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INTERNATIONAL AND INTERTEMPORAL COMPARISONS OF REAL PRODUCT IN OECD COUNTRIES: A GROWTH SENSITIVITY ANALYSIS

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This paper provides two new data sets for comparisons of real income in OECD countries. The first set provides adjusted real series for GDP and its components from 1960 to 1993 based on OECD 1990 purchasing power parities. The second set uses OECD PPP of different benchmark years, and interpolates these applying national price indices. Comparisons between both alternatives, *Penn World Table Mark 5* (PWT 5) and its new version (PWT 5.6), in terms of economic growth and convergence, reveal some remarkable differences. Moreover, there are wider differences concerning the relative countries' position in GDP per capita ranking. Estimations of convergence equations based on OECD data yield a better fit than those obtained using PWT data, although there are also some significant differences between PWT 5 and PWT 5.6. Nevertheless, a very positive result is that other parameters of interest in these equations are not affected by the use of these different data sources.

I. INTRODUCTION

Most empirical work in the growth and convergence literature is based on data drawn from the Penn World Table Mark 5 (PWT 5) (see Summers and Heston, 1991) or its new version PWT 5.6. These are the obvious choices when the investigator is interested in obtaining homogeneous data for the largest sample of countries possible, such as the 152 countries covered by PWT 5.6. However, the choice is less obvious if the investigator is interested in making comparisons among a relatively small set of countries, such as the OECD.

The difficulty arises first from the well-known conflict between the properties of transitivity and characteristicity in multilateral and bilateral comparisons (Kravis, Heston, and Summers, 1982). Transitivity guarantees the invariance of binary comparisons when they are made through a third country. Characteristicity refers to the optimal character of the basket of goods taken as representative of

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the patterns of expenditure in two countries, and also requires that the weights used in the comparison be solely based on spending patterns of these two countries. Thus, if one wants transitive comparisons, the more countries included in the sample, the more the reference basket of goods has to depart from being the best sample of representative items for each country. Besides that, if each bilateral comparison utilize a set of weights unique to a specific pair of countries, the results would not be transitive. It is clear that the trade-off depends on the number of countries in the sample, on the heterogeneity of expenditure patterns, and on the weighting scheme used to produce an average international price.

A second potential source of problems, related to the previous one, is that PWT 5 and PWT 5.6 do not maintain the fixity convention in Purchasing Power Parities (PPP) agreed by the OECD. This convention permits the original OECD and Eurostat results to remain unchanged when their countries are included in a larger sample. When fixity is not maintained, the inclusion in the sample of countries with different price structures and GDP compositions introduces distortions in the original comparisons among OECD countries. A third drawback is found when the investigator is interested in using macroeconomic variables not included in PWT 5 or PWT 5.6. Then there may be a problem of coherence between different sources of data.

The aim of this paper is twofold. First we present two alternative data sets, covering the expenditure composition of GDP from 1960 to 1993, for comparisons of real income among OECD countries. The first data set is based exclusively on OECD 1990 PPP. The second one uses OECD PPP for benchmark years 1980, 1985, and 1990, and interpolates between them using national price indices. The first alternative maintains the original rates of growth of GDP given by National Accounts, while the second one does not necessarily respect these rates, but is anchored by the original PPP benchmark estimates. PWT 5 takes an intermediate approach, adjusting both rates of growth and benchmark estimates.

The second aim of the paper is to check whether the use of one or another of the different data sets has any influence on the assessment of convergence, the ranking of countries according to their per capita income, and some related issues. Comparisons of both alternatives with PWT reveal some remarkable differences. Both versions of PWT show a higher dispersion of per capita GDP from the mid-seventies on, producing a pattern of σ-convergence that differs from the one derived from our data sets. There are also some noticeable differences in the ranking of countries according to their per capita GDP. Convergence regressions fit worse with both PWT, and conditional or unconditional convergence is lower with PWT 5 data. However, other parameters of interest, as the coefficients of physical and human capital, seem quite robust with respect to the data used in their estimation.

The rest of the paper is organized as follows. In Section II we describe the procedures and sources used to build our data sets. In Section III we compare the dispersion in per capita income of our data sets with those of PWT 5 and PWT 5.6; we also analyze the variations in the ranking of OECD countries according to their per capita income induced by the use of one or other data source. In Section IV we discuss the differences in the estimation of convergence equations caused by the use of different data. Section V contains some final remarks.

II. Alternative Multilateral Comparisons in OECD Countries

The OECD provides detailed PPP and real GDP data for benchmark years 1980, 1985, and 1990. We have used two approaches in order to generate real values for non-benchmark years.

1. Using data contained in the OECD National Accounts, we obtain series from 1960 to 1993 in national currencies at 1990 prices for GDP and its components: private consumption (C), public consumption (G), investment (I), exports (X), imports (M) and variations in stocks (VS). These series could be converted to 1990 international prices using the OECD's PPP estimates for 1990.[1] However, this approach presents some difficulties. First, the aggregation method used to obtain PPP for 1990 is the EKS, while the Geary–Khamis method was used in 1980 and 1985 benchmark studies.[2] In contrast with the Geary–Khamis method, the EKS is not additive, that is, the real value of GDP is not the sum of the real values of its components. Although differences are small, we want to ensure additivity of the PPP converted components of GDP in order to respect national accounts identities for 1990 and also for other non-benchmark years. Let $(PPP_j^{90})_i$ be the EKS purchasing power parity of aggregate i in 1990 for country j provided by the OECD, $RGDP90_j^t$ the real GDP of year t for country j at 1990 international prices, and $e_{ij}^{t,90}$ the expenditure level in category i of year t for country j at 1990 national prices.[3] Then, we have:

$$(1) \qquad RGDP90_j^t = \frac{GDP_j^{t,90}}{PPP_j^{90}} \neq \sum_i \frac{e_{ij}^{t,90}}{(PPP_j^{90})_i} \qquad e_i = C,\ G,\ I,\ X,\ M \text{ and } VS.$$

In order to ensure the adding-up condition in national accounts for all years,

[1]National accounts data and PPP for Turkey present cumbersome problems. The OECD PPP estimate for GDP in 1985 equals 153 liras per U.S. dollar, while the extrapolation of 1990 estimate to 1985 equals 232 liras. The difference represents 51.6 percent of the 1985 parity. Heston and Summers (1993) explained that difference arguing problems with Turkish data because 1985 was the first year in which Turkey participated in the OECD studies. Also the OECD suggested that 1985 results for Turkey and Portugal were affected by the Gerschenkron effect because of the use of the Geary–Khamis method. However, 1985 GDP PPP for Portugal was 66.2 escudos per U.S. dollar while 1990 extrapolation to 1985 was 64.5 escudos, the difference representing only −2.6 percent. After a cautious analysis of 1985 and 1990 results, for Turkey we have detected a large discrepancy between the national accounts data used in estimating the 1990 PPP (where GDP was 37 percent higher) and those appearing in the OECD National Accounts, 1960–91, taking 1985 as base year. However, the latest publication of the OECD National Accounts from 1960 to 1993 yields a GDP estimation for 1990 very close to that of the PPP study. This suggests that in some cases it is more advisable to use the PPP compatible with the National Accounts methodology, i.e. in the case of Turkey, to use the 1990 PPP when we use data having 1990 as base year (as in our case) or 1985 PPP when National Accounts have 1985 as base year. We attribute this problem to the changes in the relative position of Turkey's GDP per capita that can be observed in different publications of the OECD.

[2]Eurostat has selected the EKS results as the official ones for EEC countries and the OECD agreed to publish for 1990 both EKS and Geary–Khamis results. Usually, EKS results are claimed to be more neutral in relation to national price structures than those of the Geary–Khamis method. In the evaluation process of this paper, the OECD has published PPPs for 1993. Preliminary results with these new PPPs support the main findings we present in this paper using the PPPs for 1990 as the latest ones.

[3]Following Summers and Heston (1991) the mnemonic first letter refers to real international prices. However, notice that most of the PWT 5 variables are in per capita terms. For direct comparisons between both data sets RGDP90 has to be divided by population levels.

we have redefined expenditure levels in each category at 1990 international prices as follows:

$$(2) \qquad re_{ij}^{*t,90} = \frac{e_{ij}^{t,90}}{(\mathrm{PPP}_j^{90})_i} \frac{\mathrm{RGDP90}_j^t - X_j^{t,90} + M_j^{t,90}}{\sum_i e_{ij}^{t,90}/(\mathrm{PPP}_j^{90})_i} \qquad e_i = C, G, I \text{ and } VS.$$

Notice that this approach is just the opposite to the one used by Summers and Heston (1991) in the elaboration of variable RGDP in PWT 5. In this data set, RGDP consists of the sum of extrapolated GDP components obtained by applying the rates of growth to the 1985 levels of C, I, G, X and M expressed in 1985 international prices. Our procedure has the advantage of maintaining the same rates of growth of GDP, exports and imports as those given by National Accounts.[4]

2. The second method consists in using the estimated PPPs for several benchmark years and in extrapolating them with national price indices. However, PPPs are calculated using data and methodologies which are different from those used in the calculations of national price indices. The latter are computed using data corresponding to baskets of goods and services specific to each different country of the sample, while the former refer to a common basket of goods and services. Thus, the reliability of this extrapolation procedure is affected by the heterogeneity of expenditure patterns across the covered countries and by the length and characteristics of the extrapolation period.[5]

As Heston and Summers (1993) have noted, successive benchmark estimations of PPP contain useful information about the evolution of price structures. Ideally, the use of PPP for comparisons of final domestic expenditure or GDP should be done in a framework in which space and time are simultaneously involved, and temporal indices and parities should be transitive in both dimensions. Krijnse Locker and Faerber (1984) have put forward different methods to obtain space and time transitive PPP and price indices. As the change of parities over time is due to the relative change in price levels of the involved countries, and national price indices are the only relevant information about this change, both could be combined to construct a time series of PPP. First, for countries with only one benchmark estimated PPP available, the simplest method of extrapolation consists in:

$$(3) \qquad \mathrm{PPP}_{jh}^t = \mathrm{PPP}_{jh}^{t_0} \frac{I_{t_0,t}^j}{I_{t_0,t}^h}, \qquad \forall h, j, \qquad \forall t,$$

where $\mathrm{PPP}_{jh}^{t_0}$ is the purchasing power parity of country j with respect to country h used as numeraire (usually the United States) in benchmark year t_0, and $I_{t_0,t}$ is the price index change between t_0 and t.

[4]Growth rates of each component, after redefinition given by (2), are not significantly different to those in the National Accounts.

[5]Since growth rates of real GDP in National Currency represent domestic rather than international price weights, the rate of growth of GDP at constant prices derived from two benchmark years is not necessarily equal to the national accounts rate of growth. Summers and Heston (1988) have proposed a "consistentization" procedure in order to overcome this problem. In PWT 4 and PWT 5 they introduced some adjustment factors for both national accounts rates of growth as well as for benchmark estimates.

For countries with two or more benchmark estimations, when we want to maintain benchmark PPP unchanged, an appropriate interpolation formula to estimate parities for the intermediate periods is given by:

$$(4) \qquad PPP^{t}_{jh} = \left(PPP^{t_0}_{jh} \frac{I^{j}_{t_0,t}}{I^{h}_{t_0,t}} \right)^{t_1 - t/(t_1 - t_0)} \left(PPP^{t_1}_{jh} \frac{I^{j}_{t_1,t}}{I^{h}_{t_1,t}} \right)^{t - t_0/(t_1 - t_0)}$$

where t_0 and t_1 are successive benchmark years, such that $t_0 \leq t \leq t_1$, $It_{1,t}$ is the price index from t, t_1 and $I_{t_0,t}$ is the price index from t_0 to t.

As we have available OECD PPP estimates for 1980, 1985, and 1990 as benchmark years, we can apply the above procedure given by (3) and (4) to obtain a set of annual PPP. For 1980 we have used the OECD preliminary results of ICP Phase IV published by Ward (1985), where fixity convention is applied for EEC countries and parities for SNA aggregates are available.[6] For 1985 we have used the results published by OECD in *Purchasing Power Parities and Real Expenditures, 1985* (1987).[7] Finally, for 1990, we have used again the EKS results published by OECD in 1992.

Given these benchmark parities for 1980, 1985, and 1990, and expressions (3) and (4), we obtain time series of PPP for GDP and its components from 1960 to 1993. Some aspects about these series are worth noticing. First, both 1980 and 1985 PPP use the Geary–Khamis aggregation method, while 1990 parities use the EKS method. The Geary–Khamis method may suffer from the Gerschenkron effect, i.e. may produce biased estimates for those countries whose expenditure and price structure differ substantially from the international average, which tends to be dominated by high-income countries, since the weighting scheme reflects country shares in total expenditure. Then, at aggregated level, output of the lower-income countries is evaluated using higher prices than those consistent with their economic structure and their PPP for GDP may be overestimated. This indicates that the time series of GDP may be affected by the combination of 1985 Geary–Khamis PPP with 1990 EKS PPP in the sense of showing lower rates of growth for poor countries. Second, by applying the resulting PPP to GDP and its components we obtain comparable magnitudes across countries but not over time. Third, the basic national accounts identity does not hold, i.e. GDP components in international prices do not add up to the GDP. Finally it is not possible to use this procedure with the increase in stocks (VS) because there is not a price index for this GDP magnitude.

In order to procure comparability over time while maintaining national accounts identities, we have proceeded as follows. First, as U.S.A. is the numeraire country, we have divided all PPP converted series (GDP as well as its components) by the corresponding U.S.A. price indices. Second, to ensure the adding-up condition in national accounts magnitudes for all years, we have applied the procedure defined in (2), using the GDP PPP for the increase in stocks. Therefore, the

[6]Countries included in this study are Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, United Kingdom, Austria, Finland, Norway, Canada, Japan and U.S.A. PPP have been taken from Table F of the Annex.

[7]This survey includes all OECD countries with the exception of Switzerland and Iceland. PPP have been taken from Table 9, Part Two.

new variable termed RGDPb maintains the original comparisons given by GDP benchmark parities and it is equal to the sum of its adjusted components.[8] As a result of this procedure that fixes all parities in benchmark years, the rates of growth of RGDPb are different from those of each country National Accounts, with the exception of the numeraire country and those with only one benchmark estimate.

III. Growth and Convergence: Empirical Differences Among Data Sets

Growth Rates

As a consequence of the different methodologies used in the construction of PWT 5, PWT 5.6 and of our two data sets, the average rates of growth of the OECD as a whole and those of individual countries show some variations from one data set to another. Both PWT 5.6 and RGDP90 respect the rates of growth of each country National Accounts, although there are some differences between them due to the different original sources.[9]

TABLE I

Average Rates of Growth of GDP per capita, 1960 90

	PWT 5.6	PWT 5	RGDP90	RGDPb
OECD	2.98	2.88	2.94	2.73
G7	3.08	2.99	3.03	2.82
Poorest 1990[b]	3.36	3.10	3.03	2.99
Poorest 1960[a]	4.05	3.81	3.87	3.58

Notes:

We have applied the rates of growth of PWT 5.6 to PWT 5 in the extrapolation of variable RGDP to 1989 and 1990.

[a] Poorest 1960: Greece, Turkey, Portugal, Japan, Ireland and Spain.

[b] Poorest 1990: Greece, Turkey, Portugal, Ireland, Spain and New Zealand.

Table I shows the average rates of growth for the OECD, for the G7 countries (U.S.A., Japan, Canada, France, Germany, U.K. and Italy) and for the six poorest countries in 1990 (Greece, Portugal, Turkey, Spain, Ireland and New Zealand) and in 1960 (Greece, Portugal, Turkey, Spain, Ireland and Japan). PWT 5.6 yields almost the same rate of growth than RGDP90 for the whole OECD, but there are larger differences as far as the groups of rich and poor countries are concerned. RGDP90 has higher rate of growth than RGDPb. This may be partially explained by the Gerschenkron effect on poor countries induced by the Geary–Khamis method, although the similar difference observed for rich countries casts some doubts over this interpretation. PWT 5 yields, as expected, rates of growth in between those of RGDP90 and RGDPb, with the exception of the group of poorest countries in 1990.

[8] Again, the mnemonic first letter refers to real international prices. The lowercase letter *b* is used to recall that different benchmarks have been used.

[9] We have taken OECD official statistics (National Accounts 1960 93) while PWT 5.6 data are taken from the World Bank.

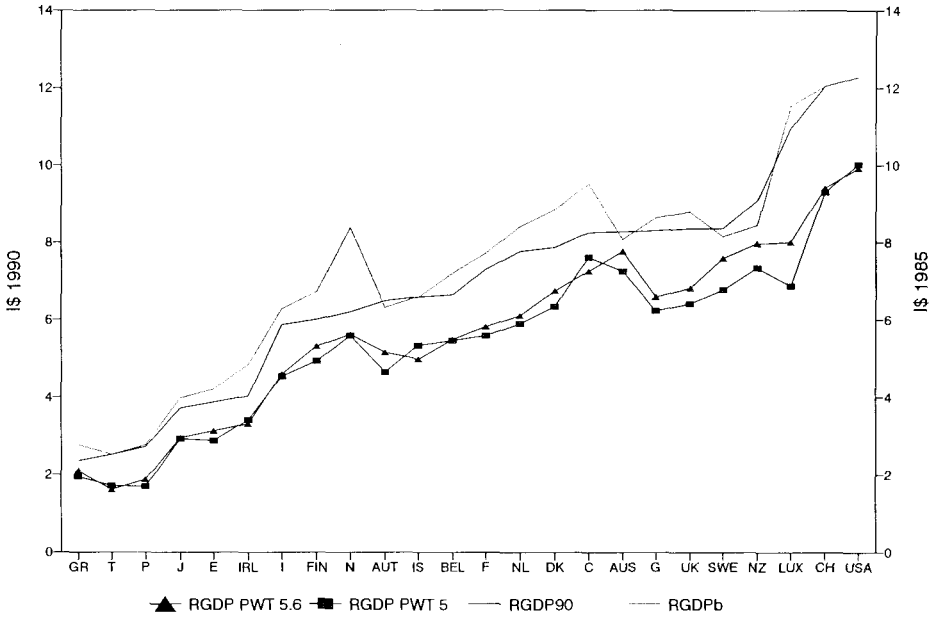

Figure 1(a). Comparisons of GDP per capita in 1960

Rankings

Let us consider the question of how alternative measures of real GDP affect the ranking of OECD countries according to their per capita income. In the horizontal axis of Figure 1(a) and (b), countries have been arrayed in order of their 1960 and 1990 RGDP90 per capita level, measured on the right-hand vertical axis in 1990 international dollars (I$). Following this order, these figures also display the GDP per capita levels for RGDPb and RGDP from PWT 5 and PWT 5.6. These are measured on the left-hand vertical axis in 1985 international dollars. Thus, while the line corresponding to RGDP90 is continuously increasing by definition, changes in the sign of the slope for other variables represent a change in the ranking of countries.[10] Some countries vary sharply their position from one data set to another. Notice also that PWT 5.6 produces a different ranking than PWT 5. It can be shown that there is not a clear relationship between the discrepancies of the relative position of each country with respect to the OECD mean for these variables and the level of income per head, except for RGDP90 and RGDPb, whose differences appear to be positively correlated with per capita income. The case of the U.K. is specially illustrative. Its relative position has suffered a large fall between 1960 and 1990, moving from the 6th position in 1960 to the 18th in 1990, as measured by RGDP90. However, if we consider PWT 5.6, the starting position of the U.K. in 1960 is the 11th, and the final one in 1990 is the 14th. Therefore the fall is far less dramatic with PWT 5.6 than with RGDP90.

[10]In Figure 1(b), RGDP90 and RGDPb overlap because both use the same PPP for this benchmark year.

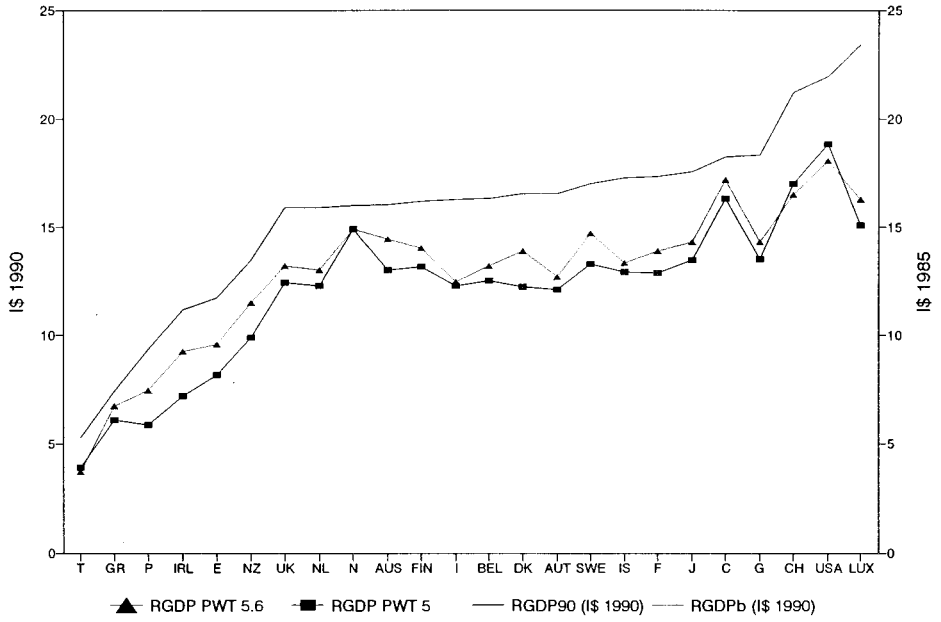

Figure 1(b). Comparisons of GDP per capita in 1990

Dispersion in per capita Income

In Figure 2 we show the evolution over time of the standard deviation of the logarithm of real per capita GDP according to the four different data sets. This

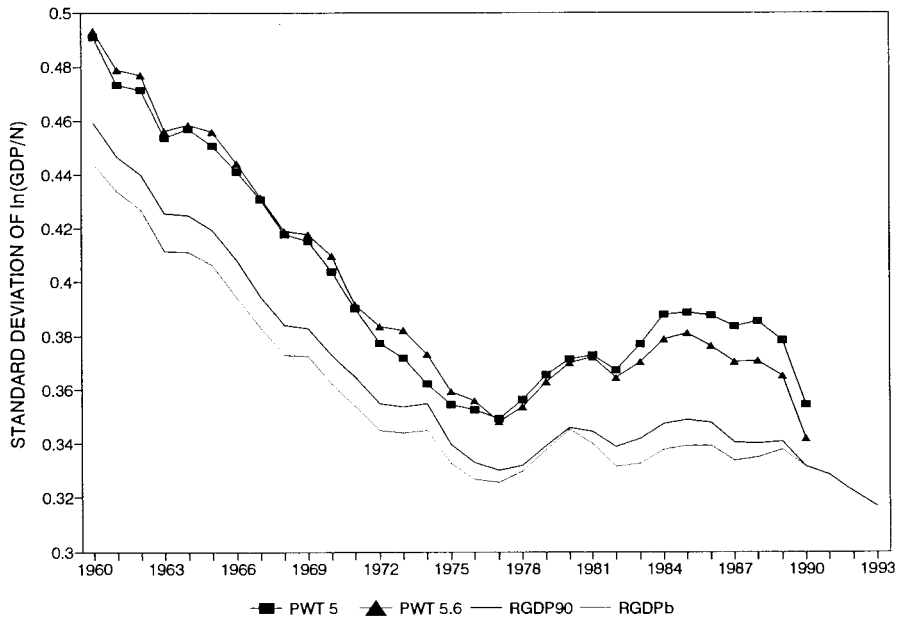

Figure 2. Sigma Convergence in OECD Countries

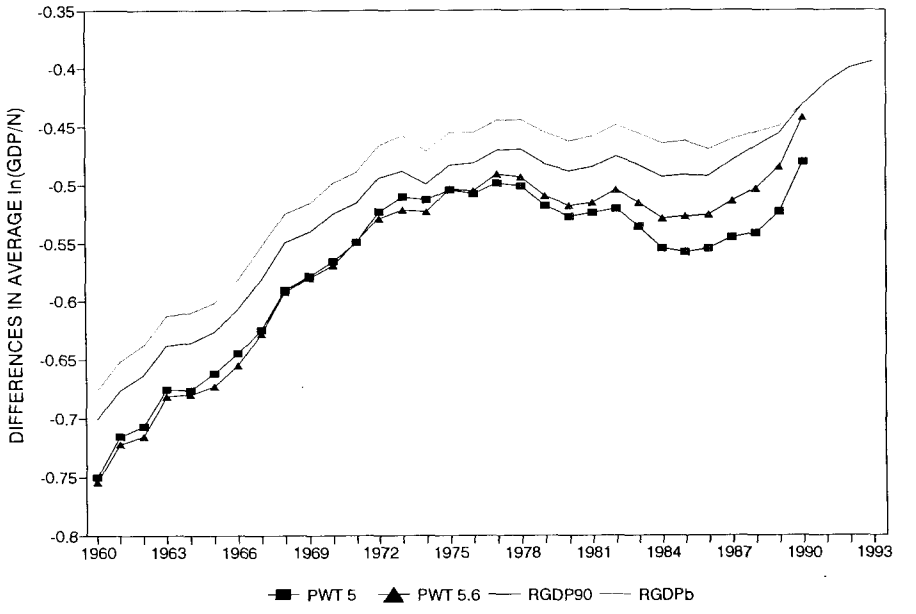

Figure 3. Relative Position to OECD Average
(Six Poorest Countries)

depicts the so called σ-convergence (see Barro and Sala-i-Martín, 1991a and 1991b) in the OECD. The picture from the different data sets is very similar from 1960 to 1977: in this period there is a clear process of convergence, more pronounced in both versions of PWT, although differences are small. However, from 1978 to 1990, PWT and our two data sets tell different stories. According to our data sets convergence stopped in the mid-seventies, but there is not a clear pattern of divergence since these years. On the contrary, both PWT data sets show divergence processes since 1978. It is very difficult to give a full account of this difference. However, if we exclude from the sample the six poorest countries in 1960 (Greece, Turkey, Portugal, Japan, Spain and Ireland), the four data sets show more homogeneous patterns of σ-convergence. Thus, it is the different treatment given to the poorest countries, in particular if we exclude Japan from this subsample which constitutes the most relevant example of convergence in the OECD, that accounts for most of the dissimilarities of Figure 2. A detailed analysis of the evolution over time of the relative position with respect to the OECD average of the income quartiles shows, as it is depicted in Figure 3, that PWT 5 and, to a lesser extent PWT 5.6, yield lower income for poor countries in the sample.

IV. A Sensitivity Analysis of Cross-Country Growth Regressions

In this section we investigate the sensitivity of the estimates of convergence equations, of the kind used in empirical growth literature, with respect to the use of different data sets. Our aim here is not to assess the postwar performance of OECD countries related to the convergence process, this has been analyzed in

other papers (Andrés, Doménech, and Molinas, 1996a and 1996b; Crafts and Toniolo, 1995). Rather, we want to illustrate the consequences of using different data sets on the most common tools used in empirical analysis in the growth and convergence literature.

Following Mankiw, Romer, and Weil (1992), and starting from a human capital augmented version of Solow growth model, we can obtain the following conditional convergence equation

$$(5) \qquad \ln y^i_{T+\tau} - \ln y^i_T = \phi_i \tau + (1 - \exp\{-\lambda_i \tau\})(B_{i1} + \phi_i T - \ln y^i_T + \ln y^{i*}_{T+\tau}).$$

This equation states that the rate of growth of per capita income y of an economy depends positively on its starting conditions relative to its steady state, y^* which is described by physical and human capital saving rates, s^*_k and s^*_h respectively, and the population growth n^*:

$$(6) \qquad \ln y^{i*}_{T+\tau} = B_{i2} + \phi_i T + (1 - \alpha_i - \gamma_i)^{-1}[\alpha_i \ln s^{i*}_k + \gamma_i \ln s^{i*}_h - (\alpha_i + \gamma_i) \ln (n^{i*} + \phi_i + \delta_i)].$$

Avoiding the discussion about the existence of different convergence clubs as well as the stability of this convergence equation over time, we assume that countries do not differ in the underlying technology, that is, all the parameters in equation (5) and (6) are the same across countries.[11] As Mankiw, Romer and Weil (1992) have noted, if the steady state is the same for all countries, equation (5) collapses to the unconditional convergence equation:

$$(7) \qquad \ln y^i_{T+\tau} - \ln y^i_T = \phi \tau + (1 - \exp\{-\beta \tau\})(B_2 + \phi T - \ln y^i_T) + v_{it}.$$

When the underlying technology, the fraction of income devoted to accumulate both human and physical capital, and the population growth across countries are the same, poor countries grow faster than rich ones if β is positive.

The usual procedure in empirical growth literature has been to estimate linear versions of both unconditional as well as conditional convergence equations using cross-section data. In this paper, we estimate the nonlinear version for both cross-section and pooled data.[12] Table 2 presents the cross-section estimates of the convergence equations, where the dependent variable is the rate of growth of average income in 1985–90 with respect to 1960–65, for the four alternative data sets.[13] Columns (1), (4), (7) and (10) refer to the unconditional convergence equation for the four data sets. β-convergence is very similar in all cases although the fit of this convergence equation is different across the data sets, providing

[11] Andrés and Boscá (1993) exploit the parameter across countries restrictions in convergence equations to show the presence of three different groups in OECD countries. Andrés, Doménech, and Molinas (1996b) analyze the stability over time and across countries of convergence equations in OECD countries.

[12] The proxy for human capital accumulation corresponds to third level enrollment rates from UNESCO Statistical Yearbook (various issues). Data for Luxembourg are very poor since an important fraction of undergraduates study in nearby countries such as Belgium, France or Germany. As a solution of this problem, for Luxembourg we use Belgium as enrollment rates. We also tried other human capital variables as secondary enrollment rates, including years of schooling of the labour force, (from Kyriacou, 1991), and different variables from the Barro and Lee (1993) data base. However, third level enrollment rates from UNESCO produce the best results.

[13] Taking five year averages at the beginning and at the end of the period we avoid the problems originated by the presence of an abnormal year or by cyclical fluctuations of GDP.

TABLE 2

DEPENDENT VARIABLE $\log(y^i_{(90\ 85)}/y^i_{(65\ 60)})$. SAMPLE i: 1, . . . , 24

	PWT 5.6			PWT 5			RGDP90			RGDPb		
	1	2	3	4	5	6	7	8	9	10	11	12
B_2	2.42	−7.14	−7.60	2.39	−6.51	−7.28	2.65	−5.85	−6.36	2.47	−7.22	−7.64
	(12.0)	(5.59)	(5.39)	(12.8)	(5.25)	(7.04)	(14.3)	(5.59)	(6.67)	(22.7)	(5.12)	(6.22)
α		0.43	0.45		0.40	0.40		0.44	0.44		0.53	0.53
		(6.19)	(6.24)		(5.30)	(6.24)		(8.04)	(8.23)		(7.78)	(8.35)
γ		0.18	0.17		0.19	0.21		0.15	0.16		0.09	0.10
		(3.65)	(3.50)		(3.15)	(4.74)		(4.07)	(4.75)		(1.86)	(2.39)
λ	0.013	0.025		0.012	0.019		0.014	0.022		0.013	0.020	
	(2.56)	(5.16)		(2.87)	(3.56)		(2.68)	(5.63)		(2.72)	(4.42)	
R^2 Adj.	0.426	0.735	0.750	0.347	0.536	0.553	0.410	0.785	0.810	0.397	0.758	0.788
σ_v	0.202	0.202	0.202	0.198	0.198	0.198	0.193	0.193	0.193	0.178	0.178	0.178
σ_u	0.153	0.104	0.101	0.160	0.135	0.132	0.149	0.090	0.084	0.138	0.088	0.082
λ_{imp}			0.022			0.022			0.023			0.021
$\chi_1(\lambda)$		0.18			0.63			0.12			0.08	
Sign. level		67.4%			42.7%			72.7%			77.7%	
N. Observ.	24	24	24	24	24	24	24	24	24	24	24	24

Notes: Estimation method: Non-linear least squares with robust errors, t-statistics shown in parentheses. λ_{imp} (implicit λ) is equal to $(1-\hat{\alpha}-\hat{\gamma})(\bar{n}+\phi+\delta)$ where $\phi=0.02$ and $\delta=0.03$. Test for restriction $\lambda=(1-\alpha-\gamma)(\bar{n}+\phi+\delta)$ is a $\chi(1)$ (critical value = 3.84). We have applied the rates of growth of PWT 5.6 to PWT 5 in the extrapolation of variable RGDP to 1989 and 1990.

PWT 5 the highest standard error of the residuals. Columns (2), (5), (8) and (11) report the cross-section estimates of conditional convergence showing RGDP90 the best fit. Finally, we impose the theoretical restriction on the rate of convergence $\beta = (1-\alpha-\gamma)[\Sigma_i(n_i+\phi+\delta)]/N$, where N is the number of countries and n the population rate of growth. Estimations results under this restriction are reported in Columns (3), (6), (9) and (12). In this case, the standard error of the residuals of RGDP90 equation is 57 and 20 percent lower than those for PWT 5 and PWT 5.6, respectively, and almost the same to RGDPb. The important result, here, is that the estimated coefficients do not seem to be affected by changes in the data set. In particular, we can accept that γ and α are the same across equations, yielding a rate of convergence around 2.2 percent per year.[14] Nevertheless, the unconditional rate of convergence for the RGDP90 data set is slightly higher than that obtained when using the RGDPb data set. As we have seen, RGDPb gives higher incomes at the beginning of the sample period, and lower rates of growth for the poorest countries in the sample.

Table 3 provides the regression results of the convergence equation using pooled data. Variables now consist in five year averages from 1960 to 1990. Aside from the usual set of explanatory variables, regressions include a time dummy variable for each period. Estimation method is non-linear instrumental variables with White's consistent standard errors. We instrument investment rates and population growth with their lagged values. Estimated coefficients do not suffer special changes from one data set to another. We have also estimated equations in Table 3 without including time dummies. The most remarkable feature of the regression results (not reported here) when compared with Table 3, is the fall in the adjusted R^2 for the four alternative data sets. However, the decrease in the fit of equations is proportionally higher with RGDPb and PWT 5, which do not maintain the national accounts rates of growth. That means that time dummies play a major role when these two data sets are used. Moreover, human capital is not significant in five of eight estimations, and estimated parameters are quite different from one equation to another.

V. Final Remarks

In this paper we have presented two data sets for real GDP and its components for OECD countries. The first set has been built by extrapolating backward OECD's 1990 PPP using national price indices. We have adjusted the series in order to ensure additivity of the PPP converted series of GDP components. In this set, the rates of growth of each country's GDP are the same as the ones given by National Accounts. The second set uses PPP information for benchmark years 1980, 1985 and 1990, and interpolates between them by means of national price indices. Original PPP converted magnitudes are respected in this set, while national accounts rates of growth of GDP are not maintained.

[14]Nevertheless, this constancy in parameters estimates does not seem to hold in enlarged samples of countries. Thus, Frankel and Romer (1996) have re-estimated some of the equations of Mankiw, Romer, and Weil (1992) using PWT 5.6 instead of PWT 4, showing that physical capital accumulation presents a lower coefficient whereas that of the human capital is higher than those estimated by Mankiw, Romer, and Weil (1992).

TABLE 3

DEPENDENT VARIABLE $\log(y_t^i/y_{t+5}^i)$. SAMPLE i: 1, . . . , 24; t: 1965, 70, 75, 80 AND 1985
EQUATIONS INCLUDE A TIME DUMMY FOR EACH SUBPERIOD

	PWT 5.6			PWT 5			RGDP90			RGDPb		
	1	2	3	4	5	6	7	8	9	10	11	12
B_2	2.90	−6.19	−6.19	2.87	−5.68	−6.32	3.01	−4.97	−5.57	3.47	−5.39	−5.62
	(14.6)	(3.96)	(3.68)	(11.9)	(2.75)	(3.45)	(15.3)	(4.21)	(4.57)	(8.71)	(3.39)	(3.07)
α		0.42	0.44		0.39	0.41		0.42	0.44		0.46	0.48
		(7.24)	(5.98)		(5.45)	(5.92)		(6.60)	(6.79)		(5.97)	(5.09)
γ		0.17	0.15		0.19	0.19		0.15	0.15		0.13	0.12
		(4.20)	(3.23)		(3.59)	(4.53)		(3.14)	(3.41)		(2.45)	(1.98)
λ	0.015	0.032		0.014	0.024		0.013	0.026		0.014	0.031	
	(3.58)	(5.80)		(3.29)	(4.56)		(3.52)	(5.06)		(3.05)	(4.39)	
R^2 Adj.	0.340	0.469	0.444	0.336	0.418	0.410	0.316	0.459	0.458	0.488	0.545	0.541
σ_y	0.082	0.082	0.081	0.086	0.086	0.086	0.074	0.074	0.074	0.104	0.104	0.104
σ_u	0.067	0.060	0.061	0.070	0.066	0.066	0.061	0.055	0.055	0.075	0.070	0.071
λ_{imp}			0.023			0.023			0.024			0.023
$\chi_1(\lambda)$		2.03			0.001			0.12			1.02	
Sign. level		15.4%			98.1%			73.1%			31.1%	
N. Observ.	120	120	120	120	120	120	120	120	120	120	120	120

Notes: Estimation method: Non-linear instrumental least squares with robust errors. t-statistics shown in parentheses. λ_{imp} is equal to $(1-\hat{\alpha}-\hat{\gamma})(\bar{n}+\phi+\delta)$ where $\phi=0.02$ and $\delta=0.03$. Test for restriction $\lambda=(1-\alpha-\gamma)(\bar{n}+\phi+\delta)$ is a $\chi(1)$ (critical value = 3.84). We have applied the rates of growth of PWT 5.6 to PWT 5 in the extrapolation of variable RGDP to 1989 and 1990.

PWT 5 and PWT 5.6 use PPP calculated for a larger sample of countries. As they do not maintain the fixity convention, they produce comparisons among OECD countries that are different from the ones obtained from our data sets. The rankings of countries according to their per capita income in 1960 and 1990 are severely affected in some cases by the use of one or another data set. Also, the history of convergence in the OECD is different as told from PWT 5 and PWT 5.6 or as told from our data sets. In the first case, the convergence period 1960–75 is followed by a decade of clear divergence. In the second case, the same period of convergence is followed by a period in which convergence stops, but there is no divergence. These conflicting results are partially caused by our data sets producing lower incomes for rich countries and higher incomes for poor countries than PWT 5 and PWT 5.6.

The estimation of convergence equations with the different data sets yields similar results as far as the basic coefficients are concerned. The equations fit better with our data sets and there are small differences in the estimation of the convergence rate.

Appendix: Getting Data Using FTP and Files Contents

OECD data sets are available at following URL address:

ftp://aeserver.aneco.uv.es/Public/OECD-Tables/oecd-t.txt
ftp://aeserver.aneco.uv.es/Public/OECD-Tables/oecd-t.prn
ftp://aeserver.aneco.uv.es/Public/OECD-Tables/oecd-t.wks

File: oecd-t.txt

List of variables and countries included in file OECD-T.PRN

File: oecd-t.prn (Variables in ASCII format)

Column	Variable	Description and sources
[Col. 1]	*NUM*	Identification code in *PWT 5.6*
[Col. 2]	*COUNTRY*	Country Name
[Col. 3]	*YEAR*	Years from 1960 to 1991
[Col. 4]	*POP*	Population, *National Accounts, 1960–93* (1994)
[Col. 5]	*GDP*	Gross Domestic Product (1990 prices) *National Accounts, 1960–93* (1994)
[Col. 6]	*C*	Private Consumption (1990 prices) *National Accounts, 1960–93* (1994)
[Col. 7]	*G*	Public Consumption (1990 prices) *National Accounts, 1960–93* (1994)
[Col. 8]	*I*	Gross Fixed Capital Formation (1990 prices) *National Accounts, 1960–93* (1994)
[Col. 9]	*X*	Exports (1990 prices) *National Accounts, 1960–93* (1994)
[Col. 10]	*M*	Imports (1990 prices) *National Accounts, 1960–93* (1994)
[Col. 11]	*RGDP90*	Gross Domestic Product (1990 international prices) 1990 PPPs are from *Purchasing Power Parities and Real Expenditures* (1992)
[Col. 12]	*C90*	Private Consumption (1990 international prices)*
[Col. 13]	*G90*	Public Consumption (1990 international prices)*

[Col. 14]	*I90*	Gross Fixed Capital Formation (1990 international prices)*
[Col. 15]	*X90*	Exports (1990 international prices)*
[Col. 16]	*M90*	Imports (1990 international prices)*
[Col. 17]	*RGDPb*	Gross Domestic Product (1990 international prices)**
[Col. 18]	*Cb*	Private Consumption (1990 international prices)**
[Col. 19]	*Gb*	Public Consumption (1990 international prices)**
[Col. 20]	*Ib*	Gross Fixed Capital Formation (1990 international prices)**
[Col. 21]	*Xb*	Exports (1990 international prices)**
[Col. 22]	*Mb*	Imports (1990 international prices)**
[Col. 23]	*Ex$*	Exchange rates relative to U.S. dollar

File: oecd-t.wks (Same as **oecd-t.prn** in WKS format)

*Expenditure levels have been adjusted following expression (2) in the text.

**This variable uses the available PPPs of 1980, 1985 and 1990.

Extrapolation and interpolation methods are given by equations (3) and (4). See Section III of the paper for a complete description of the procedure used in the elaboration of these variables.

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