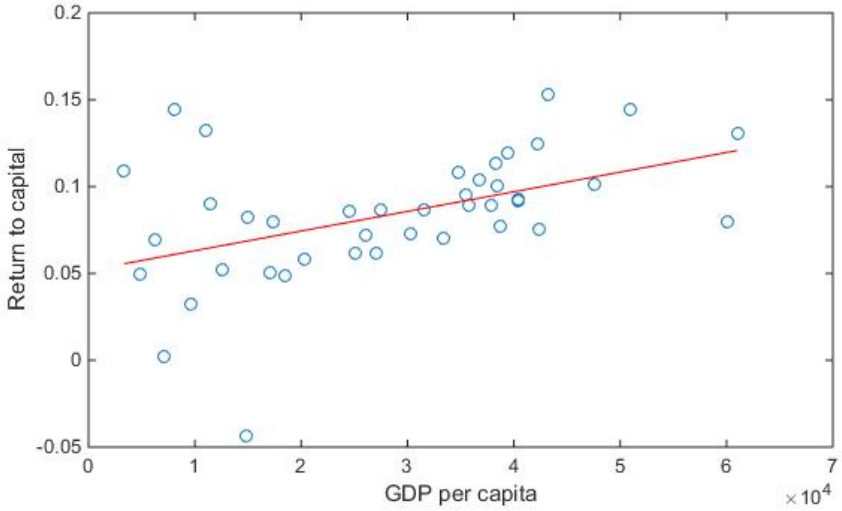
7. Appendix A: Return to book capital vs. GDP per capita



(a) Fama French Money Weighted Return



(b) Geometric Average of Time-Weighted Return