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Fernando del Rio
Departamento de Fundamentos de Análise Económica
Facultade de CC. Económicas e Empresariais
Universidade de Santiago de Compostela

INVESTMENT RATE VS RELATIVE PRICE OF INVESMENT

ENTIDAD ES COLABORADORES

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Caixanova

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Abstract

In this paper I accomplish a levels account exercise across countries in order to calculate contributions from differences in the relative price of investment and the investment rate to differences in the physical capital-output ratio -and consequently in output per worker- across countries. I find that differences in the relative price of investment account for most differences in the physical capital-output ratio across countries and consequently, if capital share is broadly consistent with national income accounts data, they have a moderate importance in accounting for differences in output per worker. However, differences in the investment rate account for very little disparity in physical capital-output ratio and output per worker across countries.

Keywords: Physical capital-output ratio, Output per worker, Investment rate, Relative price of investment.

JEL Classification E23, O47.

Resumo

Neste artigo realizo um exercício de contabilidade em níveis através de países com o objectivo de calcular as contribuições de diferenças no preço relativo do investimento e na taxa de investimento a diferenças no rátio capital físico-output -e consequentemente no output por trabalhador- entre países. Encontro que as diferenças no preço relativo do investimento explicam a maior parte das diferenças no rátio capital físico-output entre países e consequentemente, se a participação do capital na renda é em linhas gerais consistente com os dados das contas nacionais, têm uma moderada importância na explicação das diferenças em output por trabalhador. Porém, diferenças na taxa de investimento explicam muito pouca da disparidade observada entre países no rátio capital físico-output e output por trabalhador..

Palavras chaves: Rátio capital físico-output, Output por trabalhador, Taxa de investimento, Preço relativo do investimento.

Classificação JEL E23, O47

1 Introduction

Now, after the works of Hall and Jones (1999) and Klenow and Rodríguez-Clare (1997) we know that if capital share is broadly consistent with national income account data differences in the physical capital-output ratio play a secondary role to account for income disparity across countries. They find that the main reason of differences in output per worker across countries are differences in productivity. However, Mankiw, Romer and Weil (1992) attach higher importance to differences in human capital. The disparity between the findings of Mankiw, Romer and Weil (1992) and those of Klenow and Rodriguez-Clare (1997) and Hall and Jones (1999) is accounted for the different measures of human capital used by these authors.[1]

Despite the secondary role of the physical capital-output ratio, it should not be underestimated. For example, output per worker of the United States multiplied by 25.64 output per worker of Benin in year 2000. Differences in the Harrod-neutral productivity contributed a factor of 4.78 and differences in human capital per worker contributed a factor of 3.13, while differences in the physical capital-output ratio contributed a factor of 1.73. Therefore, if Benin and the United States had the same physical capital-output ratio, differences in output per worker would be reduced to almost the half.

However, differences in physical capital-output ratio across countries can be due to differences in the investment rate and/or the relative price of investment. Relationship across countries between the investment rate and the relative price of investment with both output per worker and physical capital-output ratio is displayed in figures 1 to 4.[2] It can be seen that the relative price of investment is more correlated with both output per worker and physical capital-output ratio than the investment rate. An important target of economic policy could be increase the physical capital-output ratio of less developed countries. But, necessary economic policies if differences in the physical capital-output ratio are mainly caused by differences in the investment rate or the relative price of investment could be very different.

[1] See McGrattan and Schmitz (1998) and Klenow and Rodríguez-Clare (1997) for a discussion in this respect.

[2] Data are taken from the Penn World Tables 6.1 for a sample of 92 countries. The values of the variables are relative to the values of these variables in the United States in year 2000.

Therefore, discovering the main reason of disparity in the physical capital-output ratio would be very useful for economic policy.

The relative price of investment can differ among countries by a number of reasons. So, differences in distortions to investment or in the level of better technology in practice in each country can lead to differences in the relative price of investment. Distortions to investment have been invoked by a lot of authors as an important reason of observed income disparity among countries. Distortions to investment can be due to (i) fiscal policies in the form of taxation and trade restrictions,[3] (ii) implicit taxation due to obstacles to production (prohibitions, corruption, bureaucratic regulations, among others),[4] and (iii) direct government production of investment goods.[5] Therefore, economic policies favoring technological adoption and removing institutions and economic policies causing distortions to investment could reduce income disparity among countries.

The objective of this paper is to calculate contributions from differences in the relative price of investment and the investment rate to differences in both physical capital-output ratio and output per worker across countries. In order to calculate these contributions I accomplish a levels account exercise in the line of Hall and Jones (1999). I find that differences in the relative price of investment account for most disparity in the physical capital-output ratio across countries, while differences in the investment rate account for very little of the observed disparity. For example, the physical capital-output ratio of the United States multiplied by 3.00 the physical capital-output ratio of Benin in year 2000. Differences in the relative price of investment contributed a factor of 2.96, while differences in the investment rate contributed a factor of 1.05.

I have also calculated contributions from differences in the physical capital-output ratio, human capital and productivity to differences in output per worker across countries. I find that if capital share is broadly consistent with national income account data, most differences in output per worker can be attributed to differences in productivity and human capital, while

[3]Nevertheless, differences in tax rates or trade barriers across countries are small to account for the large differences in capital accumulation and income (Easterly and Rebelo (1993)).

[4]See Diaz-Alejandro (1970), Taylor (1997, 1998), De Soto (1986).

[5]See Schmitz (1996, 1997).

contribution from differences in the physical capital-output ratio is lower than the contributions from differences in productivity and human capital, but not unimportant. My findings are very similiar to that of Hall and Jones in this respect. Therefore, from my analysis it follows that differences in the relative price of investment play a secondary role to account for income disparity across countries and the role of differences in the investment rate is negligible.

Several works have studied the relationship between the relative price of investment and growth and output. Jones (1994) used PPP-adjusted price of investment divided by the PPP-adjusted price of consumption as a comprehensive measure of the many distortions in capital formation, and he finds a strong negative relationship between growth and the price of machinery.[6] Chari, Kehoe and McGrattan (1997) use the investment price-consumption price ratio from the Summers and Heston data set to measure the tax on investment in a standard neoclassical growth model,[7] and they find that if the capital share is very high, on the order of 2/3, then differences in relative prices on the order of 5 or 6 imply a factor of 30 differences in incomes. Their result is confirmed by Restuccia and Urrutia (2000) who also use the relative price of investment to consumption as a measure of the barriers to investment and find that differences in relative prices cannot account for the income disparity in the data unless the capital share is very high. Restuccia (2001) introduce technology adoption and schooling decisions into a standard growth model and show that required differences in barriers implied by this model are much smaller. Jovanovic and Rob (1998) extend the basic model to include vintage capital and Parente, Rogerson and Wright (1997) introduce home production into the standard model.

The rest of this paper proceeds as follows. Section 2 displays the levels account exercise carried out and the results obtained. Section 3 concludes.

[6] This relationship is also found by Barro (1991).

[7] Easterly (1993) also use the relative price of investment as a measure of policy distortions.

2 Contributions from the investment rate and the relative price of investment

The evolution law of physical capital, K_i, in country i is

$$K_i' = I_i + (1-\delta)\, K_i, \tag{1}$$

and output, Y_i, is

$$Y_i = C_i + P_i I_i, \tag{2}$$

where $0 \leq \delta \leq 1$ is the depreciation rate, K_i is the stock of capital in country i, C_i is consumption in country i, I_i is physical investment in country i and P_i is the relative price of investment in country i.

The investment rate is defined to be

$$s_i = \frac{P_i I_i}{Y_i}. \tag{3}$$

From (1), (2) and (3) it follows that the physical capital-output ratio of country i relative to the physical capital output-ratio of the United States is given by

$$\left(\widehat{\frac{K}{Y}}\right)_i = \widehat{s}_i \left(\widehat{\frac{K}{I}}\right)_i \frac{1}{\widehat{P}_i} \tag{4}$$

where a variable with hat "$\widehat{\ }$" denotes the value of this variable relative to USA, $\widehat{x}_i = x_i / x_{usa}$. From previous equation it follows that differences in the physical capital-output ratio among countries can be due to differences in the relative price of investment, differences in the physical capital-investment ratio and differences in the investment rate.

I assume a Cobb-Douglas production function

$$Y_i = K_i^{\alpha} \left(Z_i h_i L_i\right)^{1-\alpha}, \ 0 < \alpha < 1. \tag{5}$$

where h_i is human capital per worker in country i, L_i is the number of workers in country i, and Z_i is Harrod-neutral productivity in country i.

Human capital per worker is assumed to be an exponential function of the average years of school in country i, $u_i \geq 0$,

$$h_i = e^{\frac{\theta}{1-\beta} u_i^{1-\beta}} \theta \geq 0, \ 0 \leq \beta \leq 1. \tag{6}$$

A function of human capital similar to this one has been used in several paper on growth and levels account (see for example Hall and Jones (1999), Klenow and Rodríguez-Clare (1997) and Bils and Klenow (2000)).

The production function can be rewritten in terms of output per worker relative to the United States as

$$\left(\widehat{\frac{Y}{L}}\right)_i = \left(\widehat{\frac{K}{Y}}\right)_i^{\frac{\alpha}{1-\alpha}} \widehat{h}_i \widehat{Z}_i, \tag{7}$$

where $(\widehat{K/Y})_i^{\frac{\alpha}{1-\alpha}}$, $\widehat{h}_i$ and $\widehat{Z}_i$ respectively are contributions from differences in the physical capital-output ratio, human capital and Harrod-neutral productivity to differences in output per worker. Since $(\widehat{K/Y})_i^{\frac{\alpha}{1-\alpha}}$ is contribution from differences in the physical capital-output ratio it follows from (4) into (7) that $P_i^{-\frac{\alpha}{1-\alpha}}$, $\widehat{s}_i^{\frac{\alpha}{1-\alpha}}$ and $(\widehat{K/I})_i^{\frac{\alpha}{1-\alpha}}$ respectively are contributions from differences in the relative price of investment, the investment rate and the physical capital-investment ratio to differences in output per worker.

Data are taken from the Penn World Tables 6.1 excepting educational attainments which are taken from Barro and Lee (2000). I have a sample of 92 countries which are listed in the appendix. I use data on output per worker, average educational attainments, physical capital, investment rates and relative prices of investment for year 2000.

My measure of output per worker, Y_i/L_i, is **rgdpwok**. Therafter, all variables in black letters are variables of Penn World Tables 6.1. Parameter α is assumed to be $\frac{1}{3}$, which is broadly consistent with national income accounts data for developed countries. I assume that u_i are the average years of school in country i in year 2000 of the total population aged 25 and over reported by Barro and Lee (2000). For the parameters β and θ I respectively take values 0.58 and 0.32, which have been estimated by Bils and Klenow (2000). Psacharopoulos (1994) estimated a mean Mincerian return about 0.099 across 56 countries. As Bils and Klenow (2000) show, the mean Mincerian returns to education equals $\theta u^{-\beta}$. Exploting this fact, Bils and Klenow (2000) estimate β to be 0.58 and for this value of β the value of θ so that the mean of $\theta u^{-\beta}$ equals the mean Mincerian return across Psacharopoulos' 56 countries is $\theta = 0.32$. Physical capital stocks are constructed using the perpetual inventory method. I assume $\delta = 0.06$ and my measure of I is **ki** x **rgdpl**

x **pop**. The initial value of K is taken to be $K_0 = I_0/(g+\delta)$ where g is calculated as the average geometric growth rate from the initial year of the investment series to ten years after. The measure of the investment rate, s_i, is **ci** x $\frac{\mathbf{pi}}{\mathbf{p}}$ and K_i/I_i is calculated as a residual, $K_i/I_i = (s_i K_i)/(Y_i P_i)$. The relative price of investment is measured as

$$P = \frac{\mathbf{pi}}{\mathbf{p}} \text{ x } \frac{\mathbf{rgdpch}}{\mathbf{rgdpl}} \text{ x } \frac{\mathbf{ci}}{\mathbf{ki}} \tag{8}$$

Barro (1991), Easterly (1993), Jones (1994) and Chary, Kehoe and McGrattan (1997) used the investment price-consumption price ratio as their measure of the relative price of investment. My measure given by (8) is different from this ratio. I have chosen it because it is consistent with my measure of output per worker and investment. I justify my choice of the measures of P and s in Appendix A.

Table 1 decomposes output per worker in each country into the three multiplicative terms: the contribution from the physical capital-output ratio, the contribution from human capital and the contribution from Harrod-neutral productivity. Just like Hall and Jones (1998), I obtain that contribution from Harrod-neutral productivity to differences in output per worker is higher than contributions from the physical capital-output ratio and from human capital. Contribution from the physical capital-output ratio is low if compared with contributions from the other two terms. For example, USA output per worker multiplies by 19.23 average output per worker of countries between 10% and 0% of USA output per worker. Differences in the physical capital-output ratio contributed a factor of 1.45, while differences in human capital and productivity respectively contributed a factor of 2.56 and 5.0. However, as argued in the introductory section, removing differences in the physical capital-output would have an important effect in reducing output per worker disparities. For example, for the considered group of countries differences in output per worker would be approximately reduced from a factor of 19.23 to 12.53 if differences in the physical capital-output ratio were removed.[8]

Table 2 breaks down contribution from the physical capital-output ratio to output per worker into three multiplicative terms: the contribution of the

[8]Note that multiplying the average contributions from the physical capital-output ratio, human capital per worker and productivity is not equal to the average relative output per worker. The reason is that the average of a product is not equal to the product of the averages of the factors. But, difference is little in the data and I abstract from this problem.

investment rate, the contribution of the physical capital-output ratio and the contribution of the relative price of investment. I haven chosen to diplay my results in terms of the contributions from differences in the investment rate and in the relative price of investment to differences in output per woker. However, contribution from differences in the investment rate (resp. in the relative price of investment) to differences in the physical capital-output ratio equals contribution from differences in the investment rate (resp. in the relative price of investment) to differences in output per worker power to $\frac{1-\alpha}{\alpha}$. Of course, looking at (4), it is clear that contributions from differences in the investment rate and the relative price of investment to differences in the physical capital-output ratio don't depend on α.

From Table 1 and Table 2 it follows that differences in the relative price of investment account for most differences in the physical capital-output ratio across countries, and consequently, if capital share is broadly consistent with national income accounts data, they have a moderate importance in accounting for differences in output per worker. For example, USA physical capital-output ratio multiplies by 2.1 the average physical capital-output ratio of countries with output per worker between 10 and 0 per cent of USA output per worker. Differences in the relative price of investment contributed a factor of 2.8, while differences in the investment rate contributed a factor of 0.98. Moreover, in Table 2 it can be seen that correlation of the investment rate with the physical capital-output ratio is much lower than correlation of the relative price of investment with the physical capital-output ratio (0.321 and -0.868 respectively). It can also be seen that for every decil of the output per worker distribution differences in the investment rate are very little, while differences in the relative price of investment are higher. Therefore, contribution from differences in the investment rate to differences in output per worker is negligible. So, correlation of investment rate with output per worker is low (0.217) and for every decil its contribution is not very different to one.

Contribution from differences in the relative price of investment to differences in output per worker has a moderate importance, as I have pointed out before. But its contribution is lower than contributions from human capital and Harrod-neutral productivity. For example, USA output per worker multiplies by 19.23 the average output per worker of countries between 10 and 0 per cent of USA output per worker. Differences in the relative price of invest-

ment contributed a factor of 1.67 (physical capital-output ratio contributed less), while human capital and Harrod-neutral productivity contributed respectively a factor of 2.56 and 5. However, contribution from the relative price of investment even is higher than contribution from the physical capital-output ratio. So, the average of the relative price of investment relative to USA is 0.767 while the average of the physical capital-output ratio relative to USA is 0.888. It can be seen in Table 2 that differences in the investment rate and the physical capital-investment ratio partially offset the influence of differences in the relative price of investment on differences in the physical capital-output ratio and output per worker.

Contribution from the relative price of investment to output per worker is given by $P_i^{\frac{-\alpha}{1-\alpha}}$. Therefore, it depends a lot on the choice of α. In this work I chosen $\alpha = \frac{1}{3}$, as Hall and Jones (1999), which implies that $\frac{\alpha}{1-\alpha}$ equals $\frac{1}{2}$. So, it is the square root of the difference in the relative price of investment that matters for output per worker. When α increases so do the contribution of differences in the relative price of investment. It explains the result of Chari, Kehoe and McGrattan (1997) and Restuccia and Urrutia (2000) that differences in the relative price of investment can not account for the income disparity in the data unless we assume a capital share very high. However, little differences in the relative price of investment could provoke great differences in output per worker even if capital share is low if we assume that these differences cause differences in human capital accumulation and/or Harrod-neutral productivity. This way is explored by Restuccia (2001).

3 Conclusion

In this paper I calculated contributions from differences in the relative price of investment and the investment rate to differences in output per worker and physical capital-output ratio across countries. I shown that if capital share is broadly consistent with national income accounts data for developed countries -about 1/3- then contribution from differences in the relative price of investment to differences in output per worker is moderate, but lower than contribution from differences in human capital or Harrod-neutral productivity. However, differences in the relative price of investment are the main reason of differences in the physical capital-output ratio across countries, while the role played by differences in the investment rates is very little.

And so contribution from differences in the investment rate to differences in output per worker is negligible.

Distinction between contributions from the relative price of investment and the investment rate could be very important for economic policy. If differences in the investment rate were the main cause of differences in the physical capital-output ratio, perhaps efforts of economic policy would be concentrated in the capital market, favoring saving and removing credit constraints. However, if the main reason are differences in the relative price of investment -as I found- perhaps economic policy would be aimed in favoring technological adoption and removing distortions to investment.

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Appendix A

The relative price of investment is measured as

$$P = \frac{\mathbf{pi}}{\mathbf{p}} \text{ x } \frac{\mathbf{rgdpch}}{\mathbf{rgdpl}} \text{ x } \frac{\mathbf{ci}}{\mathbf{ki}}, \tag{A.I}$$

where:

pi	$\equiv$	price level of investment,
p	$\equiv$	price level of Gross Domestic Product,
rgdpch	$\equiv$	Real GDP per capita (Constant prices: Chain series),
ci	$\equiv$	Investment share of **cgdp**,
ki	$\equiv$	Investment share of **rdgpl**,
rgdpl	$\equiv$	Real GDP per capita (Constant prices: Laspeyres index).

Using the penn World Tables 6.1, nominal investment of a country is given by

$$P_I I = \mathbf{xrate} \text{ x } \mathbf{pi} \text{ x } \mathbf{ci} \text{ x } \mathbf{cgdp} \text{ x } \mathbf{pop}$$

where P_I is the price of investment,**pop** $\equiv$ population, **xrate** $\equiv$ exchange rate, **cgdp**$\equiv$ Real GDP per capita (Current prices) and I is real investment which is assumed to be given by

$$I = I = \mathbf{ki} \text{ x } \mathbf{rgdpl} \text{ x } \mathbf{pop}. \tag{A.II}$$

From two previous equations it follows that

$$P_I = \mathbf{xrate} \text{ x } \mathbf{pi} \text{ x } \frac{\mathbf{ci}}{\mathbf{ki}} \text{ x } \frac{\mathbf{cgdp}}{\mathbf{rgdpl}}. \tag{A.III}$$

Nominal output in Penn Wolrd Tables 6.1 is given by

$$P_Y Y = \mathbf{cgdp} \text{ x } \mathbf{pop} \text{ x } \mathbf{p} \text{ x } \mathbf{xrate},$$

where P_Y is the price of output, and Y is real output which is assumed to be given by

$$Y = \mathbf{rgdpch} \text{ x } \mathbf{pop}. \tag{A.IV}$$

And from two previous equations it follows that

$$P_Y = \frac{\mathbf{cgdp}}{\mathbf{rgdpch}} \text{ x } \mathbf{pop} \text{ x } \mathbf{p} \text{ x } \mathbf{xrate} \tag{A.V}$$

Therefore, from equations (A.III) and (A.V) it follows that the relative price of investment, $P = \frac{P_I}{P_Y}$, is given by (A.I).

The investment rate is defined as

$$s = \frac{PI}{Y}.$$

Therefore, from (A.I), (A.II) and (A.IV) it follows that

$$s = \mathbf{ci} \times \frac{\mathbf{pi}}{\mathbf{p}}.$$

Appendix B

TABLE 3: Productivity Calculations

Country	Code	Y/L	$\widehat{K/Y}^{\frac{\alpha}{1-\alpha}}$	$\widehat{h}$	$\widehat{Z}$	$\widehat{P}^{\frac{-\alpha}{1-\alpha}}$	$\widehat{s}^{\frac{\alpha}{1-\alpha}}$	$\widehat{K/I}^{\frac{\alpha}{1-\alpha}}$
Ireland	IRL	1,008	0,836	0,769	1,569	0,848	1,091	0,904
U. S. A.	USA	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Belgium	BEL	0,879	1,116	0,749	1,053	0,960	1,019	1,140
Norway	NOR	0,837	1,220	0,971	0,707	1,024	1,033	1,154
Italy	ITA	0,836	1,119	0,633	1,180	0,944	0,993	1,193
Canada	CAN	0,810	1,082	0,939	0,797	1,029	1,002	1,049
Netherlands	NLD	0,809	1,079	0,784	0,957	0,918	1,043	1,127
Hong Kong	HKG	0,808	1,048	0,800	0,965	0,870	1,153	1,045
Australia	AUS	0,799	1,076	0,877	0,846	0,964	1,009	1,107
Denmark	DNK	0,787	1,110	0,843	0,841	0,978	1,021	1,111
Austria	AUT	0,784	1,158	0,753	0,898	0,931	1,088	1,144
France	FRA	0,761	1,145	0,724	0,918	0,989	0,996	1,162
Finland	FIN	0,755	1,108	0,847	0,805	0,922	0,990	1,215
Switzerland	CHE	0,735	1,265	0,864	0,672	1,041	1,011	1,202
Germany	GER	0,719	1,180	0,819	0,744	0,942	1,036	1,209
Sweden	SWE	0,704	1,080	0,934	0,698	0,977	0,931	1,187
Island	ISL	0,698	1,096	0,750	0,850	0,994	1,081	1,020
U.K.	GBR	0,692	0,996	0,791	0,878	0,980	0,923	1,101
Spain	ESP	0,684	1,105	0,650	0,952	0,915	1,112	1,086
Israel	ISR	0,675	1,090	0,783	0,790	1,043	0,966	1,082
New Zealand	NZL	0,610	1,085	0,946	0,594	0,950	1,008	1,134
Japan	JPN	0,600	1,306	0,817	0,562	0,981	1,119	1,190
Korea	KOR	0,571	1,144	0,869	0,574	0,882	1,197	1,083
Greece	GRC	0,546	1,099	0,734	0,677	0,925	1,046	1,136
Portugal	PRT	0,542	1,047	0,499	1,039	0,890	1,192	0,987
Slovenia	SVN	0,514	0,944	0,656	0,830	0,926	1,156	0,881
Barbados	BRB	0,511	0,706	0,775	0,934	0,430	0,935	1,755
Mauritius	MUS	0,467	0,704	0,539	1,231	0,604	1,114	1,047
Malaysia	MYS	0,426	0,973	0,691	0,634	0,802	1,111	1,092
Trinidad & Tob.	TTO	0,419	0,729	0,674	0,852	0,622	0,953	1,230

Country	Code	Y/L	$\widehat{K/Y^{\frac{\alpha}{1-\alpha}}}$	$\widehat{h}$	$\widehat{Z}$	$\widehat{P^{\frac{-\alpha}{1-\alpha}}}$	$\widehat{s^{\frac{\alpha}{1-\alpha}}}$	$\widehat{K/I^{\frac{\alpha}{1-\alpha}}}$
Argentina	ARG	0,398	0,950	0,732	0,572	0,867	0,877	1,250
Hungary	HUN	0,395	1,063	0,754	0,492	0,841	1,213	1,043
Chile	CHL	0,389	0,894	0,692	0,628	0,838	1,063	1,002
Mexico	MEX	0,381	0,937	0,615	0,661	0,891	1,058	0,993
Czech Rep.	CZE	0,377	1,176	0,799	0,401	0,841	1,197	1,169
Slovak Rep.	SVK	0,365	1,309	0,780	0,358	0,853	1,205	1,274
South africa	ZAF	0,341	0,736	0,691	0,670	0,633	0,850	1,367
Uruguay	URY	0,328	0,821	0,650	0,615	0,786	0,818	1,277
Poland	POL	0,314	1,059	0,830	0,357	0,877	1,131	1,068
Tunisia	TUN	0,305	0,783	0,454	0,859	0,639	1,150	1,067
Iran	IRN	0,303	0,891	0,483	0,705	0,794	0,982	1,143
Brasil	BRA	0,298	0,962	0,476	0,650	0,811	0,993	1,195
Croatia	HRV	0,279	0,737	0,600	0,632	0,788	1,030	0,907
Venezuela	VEN	0,275	0,971	0,543	0,522	0,833	0,920	1,266
Jordan	JOR	0,251	0,821	0,657	0,465	0,682	0,989	1,217
Dominican Rep.	DOM	0,251	0,713	0,515	0,683	0,706	1,069	0,944
Russia	RUS	0,247	0,698	0,871	0,406	0,715	0,909	1,073
Panama	PAN	0,246	1,021	0,693	0,348	0,880	1,206	0,962
Syria	SYR	0,244	0,673	0,552	0,657	0,551	0,971	1,258
Turkey	TUR	0,236	0,917	0,492	0,523	0,909	1,034	0,976
Costa rica	CRI	0,230	0,850	0,569	0,475	0,813	0,908	1,153
Algeria	DZA	0,225	0,921	0,487	0,503	0,640	1,072	1,343
Egypt	EGY	0,213	0,518	0,508	0,811	0,455	1,073	1,061
El salvaor	SLV	0,210	0,632	0,473	0,702	0,661	0,903	1,058
Gutemala	GTM	0,206	0,623	0,385	0,857	0,660	0,898	1,051
Thailand	THA	0,197	1,177	0,575	0,291	0,844	1,052	1,326
Swaziland	SWZ	0,194	1,010	0,551	0,349	0,862	0,972	1,205
Bulgaria	BGR	0,184	0,630	0,818	0,358	0,610	0,890	1,162
Colombia	COL	0,178	0,783	0,505	0,450	0,787	0,768	1,296
Ecuador	ECU	0,169	0,995	0,602	0,282	0,811	0,901	1,361
Paraguay	PRY	0,162	0,790	0,552	0,371	0,641	1,031	1,195
Peru	PER	0,156	1,018	0,655	0,235	0,852	0,984	1,214
Indonesia	IDN	0,139	0,873	0,486	0,327	0,727	0,929	1,293

Country	Code	$\widehat{Y/L}$	$\widehat{J/Y}^{\frac{\alpha}{1-\alpha}}$	$\widehat{h}$	$\widehat{Z}$	$\widehat{P}^{\frac{-\alpha}{1-\alpha}}$	$\widehat{s}^{\frac{\alpha}{1-\alpha}}$	$\widehat{K/I}^{\frac{\alpha}{1-\alpha}}$
Jamaica	JAM	0,113	1,068	0,518	0,205	0,757	1,138	1,240
Pakistan	PAK	0,109	0,697	0,342	0,456	0,696	0,868	1,154
Bolivia	BOL	0,106	0,721	0,539	0,272	0,713	0,937	1,080
Bangladesh	BGD	0,103	0,669	0,342	0,450	0,665	1,054	0,953
Honduras	HND	0,099	0,865	0,446	0,256	0,700	1,300	0,950
India	IND	0,096	0,690	0,490	0,285	0,690	1,075	0,930
China	CHN	0,096	0,831	0,552	0,209	0,730	1,250	0,910
Nicaragua	NIC	0,084	0,901	0,468	0,200	0,676	1,289	1,034
Zinbawe	ZWE	0,079	0,950	0,497	0,168	0,748	0,789	1,609
Camerun	CMR	0,064	0,621	0,389	0,265	0,544	0,891	1,282
Congo, Rep. of	COG	0,057	0,755	0,484	0,156	0,392	0,959	2,011
Nepal	NPL	0,054	0,803	0,309	0,218	0,751	1,084	0,987
Senegal	SEN	0,053	0,581	0,328	0,276	0,546	0,978	1,088
Lesotho	LSO	0,052	1,120	0,471	0,099	0,820	1,396	0,979
Ghana	GHA	0,043	0,586	0,442	0,166	0,419	1,069	1,310
Gambia	GMB	0,041	0,591	0,303	0,230	0,608	0,914	1,063
Zambia	ZMB	0,040	0,898	0,532	0,085	0,830	0,900	1,200
Benin	BEN	0,039	0,577	0,319	0,209	0,581	0,976	1,019
Kenya	KEN	0,038	0,673	0,440	0,129	0,711	0,779	1,214
Togo	TGO	0,033	0,717	0,367	0,127	0,715	0,994	1,009
Mozambique	MOZ	0,033	0,411	0,256	0,314	0,345	1,274	0,934
Mali	MLI	0,032	0,592	0,222	0,239	0,480	1,045	1,180
Uganda	UGA	0,031	0,340	0,374	0,240	0,415	0,935	0,877
Malawi	MWI	0,029	0,651	0,351	0,126	0,486	0,795	1,687
Niger	NER	0,028	0,559	0,227	0,222	0,547	0,715	1,430
Rwuanda	RWA	0,028	0,471	0,315	0,187	0,430	0,855	1,280

TABLE 1: Contributions to differences in output per worker

Decil	$\widehat{Y/L}$	$\widehat{K/Y}^{\frac{\alpha}{1-\alpha}}$	$\widehat{h}$	$\widehat{Z}$
$\geq$ **80**	0.874	1.063	0.830	1.028
80-70	0.756	1.140	0.833	0.803
70-60	0.660	1.113	0.789	0.771
60-50	0.537	0.998	0.707	0.881
50-40	0.437	0.802	0.635	0.905
40-30	0.354	0.965	0.680	0.574
30-20	0.244	0.790	0.559	0.588
20-10	0.146	0.882	0.569	0.312
10-0	0.052	0.690	0.390	0.200
Average	0.344	0.888	0.608	0.540
Stand. desv.	0.280	0.218	0.190	0.308
Corr.. w/ $\widehat{Y/L}$	1.000	0.696	0.840	0.879
Corr.. w/ $\widehat{K/Y}^{\frac{\alpha}{1-\alpha}}$	0.696	1.000	0.726	0.326
Corr.. w/ h	0.840	0.726	1.000	0.527

Note: correlations refer to the variables in logs.

TABLE 2: Differences in the physical capital-output ratio

Decil	$\widehat{K/Y}^{\frac{\alpha}{1-\alpha}}$	$\widehat{s}^{\frac{\alpha}{1-\alpha}}$	$\widehat{K/I}^{\frac{\alpha}{1-\alpha}}$	$\widehat{P}^{-\frac{\alpha}{1-\alpha}}$
$\geq$ **80**	1.063	1.042	1.076	0.949
80-70	1.140	1.010	1.167	0.968
70-60	1.113	1.035	1.102	0.977
60-50	0.988	1.105	1.168	0.811
50-40	0.802	1.059	1.123	0.676
40-30	0.965	1.050	1.150	0.805
30-20	0.790	0.998	1.105	0.722
20-10	0.882	0.971	1.222	0.743
10-0	0.690	1.012	1.181	0.598
Average	0.888	1.018	1.154	0.767
Stand. Desv.	0.218	0.127	0.084	0.171
Corr.. w/ $\widehat{Y/L}$	0.696	0.217	-0.125	0.717
Corr.. w/ $\widehat{K/Y}^{\frac{\alpha}{1-\alpha}}$	1.000	0.321	0.084	0.868
Corr.. w/ $\widehat{h}$	0.726	0.170	0.019	0.686
Corr.. w/ $\widehat{Z}$	0.326	0.128	-0.245	0.436
Corr.. w/ $\widehat{P}^{-\frac{\alpha}{1-\alpha}}$	0.868	0.169	-0.246	1.000
Corr., w/ $\widehat{s}^{\frac{\alpha}{1-\alpha}}$	0.321	1.000	-0.532	0.169
Corr.. w/ $\widehat{K/I}^{-\frac{\alpha}{1-\alpha}}$	0.084	-0.532	1.000	-0.246

Note: correlations refer to the variables in logs.

Figure 1: Investment Rate and the Physical Capital-Output ratio

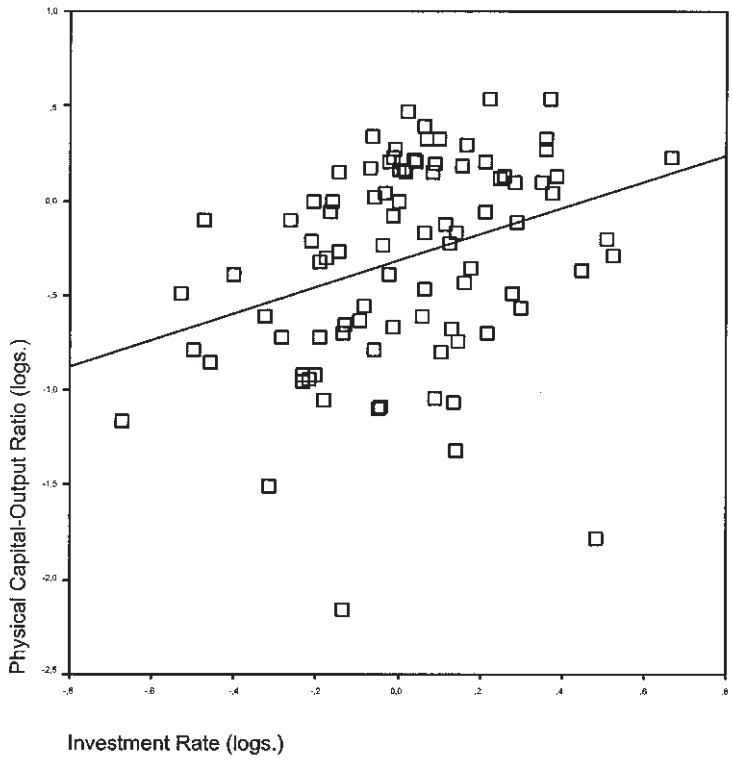


Figure 2: Investment Rate and Output per Worker

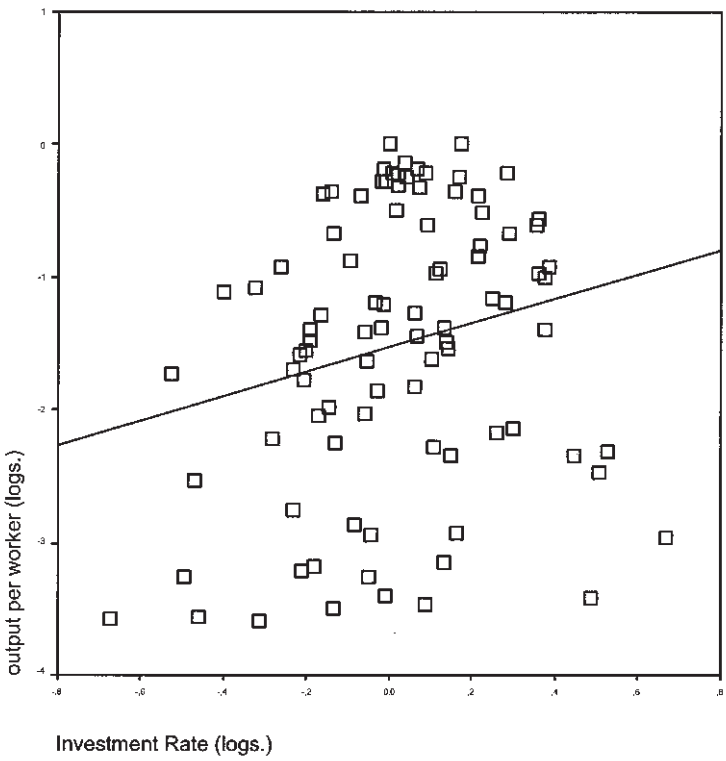


Figure 3: Relative Price of Investment and Physical Capital-Output Ratio

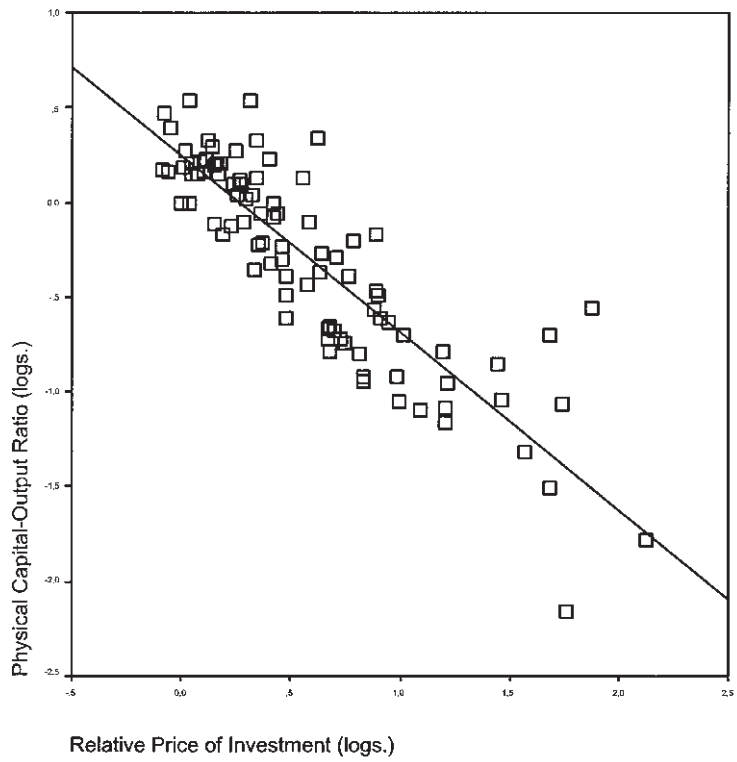
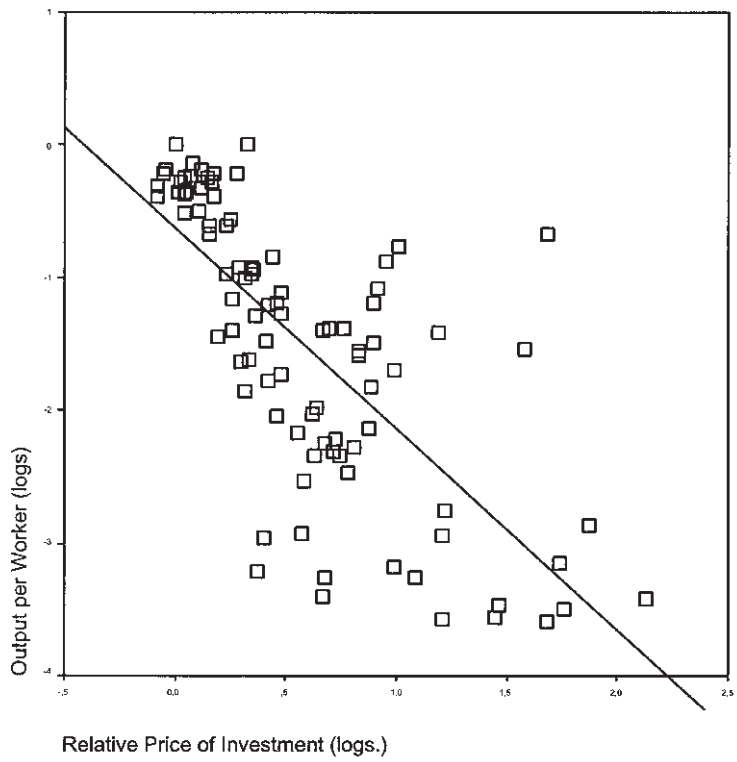


Figure 4: Relative price of Investment and Output per Worker



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