Economics Bulletin

Volume 33, Issue 3

Productivity Bias Hypothesis: The Case of South Asia

Mahmood-ur- Rahman
Bangladesh Institute of Bank Managment

Sujan Kumar Ghosh
North South University

Abstract

The productivity bias hypothesis states that the countries with relative higher growth trajectory have a tendency for experiencing real appreciation in their domestic currencies as an outcome of a positive productivity shock. It has also been found in the literature that this phenomena is particularly more prominent in the non-tradable sector, which is predominantly service intensive in nature and mostly in the public or government sector. Several researchers have endeavored to scrutinize this, either using the cross section or time series frameworks for different countries. This paper has attempted to reexamine the hypothesis empirically where we have resorted to a random coefficient model which incorporates country and time specific productivity effects in a panel regression set-up for eight SAARC countries covering the time length 1970-2008 with five different panel specifications controlling for both country specific heterogeneity and time specific heterogeneity. The paper has come up with the conclusions that the hypothesis is not much eminent for South Asian Countries.

The authors are respectively Assistant Professor, Bangladesh Institute of Bank Management, Dhaka and Graduate Student of Economics, North South University, Dhaka, Bangladesh.
Citation: Mahmood-ur- Rahman and Sujan Kumar Ghosh, (2013) "Productivity Bias Hypothesis: The Case of South Asia", *Economics Bulletin*, Vol. 33 No. 3 pp. 1771-1779.
Contact: Mahmood-ur- Rahman - mahmood_eco_bibm@yahoo.com, Sujan Kumar Ghosh - sujan05ku@gmail.com.
Submitted: June 02, 2013. **Published:** July 11, 2013.

1. Introduction

Throughout the past twenty years, we have witnessed that a considerable effort has been devoted to analyze the exchange rate behavior and in particular for purchasing power parity which is more popular as the PPP, an aggregate interpretation of the law of one price hypothesis. However, the perception that in the long-run the PPP tends to hold implies that the observed exchange rates of the economies approach to the equilibrium exchange rates. But the modern economists and researchers have not got that much of research works in this particular intriguing topic using a somewhat similar doctrine, generally known as the Productivity Bias Hypothesis for empirically verifying whether the theory prevails or not[1]. In fact, as noted by Clague (1985; 1986) and Kravis and Lipsey (1983), the data exhibit a strong positive relationship between the levels of real per capita income showcasing productivity and the respective price levels indicating the divergence from the PPP theory. Differences in productive capacity among countries due to real factors such as variant capital-labour ratio due to factor endowment differences or monitory proponents like central bank intervention in foreign exchange rate determination process - these have been found to be the prime factors for the divergence in this regard. As per Balassa (1964) and Samuelson (1964), the price levels of countries systematically deviate from the PPP, which is manifested by a positive relationship between the national price levels and the productivities, proxied by per capita income levels; this systematic deviation is termed as the 'productivity bias hypothesis' (henceforth, PBH), which states that countries with more productivity have a tendency for real appreciation in their local currencies. This has been further substantiated, in the subsequent papers (such as, Kravis and Lipsey 1983; Bhagwati, 1984).

For verifying the PBH[2], there have been several empirical works. Although the cross sectional studies have come up with mixed results, studies incorporating time series data have mostly supported the PBH. Asea and Mendoza, 1994 and Bahmani-Oskoee and Nasir, 2001, in their recent studies have tested the hypothesis with panel data and received more evidence in favour of the hypothesis. All the empirical studies for examining the Balassa-Samuelson hypothesis have been divided into three different groups depending on the set of data which is being used: cross-section, time-series and panel data studies. It is quite apparent from the extensive literature review that the studies, using cross-section data have provided mixed evidences on the productivity bias hypothesis, while those based on time-series, mostly have supported the hypothesis as mentioned earlier. Apparently, the study deploying the panel data has provided some support to the productivity bias hypothesis for OECD countries (Asea and Mendoza, 1994). Indeed, there has been a gap in the relevant literature in terms of using panel data for corroboration. The use of panel data would enable a more comprehensive specification of the productivity bias perception to obtain more reliable results. Banking on this proposition, they used panel data of 69 developing and industrialized countries covering a time span of thirty years, from 1960 up to1990 in order to enrich the understanding of the true relationship between a country's productivity and real exchange rate, represented by the price level.

In spite of its gravity, the researchers have not fully unleashed the true potentials which are being provided by the available panel data. More preciously, as per our understanding, their empirical specification of the productivity bias hypothesis has two crucial shortcomings: first, those did not take into consideration time-specific factors that may have significantly

[1] The most notable examples of these studies include Frenkel (1981a), Frenkel, (1981b), Bahmani-Oskooee (1993), Karfakis and Moschos (1989), Hoque (1995), and Engel (1999).

[2] For a thorough literature review on productivity bias and the PPP see Bahmani-Oskooee and Nasir (2005) and Goswami and Rahman (2008).

influenced the relationship between productivity and real exchange rates and secondly, the assumption that the unobservable country-specific factors neutrally affect the estimated productivity bias equation, i.e. the impact of labor productivity on real exchange rate is assumed to be common across the countries and over the time span (Goswami and Rahman, 2008).

This paper has got a purpose to generalize the empirical specifications of the productivity bias equation suggested by Bahmani-Oskooee and Nasir (2001) for eight South Asian countries. To be precise, using the notion of the random coefficient regression model proposed by Hildreth and Houck (1968) we have tried to model both country and time specific unobservable effects in a consistent way into the productivity bias equation. This resulting model is non-neutral in the sense i.e. the unobservable country-specific and time-specific factors directly affect the way in which a country's productivity influences real exchange rate. Thus, it has been possible for us to undertake a country by country empirical examination of the Balassa-Samuelson productivity bias hypothesis.

Before proceeding further we feel that it is of paramount importance to make some notes on the structure of this paper; Section II entails the mathematical model, which is being used for examining the Balassa-Samuelson productivity bias hypothesis empirically. Section III captures the data set and the empirical results. Finally, section IV wraps up the paper with the concluding remarks.

1.1 The Theory of Productivity Bias Hypothesis

Balassa (1964) did come up with the explanations of the systematic deviations in price level in terms of asymmetric productivity growth using the notions of traded and non-traded goods. Disregarding trade restrictions, the domestic prices of tradable goods, which is more capital intensive in nature is basically tied with its international prices. So, productivity growth only end up in an increase in wages in both the traded goods as well as in non-traded goods sectors, which includes a lot of service industries. Consequently, the national price level, being the weighted average of the price of both traded goods and non-traded goods, also spike up. Thus productivity growth in the traded goods sector results in increase in national price level. So, the productivity bias hypothesis goes as - the rich countries usually have higher productivity that ultimately leads to higher price level within a cross section of countries. Kravis and Lipsey (1983) and Bhagwati (1984) provided an alternative explanation of the same in terms of differences in capital labor ratios across economies, which states that capital-labor ratio is high in the rich countries compared to the poor ones resulting in higher wage rates (provided that there are huge disparities in initial endowments and no factor price equalization). On the other hand, the poor countries with large labor endowments tend to have a lower capital-labor ratio as labor is relatively cheap in such countries. So, the more labor intensive non-traded goods will be cheaper in poor countries and expensive in rich countries. Consequently, price levels will be also high in the rich countries as compared to those of the poor countries. So, as per the productivity bias hypothesis countries have a tendency for real appreciation in their domestic currencies as a result of a positive productivity shock. This puts forward an explanation why the doctrine of the purchasing power parity does not usually work out well revealing that the observed exchange rates of the economies, by and large, persistently deviate from the parity.

2. The Model

Assuming the United States as the base country and the US dollar as the base currency, the empirical model takes the following shape in its pooled OLS form:

$$\text{Log } RER_{it} = \beta_0 + \beta_1 \text{ Log } RPROD_{it} + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots\ldots(1)$$

$$\text{where, } RER_{it} = \left(\frac{P_{it}}{e_{it}P_{it}^{*}}\right);\ RPROD_{it} = \frac{DPROD_{it}}{USPROD_{it}}$$

If a country is more productive then it is supposed to experience a real appreciation of its currency, so an estimate of β1 should be positive and significant[3]. Here, P_{it} is the domestic price level and P^{*}_{it} is the US price level. e_{it} is the price of one unit of US currency in terms of domestic currency. Higher value of real exchange rate represents real appreciation in domestic country. $DPROD_{it}$ represents domestic productivity and $USPROD_{it}$ represents the productivity of the USA which is used as the base foreign country in constructing the real exchange rate. Hence, the expected sign of β_1 should be positive to support the PBH. The quantum of significance of β_1 depicts the extent of productivity bias. Here, ε_{it} is the error term with the usual standard assumptions. This equation has been tried for five different cases of panel estimation and the results are presented in Table 1. It seems to us quite sensible to provide a brief clarification for the different types of panel estimations that we have used in the paper. It is to be noticed that we have deployed five different types of panel estimations and those have been labeled as Case 1, Case 2, Case 3, Case 4 and Case 5. Case 1 is the pooled OLS estimation which assumes that both the intercepts and the slopes are the same across the eight SAARC countries over time. This method is highly implausible in the sense that some countries might be different from other countries in many respects. The region has been composed up of basically two categories of countries - developing countries and least developed countries. To address this issue we have incorporated Case 2 which captures the country specific heterogeneity by introducing different intercepts for each country and is known as one-way fixed-effects estimation. To capture the time-specific heterogeneity along with the country-specific heterogeneity we have used Case 3 which is nothing but two-way fixed effects estimation. Case 2 and 3 assume that the intercepts are deterministic. To take care of this kind of randomness in intercepts we have considered Case 4 which assumes that country-specific intercepts come from a distribution. Case 4 is known as one-way random-effects estimation. Similarly, to allow for randomness in both the country-specific and the time specific intercepts we have used Case 5 which is known as two-way random-effects estimation. Case 4 and 5 use some sort of feasible generalized least squares methods for conducting the estimation. Alternative estimation is essential for checking robustness of our results across different types of panel specifications while the test of the hypothesis with price data extends the existing literature of the PBH and assists in better understanding of the issue.

3. Data and Empirical Results

For the quantitative assessment of the effect of productivity on real exchange rate, we have used a panel data set of eight SAARC countries (in addition to the US which has been used as the base country) covering the period from 1970 to 2008. The used variables, GDP per worker (variable 19), denoting the productivity and exchange rates (variable 13) have been obtained from the Penn World Tables Mark 7.0 which is a revised and updated version of the preceding (Mark 6.3) version as per the detailed description of R. Summers and A. Heston. For real exchange rate we have used variables p which comes as the variable number 18 in the Penn World Table, Version 7.0. RPROD has been constructed through dividing the real GDP per worker of each country by the US real GDP per worker. This is placed as variable

[3] This model has been used by other researchers in cross-sectional as well as time-series studies

number 25 in the Penn World Table, Version 7.0 and labeled as 'RGDPWOK' in the database. Both the data of real exchange rates and relative productivities have been derived from the same source (Heston, Summers and Aten, 2011).

The OLS estimation results of the productivity bias equation (1) have been presented in Table 1 with all the five different cases. From the results in table 1, it could be visible that the mean response coefficient (β), which measures the impact of changes in labor productivity on real exchange rates is negative. As the model in (1) is expressed in logarithms, this value coincides with the elasticity of real exchange rate with respect to labor productivity. As all the values are negative, so based on the results, it can be mentioned that the PBH does not hold out in these SAARC countries.

Table 1: Estimated Panel Result for SAARC Countries

	Intercept	**Inrprod**
Case 1	54.22914 (27.33791)	-0.001846 (4.452529)
Case 2	69.98320 (38.55718)	-0.005664 (13.98161)
Case 3	54.93348 (31.87113)	-0.002017 (5.032301)
Case 4	68.70545 (18.30423)	-0.005355 (13.48240)
Case 5	58.71603 (14.11377)	-0.002934 (7.481668)

Note: in parentheses are the absolute values of t-ratios.

The panel regression with the price levels and the real GDPs supports the previous results of the panel tests on the PBH. Bahmani-Oskooee and Nasir (2001) used data for 69 countries for the period 1960-90. Our study has tried to examine the issue of PBH covering a larger dataset as well as involving more recent timeframe.

Table 2: Estimated Panel Result for Emerging South Asian Countries

	Intercept	**Inrprod**
Case 1	57.63307 (27.28345)	-0.003623 (-7.935113)
Case 2	64.99723 (22.35379)	-0.005373 (-8.128633)
Case 3	34.48366 (9.767656)	0.001879 (2.268783)
Case 4	57.63307 (28.26298)	-0.003623 (-8.219998)
Case 5	52.36049 (21.48071)	-0.002370 (-4.922032)

Note: in parentheses are the absolute values of t-ratios.

Table 2 presents the estimates of the total average effects of the emerging SAARC countries, which includes India, Pakistan, Sri Lanka and Bangladesh. On the other hand, Table 3 and Table 4 have computed the sum of the country specific effects and the average of the time specific effects. For comparative purposes, it would be interesting at this point to check how individual country and time specific factors affect the relationship between real exchange rate and labor productivity.

At a first glance, the estimates exhibit great variability across countries, the highest positive values correspond to Maldives (29.634555) followed by Bhutan (9.516557) and the estimates are negative but not significant for the other six SAARC countries. As per our results, the Balassa-Samuelson hypothesis has received support, for only two of the SAARC countries in the sample. A common feature of these results is that the estimates are not significant for most of the SAARC countries with the exception of Maldives and Bhutan. In particular, for the sample containing the four emerging SAARC countries, the productivity bias hypothesis has been failed to establish its authority implying that the parameter of labor productivity turned out to be non-significant for real exchange rates.

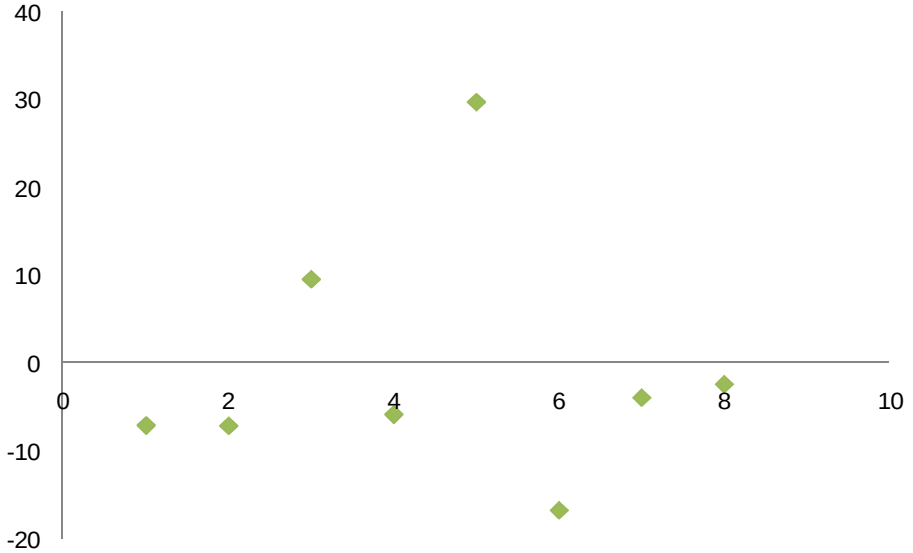
Table 3: Individual Country Specific Effects

Country	Case 2	Case 3	Case 4	Case 5	Average
Afghanistan	-10.40770	-3.465843	-9.387656	-5.102647	-7.0909615
Bangladesh	-10.80382	-3.078256	-9.702778	-4.915983	-7.12520925
Bhutan	11.79153	7.195678	10.90123	8.177790	9.516557
India	-6.303089	-5.556757	-5.966024	-5.625336	-5.8628015
Maldives	33.95664	25.63655	31.79175	27.15328	29.634555
Nepal	-20.30281	-13.13741	-18.83058	-14.62887	-16.7249175
Pakistan	1.315584	-4.719936	0.767928	-3.136631	-3.9282835
Sri Lanka	0.753675	-2.874027	0.426127	-1.921600	-2.3978135

Therefore, the level of economic development might have played an important role when determining the effects of productivity differentials on real exchange rates. Figure 1 shows the relation between the total average country effects and the level of real GDP, pointing out that the productivity bias hypothesis is true for only two countries.

On the other hand, since our analysis has allowed us to examine case-by-case basis, regarding the validity of the Balassa-Samuelson hypothesis, we can observe from the findings, that there exists a lack of homogeneity among the countries. We have already mentioned earlier that only two of the SAARC countries exhibit high estimated values (Maldives and Bhutan), while for the rest of them the estimates are found to be negative and not significant.

Figure 1: Relationship between Real GDP Per Capita and Average Total Country Effects



In order to grasp the time effects, we have grouped the data, considering four sub periods (1970-79, 1980-89, 1990-99 and 2000-08). Table 3 shows the total average effects for each of the four sub periods for all SAARC countries. The results emphasize on the fact that the productivity bias perception is again not too stronger in SAARC countries except in the 70s. As a matter of fact, the productivity bias hypothesis does not seem to hold for the "SAARC group" during the last three sub periods. In their recent panel data study for Asia, Latin America and Africa conducted for the period 1980-1996, Drine and Rault (2003) have also found the evidence that the strength of Balassa-Samuelson effect is much lower for Africa and some Asian countries, which is similar to our findings.

Table 4: Time Specific Effects for SAARC Countries

Period	Case 3	Case 5
1970-1979	16.71735	12.69351
1980-1989	-4.30724	-1.91157
1990-1999	-7.45081	-5.74729
2000-2008	-8.33057	-5.59406

A striking feature of the average estimates presented in table 4 is the fact that the productivity bias effect has gone down considerably in the last two sub periods. Possible explanations for this phenomenon could lie in the two major events of the early seventies. The first one is the end of the Bretton Woods System. The switch to floating exchange rates has been reported to have produced an increase in the volatility of exchange rates not matched by changes in the distribution of fundamental macroeconomic variables (e.g., Baxter and Stockman, 1989). Although, the literature does report about the systematic differences in the behavior of real exchange rates under different regimes but all the countries did not switch over to more flexible regimes at the same time, and as a matter of fact for many developing countries the shift to floating exchange rates has been more recent. All these boils down to the fact, that in this modern era of globalization, most of the observed economies did prefer to move on with the managed floating exchange rate regime perhaps with undervalued local currencies to enjoy probable gains in the external account which simply weakens the strength of the PBH. The first oil price shock could be jolted down as the second factor for the ineffectiveness of the PBH. As far as the second explanation is concerned, Rogoff (1992) has argued that real oil prices could play the role of supply shocks. We also support that it could very well be the case that the seventies' oil shock led to a real currency appreciation for exporters of oil, which was not matched by an increase in the productivity differential as well as it led to a currency depreciation for oil importers again not accompanied by a decrease in the productivity differential. DeLoach (2001), while finding evidence in favor of the Balassa-Samuelson hypothesis for nine OECD countries has also pointed out the role of oil prices in determining real exchange rates. It is evident from table 3, that during the decades of 70s, the estimates have supported the Balassa-Samuelson hypothesis, on an aggregated basis. Apparently this has been found to be true for the group of African countries as well, for which again the hypothesis has failed to establish itself in the last two sub-periods. Theoretically, from the equation we can comment that there might be quite a few possibilities of malfunctioning of the PBH. The first proposition is that, may be in these selected economies, due to economic growth accompanied with development as a much pronounced rate the relative hike in domestic price levels as compared to the US price level might have not been that much. It means that due to competition as well as gradually moving towards

more efficient production system, propelled by proficiency of work force the spike in wages might have exceeded the inflation rates on an average in these economies, which might have been relatively better than that of the USA. Moreover, we all know that USA has been an import depended economy, which is more susceptible to international price shocks. Again, it has been already mentioned that the observed economies have had a long tradition of perusing managed floating exchange rate regimes with a high bias for undervalued local currency to gain in terms of exports as well remittance, which might have been one of the nullifying factors.

4. Conclusions

Productivity bias hypothesis might be a very potent theory which can be used to examine the long run behavior of real exchange rates. Since its inception many researchers have used different econometric models or methods to examine the validity of this hypothesis. For the empirical assessment of the Balassa-Samuelson productivity bias hypothesis, panel data can be more robust than simple cross-section or time series based studies. To take that advantage of the panel data, we have tried to deploy a more flexible specification of the productivity bias hypothesis model. In essence, our model is based on the random coefficient regression model of Hildreth and Houck (1968), which allows for unobservable country and time specific factors to be accounted for in the productivity bias equation. This flexible specification permits a more realistic country by country evaluation of the Balassa-Samuelson productivity bias hypothesis through using a single equation estimation framework. Our model has been applied to a sample of eight SAARC countries. Our empirical results suggest that the Balassa-Samuelson productivity bias hypothesis does not hold for all countries in the sample except for Bhutan and Maldives if we consider the entire time period. Although, there are strong evidences from Bhutan and Maldives, but for the other SAARC countries, the corresponding average elasticity values turn out to be statistically insignificant estimates. Further, our results indicate that the effect of labor productivity on real exchange rates is not uniform across countries. The level of economic development, as also acknowledged by other researchers in the past, plays an important role in identifying the productivity bias hypothesis as well. Finally considering the time affect, we can finish with remarks that the hypothesis tends to fade away if we move across the time horizon.

References

Asea, P.K. and E.G. Mendoza (1994) "The Balassa-Samuelson Model: A General Equilibrium Appraisal" *Review of International Economics* **2**, 244-67.

Bahmani-Oskooee, M. (1993) "Purchasing Power Parity Based on Effective Exchange Rate and Cointegration: 25 LDCs Experience with its Absolute Formulation" *World Development* **21**, 1023-31.

Bahmani-Oskooee, M. and A. Nasir (2001) "Panel Data and Productivity Bias Hypothesis" *Economic Development and Cultural Change* **49,** 395-402.

Bahmani-Oskooee, M. and A. Nasir (2005) "Productivity Bias Hypothesis and The Purchasing Power Parity: a review article" *Journal of Economic Surveys***19(4)**, 671-696.

Balassa, B. (1964) "The Purchasing Power Party Doctrine: A Reappraisal" *Journal of Political Economy* **72,** 584-96.

Baxter, M. and A.C. Stockman (1989) "Business Cycles and the Exchange Rate Regime" *Journal of Monetary Economics* **23**, 377-400.

Bhagwati, J.N.(1984) "Why are services cheaper in the poor Countries" *The Economic Journal* **94**, 279--286.

Clague, C. (1985) "A Model of Real National Price Levels" *Southern Economic Journal* **51**, 998-1017.

Clague, C. (1986) "Determinants of the National Price Level: Some Empirical Results" *Review of Economics and Statistics* **68**, 320-323.

DeLoach, S.B. (2001) "More Evidence in Favor of the Balassa-Samuelson Hypothesis" *Review of International Economics*, 9: 336-342.

Drine, I. and C. Rault (2003) "On the Long-run Determinants of Real Exchange Rates for Developing Countries: Evidence from Africa, Latin America and Asia" William Davidson Institute Working Papers Series 2003-571, William Davidson Institute at the University of Michigan Business School.

Engel, C. (1999) "Accounting for US Real Exchange Rate Changes" *Journal of Political Economy* **107**, 507-538.

Frenkel, J.A. (1981a) "The Collapse of Purchasing Power Parities During the 1970s" *European Economic Review* **16,** 145-165.

Frenkel, J. A. (1981b) "Flexible Exchange Rates, Prices, and the Role of News Lessons from the 1970s" *Journal of Political Economy* **89**, 665-705.

Goswami, G. and A.K.M.A. Rahman (2008) "Disaggregated Spending and the Productivity Bias Hypothesis" *The Journal of Developing Areas* **41(2)**, 79-98.

Heston, A., R. Summers and B. Aten (2012) Penn World Table Version 7.0, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania. URL http://pwt.econ.upenn.edu.

Hildreth, C. and J.P. Houck (1968) "Some Estimators for a Linear Model with Random Coefficients" *Journal of the American Statistical Association* **63,** 584-595.

Hoque, A. (1995) "A Test of the Purchasing Power Parity Hypothesis" *Applied Economics*, **27**, 311-315.

Hsiao, C. (1986) *Analysis of Panel Data*, Cambridge: Cambridge University Press.

Karfakis, C. and Moschos D. (1989) "Testing for Long-Run Purchasing Power Parity: A Time-Series Analysis for the Greek Drachmas" *Economic Letters* **30**, 245-248.

Kravis, I.B. and Lipsey R.E. (1983) "Toward an Explanation of National Price Levels" *Princeton Studies in International Finance* **52**, Princeton, N.J., Princeton University.

Rogoff, K. (1992) "Traded Goods Consumption Smoothing and the Random Walk Behavior of the Real Exchange Rate" *Bank of Japan Monetary and Economic Studies* **10,** 1-29.

Samuelson, P. (1964) "Theoretical Notes on Trade Problems" *Review of Economics and Statistics* **46**, 145-54.

Summers, R. and A. Heston (1991) "The Penn World Table (Mark 5): An Expanded Set of International Comparisons, 1950-1988" *Quarterly Journal of Economics* **106**, 327-68.