

Equipment Investment and Economic Growth: An Examination of New Empirical Evidence

Gustav Hansson^{*}
Göteborg University

March 31, 2006

Abstract

Equipment investment is one of the very few variables claimed to be robustly related to income growth. This paper examines new empirical evidence on whether this “stylized” fact is still valid. Firstly, the main result from DeLong and Summers (1991) is extended and tested. Secondly, the paper examines the behavior of investment prices and their relation to investments shares. Thirdly, the relationship between equipment investment and total factor productivity growth rates is analyzed using a large panel dataset and a variety of investment shares. Still, the paper repeatedly fails to demonstrate a statistically robust relationship between equipment investment and growth.

JEL classification: E31; O11; O16; O40.

Keywords: Economic Growth; Productivity; Equipment; Investment; Prices.

1 Introduction

To understand why some countries are poor while others are rich is one of the most important questions in economics. However, to empirically determine the robust correlates to economic growth has proven surprisingly hard. In a series of influential papers DeLong and Summers (1991, 1992, 1993) argued for equipment investment as an important driver for income growth. The investment share was also one of the very few variables found robustly related to growth by Levine and Renelt (1992), Sala-i-Martin (1997a, b) and Hoover and Perez (2004). The importance of investment as a promoter for growth has therefore almost been accepted as a stylized fact (Abel, 1992).

^{*} Department of Economics, Göteborg University, P.O. Box 640, SE-405 30 Gothenburg, Sweden, (email: gustav.hansson@economics.gu.se). I would like to thank Ola Olsson, Arne Bigsten, Ali Tasiran, Sven Tengstam, Annika Lindskog, Ann-Sofi Isaksson and Ida Hanson for helpful comments and suggestions. I also thank seminar participants at Göteborg University for helpful comments on an earlier draft. All errors are my own.

Although, this “stylized” fact has also been met by considerable critique by Auerbach, Hassett, and Oliner (1994), Blomström, Lipsey, and Zejan (1996), Easterly and Levine (2001), and Easterly (2001) among others. Since a large part of the critique in Auerbach et al (1994) was of an empirical nature and due to poor data, DeLong and Summers (1994, p. 807) “hope and expect to see others either confirm or disconfirm” their results.

The purpose of this paper is to examine new empirical evidence concerning the relationship between the equipment investment share of GDP and income growth. Updates of the International Comparison Program (ICP) data makes it possible to replicate and extend the influential analysis of DeLong and Summers (1991, 1992, 1993). Replicating and extending the data as well as the regression equations as closely as possible to DeLong and Summers (1991), taking advantage of the more recent data, the relationship between equipment investment and growth falls apart. When extending and updating the analysis, equipment investment is no longer found to be a robust correlate to income growth in the DeLong and Summers regression set-up.

In short, the question is whether there are diminishing returns to capital accumulation, like in the Solow (1956) growth model, or whether there is a “learning by doing” effect, like in the $Y = AK$ -model. Therefore, if equipment investment causes growth, there should be an almost equally strong relation between investment and TFP growth. DeLong and Summers (1992, 1993) and Bernanke and Gürkaynak (2001) has found that investments are indeed positively correlated to TFP growth rates. There are, however, some important weaknesses with these empirical findings, most notably the probable presence of endogeneity. Time series studies on investment and growth find that growth cause investments and not the other way around (Blomström, Lipsey, and Zejan, 1996), or at best that causality runs in both directions (Podreccan and Carmeci, 2001). The robust relation found by DeLong and Summers (1991, 1992, 1993), Levine and Renelt (1992) Sala-i-Martin (1997a, b) Hoover and Perez (2004) and Bernanke and Gürkaynak (2001) is between the average investment share and the income growth rate for the same period (or a majority thereof), and could therefore be due to that growth is causing investment.

The relationship between investment and TFP growth is also examined in this paper. The approach is straightforward. Using panel data with the best possible data available, the ICP benchmark data, the initial equipment share is related to the

subsequent TFP growth rate in a regression equation similar to DeLong and Summers (1992, 1993). Nonetheless, there are no evidence for a robust relationship between equipment investment and growth. An innovating aspect of the analysis is the recognition of analyzing investment shares valued at both international PPP prices as well as domestic prices. To my knowledge, this is a novelty in the literature.

Furthermore, this paper analyzes the behavior of investment prices. The question whether investment causes growth, is closely related to the behavior of investment prices. The argument, as in DeLong and Summers (1991), can be simplified as; equipment prices are higher in relatively poor countries, countries with lower prices have higher investment shares which then correspond to higher income growth rates. Hsieh and Klenow (2005) recently proved that investment prices are not systematically higher in relatively poor countries compared to rich. Poor countries does therefore not seem to be poor because of high prices on investment goods. Building on these findings, this paper shows that countries that do have lower investment prices are found to have higher investment shares, although these higher investment shares are not found to be promoting growth.

There are three main contributions of this paper: Firstly, the main result from the seminal paper by DeLong and Summers (1991) is extended and tested, Secondly, there is a thorough discussion linking recent findings about investment prices as well as new evidence on how prices relates to investments. Thirdly, the paper examine the relation between equipment investment and TFP growth with an innovative use of both real and nominal investment shares.

The paper is organized as follows: Section 2 discusses DeLong and Summers (1991) as well as extends and tests the main results. Section 3 presents recent as well as new evidence on the behavior of investment prices. Section 4 analyzes the relation between equipment investment and TFP growth rates. Section 5 concludes the exposition.

2 Extending DeLong and Summers (1991)

Let us start by having a look at the work of DeLong and Summer (1991) (henceforth DS) which is one of the strongest and most influential advocates for the equipment share being an important promoter of income growth.

Investment, or more formally, Gross Capital Formation is divided into: Construction (residential, nonresidential, and land improvements); Producer Durables (transport equipment, electrical and non-electrical machinery and equipment); and Increases in Stocks (inventories and valuables). Gross *Fixed* Capital Formation is simply Gross Capital Formation less Increases in Stocks. The focus in DS is on equipment investment which consists of electrical and non-electrical machinery. That is, excluding transport equipment from Producer Durables. The main regression specification used in DS to test and describe the impact of equipment investment and growth is formulated as

$$growth_i = \beta_0 + \beta_1(equip. share_i) + \beta_2(struct. share_i) + \beta_3(n_i) + \beta_4(gap_i) + \varepsilon_i \quad (2.1)$$

where “*growth*” is the annual growth rate of GDP per worker 1960 to 1985. The “*equipment share*” is the average equipment investment share to GDP 1960 to 1985, and the “*structures share*” is the average structures (constructions) and transport investment share for the same period. “*n*” is the growth rate of the labor force for the same period, “*gap*” is the proportionate initial gap in real GDP per worker relative to the US in 1960¹. The control variables “*gap*” and labor force growth “*n*” are included to capture other factors that could influence the growth rate of GDP per worker. More specifically, the “*gap*” variable is included to control for any “systematic causal relationship running from the level of GDP per worker to the level of equipment investment” (DeLong and Summers, 1991, p.453).

As a first test, this paper will try to replicate regression 2.1 by extending the analysis using more recent data. That is, using more recent data, does the main result from DeLong and Summers (1991) still hold? To do this, let us first get a clear understanding of the data and how the investment share is constructed.

¹ $Gap = 1 - (Y/L)_i / (Y/L)_{us}$, where Y is GDP, L is labor force, and subscripts i and us stands for country i and the US, respectively.

2.1 Data and Sample

International comparisons of national accounts are usually facilitated by using common international prices based on Purchasing Power Parities from the United Nations International Comparison Programme (ICP). The ICP collects prices of hundreds of identically specified goods and services around the world in order to make detailed price comparisons. This data collection is made almost every fifth year for a limited number of countries and form a so called benchmark. The years and the number of countries for the different ICP benchmark studies are; 1970 (16 countries), 1975 (35 countries), 1980 (61 countries), 1985 (64 countries), 1990 (24 countries), and 1996 (115 countries). The price comparisons that come out are Purchasing Power Parity estimates (PPP's). The PPP's for the countries and years not part of the benchmark are then estimated based on the ICP benchmark data. The PPP's that finally emerge are used to convert expenditures in domestic currency into a common currency, and therefore making international comparisons possible. Well known datasets such as the Penn World Tables (PWT) and the World Development Indicators (WDI) have based their PPP adjusted data on these benchmark studies from the ICP. The ICP benchmark data is therefore the most appropriate data on real expenditures for detailed headings.²

DS makes use of the ICP benchmark data when constructing their investment shares. As stated previously, DS focus on equipment investment consisting of electrical and non-electrical machinery. DeLong and Summers (1992, 1993), however, instead focus on producer durables (including transport equipment). Auerbach et al (1994, p.761n) comment on that this shift between equipment investment and producer durables is “puzzling” and where the DS rationale for the learning by doing effects appears “strained” when applied to transportation equipment. In this paper, I am not making a case for which investment share is the most important. Although, since this paper primarily follows DeLong and Summers (1991), the equipment share is mostly used. Due to data limitations, the producer durables share is also going to be used in some samples.

² For more information on ICP procedure and PWT methodology see for example: Handbook of the International Comparison Programme (1992), Summers and Heston (1991), Data Appendix for Space-Time System of National Accounts: Penn World Table 6.1 (PWT 6.1), and PWT6 Technical Documentation.

DS create the equipment share by using data from the ICP benchmarks on the equipment to total investment ratio for the years 1970, 1975, and 1980, as well as data on the total investment share to GDP ratio from Summers and Heston (1990). If the ratio between equipment and total investment were available for all three benchmark years, the average equipment share was made by multiplying the 1970 ratio to the average total investment share of GDP from 1960-72, multiplying the 1975 ratio by the average total investment share of GDP from 1973-1977, and the 1980 ratio by the average equipment shares from 1978-1985. These three values were then averaged. If only 1975 and 1980 ratios were available, they were multiplied by the average investment share of GDP 1960-1977 and 1978-1985, respectively, and then averaged. Finally, if only the 1980 equipment share of investment was available, it was simply multiplied by the average investment share of GPD 1960 to 1985.

Furthermore, after having derived the equipment and structures shares, DS divide the sample into a “large” sample ($n=61$) and a “high productivity” sample ($n=25$). The high productivity sample is created since DS are skeptical of what can be learnt by combining very poor countries (which have very low productivity levels) with very rich countries (which have high productivity levels). The high productivity sample consists of those countries with GDP per worker levels greater than 25 percent of the US level in 1960 ($(Y/L)_i / (Y/L)_{us} > 0.25$), and is therefore constructed to consist of the industrialized countries most like the USA.

In the critical comment by Auerbach et al (1994) an OECD sample is preferred. By using the same data as DS, Auerbach et al (1994) demonstrates that the relationship between equipment investment and growth falls apart for the OECD sample. DeLong and Summers (1994) reply by stating the fact that the OECD is foremost a political grouping, not an economic grouping. Since the goal of DS is to create a high productivity sample with industrialized countries most like the USA, it is argued that the high productivity sample appropriately should be based on economic rather than political grounds. Furthermore, in DeLong and Summers (1993) it is shown by using an alternative dataset that the equipment investment and growth nexus is the strongest amongst the developing countries, and actually weaker amongst the rich countries in western Europe. Since I primarily follow in the footsteps of DeLong and Summers (1991), both a large and a high productivity sample will be used. Regardless of sample, the empirical examination will put special attention into

finding influential outliers or if a special group of countries are driving the regression results.

2.2 Replication and Extension of the Main Results

The main specification, as formulated in equation 2.1 is replicated and extended in three ways: Firstly, the data is being replicated for the 1960-1985 period using the same method as DS but with more up-to-date data (Penn World Tables mark 5.6). The usage of this more recent data source allows the addition of three more countries. Secondly and thirdly, the availability of the ICP benchmark also allows the analysis to be extended to 1985 and 1996.³

Table 1 presents the regression results. Columns 1 until 6 presents the regression results while using the same sample as in DS, the 1960-1985 sample. Columns 1 and 2 contain the regression result for the high productivity sample (hp-sample) and the larger sample using the original DS data as it appears in the journal article⁴. Not surprisingly the parameter estimates for the real equipment shares are positive and statistically significant in both the hp-sample as well as the large sample. If the parameter estimate for the equipment share in the hp-sample were to be interpreted, a one standard deviation increase in the equipment share would lead to a 1.05 percentage point increase in the annual GDP per worker growth rate. This is a fairly large effect.

Columns 3 and 4 present the regression results for the same sample of countries and using the same benchmark years as in the previous columns, but using the updated Penn World Tables mark 5.6 database. The updated investment share has a correlation of 0.9 to the original DS data. The parameter estimates for the equipment shares are therefore also very similar to the original DS results.

The regression results in the following columns 5 and 6, are based on the same data as in columns 3 and 4 but also includes the countries; Syria, Romania, and Yugoslavia. These countries are in the 1970, 1975 or 1980 ICP benchmarks but were for some reason not included in the original DS regressions. The high productivity

³ For further information of derivation please see the data appendix. The ICP benchmark data has been retrieved from <http://pwt.econ.upenn.edu/Downloads/benchmark/benchmark.html>

⁴ I am aware of that DeLong and Summers has made a slight modification in this dataset due to an error. Nonetheless, the error is supposed to play only a minor role, and the replications in columns (1) and (2) still serve their purpose.

sample is here based on PWT 5.6, and as a result Hong Kong and Japan are now no longer part of the high productivity sample. Nonetheless, the regression results in columns 5 and 6 are still in line with the original DS results. That is, replicating the data using the same ICP benchmark years as DS, does not present any significant differences.

In the following two columns, 7 and 8, the benchmark year 1985 has been added. The period studied is now 1960-1990 and the investment shares are still created in the same spirit as in DS (see data appendix for details). The coefficients for the equipment share in columns 7 and 8 are still positive and significant. Although the coefficient for the equipment share in column 7 is statistically different from the corresponding coefficient in column 1, the DS result (that is the parameter estimate in column 7 is not included in the 95 percent confidence interval for the parameter estimate in column 1). The main conclusion is nonetheless the same; equipment investment is positively related to GDP per worker growth.

Finally, in the last two columns of Table 1 (columns 9 and 10) the ICP benchmark year 1996 is added. The period studied is now 1960-2000 and the data is still created in the same spirit as in DS, but with the addition of the 1985 and the 1996 benchmarks. Due to data limitations in the 1996 benchmark, this data is only derived for producer durables (including transport equipment). As described above, this is still in line with DeLong and Summers (1992, 1993).

The 1960-2000 sample is not only the largest of the samples in Table 1. That sample also makes use of the most ICP benchmark studies and the most recent version of the Penn World Tables (mark 6.1). The 1960-2000 sample should therefore be the most precise and most important of the samples in Table 1. Interestingly, the coefficient for producer durables in columns 9 and 10 are both statistically insignificant and statistically different from the coefficients in columns 1 and 2. If the coefficient for producer durables in column 9 were to be interpreted as causal; a one standard deviation increase in the producer durables share would increase the growth rate by 0.2 percentage points, a rather meager effect.

So why are the results for the 1960-2000 sample so different? If the 1960-2000 sample is reduced to only include those countries of the *large* DS sample (as in column 2 and 4, with the exception of Tunisia, West Germany, and Botswana, all due to data limitations), the coefficient for producer durables is still insignificant. If instead the 1960-2000 sample is reduced to the DS *hp* sample (as in column 1 and 2,

except West Germany) the coefficient for the producer durable share is instead positive and significant. Although this last result is sensitive to the inclusion of Uruguay, and if Uruguay is dropped the estimate is insignificant. The insignificant coefficient for producer durables in column 9 is therefore not due to strange data, but instead dependent on what sample is being used.

Figure 1 illustrates the partial scatter plot between the equipment share and income growth for the 1960-2000 hp-sample (column 9 in Table 1). More precisely the figure illustrates the component of the equipment share that is orthogonal to the GDP per worker gap, labor force growth, and the structures share, against the component of income growth which is orthogonal to the same three variables. As can be seen from the figure there is a pretty bad fit between the equipment share and income growth. Also evident is the obvious outlier Uruguay (URY).

In the creation of the 1960-1990 and the 1960-2000 samples, a number of countries which were in at least one of the benchmarks from 1970 to 1996, unfortunately had to be dropped since they simply missed observations for either real GDP per worker or labor force. An extended sample has therefore also been created where countries that miss at most 2 years of observations for these two variables have been included. However, these regressions do not change the main results and are thus not reported.

It is important to observe that the parameter estimate for the structures share (column 1) is statistically insignificant. DS argued that this is an indication of that the equipment investments are driving growth. If it were the case that income growth would cause investments, the parameter estimates for both the equipment *and* structures shares would be significant. In Table 1, the parameter estimate for the structures share is significant in column 7 (the hp-sample) and in all large samples (columns 2, 4, 6, 8, and 10). Therefore, when extending the data, the DS argument does no longer hold.

To summarize, there are two main conclusions from Table 1: Firstly, the parameter estimates for the equipment shares and producer durables share are positive in all specifications, but statistically insignificant for the 1960-2000 samples. The relationship between the equipment share and income growth is therefore no longer a robust finding in a DeLong and Summers regression set-up. Secondly, in the 1960-1990 sample (when the 1985 benchmark is added) as well as in all large samples, the parameter estimate for the structures share is positive and significant. This indicates

that income growth could be causing investments and not necessarily the other way around. The next subsection discusses the endogeneity problem further.

2.2.1 Endogeneity

Using the DeLong and Summers (1993) data on equipment shares, Sala-i-Martin (1997a, b) and Hoover and Perez (2004) found that equipment investment is one of the very few variables robustly related to income growth⁵. The average equipment share for 1960-1985 is here related to the income growth rate for 1960-1992. Sala-i-Martin (1997a, p.8) makes clear that the inclusion of “such a variable may be ‘more endogenous’ than exogenous” and that a variable measured at the beginning of a period would be preferable. Hoover and Perez (2004, p.788n) also remark that it is “ambiguous” to interpret the coefficient for equipment investment in their final specification due to endogeneity concerns. That is, although both Sala-i-Martin (1997a, b) and Hoover and Perez (2004) found equipment investment as one of the very few variables robustly related to growth, they also clearly acknowledge that their results could be due to reverse causality.

Time series studies on investments and growth put more light on this issue. Blomström et al (1996) find that growth rates cause investments, but investment shares do not cause growth rates. Carroll and Weil (1994) find a similar result between savings and growth. Podrecca and Carmeci (2001) find that causality runs in both directions. Investment shares Granger-cause growth rates, and growth rates Granger-cause investment shares. Additionally, the causality from investment shares to growth rates is in Podrecca and Carmeci (2001) found to be negative.

In DS the endogeneity concern is addressed to some degree by having the lagged investment shares for the 1960-1975 period to determine the income growth rate for the 1975-1985 period (Table VII in DS). Using the original DS data as well as reconstructing the data using PWT 5.6, the “lagged” investment regressions are presented in Table 2. In the large sample, neither the DS data nor the replicated data can show a statistically significant coefficient for the lagged equipment share or the lagged structures share. In the hp-sample, using the DS data, the parameter estimate for the lagged equipment share is positive and significant. Although, using the replicated data for the hp-sample, the coefficient for the lagged equipment share is

⁵The reference cited in Sala-i-Martin (1997a,b) is DeLong and Summers (1991), while the data is in fact from DeLong and Summers (1993).

insignificant. The replicated hp-sample is based on PWT 5.6, where Hong Kong and Japan no longer meet the requirements for being part of the hp-sample, and are therefore not included. In fact, this small change makes a difference. If Hong Kong and Japan instead are included; the parameter estimate for the lagged equipment share is positive and significant also by using the replicated data. This small exercise therefore demonstrates that the results are sensitive to small sample modifications.

Furthermore and more importantly, the lagged equipment share as constructed by DS and used in Table 2 is not really a “lagged” equipment share. The lagged equipment shares was constructed by taking the average of the ratio from equipment investment to total investment for the benchmark years 1970, 1975, and 1980, and then multiply it to the total investment share of GDP for 1960-1975. Amongst the 25 countries in the hp-sample, 10 of these countries are only part of the 1980 benchmark. For example, Hong Kong and Israel which both have a relatively large lagged equipment share and high growth are only in the 1980 benchmark. If then, for some reason, the equipment to total investment share is larger 1980 than for 1960-1975, the “lagged” equipment share for these countries would be smaller. The lagged equipment share for Hong Kong and Israel could therefore be larger than it actually should be due to the data usage. The “lagged” investment share is therefore not really a lagged investment share.

3 Motivations for Causation

As already mentioned, the crucial question with the results in DS is if equipment investment caused income growth or if it was the other way around. DS therefore presents several motivations arguing for equipment investment causing growth. This section will take a closer look at the probably most important of these motivations; the behavior of equipment prices. The argument can simply be divided into three parts: 1, equipment prices are higher in poor countries, 2, countries with lower prices have higher investment shares, and 3, countries with high investment shares have high income growth rates.

3.1 Equipment Prices

As is portrayed in Figure 2, the relative price of equipment investment is higher in relatively poor countries compared to rich. This has lead DeLong and Summers

(1991, 1993), Jones (1994) and others to conclude that in order for development to take place, the relative price of equipment has to be reduced. Therefore policy should aim at reducing trade restrictions and taxes on equipment goods. As is explained by Hsieh and Klenow (2003, 2005); although this is not untrue it is not the whole story. In order to make things clear, let us take a look at the relative price, which can be denoted as

$$R_{ij} = \frac{p_{ij}^{dom} q_{ij}}{\sum_{i=1}^m p_{ij}^{dom} q_{ij}} \bigg/ \frac{p_i^{ppp} q_{ij}}{\sum_{i=1}^m p_i^{ppp} q_{ij}} \quad (3.1)$$

where the relative price (R_{ij}) is the amount of expenditure spent on good i in country j (price times quantity; $p_{ij}^{dom} q_{ij}$) in relation to total spending ($\sum p_{ij}^{dom} q_{ij}$) (both at domestic prices), relative to the amount spent on good i in relation to total spending at international prices ($p_i^{ppp} q_{ij} / \sum p_i^{ppp} q_{ij}$) (note that prices at international PPP prices are constant across countries). Equation 3.1 therefore tells us the relation of the price *structure* of good i in country j , compared to some world average price *structure* of good i . To use the language of Kravis, Heston, and Summers (1982) equation 3.1 is maybe better referred to as the relative “price structures”, instead of the “relative price”. Alternatively, the price level as denoted in for example Penn World Tables mark 6.1 is

$$P_{ij} = \frac{PPP_{ij}}{xrate_j} = \frac{p_{ij}^{usd}}{p_i^{ppp}} \quad (3.2)$$

where P_{ij} , the price level for good i in country j , is equal to the PPP (Purchasing Power Parity) of good i for country j , divided by the exchange rate of country j in relation to US dollars. The price level for good i in country j is therefore the price for good i in country j converted to US dollars, compared to the international (PPP) price of the same good (where the international price is expressed in US dollars).

The price level (P_{ij}) therefore compares the price of a specific good to some “average” price for the same good. The relative price structure (R_{ij}), on the other hand, compares the price *structure* at domestic currency (that is the expenditure on a

specific good compared to all other goods) to the price *structure* at international prices.

Figure 3 illustrate the relation between the log equipment price level and log real GDP per worker. From the figure it is evident that investment prices are not systematically higher in relatively poor countries. On the contrary, equipment price seem somewhat higher in relatively rich countries. The reason why the relative price is negatively related to income, while the price level is not, can be easily explained. Let us consider equation 3.1 again, and simplify so that there are only two goods; investment goods and consumption goods. The relative price structure for investment goods can then be denoted as

$$R_{Ij} = \frac{p_{Ij}^{dom} q_{Ij}}{p_{Ij}^{dom} q_{Ij} + p_{Cj}^{dom} q_{Cj}} \bigg/ \frac{p_I^{ppp} q_{Ij}}{p_I^{ppp} q_{Ij} + p_C^{ppp} q_{Cj}}$$

where the subscript I stands for investment goods and C stands for consumption goods. Let us rewrite this as:

$$R_{Ij} = \frac{q_{Ij}}{q_{Ij} + \left(\frac{p_{Cj}^{dom}}{p_{Ij}^{dom}} \right) q_{Cj}} \bigg/ \frac{q_{Ij}}{q_{Ij} + \left(\frac{p_C^{ppp}}{p_I^{ppp}} \right) q_{Cj}}. \quad (3.3)$$

Assume now that we have two types of countries: rich and poor ($j=rich, poor$). As is shown in Figure 3 and Table 3; the price level for investment goods is roughly the same for poor and rich countries, whereas consumption prices (or as in Table 3 “the aggregate price level for all other goods than equipment goods”⁶) are lower in poor countries compared to rich. The results in Table 3 are perfectly reasonable. To give an intuitive explanation, it simplifies if we think of investment goods as highly internationally traded goods (for example computers), while consumption goods can be said to consist mainly of not-internationally traded goods (for example haircuts). Computers cost roughly the same in poor and rich countries, whilst the price of a haircut probably varies greatly. The fact that consumption goods in general are

⁶ Which are mostly consumption goods or modestly international traded goods.

cheaper in relatively poor countries is a well known fact and is the so called the “Penn Effect” or the “Balassa-Samuelson Effect”⁷.

To continue with the relationship between the relative price and the price level, it is useful to know that the Gheary-Khamis aggregation method, used in for example Penn World Tables to generate international PPP prices, uses weights according to aggregate quantities. This means that there will be more weight put on rich country prices relative to poor country prices. The derived international price will therefore tend to be closer to the prices in rich countries than in poor countries.⁸

With this knowledge we can do the following simplifications that $p_I^{ppp} = p_{I,poor}^{dom}$ = $p_{I,rich}^{dom}$ and $p_C^{ppp} = p_{C,rich}^{dom} > p_{C,poor}^{dom}$. The price ratio of consumption goods to investment goods will therefore for a poor country seem smaller in domestic currency than at international currency:

$$\left(\frac{p_{C,Poor}^{dom}}{p_{I,Poor}^{dom}} \right) < \left(\frac{p_{C,Poor}^{ppp}}{p_{I,Poor}^{ppp}} \right). \quad (3.4)$$

From (3.3) and (3.4) we can then see that the relative price structure will be smaller in a relatively poor country compared to a rich ($R_{Ipoor} < R_{Irich}$). This is not due to differences in investment prices across countries, on the contrary it is due to the fact that consumption prices differ.

To summarize, the equipment price is roughly the same for poor and rich countries, but the relative price is not. To use our example of computers and haircuts; a computer costs roughly the same in Tanzania as in the USA, whereas the price of a computer compared to a haircut is probably higher in Tanzania than in the USA.⁹

3.1.1 Implications for the Investment Share

Interestingly, the relation between consumption and investment prices also help to explain the relation between the investment share of GDP and GDP per worker. As is

⁷ The Penn effect is the empirical finding that consumer price levels are systematically higher in rich countries compared to poor. The Balassa-Samuelson hypothesis, from Balassa (1964) and Samuelson (1964), is one of the theories that try to explain the Penn effect, hence it is also known as the Balassa-Samuelson effect. For another explanation of the Penn effect see Bhagvati (1984).

⁸ See for example the Handbook of the International Comparison Programme (1992, page 75), or Hsieh and Klenow (2005, page 9).

⁹ For further discussion see Hsieh and Klenow (2003, 2005).

demonstrated by Hsieh and Klenow (2003, 2005), Eaton and Kortum (2001), Restuccia and Urrutia (2001), and also shown in Table 4; real investment shares measured at international prices are higher in relatively rich countries compared to poor, whilst the investment share measured at domestic prices is roughly the same for poor and rich countries. To understand why, let us again simplify so that GDP consists of two goods (investment and consumption) and two countries (rich and poor). The investment share at domestic prices for country j can then be denoted as:

$$i_j^{dom} = \frac{q_{Ij}}{q_{Ij} + \left(\frac{p_{Cj}^{dom}}{p_{Ij}^{dom}} \right) q_{Cj}}.$$

With the same reasoning as above, if $p_I^{ppp} = p_{I,poor}^{dom} = p_{I,rich}^{dom}$ and $p_C^{ppp} = p_{C,rich}^{dom} > p_{C,poor}^{dom}$ are approximately true, the relation between relative prices in (3.4) will still be valid. This implies that for a poor country the investment share will be smaller at international prices than at nominal prices ($i_{poor}^{ppp} < i_{poor}^{dom}$). This difference is not due to differences in quantities or investment prices, but simply due to differences in consumption prices. We will return to this important result in section 4.

3.2 Equipment Prices and the Investment Share

Section 3.1 above shows that investment goods are not more expensive in poor countries compared to rich. The next part of the DS argument state that; low equipment prices is associated with high equipment shares which in turn is associated with high income growth rates. This proposition can easily be tested in an instrumental variables framework. The identification strategy is to regress income growth on labor force growth, the GDP per worker gap, the structures share, and the equipment share, where the equipment share is being instrumented by the equipment price level (P_{ij}).

In order to use the most accurate data available, the ICP benchmark data on equipments, structures, and prices is used. The data is from the years 1975, 1980, 1985 and 1996, where there are large cross sections of countries available. The

equipment share for 1975 is then used to explain the income growth rate from 1975 until 1980, and similarly for the other years. Table 5 reports the results.

Interestingly, in the first stage regressions, the coefficient for the equipment price is negative and, most of the time, statistically significant. This means that although there are little differences between equipment prices in poor and rich countries, those countries that do have lower equipment prices indeed seem to have higher equipment shares. However, focusing on the second stage regressions, the equipment shares do not seem to be related to the income growth rate. The coefficients for the equipment share are statistically insignificant in all columns except for when the 1980 benchmark is used.

To summarize: Investment prices are not systematically higher in poor countries compared to rich, consumption price are. Those countries that do have lower investment prices than average seem to have higher investment shares, although these higher investment shares are not found to be boosting growth.

4 Total Factor Productivity Growth

In the regressions above, we are trying to test whether countries with a high level of investment have on average a high income growth rate. According to the Solow (1956) growth model there should be no such relation due to diminishing returns to capital. The implicit assumption made in DeLong and Summers (1991, 1992, 1993) is instead that there are additional benefits to capital accumulation, or as it is written in DeLong and Summers (1992, p.184): “The correlation of equipment investment and output per worker growth implies an equally strong and almost as large a correlation between equipment investment and TFP growth.” The intuition is that although there might be diminishing returns to capital accumulation, the accumulation in itself will teach us something more about the production process, and this “learning by doing” (or learning by investing) will help us use the capital more effectively and therefore be an important determinant of Total Factor Productivity (TFP). Investment would then be a determinant of sustained long run growth, and is in line with for example the $Y = AK$ -model.¹⁰

¹⁰ See for example Barro and Sala-i-Martin (1999), and Romer (2001, ch: 1, 3)

Since the robust relation found between investment and growth in DeLong and Summers (1991), Levine and Renelt (1992), Sala-i-Martin (1997a,b), Hoover and Perez (2004) focus on the income growth rate, it is hard to single out if the robust correlation between investments and income growth is due to transition dynamics or if investments actually have an effect on the growth rate of TFP. In order to analyze if investments give sustained income growth, one should instead study the relation between the investment share and the TFP growth rate. This is the approach adopted by DeLong and Summers (1992, 1993) and Bernanke and Gürkaynak (2001). The average real investment shares are in these three studies found to be both economically and statistically related to the TFP growth rate.

As will be discussed below, the results in DeLong and Summers (1992, 1993) as well as Bernanke and Gürkaynak (2001) may both suffer from reverse causality. The relationship between investments and TFP growth rates are still at the very heart of the discussion whether investments are causing income growth. Therefore, I will in this paper try to examine whether investments are related to TFP growth. In order to do this, there are some important data as well as methodological issues that first should be discussed.

4.1 Data and Methodology

Following DeLong and Summers (1992, 1993) closely, the TFP growth rate will be regressed on the equipment share, the structures share, labor force growth, and the GDP gap. But apart from what variables to include there are some important difficulties in the DeLong and Summers regression set-up which should be taken into account.

The first and maybe most obvious of these difficulties is the endogeneity problem (as was dealt with in section 2.2.1). In DeLong and Summers (1992, 1993) and Bernanke and Gürkaynak (2001) the average equipment share is related to the income growth rate for the same period. Their results are therefore ambiguous to interpret in a causal way.

A second difficulty is the measurement of the equipment share. In DS, the average equipment share is made up of ICP benchmark data and total investment shares. As DeLong and Summers (1992, p.161n) themselves comments, this construction heavily relies on the ratio of equipment investment to total investment in

the benchmark years as being good proxies for the average ratio of equipment to total investment.¹¹

To address these two difficulties, endogeneity and measurement, this paper takes a more direct and straightforward approach. By using the ICP benchmark data for benchmark countries and years, we make use of the best possible data available. As is explained earlier, this data is only available about every fifth year. In order to try to reduce the endogeneity problem, the equipment share for 1970 is then used to explain the TFP growth rate from 1970 until 1975, and similarly for the other years. In order to make things clear, the identification strategy is to have the average annual TFP growth rate for the period 1970-1975 regressed on the equipment share 1970, the structures share 1970, the labor force growth rate 1970-1975, and the GDP per worker gap 1970. Furthermore, in order to control for time effects as well as possible country heterogeneity, the data is formed into panel.

The ICP benchmarks that are used are 1970, 1975, 1980, 1985, and 1996, which are related to the TFP growth for the time period 1970-75, 1975-80, 1980-85, 1985-90, and 1996-2001, respectively. The data is then divided into two samples, one for equipment shares stretching from 1970-1990, and one for producer durables stretching from 1970-2001 (once again this sample division is due to that for 1996 the data is only available for producer durables).

Since there is a restricted number of countries in the ICP benchmarks, a third sample is also created, with as many countries as possible, based on data from World Development Indicators. Due to data limitations the fixed investment share is used for this third sample. Since the fixed investment shares consists both of producer durables and structures investment, we no longer study the difference between these two types of investment. On the positive side, there is no longer a restriction of only benchmark countries and years and the sample stretches from 1970 to 2000, using investment data for the years 1970, 1975, 1980, 1985, 1990, and 1995.

The following sections further discuss measurement, followed by a description of the growth accounting and the panel data method applied.

¹¹ DeLong and Summers (1992) therefore estimate the equipment share based on, among other things, import data. Still this data is also a rough estimation.

4.1.1 Real or Nominal?

DeLong and Summers (1991, 1992, 1993) and, to my knowledge, most other studies use the real equipment share, which is the equipment investment share of GDP, both measured at international PPP adjusted prices. The reason why is straightforward: As we saw in section 3, prices across countries vary, especially for non-traded consumption goods. Therefore, when comparing the GDP of two countries, the comparison is made more transparent if the expenditures are valued at common international prices. A comparison between the two countries would then not be influenced by the relative price level in the two countries, but rather more a comparison of quantity.

However, as we saw in section 3 and what is portrayed in Hsieh and Klenow (2005), the real equipment share is higher in relatively rich countries compared to poor, while the nominal equipment shares are not. That is, looking at domestic prices, poor countries do not spend less on investment goods compared to their income than rich countries. So which ones of these equipment shares should we use, the real (at international prices) or the nominal (at domestic prices)? The answer to that question depends on what we mean by “investment effort”. A simplified view to interpret the real equipment share is that it is more a matter of looking at quantity. When comparing an equipment share for two countries valued at the same *real* prices, it is more a question of comparing how many investment goods compared to all other goods one country has in comparison to the other. The *nominal* equipment share is instead a pure expenditure measure. That is, based on the countries actual income, valued at domestic prices, how much is spent on investment goods. Remember then that this investment share is determined at the prevailing actual domestic prices, which is what investors actually face and base their decision on. So although equipment goods are *relatively* more expensive in poor countries, the nominal equipment shares are still approximately the same as in rich countries. Does this mean that their investment effort is the same?

If there is indeed a “learning by investing” effect, as is the implicit assumption for why investment should cause growth, then do we learn by having many machines (looking at real shares), or could it be the case that if the machine is relatively more expensive (nominal shares), more care will be put into the machine and therefore more will be learnt? This paper examines both alternatives. The use of nominal

investment share in a cross country growth regression is, to my knowledge, a novelty in the literature.

4.1.2 Growth Accounting

In order to save space and time, the reader is referred to the data appendix for a more explicit explanation of the growth accounting procedure used. This section only presents the most interesting features.

The crucial questions in growth accounting are how to get estimates for K (the capital stock) and α (the capital share). The estimation of K follows closely to the growth accounting procedure implemented in Bernanke and Gürkaynak (2001)(see data appendix). The value for α is set to a value of one third. Overall, a value for the capital share around one third is common in the literature. Solow (1957) finds that the US capital share is about one third. Bernanke and Gürkaynak (2001) view the value 0.35 for α , as reasonable based on estimated labor shares. Instead of assigning a value for α , an alternative approach would be to simply run a regression with the growth rate of Y as the dependent variable, the growth rate of capital and labor as independent variables and the TFP growth rate as the residual. The estimated TFP growth rate using the regression approach is remarkable similar to the calculated TFP growth rate and yields a correlation coefficient of 0.9. The calculated TFP growth rate using $\alpha = 1/3$ is the one used in the panel.

4.1.3 Panel Data Methodology

If we choose to believe that TFP growth is highly individual and dependent on some unobservable country individual characteristic, a panel data approach gives us the opportunity to control for this possibility. However, the investment share does not exhibit much variation over time. Although the Hausman test suggest the fixed effects estimator, it would probably only exaggerate the measurement error. A fixed effects approach is therefore not appropriate¹². Instead, a short-cut method recently proposed by Collier and Hoeffler (2005) has been used. Collier and Hoeffler (2005) exhibit the

¹² If a fixed effects model is implemented anyway there is an interesting result; the coefficient estimate for the investment share is negative and significant. Since the investment share exhibit little variation over time, the fixed effects estimator will then only exaggerates the measurement error. These results could be interpreted as countries with larger measurement error exhibits slower TFP growth than countries with less measurement error.

same kind of problem as is faced in this paper; a cross country panel dataset with little change over time. The proposed method consists of running three regressions on the panel data set, but only including one third of the country dummies at a time. Based on these three regressions, those country dummies which were significantly different from zero (at the ten percent significance level) were included in a fourth final regression (where correlation within clusters has been adjusted¹³).

This proposed short-cut method makes intuitive sense. In a cross country regression setting with a constant intercept and the same slope parameters, we will force a common structure on the countries in the sample. It is reasonable to believe that the large part of these countries approximately has indeed got some sort of common structure, but yet there will probably also be some individual heterogeneity as well. The proposed method used by Collier and Hoeffler (2005) will still force a common structure on the countries in the sample, but at the same time allow for some country heterogeneity as well.

4.2 Results

Tables 6 and 7 report the TFP growth panel data regressions for the high productivity and the larger sample, respectively. Both Table 6 and 7 contain five regressions using three different samples. The first two regressions are for the real and nominal *equipment* share, for the 1970-1990 sample. The following two regressions are for the real and nominal *producer durables* share, for the 1970-2001 sample. The fifth and last regression is for the extended sample where the nominal fixed investment share is used. All regressions include time fixed effects. The countries that are controlled for in each regression are noted below the table.

In Table 6 row 1, we can see that the parameter estimate for the real equipment share is positive and statistically significant at the 10 percent level (p-value=0.071). This estimate can be interpreted as if the equipment share increase by one percentage point, the growth rate of TFP would increase by 0.13 percentage points, which is a large effect and is similar to the findings in DeLong and Summers (1992, Table 11). However, the regression in Table 6 row 1 is sensitive to the inclusion of one observation; Uruguay 1980. If Uruguay is dropped from the sample (or controlled for) the parameter estimate for the real equipment share is insignificant. Figure 4 illustrate

¹³ Estimation done in STATA version 8. See Rogers (1993) and Froot (1989).

the partial scatter plot between the equipment share and the growth rate of TFP, holding the GDP per worker gap, labor force growth, and the structures shares constant. From figure 4 we can see that Uruguay is an influential outlier. In the following samples, Uruguay is not uncommonly singled out to be one of the countries that are to be controlled for in the final regression. Furthermore, if the observations with the most extreme TFP growth rate ($|TFP \text{ growth}| > 0.05$) are excluded from the sample, Uruguay is automatically excluded and the parameter estimate for the equipment share is insignificant.

In the remaining regressions in Table 6, the coefficients for the nominal equipment share, the real producer durables share, the nominal producer durable share, and the nominal fixed investment share are all statistically insignificant. Additionally, the coefficient for the producer durables shares and the fixed investment share are all negative. These results also hold when excluding the observations with the most extreme TFP growth rates.¹⁴

The insignificance of the real producer durables share is interesting. The only differences between the regression with the real equipment share and the producer durables share is the inclusion of transport equipment, and one more benchmark year (1996, due to data limitations). If the year 1996 is dropped from the analysis, the coefficient is still negative and insignificant.¹⁵

If we take a look at the other variables in the Table 6; the coefficient for the structures shares are interestingly negative in all four regression and statistically significant in three. More investment in structures therefore seems to be negatively related to TFP growth. This result was also found by DeLong and Summers (1993). The coefficient for labor force growth is negative and significant in all regressions, which follows naturally from the growth accounting $[-(1-\alpha) = -0.66]$.

Moving on to Table 7 with the larger sample, a similar picture awaits us. The equipment share is insignificant in all but for one specification; the nominal equipment share ($p\text{-value}=0.089$). Once again Uruguay plays an important role, and if Uruguay is dropped from the sample the parameter estimate for the nominal equipment share is insignificant. Structures again seem to be negatively related to TFP growth, although only statistically significant in one of the specifications.

¹⁴ Excluding observations where the absolute TFP growth rate is in excess of 0.05. Nominal fixed investment share then becomes negative and significant, which is probably due to the structures share. Results are not shown but available upon request.

¹⁵ These results also hold for the exclusion of Singapore, which is an obvious outlier.

To summarize the results from Table 6 and 7, there are no strong evidence for investment, however defined, having a statistical robust relation to TFP growth. On the contrary, structures investments are in some regressions found to be retarding TFP growth.

5 Conclusions

This paper examines new empirical evidence on whether the “stylized” fact that equipment investment is an important determinant for income growth is still valid. Following closely in the footsteps of DeLong and Summers (1991), both variables and regression equations have been replicated as closely as possible to the DeLong and Summers set-up. Nonetheless, using more recent data, equipment investment is no longer found to be a robust correlate to income growth.

An often argued cause for differences in income across countries is the behavior of investment prices. Similar to Hsieh and Klenow (2005), this paper shows that the price levels in relatively poor countries are not systematically higher than in relatively rich countries. Although, countries that do have lower investment prices are found to have higher investment shares, but these investment shares are not found to be promoting growth.

The findings in DeLong and Summers (1991, 1992, 1993) all imply that there are additional benefits of investment, a sort of “learning by investing” effect, which is the prime reason of why equipment investment should be a strong promoter of income growth. This prediction can easily be tested by studying TFP growth rates. Using the best possible data on real as well as nominal equipment shares and producer durables; the investment share is not found to be a robust correlate to TFP growth. Instead, similar to DeLong and Summers (1993) structures investment seems to be retarding TFP growth.

This paper therefore repeatedly fails to confirm the stylized fact that equipment investment is a robust correlate to income growth. This finding is not controversial, it is in fact perfectly in line with the predictions of the Solow growth model. The findings in this paper therefore suggest that although investment is important, the benefits from investments are probably not as large as they often are portrayed to be. Policy that aims at promoting income growth should therefore not have an overemphasis on the importance of equipment investment.

References

- Abel, Andrew B. (1992), "Comments and Discussion." *Brookings Papers on Economic Activity*, Vol. 1992, No. 2:200-211.
- Auerbach, Alan J., Hasset, Kevin A., and Stephen D. Oliner. (1994), "Reassessing the Social Returns to Equipment Investment." *Quarterly Journal of Economics*, Vol. 109, No.3:789-802.
- Barro, Robert J., and Xavier X. Sala-i-Martin. (1995), *Economic Growth*, MIT Press,
- Barro, Robert J. (1998), "Notes on Growth Accounting", Harvard University Mimeo. <http://post.economics.harvard.edu/faculty/barro/papers/p_accounting.pdf>
- Bernanke, Ben S., and Refet S. Gurkaynak (2001), "Is Growth Exogenous? Taking Mankiw, Romer, and Weil Seriously." in: B.S. Bernanke, and Kenneth Rogoff, eds, NBER Macroeconomics Annual 2001, MIT Press, Cambridge.
- Blomström, Magnus., Robert E. Lipsey and Mario Zejan. (1996), "Is Fixed Investment the Key to Economic Growth?" *Quarterly Journal of Economics* Vol. 111, No. 1 (Feb), 269-276.
- Carrol, Christopher D. and David N. Weil (1994), "Savings and growth: a reinterpretation." *Carnegie-Rochester Conference Series on Public Policy* 40, 133-192.
- Collier, Paul., and Anke Hoeffler. (2005), "Democracy and Resource Rents." University of Oxford (August 2005), Presented at Göteborg Univeristy September 2005.
- Collins, S. M., and B. Bosworth. (1996). "Economic growth in East Asia: Accumulation versus assimilation." *Brooking Papers on Economic Activity*, 1996(2):135-191.
- Data Appendix for Space-Time System of National Accounts: Penn World Table 6.1 (PWT 6.1) <<http://pwt.econ.upenn.edu/Documentation/append61.pdf>>
- DeLong, J. Bradford., and Lawrence H. Summers (1990), "Equipment Investment and Economic Growth." *NBER Working Papers Series*, No. 3515.
- DeLong, J. Bradford., and Lawrence H. Summers (1991), "Equipment Investment and Economic Growth." *Quarterly Journal of Economics*, Vol. 106, No. 2 (May), 445-502.
- DeLong, J. Bradford., and Lawrence H. Summers. (1992), "Equipment Investment and Economic Growth: How Strong is the Nexus?" *Brookings Papers on Economic Activity*, Vol. 1992, No. 2:157-211.

- DeLong, J. Bradford., and Lawrence H. Summers. (1993), "How Strongly do developing economies benefit from equipment investment?" *Journal of Monetary Economics*, Vol. 32:395-415.
- DeLong, J. Bradford., and Lawrence H. Summers. (1994), "Equipment Investment and Economic Growth: Reply." *Quarterly Journal of Economics*, Vol. 109, No. 2: 803-807.
- Eaton, Jonathan., and Samuel Kortum. (2001), "Trade in capital goods." *European Economic Review* 45, 1195-1235.
- Easterly, William., and Ross Levine. (2001), "It's Not Factor Accumulation: Stylized Facts and Growth Models." *The World Bank Economic Review*, Vol. 15, No. 2: 177-219.
- Easterly, William., (2001), *The Elusive Quest for Growth: Economists' Adventures and Misadventures in the Tropics*, The MIT Press, Cambridge, Massachusetts.
- Froot, K.A. (1989), "Consistent covariance matrix estimation with cross-sectional dependence and heteroskedasticity in financial data." *Journal of Financial and Quantitative Analysis* 24: 333-355.
- Handbook of the International Comparison Programme*. United Nations, New York, 1992
- Heston, Alan., Robert Summers and Bettina Aten, Penn World Table Version 6.1, Center for International Comparisons at the University of Pennsylvania (CICUP), October 2002.
- Hoover, Kevin D., and Stephen J. Perez., (2004), "Truth and Robustness in Cross-country Growth Regressions." *Oxford Bulletin of Economics and Statistics*, 66, 5(2004), 0305-9049.
- Hsieh, Chang-Tai., and Peter J. Klenow (2003), "Relative Prices and Relative Prosperity." NBER Working Paper No. 9701
- Hsieh, Chang-Tai., and Peter J. Klenow. (2005), "Relative Prices and Relative Prosperity." Stanford University Mimeo, September.
<<http://www.klenow.com/RPandRP.pdf>>
- Hulten, Charles R. (2000), "Total Factor Productivity: a short Biography", NBER Working Paper Series, Working Paper 7471. <<http://www.nber.org/papers/w7471>>
- Levine, Ross and David Renelt. (1992), "A Sensitivity Analysis of Cross-Country Growth Regressions." *American Economic Review*, Vol. 82, No. 4 (Sep.), 942-963.
- Podrecca, Elena and Gaetano Carmecchi. (2001), "Fixed investment and economic growth: new results on causality." *Applied Economics*, Vol. 33, 177-182.

PWT6 Technical Documentation.<<http://pwt.econ.upenn.edu/Documentation/Doc-tech.pdf>>

Rogers, W. H. (1993), "Regression standard errors in clustered samples." *Stata Technical Bulletin* 13: 19-23.

Romer, David. (2001), *Advanced Macroeconomics*, 2-nd edition, McGraw-Hill, Boston.

Sala-i-Martin, Xavier X. (1997a), "I Just Ran Four Million Regressions." NBER Working Paper 6252 (November).

Sala-i-Martin, Xavier X. (1997b), "I Just Ran Two Million Regressions." *American Economic Review*, Vol. 87, No. 2, Papers and Proceedings of the Hundred and Fourth Annual Meeting of the American Economic Association, p. 178–183.

Solow, Robert M. (1956) "A Contribution to the Theory of Economic Growth." *Quarterly Journal of Economics*, Vol. 70 No. 1: 65-94.

Solow, Robert M. (1957), "Technical Change and the Aggregate Production Function", *The Review of Economics and Statistics*, Vol. 39, No. 3: 312-320.

Summers, Robert, and Alan Heston (1990), "The Penn World Table V." University of Pennsylvania xerox

Summers, Robert and Alan Heston (1991), "The Penn World Tables (Mark 5): An Expanded Set of International Comparisons, 1950-1988." *Quarterly Journal of Economics*, Vol. 106, No. 2 (May), 327-368.

Table 1
Replication and Extension of the Main Results in DeLong and Summers (1991)
Dependent Variable: Real GDP per worker growth

	1960-1985 sample, using the 1970-75-80 benchmarks						1960-1990 sample, 1970-75-80-85 benchmarks		1960-2000 sample, 1970-75-80-85-96 benchmarks	
	Original DeLong and Summers (1991) data		Replicated data, same sample		Replicated data, new sample ^a		hp	large	hp	large
	hp	large	hp	large	hp	large				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Equipment share ^b	0.3373*** (0.0538)	0.2653*** (0.0654)	0.3216*** (0.0773)	0.2554*** (0.0763)	0.2565*** (0.0711)	0.2421*** (0.0756)	0.2115*** (0.0615)	0.1586** [0.0695]	0.0674 (0.0564)	0.0355 [0.0607]
Structures share ^c	-0.0147 (0.0328)	0.0623* (0.0349)	0.0559 (0.0569)	0.1234*** (0.0369)	0.0755 (0.0467)	0.1300*** (0.0375)	0.0786* (0.0403)	0.1283*** [0.0352]	0.0533 (0.0396)	0.1446*** [0.0270]
Labor Force growth	-0.0004 (0.1463)	-0.0296 (0.1986)	-0.1321 (0.1681)	-0.1045 (0.1798)	-0.2724* (0.1425)	-0.1114 (0.1790)	-0.3955*** (0.1284)	-0.3195** [0.1500]	-0.6372*** (0.1369)	-0.6500*** [0.1383]
GDP/wkr gap 1960	0.0305*** (0.0088)	0.0202** (0.0092)	0.0404*** (0.0087)	0.0436*** (0.0083)	0.0281*** (0.0086)	0.0447*** (0.0080)	0.0246*** (0.0067)	0.0349*** [0.0064]	0.0234*** (0.0065)	0.0226*** [0.0059]
<i>n</i>	25	61	25	61	23	64	28	72	35	78
<i>R</i> ²	0.7179	0.3381	0.6944	0.4497	0.6867	0.4752	0.7221	0.4593	0.6444	0.5159

Notes: The superscript *** denotes significant at the 1% level, ** significant at the 5% level, * significant at the 10% level. Standard errors in (), robust standard errors in [], Robust standard errors have been used if the null-hypotheses of no heteroscedasticity according to Whites test could be rejected. Each regression includes a constant, but is not reported. hp denotes a high productivity sample where the ratio between the GDP/wkr in country *i* and the GDP/wkr 1960 in the U.S. is larger than 0.25. For further information see text and data appendix. Rows (1) until (6) has the income growth rate for the 1960-1985 period, labor force growth rate, and average investment shares for the same period. The other samples are constructed in a similar manner with the difference of considering the 1960-1985 period and the 1960-2000 period.

a: The difference from the DeLong and Summers (1991) sample is the addition of Romania, Syria, and Yugoslavia.

b: Electrical and non-electrical machinery. For the 1960-2000 sample producer durables (equipment + transport equipment) has been used due to data limitations.

c: Structures and Transport equipment. For the 1960-2000 sample only structures.

Table 2
Lagged Investment
Dependent Variable: Real GDP per worker growth rate 1975-1985

	Original Delong and Summer (1991) data		Replicated data, new samples	
Independent Var.	Hp-sample	Larger sample	Hp-sample	Larger sample
Equip. share 1960-75	0.3903*** (0.0965)	0.1304 (0.1016)	0.1271 (0.1171)	0.0286 [0.1688]
Non-equip. share 1960-75	0.0272 (0.0515)	-0.0455 (0.0368)	0.0797 (0.0597)	0.0211 [0.0569]
Labor Force Growth 1975-80	-0.0558 (0.2637)	-0.4297 (0.3403)	-0.6473*** (0.2199)	-0.5498 [0.3428]
GDP/wkr Gap 1975	0.0176 (0.0154)	0.0088 (0.0129)	0.00181 (0.0156)	0.0205 [0.0164]
R^2	0.5407	0.0737	0.5664	0.0678
n	25	61	23	64

Notes: Standard errors in (), robust standard errors in []. *** significant at the 1% level, ** 5% level, * at the 10 % level. Intercept included but not reported. HP-sample in replicated data excludes Hong Kong and Japan. The lagged equipment shares was constructed by taking the average of the ratio from equipment investment to total investment for the benchmark years 1970, 1975, and 1980, and then multiply it to the total investment share of GDP for 1960-1975. The correlation between the original DS lagged equipment share and the replicated is 0.87 for the large sample and 0.93 for the hp-sample.

Table 3
Relative Equipment Prices vs. Equipment Prices
Independent variable: log PPP GDP per worker

Dependent var.	1975	1980	1985	1996 ^a
Log Relative equipment price	-0.3933*** (0.0539) R ² =0.6244	-0.2152*** (0.0503) R ² =0.2367	-0.3806*** (0.0425) R ² =0.5645	-0.4055*** [0.0420] R ² =0.5288
Log Equipment price	-0.0319 (0.0344) R ² =0.0262	0.0125 (0.0379) R ² =0.0018	-0.0505 [0.0337] R ² =0.0213	0.0517 [0.0335] R ² =0.0209
Log Agg. Price level of all other goods than equipment	0.3858*** [0.0606] R ² =0.5587	0.2381*** [0.0435] R ² =0.3101	0.3449*** [0.0486] R ² =0.4787	0.4924*** [0.0581] R ² =0.5164
n	34	61	64	114

Notes: Standard errors in (), robust standard errors in []. *** significant at the 1% level, ** 5% level, * at the 10 % level. See text for further information.

a: Price for producer durables. Aggregate price is then the aggregate price level of all other goods than producer durables.

Table 4
Real vs. Nominal Investment shares
Independent variable: log PPP GDP per worker

Real Shares				
Dependent Var.	1975	1980	1985	1996
Real equipment share	0.0150*** (0.0051) R ² =0.2158	0.0129*** (0.0038) R ² =0.1603	0.0191*** (0.0024) R ² =0.5082	N.A.
Real producer durables share	0.0194*** [0.0047] R ² =0.2230	0.0173*** [0.0045] R ² =0.1979	0.0273*** (0.0029) R ² =0.5946	0.0253*** (0.0044) R ² =0.2265
Nominal Shares				
	1975	1980	1985	1996
Nom. equipment share	-0.0077* [0.0045] R ² =0.0780	0.0030 (0.0028) R ² =0.0192	0.0051* (0.0030) R ² =0.0431	N.A.
Nom. producer durables share	-0.0139* [0.0073] R ² =0.1322	0.0022 [0.0037] R ² =0.0068	0.0058 (0.0037) R ² =0.0375	-0.0041 (0.0060) R ² =0.0041
<i>n</i>	34	61	64	114

Notes: Standard errors in (), robust standard errors in []. *** significant at the 1% level, ** 5% level, * at the 10 % level. Producer durables are equipment plus transport equipment.

Table 5
IV-Regression, Lagged Equipment Investment
Dependent Variable: Real GDP per worker growth

	High Productivity Sample				Large Sample			
benchmarks	1975	1980	1985	1996	1975	1980	1985	1996
	Second Stage				Second Stage			
Est. Initial Equip. share	0.2595 (0.3311)	0.6377*** (0.2285)	-0.5135 (1.1083)	0.0964 (0.1320)	0.8820 (0.6925)	0.3928* (0.2139)	0.3300 (0.5762)	1.1611 (1.9562)
Initial Struct. share	-0.4926** (0.1792)	0.0117 (0.0744)	0.3033* (0.1763)	-0.0699 (0.0622)	-0.4920* (0.2444)	-0.0329 (0.0691)	0.0730 (0.1312)	-0.0238 (0.1012)
Labor Force Growth	-0.8183 (0.4921)	0.0070 (0.4768)	-2.0333* (1.1354)	-0.5462* (0.3034)	-0.1644 (0.7402)	-0.8305** (0.3707)	-1.1828*** (0.2134)	-2.1976 (2.2470)
GDP/wkr Gap	0.0426 (0.0248)	-0.0070 (0.0177)	0.0218 (0.0334)	-0.0030 (0.0137)	0.0412 (0.0284)	0.0216 (0.0155)	0.0437 (0.0288)	0.1217 (0.2076)
	First Stage				First Stage			
Log Equip. price.	-0.1034*** (0.0262)	-0.0651*** (0.0145)	-0.0317 (0.0228)	-0.1302*** (0.0456)	-0.0541** (0.0210)	-0.0562*** (0.0107)	-0.0202*** (0.0064)	-0.0084 (0.0125)
n	22	38	28	44	34	61	55	104

Notes: The superscript *** denotes significant at the 1% level, ** significant at the 5% level, * significant at the 10% level. Standard errors in (). Estimation is done by 2SLS, where $I_{eq}/Y = \alpha_0 + \alpha_1(\log equip.price) + \alpha_2(n) + \alpha_3(gap) + \alpha_4(I_{st}/Y) + e$, $growth = \beta_0 + \beta_1(est.I_{eq}/Y) + \beta_2(I_{st}/Y) + \beta_3(n) + \beta_4(gap) + v$. For 1975, growth is the income growth rate 1975-1980, n is the labor force growth for the same period, gap is the GDP per worker gap 1975, I_{eq}/Y and I_{st}/Y is the equipment share 1975, and log equip. price is the log equipment price 1975. The other benchmark years has a similar set-up. Due to data limitations in PPP GDP per worker and labor force, some countries are excluded. For 1985 these are: The Bahamas, Barbados, Botswana, Ethiopia, Nepal, St. Lucia, Suriname, Swaziland, and Tanzania. For 1996: Antigua and Barbuda, The Bahamas, Bermuda, Dominica, Grenada, Israel, Qatar, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines.

Table 6
TFP Growth Panel Data Regressions, High Productivity Sample
Dependent Variable: TFP growth rate

	GDP/wkr gap	Labor fce. growth	Equipment share	Structures share.	Sample (cluster)	R^2
(1) Real equipment share	-0.0043 (0.0062)	-0.8484*** (0.1634)	0.1394* (0.0750)	-0.0974 (0.0619)	78 (36)	0.7189
(2) Nominal Equipment share	0.0043 (0.0078)	-0.7971*** (0.1645)	0.0212 (0.0964)	-0.1184* (0.0600)	78 (36)	0.6972

	GDP/wkr gap	Labor fce. growth	Prod dur. share	Structures share	Sample (cluster)	R^2
(3) Real Prod. Durables share	-0.0036 (0.0047)	-0.6655*** (0.1287)	-0.0438 (0.0382)	-0.0665* (0.0333)	120 (48)	0.6642
(4) Nom. prod. Durables share	0.0040 (0.0049)	-0.6771*** (0.1244)	-0.0365 (0.0532)	-0.0717** (0.0304)	120 (48)	0.6577

	GDP/wkr gap	Labor fce. growth	Nominal Fixed investment share	Sample (cluster)	R^2
(5) Nom. Fixed investment. share	0.0045 (0.0048)	-0.319*** (0.098)	-0.0283 (0.0244)	259 (66)	0.3747

Notes: *** significant at the 1% level, ** 5% level, * at the 10 % level. Time fixed effects included.
Robust standard errors in (), adjusting for within cluster correlation. Data on nominal fixed investment share, PPP GDP per worker gap, and labor force data are all from World Development Indicators 2004.
(1) The following countries have been controlled for: Argentina, Colombia, Hong Kong, Republic of Korea, Luxembourg, Mexico, New Zealand, El Salvador.
(2) Argentina, Hong Kong, Republic of Korea, Luxembourg, New Zealand, El Salvador, Uruguay.
(3) Argentina, Hong Kong, Ireland, Republic of Korea, Luxembourg, Mexico, El Salvador, Uruguay, Venezuela.
(4) Argentina, Hong Kong, Ireland, Republic of Korea, Luxembourg, Mexico, El Salvador, Hungary, Venezuela.
(5) Hong Kong, Ireland, Kuwait, Luxembourg, Latvia, Malta, Nicaragua, Peru, Singapore, El Salvador, Venezuela.

Table 7
TFP Growth Panel Data Regressions, Large Sample
Dependent Variable: TFP growth rate

	GDP/wkr gap	Labor fce. growth	Equipment. share	Structures share.	Sample (cluster)	R^2
(1) Real equipment share	0.0056 (0.0071)	-0.4933*** (0.1723)	0.1442 (0.0902)	-0.0118 (0.0480)	144 (71)	0.6188
(2) Nominal Equipment share	-0.0061 (0.0052)	-0.5901*** (0.1697)	0.1581* (0.0918)	-0.1107* (0.0615)	144 (71)	0.6322

	GDP/wkr gap	Labor fce. growth	Prod dur. share	Structures share	Sample (cluster)	R^2
(3) Real Prod. Durables share	0.0048 (0.0058)	-0.5984*** (0.1378)	0.0065 (0.0286)	-0.0188 (0.0272)	240 (109)	0.5240
(4) Nom. prod. Durables share	0.0061 (0.0043)	-0.5953*** (0.1397)	-0.0162 (0.0184)	-0.0214 (0.0303)	240 (109)	0.5339

	GDP/wkr gap	Labor fce. growth	Nom.Fixed investment share	Sample (cluster)	R^2
(5) Nom. Fixed investment share	-0.0036 (0.0040)	-0.1287 (0.1384)	-0.0031 (0.0133)	574 (140)	0.3653

Notes: *** significant at the 1% level, ** 5% level, * at the 10 % level. Time fixed effects included. Robust standard errors in (), adjusting for possible within cluster correlation. The following countries have been controlled for in each of the samples:

(1) Botswana, Kenya, St. Lucia, Luxembourg, Pakistan, Rwanda, Sierra Leone, Swaziland, Thailand.

(2) Botswana, Grenada, Guatemala, Kenya, Republic of Korea, St. Lucia, Pakistan, Sierra Leone, Swaziland, Thailand.

(3) Argentina, Belarus, Botswana, Georgia, Kazakhstan, Luxembourg, Latvia, Rwanda, Sierra Leone, El Salvador, Swaziland, Tajikistan, Uruguay.

(4) Argentina, Belarus, Botswana, Georgia, Ireland, Kazakhstan, Luxembourg, Latvia, Rwanda, Sierra Leone, El Salvador, Swaziland, Trinidad and Tobago, Uruguay.

(5) Burundi, Belarus, Botswana, China, Georgia, Haiti, Ireland, Kuwait, Malta, Nicaragua, Rwanda, Singapore, Sierra Leone, Tajikistan, Venezuela, Democratic Republic of the Congo.

Figure 1: Partial Scatter Plot (regression 9, Table 1)

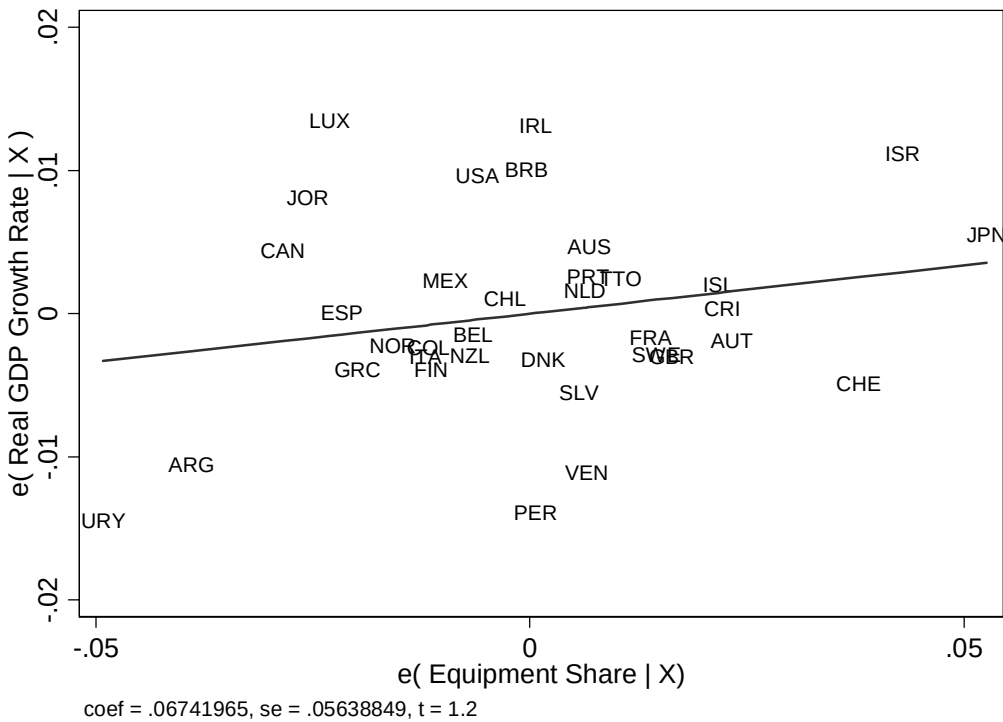
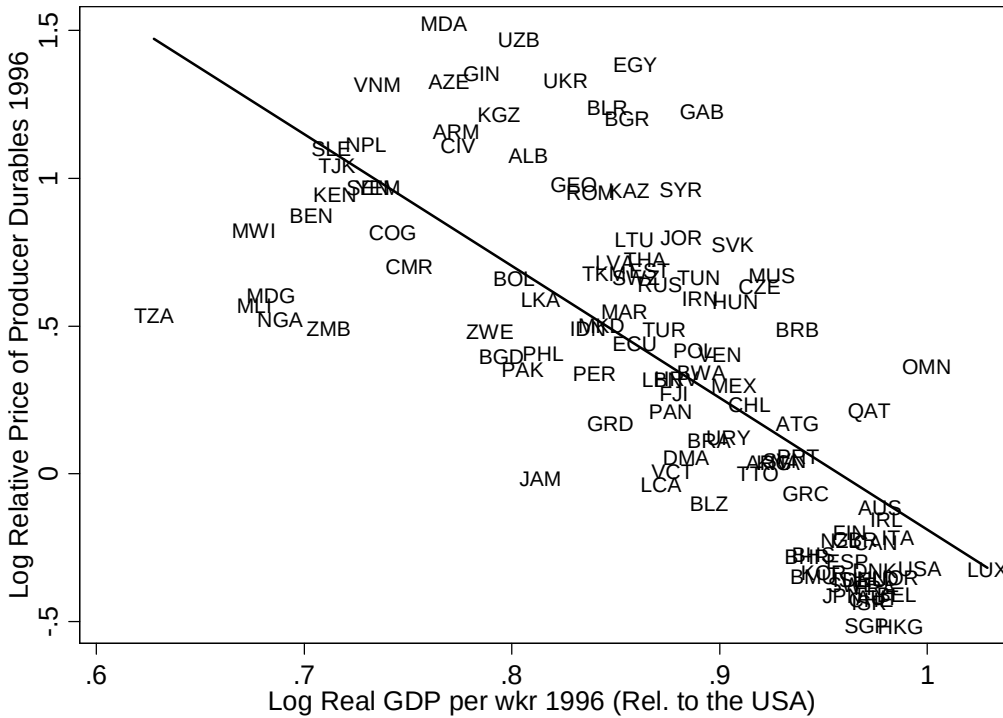


Figure 2: Relative Price of Equipment vs. Income 1996



[illegible]

Scatter plot showing the relationship between the Real Equipment Investment Share (X) and the TFP Growth Rate (Y). The plot includes a positive linear regression line and numerous data points labeled with country codes. The regression coefficient is 0.13940066, with a standard error of 0.07499384 and a t-statistic of 1.86.

Data Appendix I

For the replicated data in Table 1, the equipment and structures shares of GDP has been created by taking the ratio between equipment investment and total investment for a benchmark year and multiply it to the average total investment share of GDP for a specific period. The chart below shows how each benchmark ratio has been matched to what average total investment share of GDP.

A1: The 1970-1975-1980 sample

Benchmark			Total Investment Share		
70	75	80	70	75	80
70	75	80	1960-72	1973-77	1978-85
	75	80		1960-77	1978-85
		80			1960-85
+ 70	75		1960-72	1973-85	
+	75			1960-85	

For Thailand (part of the 1975 benchmark), Malaysia (1970, 1975) and Jamaica (1975) there are no information in DS how to calculate. The plus signs in the table above indicate how these countries have been calculated. Other countries that are in at least one of the ICP benchmarks studies from 1970, until 1980 but not in the sample are: Poland (1975, 1980), Hungary (1970, 1975, 1980) and Iran (1970, 1975). Iran is excluded because it is a major oil exporter, Hungary and Poland only has data on GDP from 1970 in PWT 5.6, and has therefore also been excluded.

A2: The 1970-1975-1980-1985 sample

Benchmark				Total Investment Share			
70	75	80	85	70	75	80	85
4 70	75	80	85	1960-72	1973-77	1978-82	1983-90
3 70	75	80		1960-72	1973-77	1978-90	
3	75	80	85		1960-77	1978-82	1983-90
3 70	75		85	1960-72	1973-79		1980-90
2	75		85		1960-79		1980-90
2 70	75			1960-72	1973-90		
2	75	80			1960-77	1978-90	
2		80	85			1960-82	1983-90
1		80				1960-90	
1			85				1960-90
1	75				1960-90		

Own assessment.

A3: The 1970-1975-1980-1985-1996 sample

	Benchmark					Total Investment Share				
	70	75	80	85	96	70	75	80	85	96
5	70	75	80	85	96	1960-1972	1973-1977	1978-1982	1983-1990	1991-2000
4	70	75	80	85		1960-1972	1973-1977	1978-1982	1983-2000	
4		75	80	85	96		1960-1977	1978-1982	1983-1990	1991-2000
3	70	75	80			1960-1972	1973-1977	1978-2000		
3		75	80		96		1960-1977	1978-1986		1987-2000
3		75		85	96		1960-1979		1980-1990	1991-2000
3			80	85	96			1960-1982	1983-1990	1991-2000
2	70	75				1960-1972	1973-2000			
2		75			96		1960-1984			1985-2000
2			80	85				1960-1982	1983-2000	
2			80		96			1960-1986		1987-2000
2				85	96				1960-1990	1991-2000
1				85					1960-2000	
1					96					1960-2000
1			80					1960-2000		

In the PWT benchmark downloads from which the data has been retrieved there is not data available for the 1990 benchmark. In the 1996 benchmark the data is only subdivided into producer durables (equipment and transport). There are 126 countries included in at least one ICP benchmark study from 1970, 1975, 1980, 1980, 1985, or 1996. Due to data limitations in especially real GDP per worker and labor force for the years 1960 to 2000 the sample of 126 countries are unfortunately reduced to 78 countries. The great majority of the countries that were excluded are so called transition countries, has not been their own entity until around the 1990ies. The difference between the DS high productivity sample in column (1) and the 1960-2000 hp-sample in column (9) is that West Germany and Hong Kong has been excluded, and the following countries has been added: Australia (AUS), Barbados (BRB), Colombia (COL), El Salvador (SLV), Greece (GRC), Iceland (ISL), Iran (IRN), Jordan (JOR), New Zealand (NZL), Portugal (PRT), Sweden (SWE), Switzerland (CHE), Trinidad & Tobago (TTO) country codes are in parentheses.

Summary Statistics for Table 1

Original DeLong and Summers (1991) Data

Variable	Obs	Mean	Std. Dev.	Min	Max
ygrowth6085	61	0.0224	0.0155	-0.0110	0.0676
n6085	61	0.0211	0.0098	0.0014	0.0378
gap1960	61	0.7258	0.2181	0.0000	0.9805
equipsh.6085	61	0.0523	0.0296	0.0138	0.1310
nonequi.6085	61	0.1399	0.0570	0.0267	0.2846

Replicated data for 1970-75-80 benchmarks, using PWT 5.6,

Same sample as in DeLong and Summers (1991)

Variable	Obs	Mean	Std. Dev.	Min	Max
ygrowth6085	61	0.0234	0.0151	-0.0126	0.0685
n6085	61	0.0201	0.0092	0.0017	0.0376
gap1960	61	0.7228	0.2348	0.0000	0.9780
equip.6085	61	0.0482	0.0277	0.0036	0.1172
nonequip.6085	61	0.1334	0.0534	0.0091	0.2526

Replicated data for 1970-75-80 benchmarks, using PWT 5.6.

New Samples based on PWT 5.6

Variable	Obs	Mean	Std. Dev.	Min	Max
ygrowth6085	64	0.0247	0.0160	-0.0126	0.0685
n6085	64	0.0198	0.0094	0.0017	0.0376
gap1960	64	0.7289	0.2316	0.0000	0.9780
equip.6085	64	0.0493	0.0281	0.0036	0.1172
nonequip.6085	64	0.1351	0.0535	0.0091	0.2526

The difference from DeLong and Summers (1991) sample is the addition of Romania, Syria, Yugoslavia.

Replicated data for 1970-75-80-85 benchmarks, using PWT 5.6

Variable	Obs	Mean	Std. Dev.	Min	Max
ygrowth6090	72	0.0199	0.0144	-0.0135	0.0593
n6090	72	0.0210	0.0094	0.0027	0.0391
gap1960	72	0.7011	0.2461	0.0000	0.9687
equip.6090	72	0.0471	0.0269	0.0082	0.1161
nonequip.6090	72	0.1278	0.0557	-0.0264	0.2453

Replicated data for 1970-75-80-85-96, using PWT 6.1 and Producer Durables.

Variable	Obs	Mean	Std. Dev.	Min	Max
ygrowth6000	78	0.0186	0.0140	-0.0121	0.0552
n6000	78	0.0205	0.0093	0.0021	0.0421
gap60	78	0.6659	0.2833	-0.0584	0.9771
Prod. Dur.6000	78	0.0690	0.0363	0.0094	0.1695
Structures6000	78	0.1075	0.0513	-0.0349	0.2308

Notes: ygrowth is the average annual real GDP per worker growth rate, n is the labor force growth, gap is the 1960 gap in GDP per worker relative to the U.S.A. 6085 refers to the years 1960-1985, 6090 refers to the years 1960-1990, and 6000 refers to the years 1960-2000.

Data Appendix II Growth Accounting

This appendix shortly explains the growth accounting procedure used. Starting from a standard neoclassical production function: $Y(t) = A(t) \cdot F(K(t), L(t))$. Assuming that factors are paid their marginal products and that there are constant returns to scale, the production function can then be transformed into:¹⁶

$$\frac{\dot{A}}{A} = \frac{\dot{Y}}{Y} - \alpha \cdot \frac{\dot{K}}{K} - (1 - \alpha) \cdot \frac{\dot{L}}{L}$$

This gives us the basic growth accounting equation. Since growth rates on GDP and Labor force are usually available, the important question is how to estimate α as well as the growth of the capital stock. The values for the capital stock (K) are estimated by using the perpetual inventory calculation where $K(t) = K(t-1) \cdot (1 - \delta) + I(t)$. The capital stock in period t consists of the capital stock in the previous period minus the depreciation of capital, plus investments in period t . The crucial question then, is about the initial capital stock. The calculation for the initial capital stock follows from Bernanke and Gürkaynak (2001) where for countries whose investment data begins in 1970, the initial capital stock is equal to $I_{1970}/(g + \delta)$. Where g is equal to the ten year average growth rate of GDP (assuming that capital and output grow at the same rate) and δ the depreciation rate (same as above) is set to 0.06. This qualified “guess” for the initial capital stock is important, but as time goes by, the initial value will continually get less important. In this data set, in order for the estimated capital stock to be used, the estimated initial capital stock must be at least 5 years prior. For example, in order to calculate the growth of the capital stock from 1975 to 1980, the initial capital stock is allowed to be for the year 1970, but not earlier.

The capital share “ α ”, is set to a value of one third (1/3). Overall, a value for the capital share around one third is common in the literature. Solow (1957) finds that the U.S. capital share is about one third. Bernanke and Gürkaynak (2001) use the value 0.35 for α , as well as individually estimated labor shares for each country. Bernanke and Gürkaynak view the fixed value of 0.35 as reasonable based on the estimated labor shares. DeLong and Summers (1992) use 0.2, 0.3, 0.4, and 0.5 as alternative capital shares.

The growth accounting procedure implemented in this paper is standard in the literature, and could be extended by correcting for returns to schooling as well as estimating individual capital shares. DeLong and Summers (1991) correct their TFP growth rates for returns to schooling, but finds no significant differences in the parameter estimates for the equipment share.

Data for GDP and investment, both in constant local currency units, were all extracted from World Development Indicators 2004¹⁷. Labor force data was extracted from World Development Indicators 2004, but with a few modifications. For the countries which did not have data on labor force but data on population, growth of GDP and growth of capital, data for labor force was imputed. According to in which region a country was situated (region according to a classification by CIA World Fact book 2005) the ratio between labor force and population, throughout all years and

¹⁶ Hicks neutral for simplicity. For more on growth accounting see for example; Solow (1957), Barro and Sala-i-Martin (1995), Barro (1998), and for a “short biography” see Hulten (2000) and the references therein.

¹⁷ Collins and Bosworth (1996) also calculate TFP growth rates using local currency units.

countries in that region, was calculated. These ratios were then multiplied to population, (where the population data was also extracted from WDI 2004). The countries which got their labor force data imputed were: Antigua &, Dominica, Grenada, St. Kitts &, St. Lucia, St. Vincent & the Grenadines, Sao Tome and Principe, Seychelles, and Vanuatu.

Summary Statistics for Tables 6 and 7

Variable	Obs	Mean	Std. Dev.	Min	Max
Real equipment share	144	0.0523	0.0298	0.0042	0.1454
Real Structures share	144	0.1300	0.0602	0.0088	0.3248
Nominal Equipment share	144	0.0666	0.0233	0.0140	0.1807
Nominal Structures share	144	0.1502	0.0431	0.0460	0.2732
Real Prod. Durables share	240	0.0742	0.0447	0.0020	0.3455
Real Structures share2	240	0.1053	0.0585	0.0031	0.4317
Nom. Producer Durables share	240	0.0979	0.0473	0.0075	0.5703
Nominal Structures share2	240	0.1190	0.0477	0.0033	0.2969
Nom. Fixed inv. share	574	0.2191	0.0757	0.0340	0.6075
Benchmark sample					
TFP growth rate	240	0.0092	0.0256	-0.1302	0.0923
GDP/wkr gap	240	0.6205	0.3254	-0.4541	0.9842
Labor fce. growth	240	0.0182	0.0118	-0.0089	0.0430
All the world sample					
TFP growth rate	574	0.0058	0.0280	-0.1934	0.1118
GDP/wkr gap	574	0.6723	0.3033	-0.8724	0.9842
Labor fce. growth	574	0.0218	0.0120	-0.0372	0.0711

Notes: Nominal Structures share is structures + transport equipment. Structures share2 contain only structures.