Documentos de trabajo
Economía y Finanzas
Centro de Investigación Económicas y Financieras

Changes in the Effect of Capital and TFP on Output in Penn World Tables 7 and 8: Improvement or Error?

Breton, Theodore R.

cief
Centro de Investigaciones
Económicas y Financieras
Universidad EAFIT

Changes in the Effect of Capital and TFP on Output in Penn World Tables 7 and 8: Improvement or Error?

Theodore R. Breton

January 19, 2015

Abstract

Lower ICP 2005 construction prices in developing countries increase the effect of capital on output in PWT 7.1 and 8.0 and cause negative world TFP growth during 1990-2010 in PWT 8.0. The investment data appear to be more accurate in PWT 6.3.

Key Words: Penn World Table; Investment rates; Economic growth

JEL Codes: O4

[*]Universidad EAFIT, Carrera 49#7 Sur-50, avenida Las Vegas, Medellin, Colombia

ted.breton@gmail.com and tbreton@eafit.edu.co

574-250-5322 (home) 574-261-9334 (office)   574-261-9294 (fax)

I. Introduction

From 2001 to 2009 there were four PWT 6 data sets with relatively similar data, created using international prices collected from 1970 to 2002. The consistency in the PWT data ended with the issuance of PWT 7 in 2011 and PWT 8 in 2013. Both versions make use of prices collected in ICP 2005, but they use these prices differently to adjust the National Accounts. Since the prices in ICP 2005 are very different from earlier ICP prices, the economic data in PWT 6, 7, and 8 are very different, and analyses using these data sets yield different results.

Presumably, the newer versions of the PWT should have more accurate data. ICP 2005 collected prices from more countries than ever before, and PWT 8 utilizes a more sophisticated methodology to incorporate these prices. But at least for the investment component of GDP, the data in the newer versions appear to be less accurate.

In this paper I examine the empirical relationships between capital and output and the trend in total factor productivity (TFP) from 1990 to 2010 using data from PWT 6.3, 7.1, and 8.0. The evidence is not conclusive, but it indicates that across countries the investment data in PWT 6.3 are more accurate than the investment data in PWT 7.1 and 8.0.

II. Relationships in the PWT Data

Breton and Garcia [2015] show that capital/output ratios in 2000 are much higher in PWT 7 and 8 than in PWT 6, and they present evidence that this is due to an underestimate of construction prices for less developed countries in ICP 2005. PWT 7 utilized the ICP 2005 prices to adjust the national accounts data for the entire 1950-2010 period, abandoning the earlier ICP prices [Breton, 2012], so the investment rates in less developed countries are considerably higher than in PWT 6.

PWT 8 employed a new methodology to adjust National Accounts data using ICP prices that vary over time [Feenstra, et al., 2013a]. The low construction prices for less developed countries in ICP 2005 create an erroneous positive trend in PWT 8 investment rates for these countries. Since TFP is a residual, this investment trend creates an erroneous negative trend in TFP growth over the period 1990-2010.

Table 1 presents estimates of Solow production functions for the period 1990-2010 using PWT 6.3, 7.1, and 8.0 data. The form of the model is:

1) $Y/L = (K/L)^{\alpha} (H/L)^{\beta} (A_0 e^{gt} L)^{1-\alpha-\beta} A_d^{\theta} T_d^{\phi}$

Where K is the physical capital stock, H is the human capital stock, L is adults, and A_d and T_d are dummy variables for countries in sub-Saharan Africa and for countries with considerable private tutoring. The human capital stocks for all the data sets and the physical capital stocks for PWT

6.3 and 7.0 are calculated using the perpetual inventory method, investment rates for physical capital and formal schooling, and depreciation rates δ_k = 0.04 and δ_h = 0.025. Documentation for the creation of the human capital stock is in Breton [2013a]. The PWT data are the rgdpch data from Heston, et al. [2009 and 2011] and the GDP output and capital stock data from Feenstra, et al. [2013b]

Table 1 presents the model results. Columns 1-3 show the basic Solow model, including the TFP residual and the associated steady-state rate g. Annual TFP growth in the basic model is positive for PWT 6.3 and 7.1, with an associated steady state growth rate of 1.5% per year. In contrast, the TFP growth rate for PWT 8.0 is negative, with a corresponding steady-state growth rate of -10% per year.

Table 1 OLS Estimates of Solow Model Production Functions 1990-2010 [Dependent Variable is Log(GDP/Adult)]						
	1	**2**	**3**	**4**	**5**	**6**
PWT	**6.3****	**7.1**	**8.0**	**6.3****	**7.1**	**8.0**
Sample	305	305	305	305	305	305
Log(K/Adult)	0.66*	0.86*	0.85*	0.36*	0.42*	0.42*
	(.01)	(.01)	(.02)	(.03)	(.03)	(.04)
Log(H/Adult)				0.33*	0.35*	0.38*
				(.03)	(.02)	(.04)
Tutoring				0.19*	0.23*	0.30*
				(.03)	(.03)	(.04)
Sub-S Africa				-0.16*	-0.32*	-0.24*
				(.06)	(.04)	(.07)
Year	0.005*	0.002	-0.014*	0.002	0.002	-0.007
	(.002)	(.002)	(.004)	(.002)	(.002)	(.003)
g (%)	1.4	1.5	-10.0	0.6	0.7	-3.5
R^2	.94	.95	.85	.96	.97	.88
*Significant at the 1% level (Robust standard errors in parentheses) **2010 is an extrapolation from 2007 using the trends in PWT 7.1 data						

Columns 4-6 show estimates of the complete model in (1). According to theory α is the share of GDP accruing to physical capital. The estimate of α is 0.36 with the PWT 6.3 data, which is consistent with Gollin's [2002] estimate of the capital share across countries in 1990. Breton [2013a] shows that OLS and 2SLS estimates of this model in 1990 are similar.

The estimate of α is higher (0.42) with the PWT 7.1 and 8.0 data. Since investment rates are higher in the less developed countries in these data sets, the difference in K/L between developed and less developed countries is smaller, and the effect of K/L required to explain cross-country differences in Y/L is larger.

The TFP growth rate is positive for the complete model with the PWT 6.3 and 7.1 data. The associated world steady-state rate of 0.7%/year is consistent with Breton's [2013b] estimate of 1.0 %/year during 1910-2000. The TFP growth rate is negative with PWT 8.0 data, and the associated steady state growth rate is an unlikely -3.5% per year. The explained variation in Y/L is lower with the PWT 8.0 data, evidently due to the changing ICP prices used to create the data. Feenstra et al. [2013c] recognize this problem and recommend that the GDP output data in PWT 8.0 not be used for TFP and growth analyses.

Figure 1 shows the effect of the different prices for investment on investment rates in PWT 6.3, 7.1, and 8.0 for the Philippines. The Philippines is an appropriate country for the comparison because it was one of the few less developed countries that participated in all of the ICP price comparison studies, which began in 1970 [Feenstra, et al., 2013a].

Figure 1

**Investment Rates in the Philippines 1950-2010**
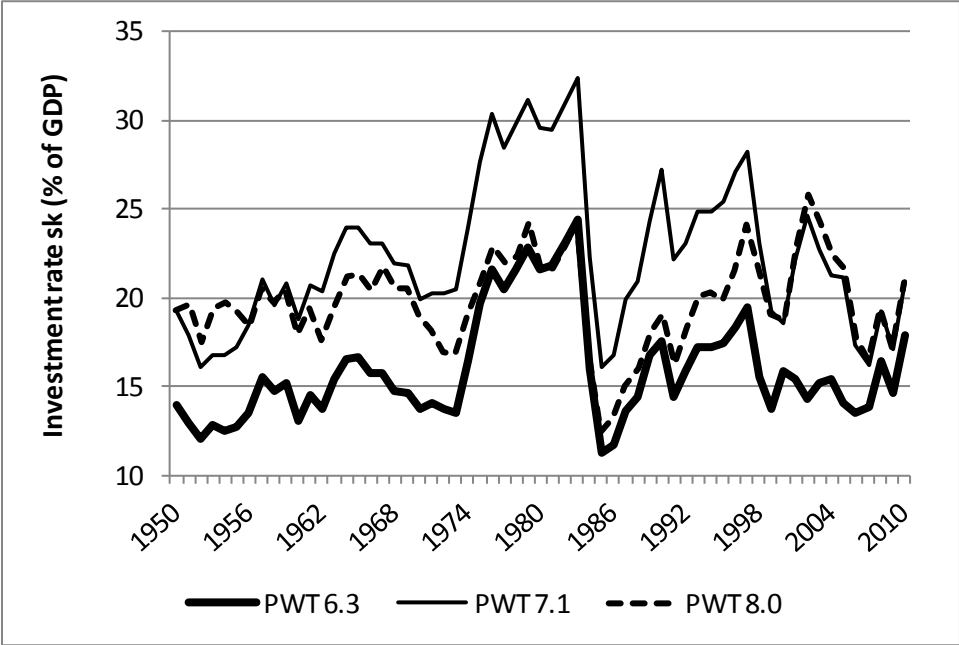
The investment rates in PWT 6.3 and 7.1 have identical patterns because they reflect the annual changes in the National Accounts data. The investment rate is consistently about 35% higher in PWT 7.1 because the ICP 2005 price of construction used to estimate construction investment was uniformly so much lower. The investment rate in PWT 8.0 is

similar to PWT 6.3 during 1975-1990, and then transitions to the PWT 7.1 rates, which are based on ICP 2005. It is not evident why the PWT 8.0 investment rate is similar to the PWT 7.1 rate during the 1950-70 period.

Figure 2 shows the investment rate data for Kenya, the only country in Africa that participated in all the ICP price comparisons back to 1970. The investment rates are lower for Kenya, but the relative differences between PWT versions and the patterns in these versions are similar to the rates in the Philippines.

Figure 2

Investment Rates in Kenya 1950-1990
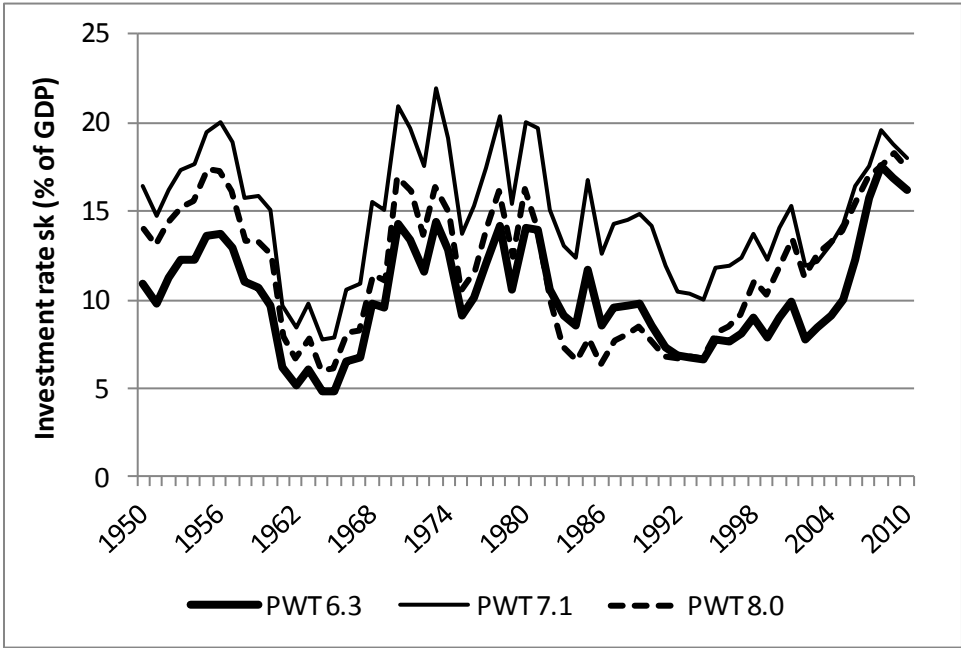
Could the PWT 6.3 investment rate data be more reliable, even though they are based on earlier construction price data for fewer countries? Potentially, yes. Construction prices in the early ICP analyses were calculated from engineering estimates of the cost of six types of construction in all participating countries [Breton and Garcia, 2015]. PWT 6.3 used the prices for these construction projects, which were limited to a few less developed countries, to estimate construction prices in all less developed countries in all years. The OECD countries continued to use this methodology in ICP 2005, but it has not been used to estimate prices in the less developed countries since ICP 1985.

The ICP 2005 construction prices in less developed countries were created from the prices of construction inputs, rather than construction projects. Breton and Garcia [2015] estimate construction prices in Colombia and the U.S. in 2005. They show that prices created from either construction projects or from the price of construction inputs in Colombia yield estimates for construction that are <u>double</u> the ICP 2005 estimate. They also show that the ratio of construction prices to GDP prices are consistently much lower in less developed countries in ICP 2005 than earlier, which suggests that the low ICP price for Colombia is a methodological problem that afflicts most, if not all the less developed countries.

The construction investment data in PWT 6.3 are somewhat error-resistant because they are based on an average of the prices collected in several time periods and are based on project estimates. PWT 7.1 is based entirely on the problematic construction prices in ICP 2005, and PWT 8.0 uses these prices for the later portion of the 1950-2010 time period. The methodology in PWT 8.0 is conceptually attractive, but if the international prices are not accurate over time, it creates spurious trends in the economic data, which show up in the residual TFP growth rates.

Table 2 shows estimates of the basic Solow model in 1990 and 2005 using PWT 6.3, 7.1, and 8.0 data. The estimated coefficients on K/L are the same for both years using either the PWT 6.3 or the 7.1 data, but they are very different for the PWT 8.0 data. With PWT 8.0 the Solow model almost becomes an AK model in 2005, and the explained variation in national output is substantially lower. The changes in the effect of capital on output are likely spurious, since they are not present in the National Accounts data, and it is unlikely that the effect of capital increased by 22% across countries between 1990 and 2005.

Table 2 OLS Estimates of Solow Model Production Functions in 1990 and 2005 (Dependent Variable is Log(GDP/Adult))						
	1	**2**	**3**	**4**	**5**	**6**
PWT	**6.3**		**7.1**		**8.0**	
Year	1990	2005	1990	2005	1990	2005
Log(K/Adult)	0.66*	0.66*	0.87*	0.86*	0.77*	0.94*
	(.03)	(.02)	(.03)	(.02)	(.04)	(.03)
R^2	.93	.96	.94	.96	.83	.86
*Significant at the 1% level						

III. Conclusions

The creation of appropriate prices for different components of GDP across countries is difficult. In theory it is desirable to incorporate the trends in these prices in the Penn World Table. But the prices in the various ICP exercises are not based on a consistent methodology. Some components of GDP are "comparison-resistant," and they are estimated in different ways in different exercises. Construction prices in less developed countries were initially based on estimates of construction project costs and now are based on the prices of project components.

As a consequence, changes in investment prices over time are due to changes in the ICP methodology, as well as to changes in actual prices. The underestimate of construction prices in ICP 2005 in less developed countries overestimates investment rates in PWT 7.1 and 8.0, which in PWT 8.0 creates negative world TFP growth and negative steady-state growth rates. The available evidence is not conclusive, but it indicates that the investment data in PWT 6.3 are more accurate than the data in PWT 7.1 and 8.0.

References

Breton, Theodore R., and Garcia, John J., 2015, "ICP 2005: Are Construction Prices Underestimated in Developing Countries?" *Review of Income and Wealth*, forthcoming

Breton, Theodore R., 2013a, "Were Mankiw, Romer, and Weil Right? A Reconcilation of the Micro and Macro Effects of Schooling on Income" *Macroeconomic Dynamics*, v17, n5, 1023-1054

Breton, Theodore R., 2013b, "World Total Factor Productivity Growth and the Steady-state Rate in the 20th Century," *Economics Letters*, v119, n3, 340-343

Breton, Theodore R., 2012, "Penn World Table 7.0: Are the Data Flawed?," *Economics Letters*, v117, n1, 208-210

Feenstra, Robert C., Inklaar, Robert, and Timmer, Marcel P., 2013a, "Comparing PWT 8.0 with PWT 7.1," http://www.rug.nl/research/ggdc/data/pwt/v80/comparing_pwt80_with_pwt71.pdf

Feenstra, Robert C., Robert Inklaar and Marcel P. Timmer, 2013b, "The Next Generation of the Penn World Table," available for download at www.ggdc.net/pwt

Feenstra, Robert C., Robert Inklaar and Marcel P. Timmer, 2013c, "PWT 8.0 – a User Guide," http://www.rug.nl/research/ggdc/data/pwt/v80/pwt_80_user_guide.pdf

Gollin, Douglas, 2002, "Getting Income Shares Right," *Journal of Political Economy*, v110, n2, 458-474

Heston, Alan, Summers, Robert, and Aten, Bettina, 2009, *Penn World Table Version 6.3*, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania (CICUP)

Heston, Alan, Summers, Robert, and Aten, Bettina, 2011, *Penn World Table Version 7.1*, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania (CICUP)