Is Newer Better?

Penn World Table Revisions and the Growth Literature

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Abstract

Versions 6.1 and 6.2 of Penn World Tables (PWT) have essentially the same methodology and the same underlying data, but report significantly different growth numbers. It is not the case that 6.2 is better or worse than 6.1; it is inherent in the PWT approach that some data will vary a great deal across versions and there is no way to determine which of the existing versions is "best". We examine 13 leading studies of growth for "Table Invariant" results that are robust across different versions of PWT. Table Invariant results are common in studies examining cross-sectional or very long run data; in contrast, results based on higher frequency data are less likely to be robust in this sense, and annual data are particularly problematic. This lack of robustness can be attributed in part to poor data quality in lower income countries, which has been flagged in the Tables' own health warnings. The lack of robustness is also due to the PWT's methodology for constructing and compiling the data. This methodology renders data for countries with relatively small total GDP and data distant from the current benchmark year especially variable. We propose an alternative way to use PWT data that might be less prone to some of these issues.

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1. Introduction

The Penn World Table (PWT) is the most widely used source of data for cross-country income comparisons.[2] In particular, version 5.0 of these Tables, which was published in 1991, represented a major step forward in data availability and helped spawn a large empirical literature on growth and its determinants. Without doubt, the economics profession has made substantial progress by paying close attention to the pioneering work of Irving Kravis, Alan Heston, and Robert Summers.

But economists may not have been sufficiently attentive to the caveats and warnings that were clearly attached to both the first version of the Penn World Tables and all subsequent versions. In particular, the Tables clearly and unequivocally warned that data quality was weak for many countries. And it turns out there is more to guard against than just data quality; the PWT methodology renders data for countries with relatively small total GDP and historical data especially variable. This paper draws attention to the fact that lack of robustness for estimates of per capita GDP growth stems as much from the PWT's methodology for constructing and compiling the data as it does from low data quality. This paper focuses on the PWT data quality warnings and methodological limitations, and examines their consequences.

We find these consequences to be first order in three ways. First, the Penn World Tables data differ across versions – in ways and to a degree that may be seen as surprising. In particular, growth rates differ greatly across Table versions over any horizon. Figure 1 illustrates this point by showing how 30-year average annual growth

[2] Roughly 2/3 of all cross-country empirical work is based on PWT. Second place is held by the World Bank's World Development Indicators, which were originally based on the Penn World Tables, but which have subsequently diverged. The IMF's World Economic Outlook dataset places a distant third.

rates (1970-1999; the available period for comparisons) differ between Penn World Tables 6.2 and 6.1. These versions differ in three relatively small ways.[3] On the other hand, both versions are within the same generation of the Tables, and therefore have almost identical methodologies, and more surprising, very similar underlying data for the majority of countries.[4] Despite these relatively minor differences, there are substantial differences in the growth numbers, and as we will show below, the differences are inversely related to country size.[5] Growth is more than 1 percent per annum different in more than half the countries and more than 2 percent different nearly a quarter of all cases. (To anticipate our finding on proximate causes below, Figure 2 illustrates that there is also a great deal of variation across versions in the calculated change in prices, measured in PPP terms; again, visual inspection of the graph suggests a role for country size.)

Second, it is not the case that revisions to the Tables change only more recent data, as usually the case with macroeconomic data produced by national statistical

[3] There are new purchasing power parities for the OECD countries, more countries (mainly transition economies) have been added, and the reference year for calculation has been changed from 1996 to 2000.

[4] In addition, an important point emerges from a careful examination of the methodological history of the Tables (e.g., Deaton and Heston, 2008). We usually think that a revised data series is better than the original series, due to various kinds of corrections. But in the case of the Tables, the methodology has not necessarily improved over time. There have been innovations, but some of these happened for bureaucratic or even political reasons, as international organizations became involved in the data collection, preparation, and presentation. As a result, it is not reasonable to assume that one version of the Tables (e.g., the latest) is necessarily better than other versions. This is another reason why results that hold in one version of the Tables, but not other versions, should probably be viewed with greater skepticism.

[5] Figure 1 shows that for the sample for which there are data on real per capita PPP GDP in both PWT6.1 and PWT 6.2, the average difference in the growth rate (for the period 1970-1995) generated by the two versions is close to zero. But the standard deviation of the differences in growth is about 0.9 percent. This is quite substantial when compared with the fact that the average growth rate (in 6.2) is 1.44 percent. The magnitudes are broadly similar when we compare PWT6.2 with WDI (available upon request) or with the WEO number or with PWT5.6 (although the sample varies depending on the comparison).

agencies (e.g., unemployment series). Figure 3 shows that while the extent of revisions for the 1960s is relatively small between versions 6.2 and 6.1, there are large revisions for the 1970s, the 1980s, and the 1990s, looking at 10-year average annual growth rates.

Third, while it is the case that there are eye-catching differences between the average annual growth rates in 6.2 and 6.1 at any horizon, these matter more for higher frequency data. Figure 4 shows the difference in annual average growth rates for annual data, 10-year averages, and 25-year averages, on the same scale (where the third panel is the same as Figure 1). The striking differences in this figure convey exactly the impression that we find when we turn to review the results of leading growth studies, seeking to establish which of those depend on using a particular version of the Tables. Results based on annual data prove to be less robust across versions of the Tables than are results based on 10-year averages. And results based on long run growth rates or levels turn out to be quite robust in our "Table Invariant" sense, although we would caution that the implied growth paths for various countries can vary a great deal across versions – Figure 5 shows some prominent cases – and this affects many of the narratives about growth. The Tables' health warnings need to be taken seriously and probably expanded upon, and this implies further robustness checks for all growth studies. If this is done, the Penn World Tables become even more valuable.

There is a large literature assessing the basic methodology employed by the PWT for determining the international prices and PPPs which go into the internationally comparable estimates of the level of per capita GDP. In addition to the series of papers by Kravis, Summers and Heston (1978) and Summers and Heston (1980, 1991 and 1996), notable contributions include Deaton (1996), Dowrick (2005), Dowrick and Quiggin

(1997), Feenstra et al (2009), Neary (2004), Nuxoll (1994), Rao and Selvanathan (1992), Samuelson (1994), Srinivasan (1994), van Veelen (2002), and Ciccone and Jarocinksi (2008). However, most of the discussion and criticism of the PWT methodology focuses on and relates to the *level* of international prices and *level* of PPP-adjusted GDP. Surprisingly little attention has been given to the methodology and estimates for the growth rates of PPP-adjusted GDP, which then has implications for PPP-adjusted GDP levels for non-benchmark years.

Section 2 briefly reviews the background and methodology of the Penn World Tables. Section 3 explains the nature of data differences between versions of the Tables, focusing on versions 6.2 and 6.1. In Section 4 we summarize the results of our robustness/replication studies for leading growth studies. Section 5 concludes with some practical suggestions for researchers. Appendix 1 contains more technical details on construction of the PWT data. Appendix 2 proposes an alternative approach to measuring growth across countries over time.

2. The Penn World Tables

Background

Penn World Tables have reported on seven rounds of data, starting in 1970 (Table 1). The latest published version is 6.2, which was released in October 2006. The prior version was 6.1 and that was preceded by 5.6.[6] These are the most commonly used versions of the Table today, and it is on these that we focus our attention. However, it is our understanding that the points made below also apply to other versions.

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[6] Version 7.1 should be available in 2009, but the precise release date is not yet known.

Conceptually, the approach adopted by the Tables is straightforward. The innovation and great contribution of the Tables was of course to convert national measures of income into internationally comparable PPP estimates. This is done – in principle – by collecting prices for the same or similar goods in different countries, and deriving price indices that can be used to compare what people can actually buy. The price collection operation is known as the International Comparison Programme/Project (ICP). [7] The Tables obtain local currency data from the national income accounts of countries. Then, based on international price comparisons, it converts these local currency data into Purchasing Power Parity (PPP)-based figures, which should be comparable across countries. These are more appealing as the basis for comparisons than data based on market exchange rates, which can fluctuate considerably and hide the real progress (or lack thereof) in economic prosperity for a country's inhabitants.

Each "generation" of the Tables is based on a different round of the ICP, i.e., so versions 5.6 and 6.1 use different prices. Each generation also uses updated estimates of GDP and its components measured in domestic currency. Within a generation of the Tables, the ICP remains the same, e.g., this is the case for 6.2 and 6.1, but there are other revisions – the nature of which varies.

[7] The International Comparison Project began in 1968, although its antecedents date back to the 1950s. Irving Kravis was the first director; http://unstats.un.org/unsd/methods/icp/ipco_htm.htm. In 1989 the "P" became Programme, rather than Project. International price comparisons have been completed for 1970, 1975, 1980, 1985, 1990, 1996 and 2005.

Methodology Changes Over Time

The ICP is a massive undertaking, requiring a vast amount of resources – mostly in terms of people's time, but the computer resources, at least until recently, were also significant. The only organizations that can sustain such an investment are government-funded, and even international organizations, such as the UN, have a hard time coming up with all the money required.[8] A substantial amount of the needed investment has come directly from governments.

As a result, control over the ICP has shifted over time. "After phase III [1975], the role of the University of Pennsylvania, which had until then been the main engine of the ICP, was gradually transformed into that of adviser on methodological issues. Another notable change in ICP responsibility was the increasing role of the Statistical Office of the European Communities (EUROSTAT). EUROSTAT, in fact, became not only the organizer of the European Community comparison, but also, with its experienced staff, it has provided substantial technical assistance to a number of regional comparisons and to the work on establishing links among the various regions."[9]

And as control has shifted, so have preferences regarding methodology both for particular regions and for how these are aggregated to global estimates. The most important change may have been regionalization: "In phase IV [1980] and onward, countries participated through regions or country groups; first regional (e.g., African, OECD etc.) comparisons were carried out and then the world comparison was built up by

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[8] The Ford Foundation did provide critical early financial support through grants to the University of Pennsylvania.
[9] Quotation is from http://unstats.un.org/unsd/methods/icp/ipco_htm.htm

linking across these groups."[10] Deaton and Heston (2008) focus on problematic methodological points, all of which arise because particular organizations control part of the methods, and their concern suggests that the methodology changes significantly such that it is harder to say if the Tables are improving or not in their accuracy. But there are other reasons to worry about this exact same issue.

3. Understanding the Differences

PWT Methodology Generates Significant Data Revisions

Appendix 1 reviews the PWT methodology and all the steps of data construction in more technical detail from the perspective of the growth estimates. The bottom line from this rather dense discussion is straightforward. Inherent in the PWT method is the fact that different versions of the Tables will <u>necessarily</u> produce different growth estimates, and hence different estimates also for the level of PPP-adjusted GDP for all years other than the year for which the ICP study is done. And there is no basis on which to say that a particular version's data are better or worse than any other version. This lack

[10] The pattern of support for the Tables has shifted over time. "For the most part, participating countries have provided domestic resources for the data collection for ICP, while the Statistical Division of the Department of Economic and Social Development of the United Nations Secretariat, EUROSTAT, OECD and the Austrian Central Statistical Office, in its capacity as organizer of the Eastern European comparison, have units concerned with ICP-type work. Early sponsors of the ICP, such as the Ford Foundation and a consortium of contributing countries organized by the World Bank, provided resources that allowed coordination of the benchmark comparisons, particularly among developing countries. In phases IV and V, EUROSTAT became the financial supporter of the African and Caribbean comparisons. In phase IV, the Inter-American Development Bank (IADB) provided a major contribution to the Latin American regional comparison; however, this effort was organized through a group of experts visiting countries and little experience was gained by country statistical offices, so that when IADB support was unavailable in phase V, no Latin American regional comparisons took place. The ESCAP regional comparison in phase V was assisted by the Government of Japan, the United Nations Development Programme (UNDP), the World Bank, and the Asian Development Bank." http://unstats.un.org/unsd/methods/icp/ipc6_htm.htm

of data robustness across versions of the PWT is what Figures 1-5 have highlighted. But what exactly explains this data variability?

At first pass, the problem may seem to arise from the fact that for many countries there have not been many ICP Benchmark Studies, in which prices were carefully measured first-hand (Figure 6). In fact, for 42 countries in the Tables, there had never been a single such Study, and for 91 countries there had been no more than one Study. For countries without a Benchmark Study, the prices are imputed through various methods. These methods have changed over time, and it is not clear that such changes have always been for the better (again, see Deaton and Heston 2008).

The Tables have always been quite transparent about this data quality issue, and in fact they prominently assigned "Quality Grades" for each country (e.g., to version 5.0 in 1991) – these grades are subjective assessments made by the authors of the PWT, based on a number of factors described in the Technical Appendix to PWT 6.1, pp.13-18. Figure 7 shows the breakdown of countries by their Grades in version 6.1. Strikingly, only 32 countries received a grade of A or B. Grades of C or D were received by 147 countries.

These letter grades turn out to be meaningful, in the sense that they point in the right direction with regard to what data do or do not change across versions of the Tables. The left-hand panel in Figure 8 shows differences in 30-year annual average growth rates (1970-1999) for countries with Data Quality Grades of A or B. The right hand panel shows the same for countries with Grades of C or D. All the major variation across versions of the Tables occurs in the countries with lower grades. The same comparison holds across higher frequency growth data also. The Quality Grades are obviously informative, but do not fully explain the data variability across revisions.

A key insight of Rao and Selvanathan (1992) is that the PPPs computed by the PWT are subject to variability, where the variability is inversely related to country size, measured as the log of a country's total GDP. Appendix 1 below also shows that the variability of PPPs will also increase the farther away the measurement is from the benchmark year. The reason again relates to the way PPPs are calculated for non-benchmark years. If this view is correct, a major underlying cause of variability in the GDP and growth estimates arises from variability in the PPPs. We first present the evidence on the (variability) of the PPPs, and then the evidence on the level of GDP and growth rates.

In Table 2, the dependent variable is the absolute value of the difference in the log(level of PPP) between version 6.2 and version 6.1.[11] We have three explanatory variables: data quality, country size, and the distance of the measurement year from the benchmark year. Since the benchmark year for PWT 6.1 is 1996, the latter variable is measured as the number of decades from 1996 (with each year being 1/10th of a decade; the observation for 1995 will therefore be 0.1). We use two alternative measures for data quality: the first is the grading by PWT itself and we convert the 4 letter grades for data quality into an index, from 1 to 4, where 4 is the best ("A"). The second measure is simply the number of ICP studies in which a country has participated.

[11] All the regressions are done at annual frequency but we have also done them at a decadal and 25-year frequencies and obtain broadly similar results.

Column 1 shows that a higher grade is negatively related to differences in the data, which confirms that the PWT team knows their data well. Column 2 shows that if there have been more ICP benchmark studies for a country, this also reduces the extent of data revisions between versions 6.2 and 6.1 – again, no surprise. Log GDP has a similar effect, although of course this may be a proxy for data quality or the existence of a benchmark study.

The interesting result is in column 4. This shows that the further a datapoint from the benchmark year, measured in absolute value of years from 1996, the more likely is its data to change between versions 6.1 and 6.2, i.e., the coefficient is positively signed. Columns 5 and 6 show that the result on size and distance from benchmark year hold, and even becomes stronger after we control for data quality – despite the fact that data quality and size are highly correlated. In part, also, there is an interaction effect – the effect of distance from the benchmark year is greater when data quality (measured as Letter Grade or number of ICPs) is lower. So, using the coefficients in column 6 in table 2, we find that for a grade D country, the average annual revision in the PPP level would be about 12.9% greater than for a grade A country.[12] These results on the variability of the PPPs and their relationship to country size (log total GDP) and distance are graphically represented in Figures 2 and 9. Figure 2 depicts the variability with respect to size and grade quality, and Figure 9 plots variability relative to distance from benchmark years. Figure 9 is striking in depicting a funnel relationship between variability and distance

[12] The coefficient on PWT grade switches signs between column 1 and column 6, and seems to be wrongly signed in column 6. But when the average effect of grade on data variability is calculated, including the interaction effect, a higher letter grade still implies smaller data revisions.

from benchmark year, particularly for countries with Grades C and D. Data variability increases as the datapoint moves away from 1996 both forward and backward in time.

Tables 3 and 4 and Figures 10 and 11 confirm the same broad pattern holds across investment and consumption data also. The reason we show this relationship for investment and consumption (specifically the shares of investment and consumption in GDP measured at their respective PPP prices) is that these shares are crucial in the computation of growth rates in the PWT (see the discussion in Appendix 1 under “Step 3.”). Distance from benchmark year has a consistently positive effect on the size of the data revision, although it is a bit less marked for consumption than investment, and this effect is larger for countries with lower quality data.

Tables 5 and 5a show similar results for both the level of GDP per capita and the growth of GDP per capita. The results with respect to country size are strong in both the level and growth regressions (Figures 12 and 13). The results with respect to distance from benchmark year are, however, stronger for variability in the level than in the growth rate of GDP (compare Figure 12 with 14).

4. Replication Exercises

The size of these revisions to data between versions of the Tables is surprising and the pattern to the revisions is interesting, but do they matter? To assess this we turn now to examine some of the most prominent studies in the growth that have used the Tables.

Most papers in the empirical growth literature use as dependent variable either the level of real per capita GDP, in PPP terms, or the growth rate in the same. Some papers use the level of income or growth rates as a right-hand side, control variable. Given the considerable variation in the data on growth rates (and levels) and the fact that there is no one "best" set of Penn World Tables to use, a natural question is which results in the literature are robust to changing versions of the Tables.

Criteria for Considering Papers

We have examined many of the leading papers in the growth literature based on Penn World Tables 5.6 or 6.1.[13] In each case, we attempted to run exactly the same specifications and samples, but using version 6.2 of the Tables instead. This approach cannot prove that a particular set of results is right or wrong, but it may illustrate patterns in terms of what kind of results are more or less robust.

We had four criteria for inclusion. First, the list had to include papers that studied the level of GDP, the growth rate of GDP, and the volatility of GDP. Second, since data revisions can be thought of as measurement error, and since estimation depends upon whether measurement error is on the left or right hand side, we included papers in which the various GDP measures (level, growth, and volatility) featured as regressors and as regressands. Third, since our preliminary analysis of the data showed that measurement error varies significantly between high and low frequency data, we chose papers that adopted a pure cross-sectional approach (very low frequency); a panel approach, with data averaged over 4-5 years (high frequency); a panel approach with annual data (very

[13] We focused our attention on "high impact" papers, measured either in terms of citations (using Google Scholar) or based on discussion with active researchers or papers that we think will prove influential. We sought to examine a range of papers, in terms of the frequency of data and methodology. However, our sample is not comprehensive, and the results are intended as illustrations only.

high frequency). Table 13 lists the various papers in the appropriate analytical category. After having decided the universe of potential papers based on these criteria, we narrowed the list to papers that we considered influential. Finally, for inclusion here, we had to be able to obtain the original data and to be able to replicate the paper's main results with those data.

Papers with Table Invariant Results

In all, we tested the robustness of 13 papers in the growth literature. Note that we did not check all specifications in all papers. Rather we concentrated on what appear to us – or to others citing the work – as the "main" results. The lower part of Table 13 lists 9 papers for which we found basically no or small changes in results. In addition, there were more substantial changes for 4 papers: Ramey and Ramey (1995), Jones and Olken (2005), Hausmann et al (2005), and Aghion et al (2005). We go through these in more detail below.

Before that, we should emphasize that many prominent papers survived the robustness checks. Whatever else is right or wrong with the growth literature, the bulk of it is not afflicted by the problem of sensitivity to changes in GDP data. This list includes work such as Acemoglu, Johnson, Robinson and Thaicharoen (2003), Barro (1999), Burnside and Dollar (2000), Delong and Summers (1991), Demirguc-Kunt, Levine and Laeven (2004), Easterly, Kremer, Pritchett and Summers (1993), and Sachs and Warner (1995). The minor changes that we found in results from these papers are mentioned briefly in Table 13. Miguel, Satyanath, and Sergenti (2004) proved robust in a particularly interesting way, which we expand on below. And we also discuss Mankiw, Romer and Weil (1992) in more detail below, because their results come close to being affected.

Ramey and Ramey

This paper, published in the *American Economic Review*, 1995, tests the link between growth and volatility. The specification involves running an annual panel with growth rate on the left hand side, a set of country- and time-varying controls on the right hand side, and a time fixed effect. There is no country fixed effect; instead there is a country-specific and time-invariant measure of volatility of growth, proxied by the standard deviation of the growth rate over the period covered by the growth data.

The paper used growth data from the PWT 5.6. In the original paper, there are 2208 observations from 92 countries, while in the balanced sample (i.e., where there are data from both PWT 5.6 and 6.2), there are 1776 observations from 74 countries.

In the paper, the coefficient on volatility is negative and significant at the 1 percent level. The magnitude of the coefficient is -0.177. We replicate this result in the first column of Table 6.

When we re-estimated their core specification on the balanced sample (column 2), the coefficient on the volatility term is smaller and barely significant. When we switch to using PWT 6.2, the volatility coefficient becomes even smaller and quite far from being significant (column 3). The same is true if we use the original dataset but drop countries with a Data Quality Grade of D (column 4) or if we drop the same countries while using version 6.2 (column 5).

Jones and Olken

This paper, published in the *Quarterly Journal of Economics*, 2005, relates growth to leadership. Specifically, it estimates the effect of random leader deaths on a country's growth rate. The two key findings are: such deaths have a significant impact on growth on average; and second, the death of leaders has a significant impact in autocracies but not in democracies. This paper used annual growth data from PWT 6.1 and their results are replicated in column 1 of Table 7.

When we re-estimated the core specification using data from PWT 6.2, in Table 7, we obtained the following differences compared with the original.

1. In the original paper, the coefficients of the random leader death are significant for the year of the leader death and for the two subsequent years. When we re-estimated it, using new data, the contemporaneous effect remained significant, but the effect for the two subsequent years ceased to be significant (p-value of 0.12 and 0.13, respectively); see column 3.
2. The really striking differences are related to the disaggregation of the results by type of political regime. In Jones and Olken (2005), random leader deaths had a significant impact in autocracies in the year of the leader death and in the two subsequent years (column 1 in the 3rd panel, labeled Autocrats). In the robustness check of column 3 in the same panel, they were not significant for any of these three time horizons.

3. Even more interestingly, Jones and Olken find no significant effects in democracies. In the re-estimation using version 6.2 of the Tables, leader deaths are significant in the year of the leader death and the following year (column 3 of the 4th panel, labeled Democrats).

Thus, not only the average effect but the pattern across political regimes seems to vary depending on whether data from PWT 6.1 or 6.2 are used.

The same pattern held when we dropped from the sample those countries categorized as very poor quality (grade D) from a data point of view (column 5 of Table 6), i.e., their original results hold (although the coefficients are smaller) with PWT 6.1 but the reversal of results is still the case with version 6.2.

Hausmann, Rodrik and Pritchett (HRP)

This paper, published in the *Journal of Economic Growth*, 2006, identifies a set of countries that are deemed to have sustained growth over a long period of time. The paper used data from PWT 6.1. The criteria used to define sustained growth are that countries must have experienced: an *improvement* in growth rates of at least 2 percentage points per capita (this captures the idea of acceleration); *sustained* growth of at least 3½ percent per capita for seven years; and a higher post-acceleration income level than the pre-acceleration peak (this is to ensure that accelerations are not simply a rebound from a prior period of very bad performance, for example, due to wars or conflict or other shocks). In addition, *growth per capita* must remain *above 3 percent* after seven years, which captures the sense that good performance is sustained.

On this basis, Hausmann et al. identified 82 country-periods (see their Table 3) that met these criteria.[14] Our exercise was simply to see how the list of countries changes when the data from PWT 6.2 are used; the results are in Table 8. Between PWT 6.1 and 6.2, 100 country-periods were identified as sustained growers on this definition. However, only 65 cases were common to both data sets. In other words, there is a discrepancy of 35 percent between the two versions. There were 17 cases which Hausmann et al, using PWT 6.1 (for example, India in 1982 and Sri Lanka in 1979), identified as sustained growers but which did not show up as such using PWT 6.2. Conversely, there were 18 instances (for example, Indonesia in 1987) which were identified by PWT 6.2 as sustained growers but which were not so categorized by Hausman et al using PWT 6.1. One way of illustrating this discrepancy is to note that only in about 65 percent of the cases was there agreement between the two datasets; in other words, in 4 out of 10 instances, the answer depends on which data set is used.

Miguel, Satyanath, and Sergenti

This paper, published in the Journal of Political Economy, 2004, attempts to identify and quantify the impact of economic factors on civil wars. The estimation is restricted to 41 countries in Africa and uses an annual panel framework using GDP data from PWT 6.1.

The key results of the paper are that in an OLS or probit framework, contemporaneous and one-period lagged growth does not have a statistically significant effect on civil conflict in Africa. However, when economic growth is instrumented with rainfall, one-

[14] They actually identified 83 growth transitions but one of them has been excluded because data for Borswana does not go farther back than 1970 1n PWT 6.2.

period lagged growth has a statistically and economically significant effect on conflict – see column 1 (OLS) and column 4 in Table 9 (IV) from the original.

When we re-ran these regressions using data from PWT 6.2 (our Table 9), we found that the IV results of Miguel et al remained unchanged. However, the OLS results changed. Specifically, in the OLS framework, contemporaneous economic growth, which did not have a significant effect in the OLS becomes borderline statistically significant (in column 3, the coefficient on contemporaneous growth has a t-statistic of 1.67).

Our explanation of these results is that the OLS and probit estimations are more prone to measurement error (in this case on the right hand side) which is substantial in the annual panel framework, especially for Africa. This results in substantial differences in results. On the other hand, a good instrument addresses measurement error, resulting in a more robust estimation.

Aghion, Howitt, and Mayer-Foulkes

This paper, published in the Quarterly Journal of Economics, 2005, examined the effect of financial development on income (or technological) convergence. The paper's two core findings are that income convergence will depend on the level of financial development; and that there will be a threshold level of financial development above which countries will converge and below which they will diverge.

Aghion et al run a simple cross-country growth regression for a sample of 63 countries, where the key innovation is an interaction term between the level of financial development and the initial level of income divergence with the frontier country, the U.S.

The key prediction of the model for which the estimation provides confirmation is that the coefficient on this interaction is negative (see the second row in column 1 of Table 10). When we re-run the Aghion et al core regression using PWT 6.2 data – shown in Table 10 –we find that while the magnitude of this coefficient drops by about 40 percent, it remains statistically significant (second row of column 3).

However, the second implication of the Aghion et al paper is not robust to changing the GDP data. Aghion et al derive a threshold value of financial development, which is the ratio of the coefficient on the income convergence term and the coefficient on the interaction between income convergence and financial development. In the Aghion et al specifications, this value is about 25 percent.

In the revised estimations, using PWT 6.2 data, the coefficient on the income convergence term is economically close to zero and statistically insignificant from zero (in one of the core specifications, the coefficient on this term switches signs relative to that in the paper). This yields a critical value for financial development of zero, suggesting that all countries will converge, which runs counter to the spirit of the main results implied by Aghion et al (see column 5 of Table 10).

Mankiw, Romer and Weil

This paper, published in the Quarterly Journal of Economics in 1992, test an augmented version of the Solow growth model, with the augmentation consisting of adding human capital as an additional input (apart from capital and labor) into production. The test comprises 2 elements: first, checking for the significance of the coefficients on savings (proxied by investment), human capital, and population growth (with the latter augmented to reflect technical progress and adjusted for depreciation); and second, importantly, checking for the magnitudes of these coefficients. In particular, the Solow model yields the result that the sum of the coefficients on savings, population and human capital should add to zero; or, in practice, the coefficient on the savings term adjusted for population growth should be equal in sign and magnitude to the coefficient on the human capital term also adjusted for population growth.

Mankiw et al estimate a simple cross-section regression in which the left hand side is the level of per capita GDP (PPP, log). They estimate it for three samples, one consisting of 98 countries for which data are available and another for a sample of 75 countries in which countries classified as D in terms of data quality by the PWT are dropped, and a third where non-oil countries are dropped from the sample.

When we re-estimate their equations for the Solow model using PWT 6.2 data (and the non-oil sample), we find that the coefficients on savings, population growth and human capital are all correctly signed and statistically significant. However, we find that the key test of the Solow model that the coefficients on savings and human capital (both adjusted for population) should be equal in magnitude comes close to being rejected by the data (in column 5, the p-value for the test of the Solow restriction is 0.166). This result is interesting because it contrasts with the general finding that long-horizon cross-sectional growth studies as well as those that use the level of GDP do not see significant changes in the results. In this study, the results change because the regressions use the investment-GDP ratio, which as the constant term in the specifications in Table 3 shows, is particularly prone to variability.

Summary

Is there an explanation for the pattern observed? The least robust papers are those that use annual panel data, for which measurement error is large. That measurement error is the probable cause is supported by fact that the 2SLS results of the Miguel et. al (2003) survive the robustness checks – despite using annual panel data. In Miguel et al, the core result is not robust to data revision in the OLS version but it is robust in the IV version. Having a good instrument helps overcome measurement error.

Conversely, all the papers that survive the robustness are those that use low frequency data (i.e. cross-sectional estimations) or 5-year panel data. Evidently, averaging reduces measurement error and makes the estimations more robust.

Other Implications

Perhaps the most important implication is that the typical handling of annual growth data in policy context is fraught with danger. As an illustration of the severity of the data problem and associated policy discussion for some low income countries, consider the very basic question of who has done well and who has done badly, say over the past 25 years.[15]

Table 12 shows the answer, looking at annual average growth rates between 1975 and 1999 just for African countries. Versions 6.1 and 6.2 agree that Botswana has done best, and they also agree that Egypt, Cape Verde, Tunisia, and Lesotho are in the top 10. But there are seven countries that appear on one list and not the other. The disagreement is even more severe for the “worst performers.” Now the lists are almost completely

[15] This basic and important question was asked, for example, by the World Bank’s recent Spence Commission. We reexamine their conclusions in a separate paper, currently under preparation.

disjoint. There are a total of 10 countries that appear to have the slowest growth according to one version but not according to the other version.

More generally, do the leading alternative versions of growth data of the Tables agree on the fastest growing countries around the world. For this we can compare "top 10" and "bottom 10" in terms of growth performance according to versions 6.1 and 6.2 of the Tables, alongside growth rates calculated from the IMF's World Economic Outlook (WEO) and the World Bank's World Development Indicators (WDI). This is the subject of another paper, so we only mention the highlights here.

All four sources agree on seven of the fastest growing countries: South Korea, China, Botswana, Thailand, Hong Kong, Ireland and Malaysia. But there are also seven countries that appear on at least one list but not on all lists. And even between the IMF and the World Bank data there is disagreement on the exact ranking (and on whether Indonesia, Portugal and Luxembourg make the cut).

Again, there is more disagreement on the countries that have done worst – probably because poorer performing countries tend to have less reliable data. Only five countries appear on all four lists: Madagascar, Nicaragua, Togo, Venezuela, and Zambia.

5. Conclusions and a Suggested Improvement

There is considerable variation in the level and growth of PPP-adjusted GDP estimates across alternative versions of the Penn World Tables. This variation is enough so that some standard results in the growth literature are not robust across alternative versions of the Tables.

However, it does appear safe (from a Table Invariant point of view) to use PPP GDP level data, i.e., looking at cross-sections. Long-run changes, e.g., over 40 years, also appear to be robust. Medium-run growth rates, e.g., 10 year panels, may also be safe, although we flag this as a point for further investigation.

It is not safe, in a Table Invariant sense, generally to use annual data from the Penn World Tables. The exception would be for countries with quality grades of A and B or if there is a good instrumentation strategy. In general, annual data from non-OECD countries should be treated with a very large grain of salt.

It remains to be seen how version 7.1 of the Penn World Tables will confirm or change any of this assessment. It is also unclear whether that version will definitively supersede all previous versions (and all alternatives, including the World Development Indicators.)

In conclusion, we would highlight a key point and make a suggestion for a possible alternative way of using PWT data. The key point is that data revisions are intrinsic to the PWT methodology. Improvements in data quality or wider participation in ICP studies might help, but they will not address the problem of data variability and data revisions. Consider this: between PWT 5.6 and 6.1, there was a big change in the underlying data because a new ICP study became available. In contrast, between 6.1 and 6.2, there was very little change in the underlying data because both were largely based on the same ICP. Yet the variability in the growth estimates between 6.1 and 6.2 was greater than in the variability between the estimate sin 5.6 and 6.1. Methodology, and not just data, is driving variability.

This leads to the suggested improvement. In Appendix 2, we argue that an arguably better way of calculating GDP growth and level data would be to use data for the benchmark years from different versions as the key underlying data. So, data for 1985 from PWT 5.6 and data for 1996 from PWT6.1 would be the basic building blocks. It is one of the remarkable features of the PWT exercise that each new version of the data leads to an almost complete discarding of data from previous versions and previous ICP studies. Our suggestion would avoid this problem. Moreover, by using estimates based on actual ICP prices, the proposal would avoid using extrapolations for all years other than the benchmark year, extrapolations which do not fully preserve the spirit that all comparisons of the standard of living should be at international prices. There are drawbacks to our proposed approach – particularly as it would reduce sample sizes and limit the period under consideration – but given the substantial disparity in growth estimates between our suggested approach and the existing PWT approach (see Appendix 2, Table), we strongly suggest that researchers consider adding it to their robustness-checking toolkit.

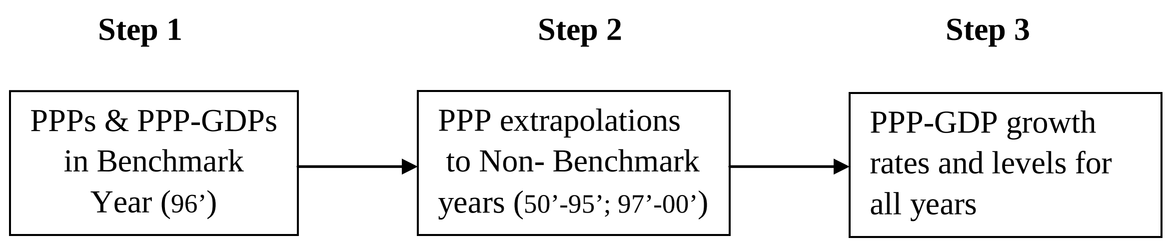
Appendix 1
The Penn World Table Calculation of the Level and Growth of PPP-Adjusted GDP

The Penn World Table (hereafter, PWT) has been immeasurably valuable because it has provided data on a key dimension of development: internationally comparable living standards or per capita GDP. But understanding how these data are constructed is obscured, perhaps unavoidably, by the fact that such construction relies on many layers of technical complexity.

We outline below in bare bones and as simple a form as possible, the construction of the purchase power parity (PPP)-adjusted level of GDP and its growth rate. In the process, we highlight some key and relatively unknown facts about PWT data construction. The description below refers to version 6.1 of PWT.[16]

The procedure used by PWT to construct PPP-adjusted GDPs can be stripped down to three main steps as shown in Figure A1. In the first step, international price levels and PPP-adjusted GDPs are calculated for the benchmark year (for PWT 6.1 in 1996). In the second step these benchmark international prices are extrapolated backward and forward to produce PPP time series for each country considered. Finally, in step 3 PPP-adjusted GDP levels and growth rates are calculated for all countries and years using the relevant PPPs from step 2 and the PPP-adjusted GDP for the benchmark year from step 1.

Figure A1: Constructing PPP-Adjusted GDPs



Next, we look into each of the three steps focusing on what we believe to be crucial in the final construction of the PWT series.

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[16] Special procedures are used for certain countries (i.e. China and India) at various stages. These are not described here and the interested reader is advised to consult the technical appendix to the PWT 6.1.

Step 1: PPP and PPP-adjusted GDP calculations for the benchmark year for the benchmark countries

All calculations start for a benchmark year (the year for which detailed price data are collected; for PWT 6.1 in 1996) and for benchmark countries (the countries which participate in the International Comparison of Prices Program (ICP)); that is, benchmark countries are those for which actual and detailed price data are collected.[17]

The raw data for calculating the GDP for the benchmark year for the benchmark countries are twofold:

1. Expenditures in local currencies $(pq)_{ij}$ (which are obtained from the national income accounts), where i refers to categories of goods and services (G&S) and j to the country; In PWT 6.1 there were 31 basic categories of G&S.[18]
2. The individual prices p_{ij} for these G&S in the different countries collected as part of the ICP exercise.
3. Dividing these expenditures by the individual prices yield notional quantities for each of the categories (i.e. $q_{ij} = (pq)_{ij} / p_{ij}$).

These data are used to derive two sets of <u>international</u> prices:

1. A set of international prices for each of the (31) categories of G&S (π_i); that is these prices are the same for each of category for all countries.[19]
2. A purchasing power parity (pl_j) for each country; PPPs for each country.

How are the (π_i)s and (pl_j)s derived? They are obtained from a system of two simultaneous equations which is also known as the Geary (1958) and Khamis (1972) (GK thereafter) aggregation procedure. These equations follow from the definition of the two prices as follows:

$$\pi_i = \sum_j \left[\left(\frac{p_{ij}}{pl_j} \right) \left(\frac{q_{ij}}{\sum_j q_{ij}} \right) \right] \qquad (1)$$

[17] See Table 1 for a list of benchmark years and benchmark countries used for different versions of PWT.

[18] Expenditures are multiplied by 'super–country weights' used by PWT to minimize the differences in results from adding or subtracting countries in the aggregation. For details on these weights see the technical appendix to the PWT 6.1 (pp. 6-7 and Table 1).

[19] International prices for each category are expressed relative to the U.S.; $p_{i,us} = 1$ for every i.

Equation (1) defines the international price for each commodity. The first expression on the right hand side ($\frac{p_{ij}}{pl_j}$) is the price of a category of goods *i* in country *j* deflated by that country's purchasing power parity, and the second ($\frac{q_{ij}}{\sum_j q_{ij}}$) is the share of *i* in country *j* in the world consumption of that good. The equation makes clear that the international price is the weighted average of the domestic prices, where the weights are the share of each country in total world consumption of that commodity. Table A1, at the end of this appendix, provides a simple 2-good, 3-country example that illustrates the GK procedure.[20]

$$pl_j = \frac{\sum_i (pq)_{ij}}{\sum_i \pi_i q_{ij}} \qquad (2)$$

Equation (2) defines the price level of a country or its purchasing power parity. For each country, the total expenditure in domestic prices divided by the sum of expenditures on each commodity at international prices yields the PPP for that country.[21,22]

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[20] In the example, in Table A1, take the equation for food:

$$10/PPP_A + 10/PPP_B + 12/PPP_C = 7*P_{food}$$

Here the expenditures on food in domestic prices by the three countries are 10, 10, and 12 respectively. From the example, information on quantities and prices in each country can be used to express the equation in the following manner:

$$1*10/PPP_A + 2*5/PPP_B + 4*3/PPP_C = 7*P_{food}$$
$$1*(P_{A,food}/PPP_A) + 2*(P_{B,food}/PPP_B) + 4*(P_{C,food}/PPP_C) = 7*P_{food}$$
$$P_{food} = 1/7*(P_{A,food}/PPP_A) + 2/7*(P_{B,food}/PPP_B) + 4/7*(P_{C,food}/PPP_C)$$

In other words, the international price of food (P_{food}) is the weighted average of the individual domestic prices, where the weights are the share of each country in total world consumption of that commodity. Evidently, the international price will be closer to the domestic prices of those countries that have a larger weight in consumption and be different from the prices in the smaller countries. This is called the Gerschenkron effect (Gershenkron, 1947).

[21] Once the PPPs are calculated for the benchmark countries for the benchmark year, the PWT proceeds to calculate the same for non-benchmark countries. This is done essentially through a two-step regression procedure, which yields coefficients which can be used to estimate the PPPs for non-benchmark countries. For the purpose of this paper, the estimation procedure is not relevant and is therefore skipped.

[22] There are also historical data on PPPs obtained from previous ICP rounds. For example, while for PWT 6.1 the ICP was done for 115 countries for the year 1996, a similar exercise was done in 1985 for 64 countries for version PWT 5.6. These 1985 PPPs can be extrapolated using national income accounts deflators for consumption, investment and government, to yield "PPPs" for

(continued)

As a result of the GK procedure, in PWT 6.1 there are 31 international prices, (π_i)s, common to all countries. In addition, purchasing power parities, (pl_j)s, for each country are produced.

A final point is worth making here. The 31 categories of goods and services are also placed into 3 more aggregate categories corresponding to the three basic categories of Domestic Absorption (DA)—Consumption (*C*), Investment (*I*), and Government (*G*). For each country *j*, the country specific purchasing power parities for *C, I,* and *G* (pl_{Cj}, pl_{Ij}, pl_{Gj}) are calculated. These will vary across countries simply because the composition of the 31 categories of goods and services (for which there are common international prices) will vary across countries.[23]

These prices are used to calculate the PPP-adjusted GDPs for the benchmark year. GDP is calculated as the sum of real domestic absorption (measured at international prices) plus the net foreign balance. The constituent elements of domestic absorption—*C, I,* and *G*—are also measured at international prices by multiplying the quantities of C, *I*, and *G* by their respective international price obtained above.

$$\text{Real}(C_j) = \pi_c * q_c \qquad (3)$$

where Real(C_j) is consumption at international prices, π_c is international price of consumption and q_c is the notional quantity of consumption. By a similar procedure real *I* and real *G* are produced. Summing these three yields real domestic absorption as follows:

$$\text{Real}(DA_j) = \text{Real}(C_j) + \text{Real}(I_j) + \text{Real}(G_j) \qquad (4)$$
$$\text{Real}(GDP_j) = \text{Real}(DA_j) + NFB_j\ , \qquad (5)$$

1996. So, for a number of countries, there are multiple data on PPPs for the benchmark year (1996). The PWT then utilizes a weighting method for these multiple data sources to arrive at a final set of international prices or PPPs for the year 1996 for all countries (see pages 9-11 of technical appendix to the PWT 6.1 for details).

[23] To demonstrate this, take the example in Table A1 and assume that food is 50% consumption and 50% investment and that haircuts are 100% investment. The PPPs for consumption and investment for country A will be calculated as follows:
Real consumption expenditure (at international prices) = quantity * price = 0.5 * 3.76 = 1.88.
Hence PPP for consumption, according to equation (2), is the expenditure at domestic prices divided by the expenditure at international prices which is (0.5*10)/1.88 = 2.66.
Similarly, PPP for investment = (0.5*10+ 10*1)/(0.5*3.6+10*0.8) = 1.52,
By a similar process, PPPs can be calculated for countries B and C.

where Real(DA_j) is domestic absorption in international prices for country j, Real(GDP)j is PPP-adjusted GDP and NFB is Net Foreign Balance.
Note that the net foreign balance does not require the calculation of PPPs because they involve all traded goods.

Step 2: Calculating international prices for the non-benchmark years

Once the data for the benchmark year are calculated, the PWT calculates the PPPs for all other years going forward and backward in time. How does it do so? Take PWT 6.1 and the year 1995, which is one year before the benchmark year. For 1995, the PWT obtains nominal expenditures for the three components of domestic absorption—consumption, investment and government—from the national income accounts. These can be denoted as nomC_j, nomI_j and nomG_j,where j refers again to the country and the values are all for 1995. Each country j will also have a price level associated with for C, I, and G (pl_{Cj}, pl_{Ij}, pl_{Gj}, respectively) for 1995. These are just the 1996 PPPs for each of these categories, calculated as shown above, deflated by the price change between 1995 and 1996 for C, I, and G, where the price changes are obtained from a country's national income accounts.

These extrapolated domestic prices for the three components of domestic absorption obtained (pl_C, pl_I, pl_G) are the equivalent of the detailed price data collected for the benchmark year. Unlike in the case of the benchmark year, where detailed prices collected for a large set of commodities, for the non-benchmark years, each country has only three sets of international prices.

With these prices and with national income data for 1995 on expenditures on consumption, investment and government, the PWT uses the GK aggregation procedure to calculate international prices (π)s for C, I, and G, as well as the PPPs (pl)s for all countries exactly as in step 1.

These international prices are then used to convert consumption, investment, and government expenditure at domestic prices into expenditures at international prices as in equation (3) in step 1.

Step 3: Calculating the Level of PPP-adjusted GDP and its Growth rate for non-benchmark years

Step 2 yields, real C, real I and real G for all countries for non-benchmark years. How is the level of PPP-adjusted GDP then calculated say for 1995? Essentially via a circuitous procedure that first calculates the growth rate of domestic absorption between 1995 and 1996 at international prices and then applies this growth rate to the 1996 level of Domestic Absorption (DA) to derive the level of DA in 1995. To this, the net foreign balance for 1995 is added to obtain the level of PPP-adjusted GDP for 1995.

<u>The Chain Series</u>:

$$\begin{aligned}\text{Real}(DA\text{growth}_{95\text{-}96})_j &= (\text{share}C \text{ in } DA_{95})_j * (\text{nom}C \text{ growth}_{95\text{-}96})_j \\ &+ (\text{share}I \text{ in } DA_{95})_j * (\text{nom}I \text{ growth}_{95\text{-}96})_j \\ &+ (\text{share}G \text{ in } DA_{95})_j * (\text{nom}G \text{ growth}_{95\text{-}96})_j \qquad (6)\end{aligned}$$

$$\text{Real}(DA_{95})_j = \text{Real}(DA_{96})_j \,/\, \text{Real}(DA\text{growth}_{95\text{-}96})_j \qquad (7)$$

$$\text{Real}(GDP_{95})_j = (DA_{95})_j + (NFB_{95})_j \qquad (8)$$

where [Real$(DA\text{growth}_{95\text{-}96})_j$]is the growth of domestic absorption in international prices between 1995 and 1996 in country *j*, [nom*C* growth] is the growth of consumption expenditure in domestic price values, and [share*C* in *DA*] is the share of consumption in domestic absorption in international prices.

Three points are worth emphasizing about equation (6). First, the growth rates of real *C*, *I*, and *G* (nom*X* growth$_{95\text{-}96}$), are from the national income accounts and mostly do not change across PWT versions. Because they are from national income accounts, these growth rates are at domestic not PPP prices. However, the weights assigned to each of these components, the shares of each component in domestic absorption (share*X* in DA_{95}), are measured at international prices in 1995 which are obtained from steps 1 and 2; - i.e. (share*C* in $DA_{95})_j$ = Real(C_j) / Real(DA_j) = $\pi_c * q_c$ / (Real(C_j) + Real(I_j) + Real(G_j)).

Second, the PWT computes two PPP-adjusted GDP series,[24] the chained series (RGDPCH) which is the most commonly used and the one recommended by the authors of the PWT, and an RGDPL (or Laspeyre's series). The difference between the two is simply that in the RGDPCH, the shares change for every year the growth rate is calculated; hence note that the shares are time-sensitive. In contrast, in the RGDPL series, the shares remain the same for all years and are the shares (calculated at international prices) for the benchmark year. Therefore, when the PWT is revised, the shares are revised for the benchmark year and all subsequent years. But for the RGDPL series, the changes in non-benchmark years are not relevant.

Third, this leads to understanding why the growth rates differ between the two series in the PWT and in turn how these differ from the PPP-adjusted growth rate calculation in the World Development Indicators. In the WDI, the <u>growth rates</u> will typically NOT

[24] There is a third series called RGDPTT which is not discussed here.

change across revisions (other than to reflect revisions of national accounts) because the growth rates are calculated from the national income accounts. In terms of equation (4), PWT and WDI use the same numbers for real consumption, investment, and government growth, all obtained from the national income accounts. It is the shares that are different: in the WDI, these shares are from the national income accounts themselves, and therefore measured at domestic prices, and change with time; for the RGDPL series, the shares are at international prices but fixed at the levels of the benchmark year; for the RGDPCH series, the shares are at international prices and change every year based on changing international prices every year.

Steps 2-3 are then repeated for each of the years before and after the benchmark year to yield PPP-adjusted GDP growth rates and levels for these years.

The Variability of the PWT Estimates of the Level and Growth of PPP-Adjusted GDP

We have documented the fact that estimates of the GDP levels and growth rates vary substantially across PWT versions. In particular, in Tables 2-5, we showed that the variability of the estimates across versions is systematically related to a country's size and also that the variability increased the farther away the measure of GDP and its growth rate are from the benchmark year. In this section, we try and explain why this might be the case.

Variability of estimate and size

In thinking about the variability of the estimates and trying to locate its causes, it is useful to recall the sequence for constructing these estimates. When a revision to the PWT occurs, the PPPs, and hence the GDP figures, change for the benchmark year due to the GK aggregation procedure. Next, the PPPs are changed for the non-benchmark years. This leads to a change in the share of real *C*, real *I*, and real *G* for non-benchmark years. Since these shares are used to construct the growth rate of domestic absorption, this is the channel by which GDP growth rates change across revisions.

The specifications in Tables 5 and 5a showed that GDP growth and level revisions were significantly related to the size of a country as proxied by its level of GDP; more specifically, the smaller the country the larger the resulting revisions. Why is this the case? Recall that growth revisions happen because the shares of the three components of absorption change across PWT versions. In turn, these shares change because the PPP estimates for the non-benchmark years change. So, the question becomes why do PPP estimates change more for small countries than for the large ones?
A formal answer to this question is provided by Rao and Selvanathan (1992). They show that the PPPs and international prices can be seen as weighted averages, which makes it

possible to interpret them as estimators of parameters from appropriately specified regression models. Once these are seen as such, it then also becomes possible to assess the reliability of the estimates of these parameters. They show—equation (5) in Rao and Selvanathan (1992)—that the standard error of estimates of the PPPs are inversely related to a country's size (more specifically, its total consumption expenditure). The smaller the country, the less reliable is the estimate of its PPP, a proposition supported in the data (see Table 2, columns 3, 5, and 6).

Variability of estimate over time

One of the less recognized aspects of the PWTs is that the GDP estimates for the non-benchmark years are based on *extrapolated* PPPs. It is striking for example, that in PWT 6.2 and 6.1, the calculated GDPs for 1985 do not use actual international prices that were available from the benchmark studies from PWT 5.6. Instead, the calculations for 1985 start with the 1996 benchmark data and extrapolated backward using national income accounts data and the aggregation methods outlined in steps 2 and 3.

So, the question arises, does a new PWT version provide more reliable data for years other than the benchmark year? In Tables 2-5, we saw that the variability of the data between versions may actually increases the farther away one gets from the benchmark year. A heuristic explanation for this phenomenon is the following. Take 1995, the first non-benchmark year in PWT 6.1. The calculations of the international prices for 1995 are estimates based on the actual price data for 1996. So, some error is added to the 1995 estimates. If we take this back one more year to 1994, we know that 1994 international prices are in turn estimated from 1995 numbers. This adds one more layer of error. Relative to the benchmark year 1996, there are two sources of error for the 1994 estimates, and so on. This error structure going back in time is analogous to the error structure going forward imposed by many forecasting exercises. It would therefore not seem surprising that estimates are more variable the farther away from the benchmark year (see the pronounced funnel shape of Figure 9).

A final point is worth noting. This sensitivity of data revisions to size and time horizon is <u>intrinsic</u> to the way PWT calculates the PPPs and GDPs. Even if data quality got better for the poorer countries, the variability that derives from size and time horizon will not be eliminated. This is best illustrated by comparing the revisions between 6.1 and 5.6 versus 6.2 and 6.1. In going from 5.6 to 6.1, there was a substantial change because a new ICP study was done for 1996 and hence new data became available. But in going from 6.1 to 6.2, there was very little change in the raw data. No new ICP studies were done, and the reference year for the calculations changed from 1996 to 2000. Yet, the revisions (in the PPPs and the growth rates) between 6.1 and 6.2 have been as large, or not significantly smaller, than between 5.6 and 6.1.

Table A1: A Simple Example for Calculating PPPs and PPP-Adjusted GDPs

Basic data

Commodities	Country A			Country B			Country C			Total
	Quantity	Price	Expenditure	Quantity	Price	Expenditure	Quantity	Price	Expenditure	Quantity
Food	1	10	10	2	5	10	4	3	12	7
Haircuts	10	1	10	12	1	12	15	1	15	37
Total			20			22			27	
Currency exchange rates	Rupees 3 per $			Pesos 2 per $			Dollars			

Geary-Khamis procedure (Need to Find PPP for each country and International price for Food and Haircuts)

For each commodity: Each country's expenditure at national prices divided by PPP for that country yields total expenditure on that commodity at international prices

For Food $10/PPP_A + 10/PPP_B + 12/PPP_C = 7*P_{food}$-----------(1)

For Haircuts $10/PPP_A + 12/PPP_B + 15/PPP_C = 37*P_{hcuts}$----------(2)

For each country: The sum of expenditures on each commodity at international prices is the real expenditure divided by the national PPPs

For country A $1*P_{food}{}^{int} + 10*P_{hcuts}{}^{int} = 20/PPP_A$------------(3)

For country B $2*P_{food}{}^{int} + 12*P_{hcuts}{}^{int} = 22/PPP_B$------------(4)

For country C $4*P_{food}{}^{int} + 15*P_{hcuts}{}^{int} = 27/PPP_C$------------(5)

Since expenditures on all commodities equals that by all countries, there are 4 equations with four unknown, with one price PPP_C being the numeraire and set at 1.

The system yields the following solution:

$P_{food}{}^{int} = 3.76$ $PPP_A = 1.69$

$P_{hcut}{}^{int} = 0.8$ $PPP_B = 1.28$

	Real GDP at PPP exchange rates	**Real GDP at Market exchange rates**
Country A	20/1.69 = 11.83	6.7
Country B	22/1.28 = 17.19	11
Country C	27	27

Appendix 2

Is there a better way of calculating PPP-adjusted GDP growth rates?

Given the inherent susceptibility of the PWT methodology to variability, is there an alternative way of computing growth rates that is less problematic? In principle, yes. Before outlining this method, it is important to understand the problem and give credit to the PWT where credit is due.

The aim of the PWT Tables is to compare the levels of income (or standards of living) across countries. For the benchmark years this is accomplished by conducting the ICPs, calculating the international price levels and PPPs, and arriving at PPP-adjusted levels of per capita GDP. Now, how are levels of income compared across countries for non-benchmark years. The World Bank and the PWT try and do this in two different ways.

The World Bank essentially ducks or finesses this comparison for the non-benchmark years. Why? Because its computation of the level of PPP-adjusted GDP for a non-benchmark year is based on applying a growth rate of GDP (which is entirely in domestic prices) to the level of PPP-adjusted GDP in the benchmark year, which is in international prices. So, for example, in the most recent revision of the GDPs, the level of PPP-adjusted GDP for 1990 is the product of the PPP-adjusted GDP for 2005 (the benchmark year based on actual ICPs) and a growth rate between 1990 and 2005 from the national income accounts. The question then is: is the level of GDP data for 1990 in domestic or international prices? The answer is that it is not obvious because it is some hybrid of domestic and international prices. To put this starkly, the WDI data cannot be used to compare standards of living across for countries for all years other than the benchmark year.

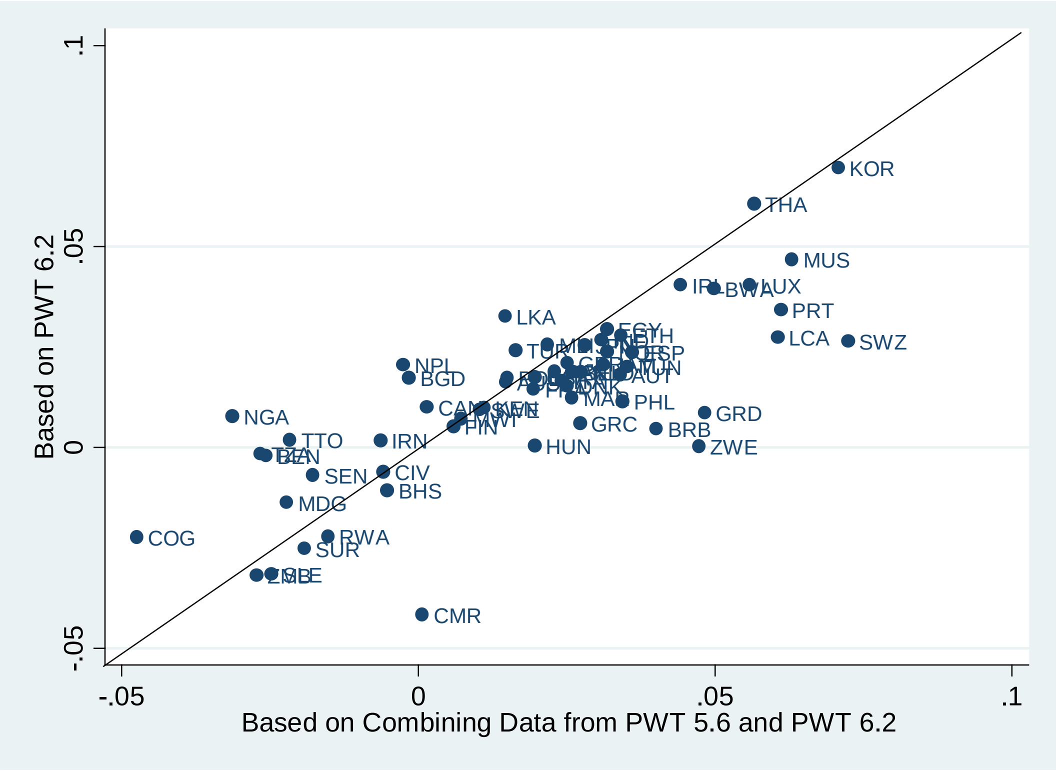
What about the PWT? Recall that the PWT like the WDI also calculates the level for a non-benchmark year by applying a growth rate to a benchmark year level of PPP-adjusted GDP. This growth rate, unlike that of the WDI, attempts to reflect international prices but in a half-hearted or partial manner. The growth rates use shares for C, I, and G, which are at international prices but also use growth rates of C, I, and G which are at domestic prices. So, even in the PWT, GDP data for non-benchmark years are not at fully measured at international prices.

The problem is that the PWT does not have the courage of its own conviction. All estimates of the level of GDP should be at international prices and growth rates should be derived from these level estimates rather than the other way around. Can this be done? The PWT already does this. It has ICPs and PPP-adjusted estimates for the different benchmark years (1980, 1985, 1996, and now 2005). These are the data that should be used because these are GDPs calculated using actual ICP data. All data for the intervening years are extrapolated not and measured at international prices and should not be used.

Supposing we used data from the benchmark years and calculated the growth rates between these years and then compared them with the growth rate emerging from say 6.2 or 5.6, how different are the growth rates. For example, suppose we wanted to calculate the growth rate of PPP-adjusted GDP between 1985 and 1996. We could do it in two ways: first, we could derive this growth rate from PWT 6.2 (or 6.1); or we could calculate it using 1985 data from PWT5.6 and 1996 data from 6.1 (or 6.2). The latter is in some ways the real growth rate because it is based on actual ICP data. There are two advantages of the latter procedure which overcome the two problems that we have identified in the paper. Since there are no revisions to data, we avoid the problem of revisions being especially sensitive to country size and to distance form the benchmark year. There is one problem with the latter exercise: the 1985 data are in 1985 US dollar terms, while the 1996 data are in 2000 US$ terms (in 6.2). So, there is the standard index number problem. Leaving this aside for the moment, how do the two growth rates compare.

In the chart below, we plot the growth rate from PWT 6.2 against the “true” growth rate obtained from combining 5.6 and 6.2 data (we restrict the sample to those 60 countries that participated in the 1985 ICP study that went into the PWT 5.6). We call this the true rate because it is based on actual ICP data rather than extrapolations. The correlation between the two series is 0.76. More importantly, we see that the standard deviation of the difference in growth rates between the two methods is 1.76 percent compared with the average growth rate of 1.80 percent: that is, for one standard deviation of the cases, the estimated growth rates in PWT 6.2 is “off” by as much as the average growth rate. In Table A2 below, we list all the countries and the difference between the growth rates obtained from these two procedures. Of the 60 countries, there is a difference of 1% in half the cases. There are substantial differences even for a number of OECD countries such as Portugal, Greece, Austria and Luxembourg. The PWT 6.2 estimates do seem meaningfully different from the “true” growth rates.

Table A2. Alternative estimates of annual average growth rates, 1985-1996



Correlation in growth rates:	0.78
Average difference in growth rates:	-0.5%
Standard deviation of difference:	1.76%
“True” average growth rate:	1.80%

One problem with our proposal is that it would only provide estimates for years for which there are benchmark studies. This would lead to a loss of high frequency (annual) data. But in assessing whether this is a major loss, two points should be kept in mind: annual data seem particularly problematic because of the extrapolation methodology. Moreover, the motivation of the PWT is to make meaningful comparisons of standards of living across countries. But these comparisons are not particularly meaningful, and it is not necessary to be make them on a high frequency basis.

We have one final remark about the current PWT methodology. Each revision of the data leads to an almost complete discarding of information from previous ICPs and previous versions. Our suggested proposal would avoid this problem.

Table A2: Alternative Estimates of Annual Real Per Capita GDP (PPP) Growth Rate, 1985-1996

COUNTRY	Combining PWT 5.6 and 6.2 (1)	From PWT 6.2 (2)	Difference (1)-(2)	Absolute Value of Difference
Zimbabwe	4.7%	0.0%	-4.7%	4.7%
Swaziland	7.2%	2.6%	-4.6%	4.6%
Cameroon	0.1%	-4.2%	-4.2%	4.2%
Grenada	4.8%	0.9%	-4.0%	4.0%
Nigeria	-3.1%	0.8%	3.9%	3.9%
Barbados	4.0%	0.5%	-3.5%	3.5%
St.Lucia	6.1%	2.7%	-3.3%	3.3%
Portugal	6.1%	3.4%	-2.7%	2.7%
Congo,	-4.7%	-2.2%	2.5%	2.5%
Tanzania	-2.7%	-0.2%	2.5%	2.5%
Benin	-2.6%	-0.2%	2.4%	2.4%
Trinidad	-2.2%	0.2%	2.4%	2.4%
Nepal	-0.3%	2.1%	2.3%	2.3%
Philippines	3.4%	1.1%	-2.3%	2.3%
Greece	2.7%	0.6%	-2.1%	2.1%
Hungary	2.0%	0.0%	-1.9%	1.9%
Bangladesh	-0.2%	1.7%	1.9%	1.9%
Sri Lanka	1.5%	3.3%	1.8%	1.8%
Mauritius	6.3%	4.7%	-1.6%	1.6%
Austria	3.4%	1.8%	-1.6%	1.6%
Luxembourg	5.6%	4.0%	-1.5%	1.5%
Tunisia	3.5%	2.0%	-1.5%	1.5%
Morocco	2.6%	1.2%	-1.3%	1.3%
Spain	3.6%	2.4%	-1.2%	1.2%
Senegal	-1.8%	-0.7%	1.1%	1.1%
Jamaica	3.1%	2.1%	-1.1%	1.1%
Botswana	5.0%	3.9%	-1.0%	1.0%
Denmark	2.5%	1.5%	-1.0%	1.0%
Netherlands	2.7%	1.9%	-0.9%	0.9%
Madagascar	-2.2%	-1.4%	0.9%	0.9%
Canada	0.1%	1.0%	0.9%	0.9%
Iran	-0.6%	0.2%	0.8%	0.8%
Norway	3.2%	2.4%	-0.8%	0.8%
Turkey	1.6%	2.4%	0.8%	0.8%
Italy	2.4%	1.7%	-0.8%	0.8%
Belgium	2.6%	1.9%	-0.7%	0.7%
Rwanda	-1.5%	-2.2%	-0.7%	0.7%
Sierra Leone	-2.5%	-3.2%	-0.7%	0.7%
Ethiopia	3.4%	2.8%	-0.6%	0.6%
Suriname	-1.9%	-2.5%	-0.6%	0.6%
Bahamas	-0.5%	-1.1%	-0.5%	0.5%
France	1.9%	1.5%	-0.5%	0.5%
Zambia	-2.7%	-3.2%	-0.5%	0.5%
Thailand	5.7%	6.1%	0.4%	0.4%
UK	2.5%	2.1%	-0.4%	0.4%
India	3.1%	2.7%	-0.4%	0.4%
Pakistan	2.3%	1.9%	-0.4%	0.4%
Mali	2.2%	2.6%	0.4%	0.4%
Ireland	4.4%	4.0%	-0.4%	0.4%
Japan	2.8%	2.6%	-0.2%	0.2%
Poland	1.5%	1.7%	0.2%	0.2%
Egypt	3.2%	2.9%	-0.2%	0.2%
USA	2.0%	1.8%	-0.2%	0.2%
Australia	1.5%	1.6%	0.2%	0.2%
Korea,	7.1%	7.0%	-0.1%	0.1%
Kenya	1.1%	1.0%	-0.1%	0.1%
Sweden	1.0%	0.9%	-0.1%	0.1%
Finland	0.6%	0.5%	-0.1%	0.1%
Cote d'Ivoire	-0.6%	-0.6%	0.0%	0.0%
Malawi	0.7%	0.7%	0.0%	0.0%

Note: In column (1), the growth rate is calculated using real per capita GDP (PPP) data for 1985 from PWT 5.6 and for 1996 from PWT 6.2.

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Table 1. The Evolution of the Penn World Tables

PWT Version	Benchmark Year	Year Released	Countries in the PWT
1.0	1970	1980	119
2.0	-	-	-
3.0	1975	1984	115
4.0	1980	1988	128
5.0	1985	1991	134
5.6	1985	1995	151
6.1	1996	2002	168
6.2	1996	2006	188
7.0	2005	TBD	TBD

ICP Phases	Year(s)	Number of Countries
Phase 1	1970	16
Phase 2	1975	35
Phase 3	1980	61
Phase 4	1985	62
Phase 5	1990	23
Phase 6	1996	115
Phase 7	2005	146

Notes:

Penn World Table, Version 2, was never released. There are some discrepancies in these numbers across different PWT sources. This table uses information from the datasets themselves and the PWT 6.1 appendix. Other information can be found in the various papers published along with releases of versions of the Penn World Table.

Table 2. Explaining Differences in Price Levels Across Datasets

Dependent Variable	**Abs(difference in log PPP)**					
	[1]	[2]	[3]	[4]	[5]	[6]
Estimation	**OLS**					
Dataset Comparison	**PWT6.2 vs. PWT6.1**					
Sample	**1970 to 1999**					
PWT Grade (D=1…A=4)	-5.657***					1.374**
	[-14.96]					[2.434]
Total ICP Studies		-2.409***			1.161***	
		[-12.99]			[4.056]	
Log(GDP)			-2.356***		-1.250***	-0.884***
			[-10.92]		[-6.212]	[-4.289]
Distance from Benchmark Year, in Decades (1996)				2.456***	5.025***	5.579***
				[6.991]	[7.294]	[11.28]
Distance * Total ICPs					-2.412***	
					[-8.273]	
Distance * Grade						-5.159***
						[-8.546]
Constant	23.46***	16.11***	67.61***	3.925***	32.02***	22.58***
	[20.48]	[22.59]	[12.42]	[9.924]	[7.172]	[5.258]
N	3016	3016	3016	3016	3016	3016
R-squared	0.085	0.062	0.073	0.062	0.174	0.197

Notes:
The dependent variable is the absolute value of the difference in the log-level of prices (P) across PWT 6.2 and PWT 6.1. The variable PWT grade can take on four values, 1-4, with 1 representing the worst PWT rating of D, and 4 representing the best PWT rating of A. Total ICP studies refers to the number of ICP studies a country has participated in. GDP is total GDP and is measured at purchasing power parity. The distance variable is calculated as the absolute difference between the year of the observation and 1996 (i.e., abs(t-1996)), and is divided by 10 to express the variable in decades. 1996 is the "Benchmark Year" used in constructing both PWT 6.2 and PWT 6.1. The sample consists of the 104 countries in the “Long Run Sample” used in other tables and figures. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Robust t-statistics in brackets.

Table 3. Explaining Differences in Levels of Investment Across Datasets

Dependent Variable →	**Abs(difference in Investment/GDP ratio)**					
	[1]	[2]	[3]	[4]	[5]	[6]
Estimation	**OLS**					
Dataset Comparison →	**PWT6.2 vs. PWT6.1**					
Sample	**1970 to 1999**					
PWT Grade (D=1…A=4)	-0.954***					-0.00644
	[-14.61]					[-0.0564]
Total ICP Studies		-0.308***			0.0608	
		[-7.983]			[1.018]	
Log(GDP)			-0.443***		-0.429***	-0.294***
			[-10.70]		[-6.947]	[-6.119]
Distance from Benchmark Year, in Decades (1996)				1.185***	1.370***	2.348***
				[9.789]	[7.470]	[7.469]
Distance * Total ICPs					-0.0766	
					[-1.313]	
Distance * Grade						-0.500***
						[-5.311]
Constant	5.028***	3.552***	13.74***	1.456***	11.90***	8.730***
	[23.06]	[27.36]	[12.87]	[13.74]	[8.191]	[8.020]
N	3016	3016	3016	3016	3016	3016
R-squared	0.035	0.014	0.037	0.04	0.078	0.091

Notes:
The dependent variable is the absolute value of the difference in the ratio of Investment/GDP across PWT 6.2 and PWT 6.1. The variable PWT grade can take on four values, 1-4, with 1 representing the worst PWT rating of D, and 4 representing the best PWT rating of A. Total ICP studies refers to the number of ICP studies a country has participated in. GDP is total GDP and is measured at purchasing power parity. The distance variable is calculated as the absolute difference between the year of the observation and 1996 (i.e., abs(t-1996)), and is divided by 10 to express the variable in decades. 1996 is the "Benchmark Year" used in constructing both PWT 6.2 and PWT 6.1. The sample consists of the 104 countries in the “Long Run Sample” used in other tables and figures. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Robust t-statistics in brackets.

Table 4. Explaining Differences in Levels of Consumption Across Datasets

Dependent Variable	→ **Abs(difference in Consumption/GDP ratio)**					
	[1]	[2]	[3]	[4]	[5]	[6]
Estimation	**OLS**					
Dataset Comparison	**PWT6.2 vs. PWT6.1**					
Sample	**1970 to 1999**					
PWT Grade (D=1…A=4)	-2.400***					2.087***
	[-10.26]					[4.939]
Total ICP Studies		-1.054***			1.003***	
		[-9.311]			[4.644]	
Log(GDP)			-1.601***		-1.598***	-1.467***
			[-11.85]		[-11.83]	[-11.38]
Distance from Benchmark Year, in Decades (1996)				1.038***	3.173***	6.354***
				[3.654]	[4.759]	[5.774]
Distance * Total ICPs					-0.884***	
					[-4.889]	
Distance * Grade						-2.284***
						[-6.044]
Constant	13.38***	10.33***	47.29***	6.606***	43.60***	37.93***
	[19.69]	[24.93]	[13.67]	[23.24]	[14.57]	[14.25]
N	3016	3016	3016	3016	3016	3016
R-squared	0.044	0.034	0.098	0.006	0.118	0.129

Notes:
The dependent variable is the absolute value of the difference in the ratio of Consumption/GDP across PWT 6.2 and PWT 6.1. The variable PWT grade can take on four values, 1-4, with 1 representing the worst PWT rating of D, and 4 representing the best PWT rating of A. Total ICP studies refers to the number of ICP studies a country has participated in. GDP is total GDP and is measured at purchasing power parity. The distance variable is calculated as the absolute difference between the year of the observation and 1996 (i.e., abs(t-1996)), and is divided by 10 to express the variable in decades. 1996 is the "Benchmark Year" used in constructing both PWT 6.2 and PWT 6.1. The sample consists of the 104 countries in the “Long Run Sample” used in other tables and figures. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Robust t-statistics in brackets.

Table 5. Explaining Differences in Levels of GDP Per Capita Across Datasets

Dependent Variable →	**Abs(difference in log per capita PPP-adjusted GDP)**					
	[1]	[2]	[3]	[4]	[5]	[6]
Estimation	**OLS**					
Dataset Comparison →	**PWT6.2 vs. PWT6.1**					
Sample	**1970 to 1999**					
PWT Grade (D=1…A=4)	-4.036***					0.00141
	[-18.04]					[0.00386]
Total ICP Studies		-2.319***			-0.468**	
		[-18.08]			[-2.141]	
Log(GDP)			-1.851***		-0.781***	-1.022***
			[-14.68]		[-6.052]	[-7.872]
Distance from Benchmark Year, in Decades (1996)				2.456***	5.025***	7.646***
				[6.991]	[7.294]	[7.870]
Distance * Total ICPs					-1.174***	
					[-6.621]	
Distance * Grade						-2.380***
						[-7.619]
Constant	21.69***	17.90***	57.32***	9.495***	29.93***	34.75***
	[30.67]	[35.39]	[17.89]	[23.74]	[9.780]	[11.56]
N	3016	3016	3016	3016	3016	3016
R-squared	0.07	0.091	0.072	0.019	0.133	0.118

Notes:
The dependent variable is the absolute value of the difference in the log-level of GDP per capita (measured in PPP terms) across PWT 6.2 and PWT 6.1. The variable PWT grade can take on four values, 1-4, with 1 representing the worst PWT rating of D, and 4 representing the best PWT rating of A. Total ICP studies refers to the number of ICP studies a country has participated in. GDP is total GDP and is measured at purchasing power parity. The distance variable is calculated as the absolute difference between the year of the observation and 1996 (i.e., abs(t-1996)), and is divided by 10 to express the variable in decades. 1996 is the "Benchmark Year" used in constructing both PWT 6.2 and PWT 6.1. The sample consists of the 104 countries in the “Long Run Sample” used in other tables and figures. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Robust t-statistics in brackets

Table 5a. Explaining Differences in Growth of GDP Per Capita Across Datasets

Dependent Variable →	Abs(difference in growth rate of per capita GDP)					
	[1]	[2]	[3]	[4]	[5]	[6]
Estimation	OLS					
Dataset Comparison →	PWT6.2 vs. PWT6.1					
Sample	1970 to 1999					
PWT Grade (D=1…A=4)	-1.716***					-0.662***
	[-17.82]					[-4.969]
Total ICP Studies		-0.678***			-0.0792	
		[-13.97]			[-1.031]	
Log(GDP)			-0.792***		-0.650***	-0.498***
			[-16.63]		[-12.44]	[-10.45]
Distance from Benchmark Year, in Decades (1996)				0.366***	0.511**	1.035***
				[3.206]	[2.279]	[2.886]
Distance * Total ICPs					-0.152**	
					[-2.531]	
Distance * Grade						-0.360***
						[-3.122]
Constant	6.767***	4.409***	22.03***	2.355***	18.62***	16.20***
	[22.64]	[23.57]	[18.10]	[15.44]	[14.11]	[12.83]
N	3016	3016	3016	3016	3016	3016
R-squared	0.093	0.058	0.097	0.003	0.104	0.123

Notes:
The dependent variable is the absolute value of the difference in the growth rate of GDP per capita across PWT 6.2 and PWT 6.1. The variable PWT grade can take on four values, 1-4, with 1 representing the worst PWT rating of D, and 4 representing the best PWT rating of A. Total ICP studies refers to the number of ICP studies a country has participated in. GDP is total GDP and is measured at purchasing power parity. The distance variable is calculated as the absolute difference between the year of the observation and 1996 (i.e., abs(t-1996)), and is divided by 10 to express the variable in decades. 1996 is the "Benchmark Year" used in constructing both PWT 6.2 and PWT 6.1. The sample consists of the 104 countries in the “Long Run Sample” used in other tables and figures. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Robust t-statistics in brackets

Table 6. Ramey and Ramey (1995) Replication Results

Dependent variable →	growth of per capita GDP				
	[1]	[2]	[3]	[4]	[5]
Dataset Substitution	None	None	PWT6.2	None	PWT6.2
Sample	Original	Balanced	Balanced	Balanced	Balanced
PWT Grades Included	All	All	All	A,B,C	A,B,C
Standard Deviation of Growth Rates	-0.177***	-0.151*	-0.074	-0.107	-0.132
	[2.426]	[1.821]	[0.94]	[1.254]	[1.460]
N	2208	1776	1776	1608	1608

Notes:
This table presents a replication exercise of Ramey and Ramey (1995) by updating their original PWT 5.6 GDP data with PWT 6.2 data. All specifications replicate Table 1, Equation 1, in Ramey and Ramey (1995). For presentation purposes we focus only on the key parameter - variation of growth rate - and omit other parameter estimates. Specification [1] replicates the main result in Ramey and Ramey (1995) using their original data. Specification [2] presents the same result using PWT 5.6 after dropping observations to balance the data with available observations in PWT 6.2. Specification [3] presents our main result when we replace the balanced sample using PWT 5.6 with PWT 6.2. Specification [4] replicates [2] when countries with quality grading "D" are dropped. Specification [5] replicates [3] when countries with quality grading "D" are dropped. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. t-statistics in brackets.

Table 7. Jones and Olken (2005) Replication Results

Dependent variable →	**Annual Growth rate**				
Hypothesis →	**Leader deaths affect growth (Wald p-value)**				
	[1]	[2]	[3]	[4]	[5]
Dataset Substitution	None	None	PWT6.2	None	PWT6.2
Sample	Original	Balanced	Balanced	Balanced	Balanced
PWT Grades Included	All	All	All	A,B,C	A,B,C
Years after leader's death	All Leaders				
0	0.057*	0.054*	0.093*	0.012**	0.110
1	0.085*	0.122	0.218	0.028**	0.130
2	0.067*	0.133	0.203	0.039**	0.141
Number of leader deaths	57	52	52	45	45
Years after leader's death	All Leaders, Tenure >=2 Years				
0	0.039**	0.039**	0.04**	0.011**	0.049**
1	0.054*	0.087*	0.140	0.021**	0.068*
2	0.031**	0.076*	0.102	0.023**	0.049**
Number of leader deaths	47	42	42	36	36
Years after leader's death	Autocrats				
0	0.019**	0.032**	0.199	0.012**	0.304
1	0.016**	0.049**	0.356	0.011**	0.227
2	0.028**	0.100*	0.314	0.026**	0.183
Number of leader deaths	29	26	26	21	21
Years after leader's death	Democrats				
0	0.460	0.326	0.044**	0.236	0.039**
1	0.552	0.415	0.092*	0.291	0.069*
2	0.432	0.370	0.134	0.359	0.113
Number of leader deaths	22	20	20	19	19

Notes:
This table presents a replication exercise of Jones and Olken (2005) by updating their original PWT 6.1 GDP data with PWT 6.2 data. All specifications replicate results from Tables III and V in Jones and Olken (2005). Specification [1] replicates the main result in Jones and Olken (2005) using their original data. Specification [2] presents the same result using PWT 6.1 after dropping observations to balance the data with available observations in PWT 6.2. Specification [3] presents our main result when we replace the balanced sample using PWT 6.1 with PWT 6.2. Specification [4] replicates [2] when countries with quality grading "D" are dropped. Specification [5] replicates [3] when countries with quality grading "D" are dropped. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 8. Haussman, Pritchett and Rodrik (2005) Replication Results

PWT 6.1 (Haussman et al.)		PWT 6.2		PWT 6.1 (Haussman et al.)		PWT 6.2		PWT 6.1 (Haussman et al.)		PWT 6.2	
ARG	1963	ARG	1963	IDN	1967	IDN	1967	PAK	1979	PAK	1977
ARG	1990	ARG	1990	IDN	1987	IDN	1985	PAN	1959	PAN	1959
AUS	1961	**No break**		IND	1982	**No break**		PAN	1975	PAN	1975
BEL	1959	BEL	1959	IRL	1958	IRL	1958	PER	1959	PER	1959
BRA	1967	BRA	1968	IRL	1985	IRL	1986	**No break**		PHL	1970
No break		BWA	1984	**No break**		IRN	1966	PNG	1987	**No break**	
CAN	1962	CAN	1961	ISR	1957	ISR	1957	POL	1992	POL	1992
CHL	1986	CHL	1986	**No break**		ISR	1989	**No break**		PRT	1959
CHN	1978	CHN	1977	ISR	1967	ISR	1967	PRT	1985	PRT	1985
CHN	1990	CHN	1991	JOR	1973	**No break**		PRY	1974	PRY	1974
CMR	1972	**No break**		JPN	1958	JPN	1958	ROM	1979	ROM	1971
No break		CMR	1978	**No break**		JPN	1984	RWA	1975	RWA	1975
COG	1969	COG	1968	KOR	1962	KOR	1963	SGP	1969	SGP	1967
COG	1978	COG	1976	KOR	1984	KOR	1984	**No break**		SGP	1987
COL	1967	COL	1967	LKA	1979	**No break**		SYR	1969	SYR	1969
DNK	1957	DNK	1957	**No break**		LKA	1958	SYR	1974	**No break**	
DOM	1969	DOM	1969	LSO	1971	LSO	1971	SYR	1989	SYR	1991
DOM	1992	DOM	1991	**No break**		LSO	1992	TCD	1973	**No break**	
DZA	1975	**No break**		MAR	1958	MAR	1958	THA	1957	THA	1957
ECU	1970	ECU	1970	MLI	1972	MLI	1973	THA	1986	THA	1986
EGY	1976	EGY	1975	MUS	1971	MUS	1970	TTO	1975	**No break**	
ESP	1959	ESP	1959	MUS	1983	MUS	1983	TUN	1968	TUN	1968
ESP	1984	ESP	1984	MWI	1970	MWI	1970	TWN	1961	TWN	1961
No break		ETH	1988	MWI	1992	MWI	1990	**No break**		TWN	1985
FIN	1958	FIN	1958	MYS	1970	MYS	1967	**No break**		TZA	1992
FIN	1967	**No break**		MYS	1988	MYS	1988	UGA	1977	**No break**	
No break		GAB	1969	**No break**		NER	1974	UGA	1989	**No break**	
FIN	1992	FIN	1992	NGA	1957	**No break**		URY	1974	URY	1974
GBR	1982	GBR	1982	NGA	1967	NGA	1968	URY	1989	URY	1988
GHA	1965	GHA	1965	NIC	1960	NIC	1960	USA	1961	USA	1961
GNB	1969	**No break**		NOR	1991	NOR	1992	**No break**		VEN	1971
GNB	1988	**No break**		NZL	1957	NZL	1957	**No break**		ZMB	1963
No break		HND	1974	PAK	1962	PAK	1961	ZWE	1964	ZWE	1967
HTI	1990	**No break**									

Notes:

This table compares growth breaks in per capita GDP (RGDPCH series) obtained from using the original PWT 6.1 in Haussman et al. (2005) with those obtained using PWT 6.2. Growth breaks are reproduced using Haussman et al. (2005) original Gauss code. **No break** indicates an inconsistency between PWT 6.1 and PWT 6.2 in obtaining growth break dates that are more than 3 years apart for each country considered. Haussman et al. (2005) identified an additional break for BWA in 1969 using PWT 6.1, but data for Botswana does not go farther back than 1970 in PWT 6.2. There are 35 cases (out of 100; 35%) where such inconsistencies are detected.

Table 9. Miguel, Satyanath and Sergenti (2004) Replication Results

Dependent variable	→		log (Growth Gap)			
	[1]	[2]	[3]	[4]	[5]	[6]
Estimation	OLS	OLS	OLS	2SLS	2SLS	2SLS
Dataset Substitution	None	None	PWT	None	None	PWT
Sample	Original	Balanced	Balanced	Original	Balanced	Balanced
PWT Grades Included	All	All	All	All	All	All
Economic Growth Rate, t	-0.145	-0.144	-0.327*	-0.383	-0.284	-1.985
	[0.767]	[0.727]	[1.668]	[0.276]	[0.217]	[1.351]
Economic Growth Rate, t-1	0.071	0.079	0.006	-2.139**	-2.078**	-2.307**
	[-0.368]	[-0.395]	[-0.029]	[2.078]	[2.096]	[2.327]
N	743	724	724	743	724	724
R-squared	0.52	0.50	0.49	0.39	0.38	0.29

Notes:
This table presents a replication exercise of Miguel, Satyanath and Sergenti (2004) by updating their original PWT 5.6 GDP data with PWT 6.2 data. All specifications replicate Table 4, Equations 3 and 5, in Miguel, Satyanath and Sergenti (2004). For presentation purposes we focus only on the key parameter - current and lagged growth rates - and omit other parameter estimates. Specification [1] replicates the main OLS result in Miguel, Satyanath and Sergenti (2004) using their original data. Specification [2] presents the same result using PWT 5.6 after dropping observations to balance the data with available observations in PWT 6.2. Specification [3] presents our main result when we replace the balanced sample using PWT 5.6 with PWT 6.2. Specifications [4], [5], [6] replicate specifications [1], [2], [3], respectively, using 2SLS, using rainfall as an instrument for current and lagged economic growth. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. t-statistics in brackets.

Table 10. Aghion, Howitt and Mayer-Foulkes (2005) Replication Results

Dependent variable →	log (Growth Gap)				
	[1]	[2]	[3]	[4]	[5]
Dataset Substitution	None	None	PWT6.2	None	PWT6.2
Sample	Original	Balanced	Balanced	Balanced	Balanced
PWT Grades Included	All	All	All	A,B,C	A,B,C
Financial Development	-0.015	-0.015	0.011	-0.009	0.013
	[0.93]	[0.94]	[0.93]	[0.60]	[1.21]
Financial Development	-0.061***	-0.061***	-0.041***	-0.048***	-0.031**
* Initial GDP Gap (1960)	[5.35]	[4.84]	[4.16]	[3.87]	[3.25]
Initial GDP Gap (1960)	1.507***	1.505***	0.402	1.031*	0.090
	[3.14]	[2.83]	[1.02]	[1.95]	[0.25]
N	71	60	60	57	57
R-squared	0.51	0.34	0.37	0.31	0.37
Implied Convergence Threshold	24.70	24.83	9.76	21.61	2.92
Number of Countries Above Threshold	37 out of 71	37 out of 71	65 out of 71	48 out of 71	71 out of 71

Instruments: legal origins, legal origins * initial GDP gap
Conditioning set: EMPTY

Notes:
This table presents a replication exercise of Aghion, Howitt, and Mayer-Foulkes (2005) by updating their original GDP data obtained from Levine, Loayza and Beck (2000) dataset with PWT 6.2 data. All specifications replicate Table 1, Equation 1, in Aghion, Howitt, and Mayer-Foulkes (2005). Specification [1] replicates the main result in Aghion, Howitt, and Mayer-Foulkes (2005) using their original data. Specification [2] presents the same result using Levine, Loayza and Beck's data after dropping observations to balance the data with available observations in PWT 6.2. Specification [3] presents our new result when we replace the balanced sample using Levine, Loayza and Beck's data with PWT 6.2 data. Specification [4] replicates [2] when countries with quality grading "D" are dropped. Specification [5] replicates [3] when countries with quality grading "D" are dropped. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. t-statistics in brackets.

Table 11. Mankiw, Romer, and Weil (1992)

Dependent variable →	**log of GDP Per Capita in 1985**				
	[1]	[2]	[3]	[4]	[5]
Dataset Substitution	None	None	PWT6.2	None	PWT6.2
MRW Sample	Non-Oil	Non-Oil	Non-Oil	Non-Oil	Non-Oil
Sample	Original	Balanced	Balanced	Balanced	Balanced
PWT Grades Included	All	All	All	A,B,C	A,B,C
log(I/GDP)-log(n+g+d)	0.738***	0.713***	0.431***	0.754***	0.430***
	[5.96]	[5.21]	[3.22]	[5.28]	[2.99]
log(school) –log(n+g+d)	0.657***	0.622***	0.711***	0.639***	0.761***
	[9.07]	[7.92]	[6.98]	[7.59]	[6.86]
N	98	83	83	77	77
R-squared	0.78	0.79	0.73	0.78	0.71
Solow Restriction p-value	0.654	0.653	0.210	0.584	0.166

Notes:
This table presents a replication exercise of Mankiw, Romer, and Weil (1992) by updating their original PWT 4.0 GDP and I/GDP data with PWT 6.2 data. All specifications replicate the Table 2 restricted regressions in Mankiw, Romer, and Weil (1992). The "Solow Restriction" is the restriction that the parameters for log(I/GDP)-log(n+g+d) and log(school)- log(n+g+d) are of equal magnitude. Specification [1] replicates the main result in Mankiw, Romer, and Weil (1995) using their original data. Specification [2] presents the same result using PWT 4.0 for the sample of non-oil countries after dropping observations to balance the data with available observations in PWT 6.2. Specification [3] presents our main result when we replace the balanced sample using PWT 4.0 with PWT 6.2. Specification [4] replicates [2] when countries with quality grading "D" are dropped. Specification [5] replicates [3] when countries with quality grading "D" are dropped. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. t-statistics are in brackets.

Table 12: Average Growth Rates between 1975 and 1999: African Countries

Top 10 Countries				
PWT 62		PWT 61		Countries Not Appearing on Both Lists
Country	Growth	Country	Growth	
Botswana	4.5%	Botswana	5.1%	Congo, Republic of
Equ.Guinea	4.0%	Cape Verde	4.7%	Equatorial Guinea
Cape Verde	3.7%	Mauritius	4.3%	Ethiopia
Egypt	3.7%	Egypt	3.7%	Malawi
Mauritius	3.7%	Tunisia	2.5%	Mali
Lesotho	3.5%	Uganda	1.7%	Mauritius
Tunisia	2.7%	Morocco	1.7%	Uganda
Mali	2.0%	Lesotho	1.5%	
Ethiopia	1.6%	Congo, Rep of	1.5%	
Morocco	1.6%	Malawi	1.2%	
Bottom 10 Countries				
PWT 62		PWT 61		Countries Not Appearing on Both Lists
Country	Growth	Country	Growth	
Gabon	-2.6%	Equ. Guinea	-2.7%	Chad
Zambia	-2.1%	Mozambique	-2.4%	Cote d'Ivoire
Madagascar	-1.9%	Zambia	-1.8%	Gabon
Togo	-1.7%	Comoros	-1.6%	Guinea-Bissau
Guinea-Bissau	-1.4%	Madagascar	-1.4%	Mauritania
Comoros	-1.2%	Cote d'Ivoire	-1.4%	Mozambique
Niger	-0.7%	Niger	-1.3%	Namibia
Nigeria	-0.5%	Mauritania	-1.3%	Niger
Chad	-0.5%	Togo	-1.0%	Nigeria
Mozambique	-0.4%	Namibia	-0.9%	Togo
				Country Switching Lists: Equ. Guinea

Notes:
This table presents the countries with the top 10 and bottom 10 average growth rates between 1975 and 1999 calculated using PWT 6.2 and PWT 6.1 GDP data (RGDPCH). Seven countries appear on the top 10 list for one dataset but not the other. Ten countries appear on the Bottom 10 list for one dataset but not the other. One country, Equatorial Guinea, switches lists. According to PWT 6.1, it is the worst-performing country; according to PWT 6.2, it is the second highest performing country.

Table 13. Replication Exercise Results Summary

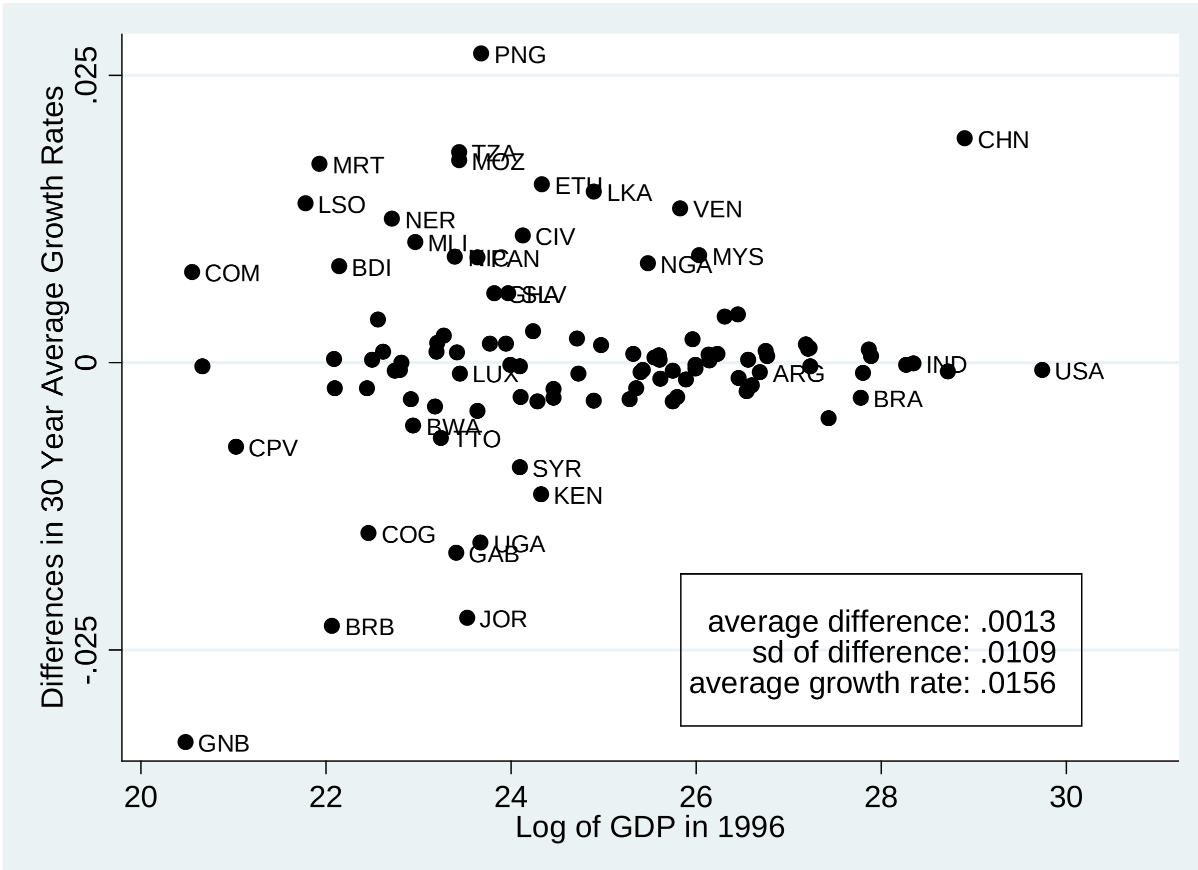
Author	Journal	Year	Tables Replicated	Replication Exercise Results Summary
Results not robust to dataset changes:				
Aghion et. al.	QJE	2005	Table 1, Cols 1-4	Initial GDP gap becomes insignificant in many exercises. Implied convergence thresholds become implausibly low.
Hausmann et. al	JEG	2005	Table 1	Discrepancies identified in 35 out of 100 growth acceleration cases between PWT 6.2 and PWT 6.1
Jones and Olken	QJE	2005	Tables 3, 5	Many differences across exercises. Most pronounced are changes in significance of Democrats' and Autocrats' deaths.
Ramey and Ramey	AER	1995	Table 1	Standard deviation of growth rates coefficient becomes weakly significant in one exercise and insignificant in three.
Results robust to dataset changes:				
Acemoglu, Johnson, et. al	JME	2003	Table 2, Rows 1-4	Minor changes to parameter magnitudes and significance levels.
Barro	JPE	1999	Table 1, Col 2	Minor changes to parameter magnitudes and significance levels.
Burnside and Dollar	AER	2000	Tables 1-3	Some changes in significance levels, but parameter magnitudes remain largely unchanged.
DeLong and Summers	QJE	1991	Table 1	Some changes in parameter magnitudes, but significance levels remain largely unchanged.
Demirguc-Kunt et. al.	JMCB	2004	Tables 5, 7	Minor changes to parameter magnitudes and significance levels.
Easterly et. al.	JME	1993	Table 5, Cols 2, 4	Minor changes to parameter magnitudes and significance levels.
Mankiw et. al.	QJE	1992	Table 2, Cols 1, 2	I/GDP coefficient halves in magnitude, nearly violating CRS Solow restriction in some exercises. Otherwise estimates are robust.
Miguel et. al	JPE	2004	Table 4, Cols 1-7	Instruments seem to reduce or eliminate parameter estimate differences when using PWT 6.2 data vs. their data.
Sachs and Warner		1995	Table 11, Col 7	Some changes in significance levels, but parameter magnitudes remain largely unchanged.

Table 14. Countries in the Long-Run Sample

ISO	Country	log GDP	Differences between PWT 6.2 and PWT 6.1					
			Prices	GDP Growth	I/GDP	C/GDP	Benchmarks	PWT Grade
ARG	Argentina	26.69	2%	-0.08%	-9%	-1%	2	B
AUS	Australia	26.77	8%	0.06%	-1%	-5%	3	A
AUT	Austria	25.99	-6%	-0.02%	-7%	-3%	5	A
BDI	Burundi	22.14	5%	0.84%	-30%	2%	0	C
BEL	Belgium	26.14	2%	0.02%	-5%	2%	6	A
BEN	Benin	22.61	8%	0.10%	16%	-9%	2	C
BFA	Burkina Faso	22.92	-2%	-0.32%	3%	13%	0	C
BOL	Bolivia	23.77	4%	0.17%	6%	0%	2	C
BRA	Brazil	27.77	30%	-0.30%	-7%	3%	3	C
BRB	Barbados	22.07	10%	-2.29%	-68%	-15%	2	C
BWA	Botswana	22.94	14%	-0.54%	2%	-7%	3	C
CAN	Canada	27.24	6%	-0.03%	0%	1%	4	A
CHE	Switzerland	25.96	-1%	0.20%	4%	2%	2	A
CHL	Chile	25.74	-5%	-0.34%	11%	-5%	2	B
CHN	China	28.90	25%	1.95%	49%	-16%	0	C
CIV	Cote d'Ivoire	24.12	12%	1.11%	5%	-4%	3	C
CMR	Cameroon	24.09	19%	-0.03%	-33%	-7%	3	C
COG	Congo, Republic of	22.46	-8%	-1.48%	16%	9%	2	C
COL	Colombia	26.13	3%	0.07%	7%	1%	3	C
COM	Comoros	20.55	14%	0.79%	56%	-9%	0	D
CPV	Cape Verde	21.02	-11%	-0.73%	-11%	-7%	0	D
CRI	Costa Rica	23.94	0%	0.17%	-42%	17%	1	C
DNK	Denmark	25.60	4%	0.03%	-6%	-8%	5	A
DOM	Dominican Republic	24.45	-2%	-0.31%	-18%	-3%	1	C
DZA	Algeria	25.80	4%	-0.30%	-9%	-12%	0	D
ECU	Ecuador	24.71	-14%	0.21%	17%	6%	2	C
EGY	Egypt	26.30	4%	0.41%	17%	2%	2	C
ESP	Spain	27.23	1%	0.13%	-7%	-11%	5	B
ETH	Ethiopia	24.33	12%	1.55%	-16%	5%	2	C
FIN	Finland	25.28	4%	-0.32%	10%	-21%	4	A
FJI	Fiji	22.09	3%	-0.22%	-6%	10%	1	C
FRA	France	27.89	0%	0.06%	-7%	-12%	6	A
GAB	Gabon	23.40	4%	-1.65%	-61%	-43%	1	C
GBR	United Kingdom	27.86	0%	0.12%	-5%	-15%	6	A
GER	Germany	28.27	-4%	-0.02%	4%	-1%	1	B
GHA	Ghana	23.82	-3%	0.61%	-4%	17%	0	C
GIN	Guinea	23.64	15%	-0.42%	-28%	-7%	1	C
GMB	Gambia, The	20.66	48%	-0.03%	26%	12%	0	C
GNB	Guinea-Bissau	20.48	23%	-3.30%	-25%	-36%	0	D
GNQ	Equatorial Guinea	20.36	78%	7.18%	-30%	-28%	0	D
GRC	Greece	25.61	5%	-0.14%	-4%	-1%	4	B
GTM	Guatemala	24.46	0%	-0.23%	-7%	-1%	1	C
HKG	Hong Kong	25.88	0%	-0.14%	-2%	1%	3	A
HND	Honduras	23.27	0%	0.23%	1%	1%	1	C
HUN	Hungary	25.32	-1%	0.08%	-3%	-20%	5	C
IDN	Indonesia	27.43	-5%	-0.48%	9%	-9%	2	C
IND	India	28.35	0%	-0.01%	-10%	-9%	4	C
IRL	Ireland	24.89	7%	-0.33%	13%	-8%	5	A
IRN	Iran	26.54	-17%	-0.24%	56%	-19%	4	C
ISL	Iceland	22.50	2%	0.03%	-5%	-7%	2	B

ISR	Israel	25.43	-2%	-0.06%	-11%	-9%	2	B
ITA	Italy	27.80	1%	-0.09%	-1%	-5%	6	A
JAM	Jamaica	23.20	-18%	0.17%	-8%	23%	3	C
JOR	Jordan	23.52	-24%	-2.21%	8%	11%	1	C
JPN	Japan	28.72	5%	-0.07%	-1%	-8%	6	A
KEN	Kenya	24.32	0%	-1.15%	10%	-1%	5	C
KOR	Korea, Republic of	27.19	9%	0.16%	2%	-3%	5	B
LKA	Sri Lanka	24.89	-2%	1.49%	27%	-10%	4	C
LSO	Lesotho	21.78	6%	1.39%	13%	15%	0	D
LUX	Luxembourg	23.44	-5%	-0.09%	8%	-7%	5	A
MAR	Morocco	25.40	0%	-0.08%	-9%	1%	3	C
MDG	Madagascar	23.18	-3%	-0.38%	33%	-9%	3	C
MEX	Mexico	27.21	11%	0.13%	-2%	-6%	3	C
MLI	Mali	22.96	-4%	1.05%	14%	-7%	3	C
MOZ	Mozambique	23.44	89%	1.76%	17%	-8%	0	D
MRT	Mauritania	21.93	16%	1.73%	110%	-2%	0	C
MUS	Mauritius	23.41	-4%	0.09%	-8%	-4%	2	C
MWI	Malawi	22.80	2%	-0.06%	-23%	7%	4	C
MYS	Malaysia	26.03	2%	0.94%	-2%	-2%	2	C
NAM	Namibia	22.81	-26%	0.00%	-36%	1%	0	D
NER	Niger	22.71	-3%	1.25%	-10%	-14%	0	D
NGA	Nigeria	25.47	6%	0.87%	-16%	-3%	3	C
NIC	Nicaragua	23.39	18%	0.92%	-21%	-11%	0	C
NLD	Netherlands	26.60	-1%	-0.20%	-1%	-6%	6	A
NOR	Norway	25.59	-1%	0.06%	-11%	-27%	4	A
NPL	Nepal	24.10	1%	-0.30%	4%	-1%	2	C
NZL	New Zealand	24.97	-1%	0.16%	-3%	-15%	1	B
PAK	Pakistan	26.46	3%	-0.13%	6%	-7%	4	C
PAN	Panama	23.64	2%	0.92%	-9%	14%	2	C
PER	Peru	25.35	-9%	-0.22%	-7%	-1%	2	C
PHL	Philippines	26.23	-2%	0.08%	-7%	-2%	5	C
PNG	Papua New Guinea	23.68	28%	2.69%	-38%	-5%	0	D
PRT	Portugal	25.75	-5%	-0.07%	-4%	-5%	4	B
PRY	Paraguay	23.99	-10%	-0.02%	1%	18%	1	C
ROM	Romania	25.55	22%	0.05%	-28%	-15%	2	C
RWA	Rwanda	22.44	3%	-0.22%	-31%	13%	1	C
SEN	Senegal	23.19	-3%	0.10%	-20%	13%	3	C
SLV	El Salvador	23.97	0%	0.60%	9%	17%	1	C
SWE	Sweden	25.99	1%	-0.05%	0%	-7%	3	A
SYR	Syria	24.09	58%	-0.91%	-34%	-8%	2	C
TCD	Chad	22.56	22%	0.38%	-8%	6%	0	D
TGO	Togo	22.08	10%	0.04%	44%	-7%	0	D
THA	Thailand	26.75	1%	0.10%	1%	6%	3	C
TTO	Trinidad &Tobago	23.24	-13%	-0.65%	91%	-1%	2	C
TUN	Tunisia	24.73	-1%	-0.09%	21%	2%	3	C
TUR	Turkey	26.56	27%	0.02%	-14%	1%	3	C
TZA	Tanzania	23.44	-10%	1.83%	-77%	24%	3	C
UGA	Uganda	23.67	-46%	-1.56%	15%	-6%	0	D
URY	Uruguay	24.24	-3%	0.28%	10%	-1%	3	B
USA	USA	29.74	0%	-0.06%	-2%	0%	6	A
VEN	Venezuela	25.83	1%	1.35%	1%	1%	2	C
ZAF	South Africa	26.45	7%	0.42%	-21%	5%	0	C
ZMB	Zambia	22.74	3%	-0.07%	62%	25%	4	C
ZWE	Zimbabwe	24.28	-25%	-0.34%	-36%	6%	3	C

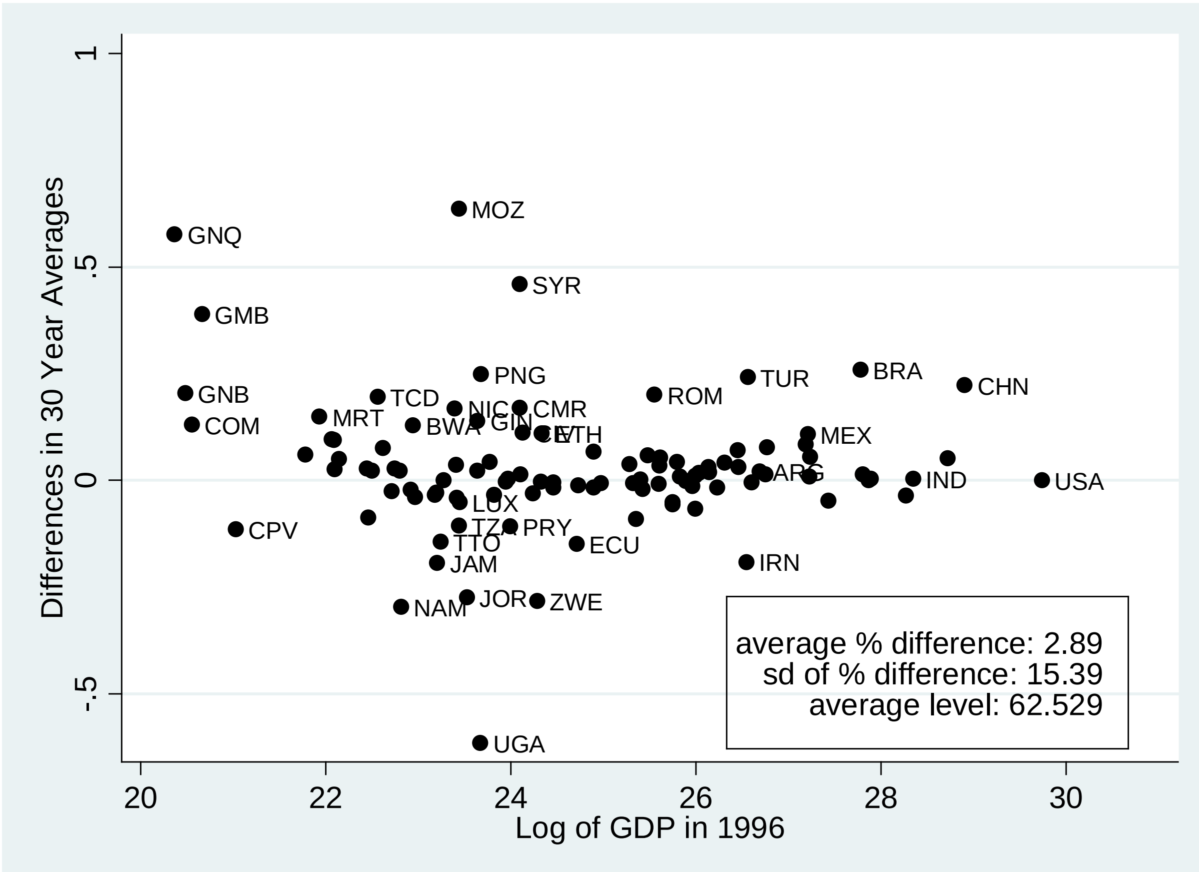
Figure 1: Differences in 30-Year Average Per Capita GDP Growth Rates between PWT 6.2 and PWT 6.1



Notes

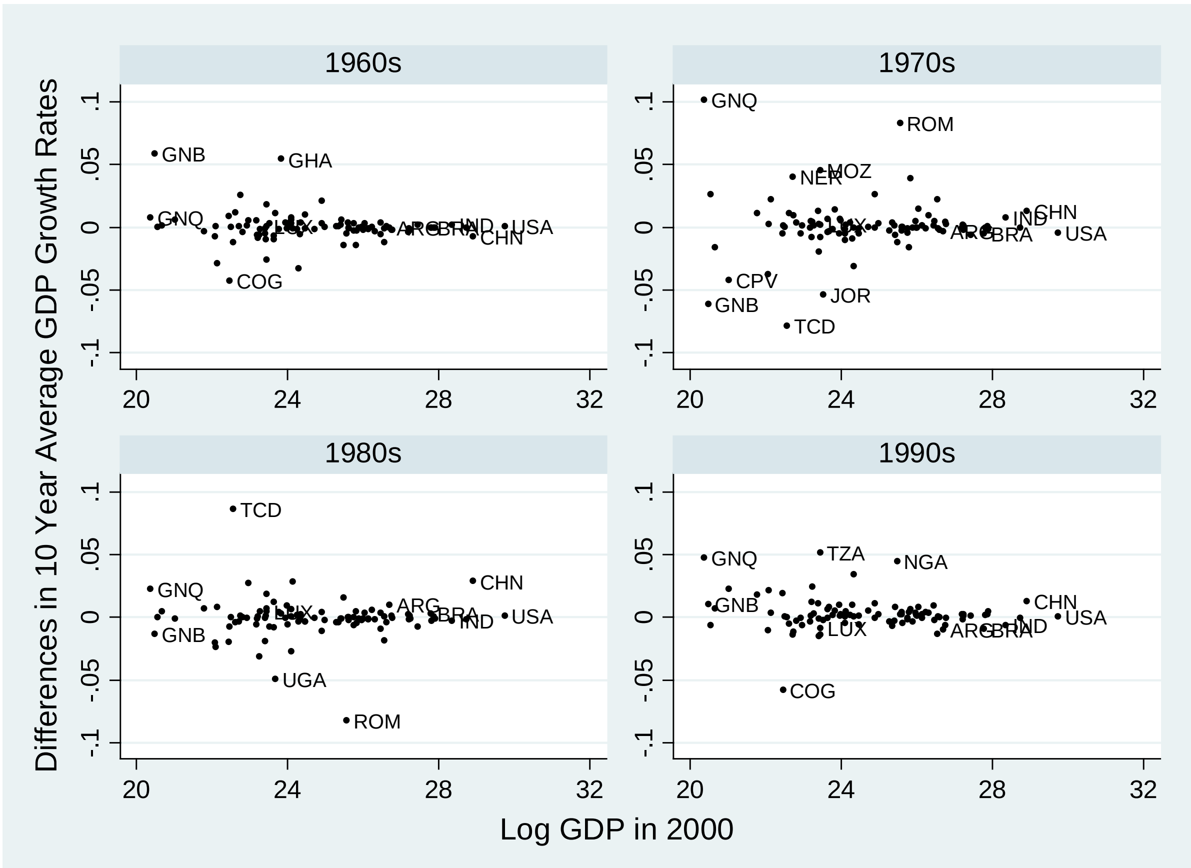
1. 30-year average annual per capita GDP growth rates are computed using the RGDPCH series for the period 1970-1999.
2. Differences in growth rates between the two versions of PWT are calculated as GDP growth from PWT 6.2 minus GDP growth from PWT 6.1.
3. Average differences for 30-year average annual per capita GDP growth rates are very close to zero (.0013) whereas the standard deviation is .0109. Average growth rate is about 1.56 percent.
4. The sample consists of the 104 countries in the “Long Run Sample” used in other tables and figures.

Figure 2: Differences in 30-Year Average Prices
between PWT 6.2 and PWT 6.1



Notes
1. 30-year average prices are computed using the average of the P series for the period 1970-1999.
2. Differences in averages between the two versions of PWT are calculated as the log of average prices from PWT 6.2 minus the log of average prices from PWT 6.1.
3. Average differences for 30-year average prices are very close to zero (2.89) whereas the standard deviation is 15.39. The average price level is 62.93, relative to a price level of 100 for the United States.
4. The sample consists of the 104 countries in the “Long Run Sample” used in other tables and figures.

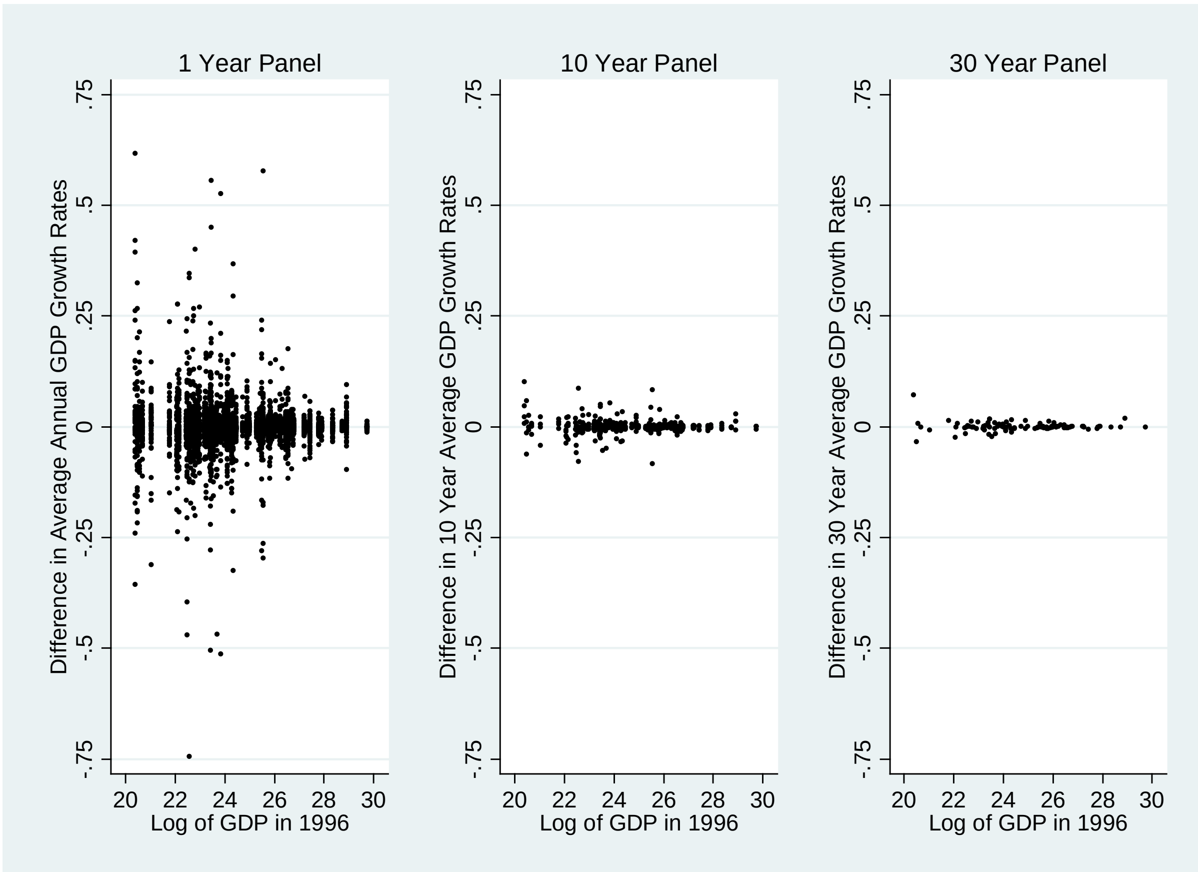
Figure 3: Differences in 10-Year Average Per Capita GDP Growth by Decade between PWT 6.2 and PWT 6.1



Notes

1. 10-year average annual per capita GDP growth rates are computed using the RGDPCH series for the period 1960-2000. Average annual growth rates are calculated as *[log(RGDPCH$_{t+10}$)- log(RGDPCH$_t$)]/10*.
2. Differences in growth rates between the two versions of PWT are calculated as GDP growth from PWT 6.2 minus GDP growth from PWT 6.1.
3. 1960s: avg. difference = .0001; sd of difference = .0123; avg. growth rate = .0279,
   1970s: avg. difference = .0012; sd of difference = .0217; avg. growth rate = .0212,
   1980s: avg. difference = -.0008; sd of difference = .0163; avg. growth rate = .0084,
   1990s: avg. difference = .0028; sd of difference = .0130; avg. growth rate = .0168.
4. The sample of countries is constant across decades, and consists of 96 of the 104 countries in the "Long Run Sample" used in other tables and figures. 8 countries were dropped because they did not have data for all four decades. This sample is called the "Decades Sample."

Figure 4: Differences in Annual Per Capita GDP Growth
between PWT 6.2 and PWT 6.1



Notes

1. Differences in growth rates between the two versions of PWT are calculated as GDP growth from PWT 6.2 minus GDP growth from PWT 6.1.
2. 1 Yr Panel: # of obs: 3840; avg. difference = .0008; sd of difference = .0539; avg. growth rate = .0186,
   10 Yr Panel: # of obs: 384; difference = .0008; sd of difference = .0163; avg. growth rate = .0186,
   30 Yr Panel: # of obs: 96; difference = .0010; sd of difference = .0108; avg. growth rate =.0151.
4. The sample of countries is constant across the three figures above, and consists of 96 of the 104 countries in the “Long Run Sample” used in other tables and figures. 8 countries were dropped because they did not have data for all four decades. This sample is called the “Decades Sample.”

Figure 5: GDP Per Capita ($2000):
PWT 6.2, PWT 6.1, and PWT 5.6

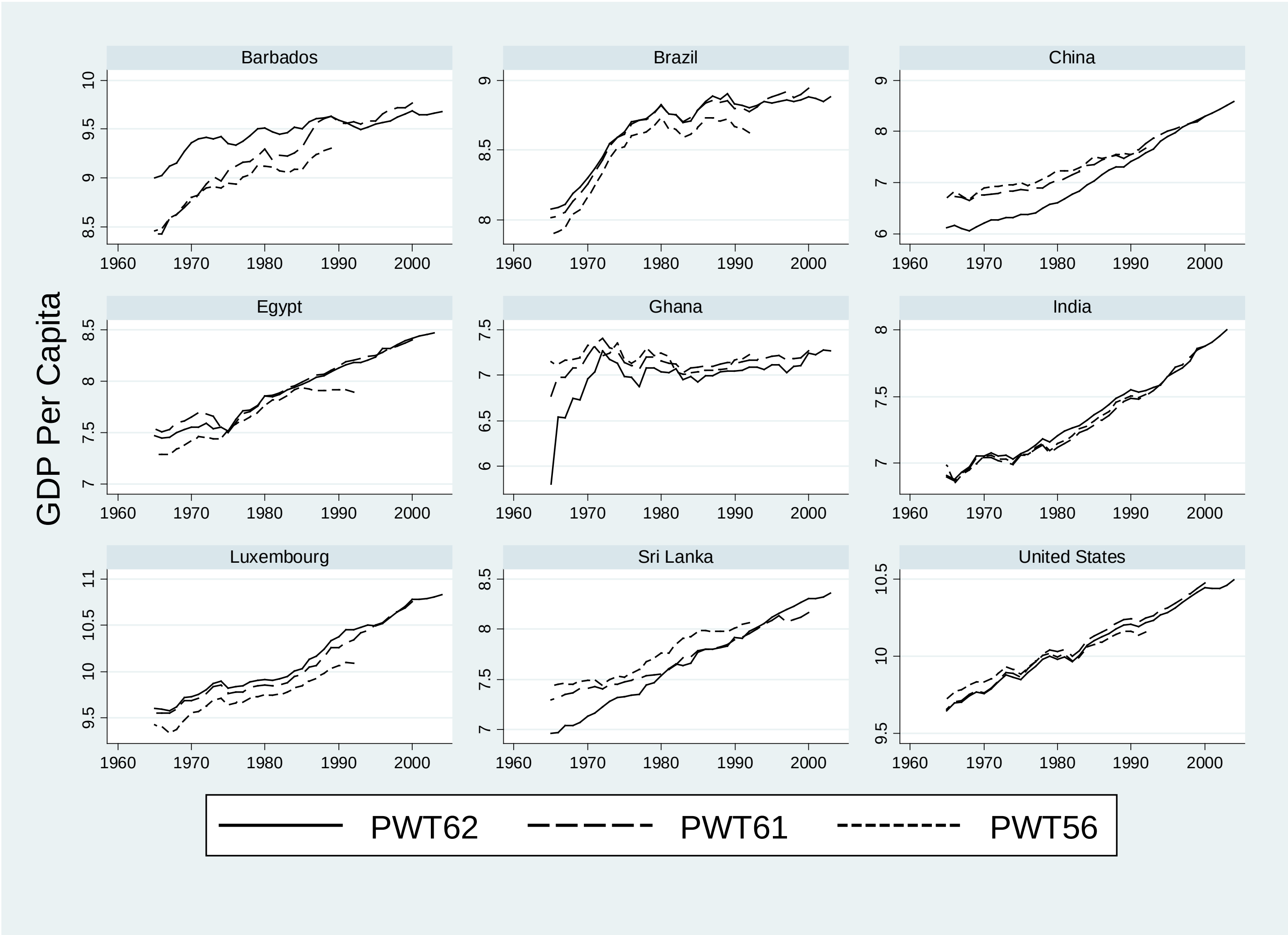
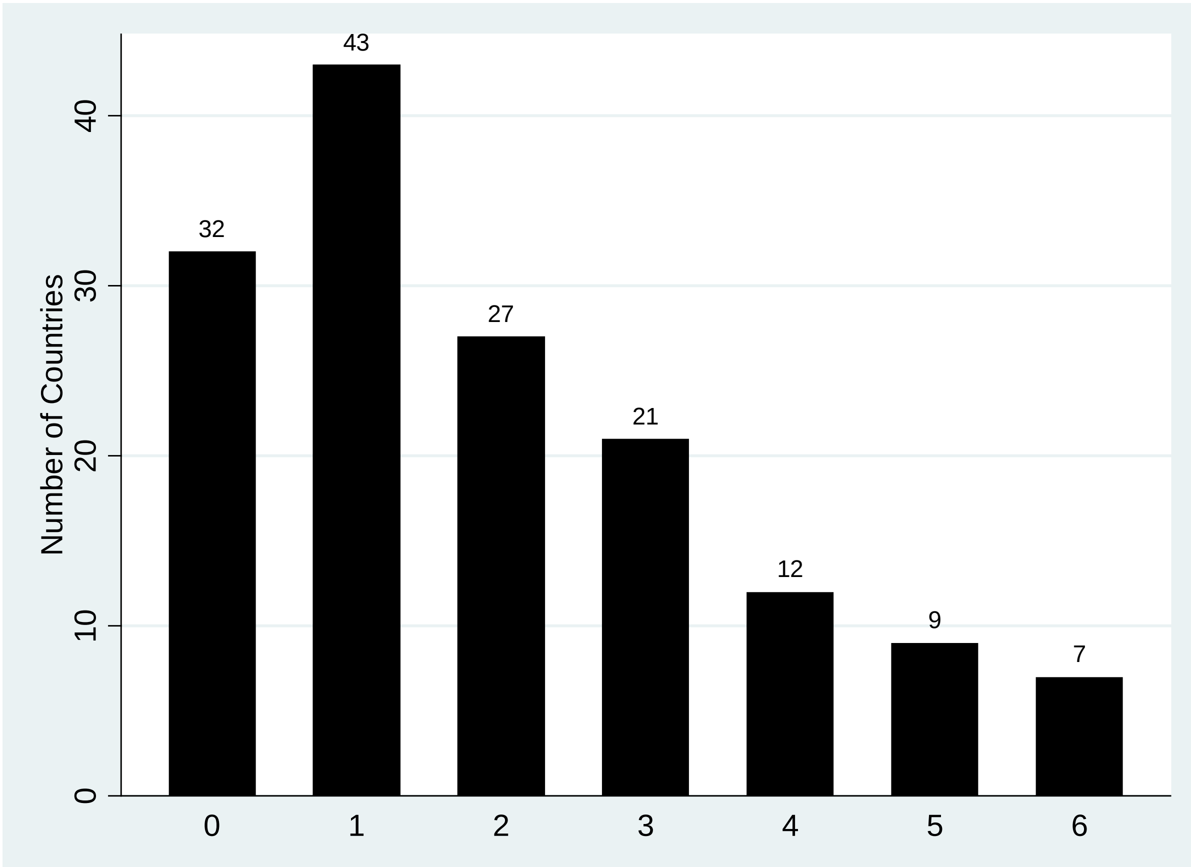
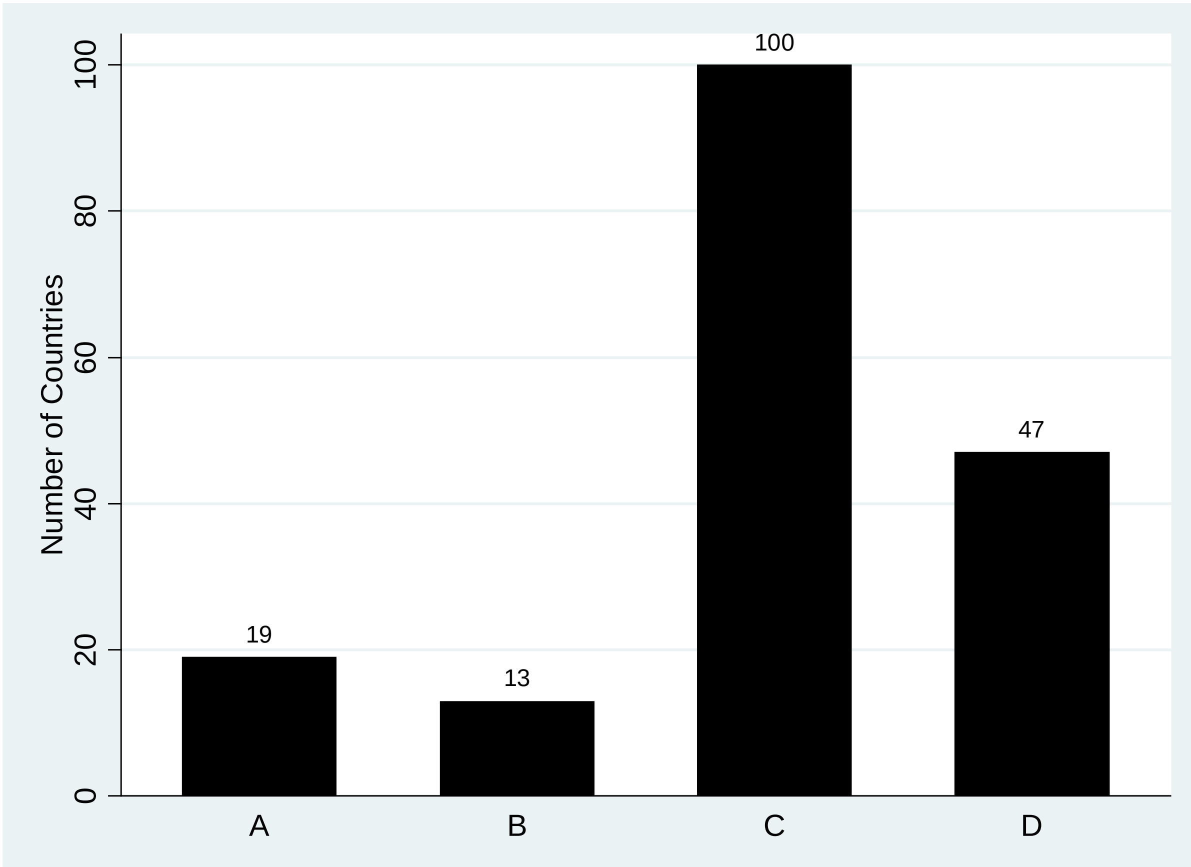


Figure 6: Countries with Respective Number of ICP Benchmark Studies



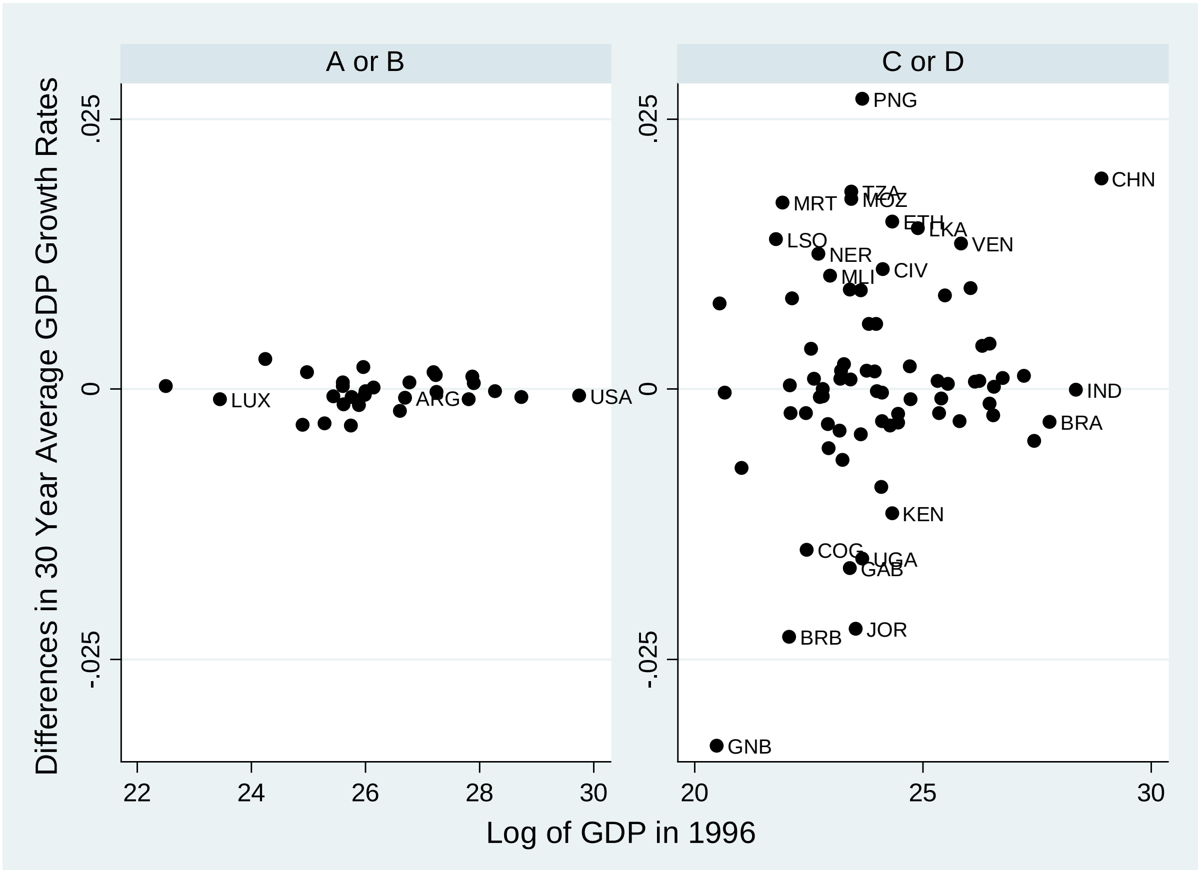
Notes
1. ICP benchmark studies used in PWT 6.1.

Figure 7: Countries with Respective PWT Data Quality Grades



Notes
1. ICP benchmark studies and quality grades used in PWT 6.1.

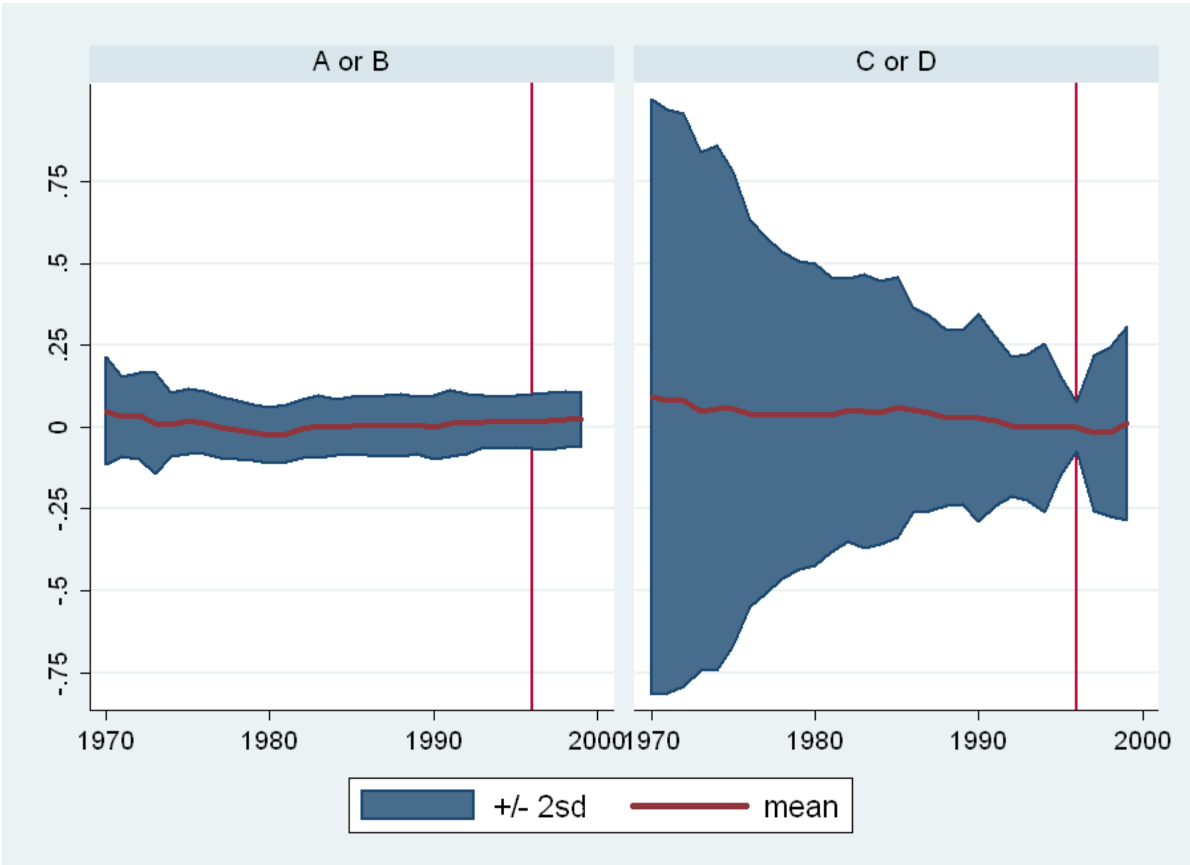
Figure 8: Differences in 30-Year Average GDP Growth by PWT Quality Grade between PWT 6.2 and PWT 6.1



Notes

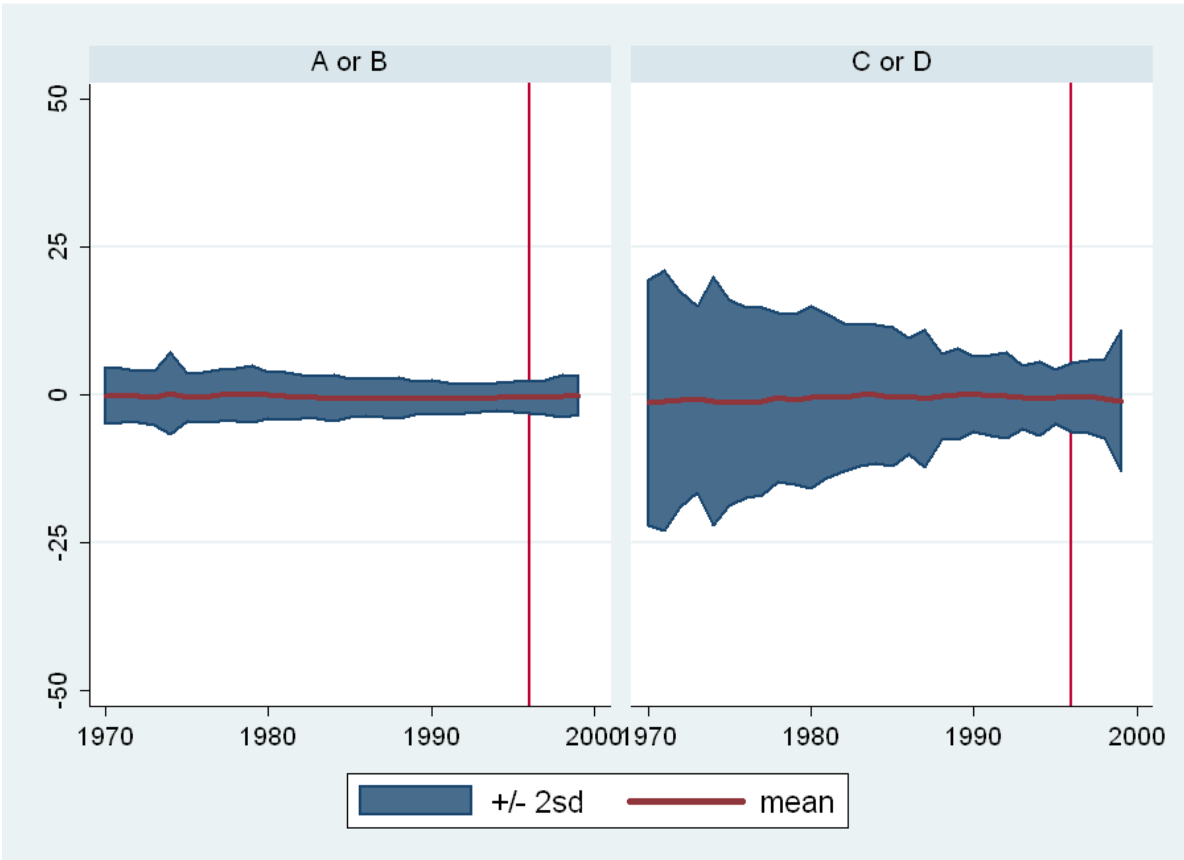
1. 30-year average annual per capita GDP growth rates are computed using the RGDPCH series for the period 1970-1999.
2. Differences in growth rates between the two versions of PWT are calculated as GDP growth from PWT 6.2 minus GDP growth from PWT 6.1.
3. The sample consists of the 104 countries in the "Long Run Sample" used in other tables and figures.
4. A or B: average difference: -.0002; sd of difference: .0015; average growth rate: .0233; countries: 29.
   C or D: average difference: .0019; sd of difference: .0127; average growth rate: .0126; countries: 75.

Figure 9: Evolution of Differences in Levels of Prices Across Time between PWT 6.2 and PWT 6.1



Notes
1. Prices is the Price (P) series.
2. Differences in levels rates between the two versions of PWT are calculated as the log-level of P from PWT 6.2 minus the log-level of P from PWT 6.1.
3. Each mean and standard deviation is computed across countries for a given year. Sample of countries for each year includes countries for which there is data for every year between 1970 and 1999.
4. Vertical line denotes benchmark year, 1996.
5. The sample consists of the 104 countries in the "Long Run Sample" used in other tables and figures.

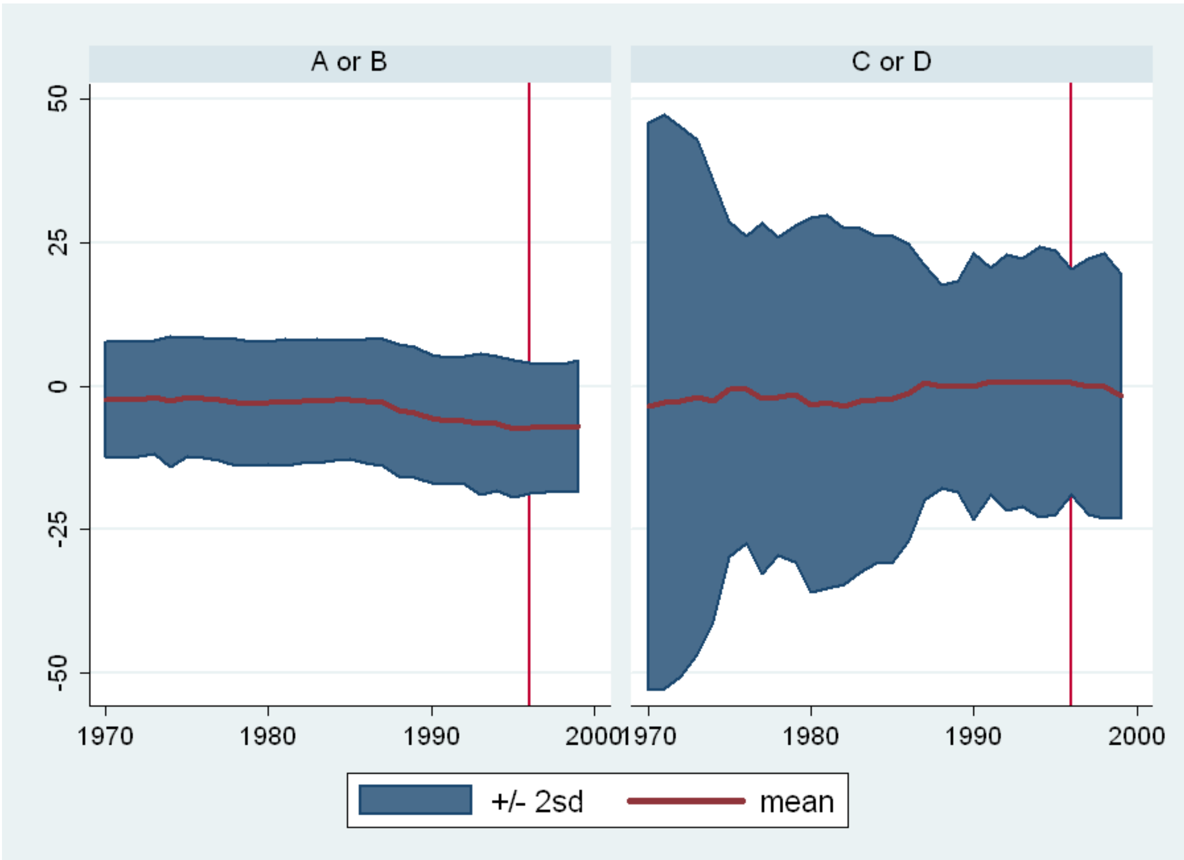
Figure 10: The Evolution of Differences in Levels of Investment Across Time between PWT 6.2 and PWT 6.1



Notes

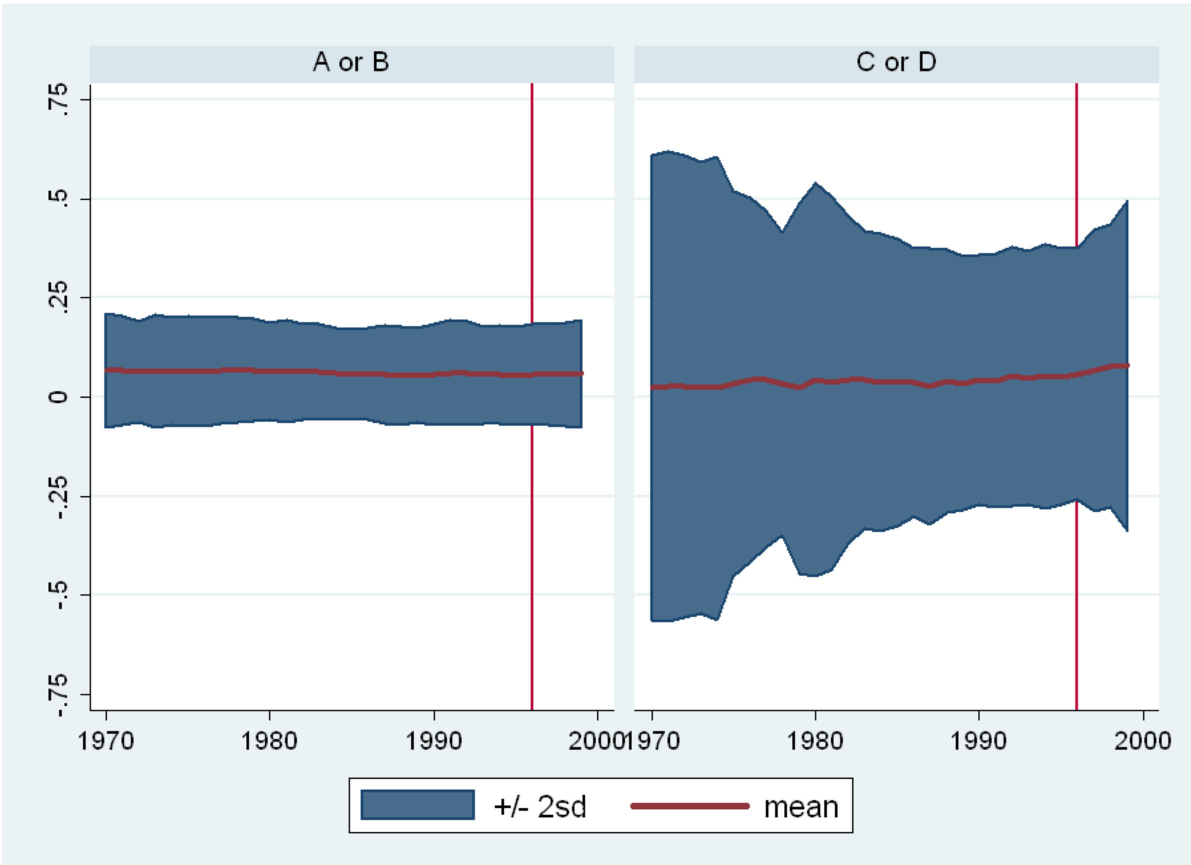
1. Investment is the Investment/GDP (KI) series.
2. Differences in levels between the two versions of PWT are calculated as the log-level of investment from PWT 6.2 minus the log-level of investment from PWT 6.1.
3. Each mean and standard deviation is computed across countries for a given year. Sample of countries for each year includes countries for which there is data for every year between 1970 and 1999.
4. Vertical line denotes benchmark year, 1996.
5. The sample consists of the 104 countries in the "Long Run Sample" used in other tables and figures.

Figure 11: The Evolution of Differences in Levels of Consumption Across Time between PWT 6.2 and PWT 6.1



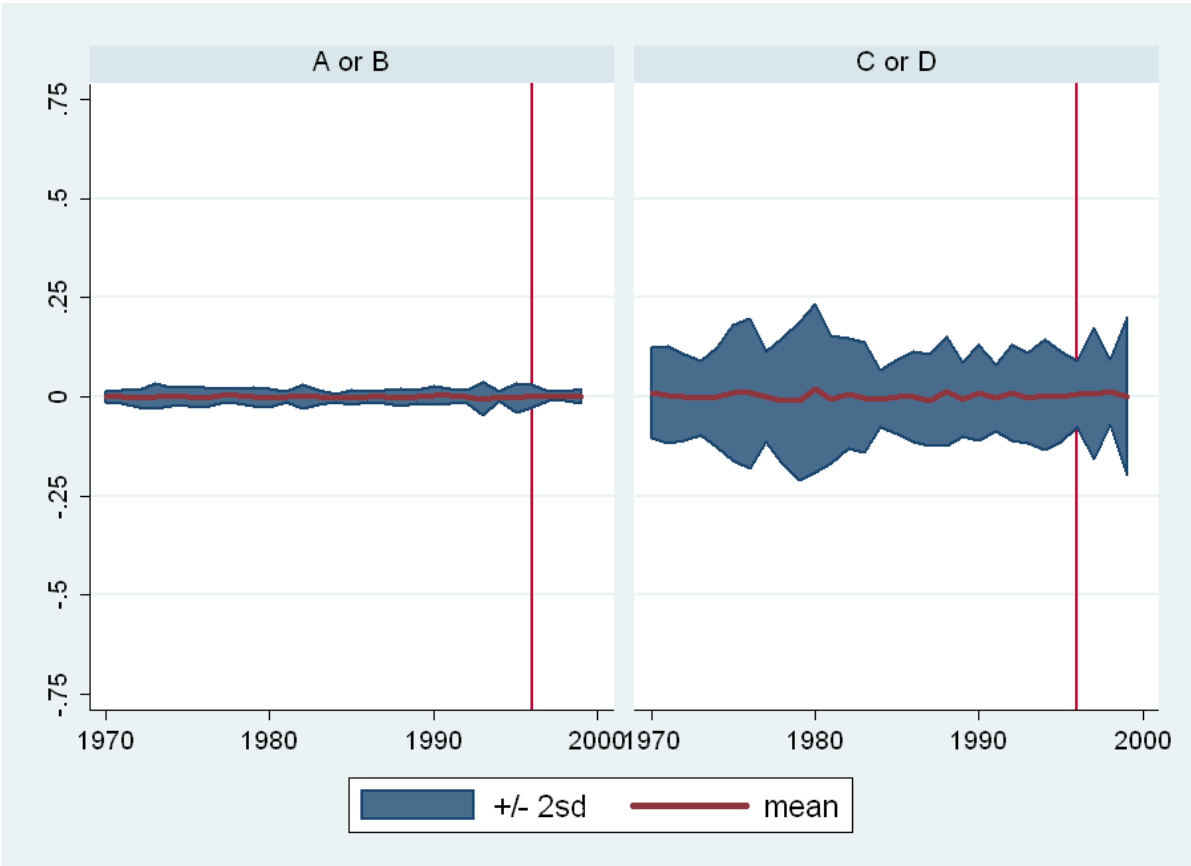
Notes
1. Consumption is the Consumption/GDP (KC) series.
2. Differences in levels between the two versions of PWT are calculated as the log-level of consumption from PWT 6.2 minus the log-level of consumption from PWT 6.1.
3. Each mean and standard deviation is computed across countries for a given year. Sample of countries for each year includes countries for which there is data for every year between 1970 and 1999.
4. Vertical line denotes benchmark year, 1996.
5. The sample consists of the 104 countries in the "Long Run Sample" used in other tables and figures.

Figure 12: Evolution of Differences in Levels of Per Capita GDP Across Time between PWT 6.2 and PWT 6.1



Notes
1. GDP is Real GDP per capita, chained series (RGDPCH).
2. Differences in levels between the two versions of PWT are calculated as the log of GDP per capita from PWT 6.2 minus the log of GDP per capita from PWT 6.1.
3. Each mean and standard deviation is computed across countries for a given year. Sample of countries for each year includes countries for which there is data for every year between 1970 and 1999.
4. Vertical line denotes benchmark year, 1996.
5. The sample consists of the 104 countries in the "Long Run Sample" used in other tables and figures.

Figure 13: Evolution of Differences in Growth Rates of Per Capita GDP Across Time between PWT 6.2 and PWT 6.1



Notes
1. GDP is Real GDP per capita, chained series (RGDPCH).
2. Differences in growth rates between the two versions of PWT are calculated as GDP growth from PWT 6.2 minus GDP growth from PWT 6.1.
3. Each mean and standard deviation is computed across countries for a given year. Sample of countries for each year includes countries for which there is data for every year between 1970 and 1999.
4. Vertical line denotes benchmark year, 1996.
5. The sample consists of the 104 countries in the "Long Run Sample" used in other tables and figures.