# The Mirage of Convergence: Why Poor Countries May Only Seem to Be Closing the Income Gap

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# A Rise By Any Other Name? Sensitivity of Growth Regressions to Data Source

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Since the path-breaking work of Barro (1991), estimation of cross-country growth regressions has become a boom industry. Literally hundreds of studies have extended the basic framework by incorporating various possible determinants of growth rate differences across countries and over time. Results are often found to be sensitive to specification, time period or sample coverage (see Levine and Renelt, 1992, Sala-i-Martin, 1997, Kalaitzidakis et. al., 2000, and Islam, 2003). Several authors have observed that results may depend on the source and data collection methods for right-hand variables (see, for example, Knowles, 2001 and Atkinson and Brandolini, 2001). In this paper we suggest that a more fundamental problem may exist with respect to the growth rates used in the majority of studies. We show that the three main data sources from which growth rates are derived often differ in the magnitude and even the direction of reported GDP changes (growth rates). These differences are predictable given the way that the data sets are constructed. More importantly, we establish that they are systematically related to the level of a country's development and that, therefore, can be expected to provide different implications regarding economic convergence. Finally, we show that the results of two recent studies, especially with respect to convergence results, depend on which data set is used to derive the growth measure.

## I. Data Sources for Growth

Economic research on growth generally uses one of three interrelated and widely available data sets, the IMF's International Financial Statistics (IFS), the World Bank's World Development Indicators (WDI) and the Penn World Tables (PWT), also known as the Summers and Heston data.

Although, in principle, any of these three interrelated data sources could be used for empirical work, in practice the vast majority of analyses of growth have used the Penn World Tables. In a sample of seventy-five recent studies,[1] three-quarters used the PWT data, 15 percent the WDI data and the remaining 10 percent the IFS data. This pattern may be partly due to the easy accessibility of the PWT data, although it is likely to be largely due to a desire for comparability with previous studies.[2]

Unfortunately, the adjustments made in the WDI and PWT data to create cross-sectional comparability can affect calculated growth rates in misleading ways. This phenomenon has long been known at a theoretical level. Heston and Summers themselves state:

> PWT has been used by many researchers to measure countries' growth rates, unaware that the rates they obtained are *not* the same as the rates implied in the countries' own national accounts. Both sets are weighted averages of the growth rates of GDP components, but the weights are different.... When told this, a number of growth researchers reacted in a

[1] The sample consisted of papers on the reading list of a graduate-level course on determinants of growth taught by one of the authors.

[2] Coverage of countries and years are somewhat different for the three data sets. The IFS provide data for 176 countries, and goes back as far as 1945. WDI contain data for 207 countries and begins in 1960, while the PWT consists of data for 167 countries since 1960. Occasionally researchers will even merge data from more than one source in order to increase coverage, apparently unaware of the significant differences in the data across sources.

> predictable way: since they were indifferent as to [which] growth rate they were using..., this clarification was entirely disregarded (Heston and Summers, 1996, p. 24).

Nuxoll (1994) makes a similar point, observing that the Penn World Tables implicitly assume that the domestic structure of relative prices in every country is similar to that of a middle-income country such as Hungary. Furthermore, he suggested that the use of inappropriate price structures would serve to systematically bias growth calculations according to whether the country in question was richer or poorer than a country with the assumed price structure (see also Gerschenkron, 1951). He concludes by observing:

> The growth rates in the Penn World Tables do differ from national accounts. International prices are useful for adjusting GDP estimates for differences in price level; they are certainly preferable to using exchange rates. However, using domestic prices to measure growth rates is more reliable, because those prices characterize the trade-offs faced by the decision-making agents, and hence they have a better foundation in the economic theory of index numbers. Probably the ideal is to use Penn World Table numbers for levels and the usual national accounts data for growth-rates (p. 1434).

This point is further reiterated in Temple (1997). As an indication of the lack of impact of the series of articles pointing out the problems with growth rates derived from the PWT data, however, we note that Nuxoll's paper was cited in only five of the literally hundreds of empirical cross-country growth studies between 1994 and 2003.[3]

In order to understand the problem posed by the use of inappropriate growth measures, it is necessary to review the process by which the various data sources adjust national income accounts to attempt to create cross-sectional comparability. The purest data is that collected and organized by the International Monetary Fund from national statistical agencies and published in the International Financial Statistics, distributed in hard copy, on CD- ROM, and on-line. Summaries of the data are also published in the IMF's biannual World Economic Outlook. Thus, this data is referred to in the literature as either the IFS or WEO data. Real GDP and growth of real GDP are reported using national price weights and indigenous inflation levels.

Data from the IFS, supplemented by direct collection efforts by World Bank staff, are processed by the World Bank and issued each year as the World Development Indicators (WDI) data. There are several potential pitfalls for researchers studying growth created by the methodology used to construct income levels in the WDI. The data set contains two GDP measures, GDP in constant local currency units and GDP in constant US dollars (1995 dollars in the latest release). What is sometimes ignored is that all conversions from local currencies into dollars are made using a single exchange rate for the base year. Thus, growth rates reported in local currency or constant US dollars are identical. [4]

The raw data contained in the WDI (except for developed countries where data is obtained from the Organization for Economic Cooperation and Development (OECD) instead) are further processed by the Center for International Comparisons at the University

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[3] Perhaps the best example of taking it to heart is Yanikkaya (2003).

[4] GNP measures in the WDI data, on the other hand, are converted using current exchange rates each year. This creates an even greater difficulty in comparing cross-country growth rates since, as stated in the technical documentation for the WDI data, the Bank uses a synthetic exchange rate commonly called the Atlas conversion factor.... The Atlas conversion factor for any year is the average of a country's exchange rate for that year and its exchange rate for the two preceding years, adjusted for the difference between the rate of inflation in the country and that in the G-5 countries (World Bank, 2000, p. 362). Furthermore, the World Bank uses an alternative conversion factor when, according to subjective expert evaluation, the Atlas conversion factor is judged to deviate from the true effective rate. The inclusion of currency effects in the measure of income means that GNP-based growth measures may indicate that various factors Granger-cause growth because of currency

of Pennsylvania to produce the Penn World Tables (PWT) data set. Often known by the names of its principle authors, Robert Summers and Alan Heston as the Summers-Heston data, the PWT are the basis for the data contained in the widely used Barro-Lee data set. Altogether there have been six major and several minor revisions of the PWT, with the latest version (currently Mark 6.1) available on line at **http://pwt.econ.upenn.edu** and several mirror sites throughout the world.

Unfortunately, the adjustments made to the WDI data to derive the PWT data introduce even further problems for the analysis of growth. The main focus of the Penn World Tables is to create cross-sectional comparability in national accounts data. Thus, each country' s disaggregated current price expenditures are converted to a common currency unit using price parities based on the benchmarking studies of the United Nations International Comparison Program (ICP). In effect, relative prices for individual goods are set equal to the weighted average of relative prices for that good in all countries, or what are called "international prices." This level of prices is then normalized so that the level of GDP in the U.S. is the same in the weighted international currency units and U. S. Dollars.

PWT 6.1 contains 117 benchmark countries (i.e., countries included in the ICP) and 50 additional nonbenchmark countries. Purchasing power parities for the latter group are obtained as predicted values from an equation regressing the price level for benchmark countries on three international cost of living comparisons that exist for both benchmark and nonbenchmark countries.[5] Furthermore, the ICP only benchmarks countries at irregular

appreciation instead of increased real economic activity.

[5] Regressions are estimated using the United Nation's International Civil Service Index, the U.S. State Department Index and an index provided by Employment Conditions Abroad, an organization of multinational

intervals. Data for other years are obtained by extrapolating benchmarked levels using domestic measures of changes in prices.

It turns out that ignoring this caution may have seriously influenced our understanding of growth determinants. Analysts may be tempted to dismiss problems with the calculation of growth rates used for growth regressions as relatively unimportant because they create measurement errors in the dependent variable, often assumed to affect the variance of estimated coefficients but not their consistency properties. This is true, however, only if the measurement error is of the classical type. If, on the other hand, the measurement error either does not have a zero mean or is correlated with one or more explanatory variable, estimated coefficients will be biased. Below we show that while the first of these conditions may be met with respect to the measurement errors introduced into growth rates by WDI and PWT adjustments, the second is clearly not met, especially with respect to one of the key issues in growth analysis, that of convergence over time.

Using the observations that all three data sets have in common, we have computed growth rates from adjacent year observations of real per capita GDP as reported in the three data sources. In line with Summers and Heston's recommendation, we use the chain-weighted series from the PWT.[6] In all, we are able to compute a total of 3,063 pairwise comparisons between any two data sets. Table 1 shows the characteristics of growth rates from these three series and the correlation among them, while Tables 2 and 3 show how these correlations vary across country income and over time.

**INSERT TABLES 1, 2, and 3 ABOUT HERE**

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firms, governments and nonprofit agencies.

Several points stand out from the tables. While mean real growth rates in Table 1 are almost identical across the three data sets, suggesting that the expected error is zero, there is surprisingly low correlation among various measures of what is supposedly the same variable. The lack of concordance between growth rates derived from various sources can be seen in Figure 1, which plots individual country-year growth rates derived from the Penn World Tables against those derived from the IFS data.7 While there is a slight positive correlation, results lie far from the 45° line that would be expected if there were identical measures.

Table 2 shows that correlations are substantially higher for Lower Middle Income countries (and somewhat higher for Upper Middle Income ones), a result consistent with Nuxoll's point that the adjustments made in creating the PWT are equivalent to imposing the price structure of a typical middle income country. Table 3 shows that although there is very little time trend in the degree of concordance across the growth measures aside from a tendency for the PWT to be less reflective of national accounts growth rates prior to 1980, there is substantial volatility in the relationship between various growth measures over time.

Table 4 shows that even the direction of change in GDP varies substantially across the various data sets. More than 15 percent of the time the IFS and PWT have opposite signs, with one series showing positive growth while the other shows the same economy contracting. Almost 8 percent of the time the IFS and WDI data show opposite directions of GDP movement. More critically, these divergences are systematically related to income

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[6] This is correlated at .999 with the Laspeyres index.

[7] We have excluded outliers where either reported growth rate was greater or less than 40% and years when the IFS reported a change in local methodology.

levels, with the number of misreported directions of growth being substantially greater for lower-income countries. Although, as seen in Table 1, growth rates calculated from IFS data are only slightly greater on average than those calculated from WDI or PWT data, perhaps by 0.1 to 0.2 percentage points annually, Table 5 shows that this difference is concentrated in upper and upper-middle income countries. Thus, the substitution of international prices for domestic ones results in reduced measured growth in richer countries (0.2 to 0.3 percentage points annually) but has little, if any, impact on average measured growth in poorer ones.[8]

**INSERT TABLES 4 and 5 ABOUT HERE**

Since the error in growth rates in the widely-used PWT and WDI data is not independent of income level, we can expect to find that coefficients on income level (measures of convergence over time) are biased in studies using these data sources. Thus, the largely ignored caution that researchers should be sensitive to this divergence and use national accounts data to determine growth rates is potentially important. We now establish just how important by replicating two recent studies using alternative growth measures.

[8] This relationship holds on average but there is a great deal of variation across countries. Among the countries where IFS measured growth rates are greater than those in the PWT or WDI data are Italy, Argentina, Botswana, Mauritius, Uruguay, the Netherlands and Thailand, while among those where IFS growth rates are lower than in the other data sets are the Congo, Korea, Japan, Panama and South Africa and the United Kingdom.

## II. Replication Results

### A) Inequality and Growth

Forbes (2000) investigates the link between income inequality and growth rates, finding that in the short and medium term, an increase in a country's level of income inequality has a significant positive relationship with subsequent economic growth. Forbes reports using World Bank (WDI) data that she has generously provided to us.[9] Table 6 presents OLS estimates of the relationship between growth and income inequality[10] as reported by Forbes as well as alternative estimates of the same specification using data taken directly from PWT, WDI and IFS sources. Table 7 repeats this exercise for panel data, fixed effects estimates.[11] All other variables are as defined in the original paper. For the OLS estimates using each country as a single data point, the results reported by Forbes are quite close to those derived from both the PWT and WDI data, but diverge substantially from those obtained when growth is measured using the source country national accounts data in the

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[9] Actually the paper says that income and the resultant growth rates are taken from the World Bank STARS data set. STARS (Socioeconomic Timeseries Access and Retrieval System) is an interface to various data at the World Bank that appears to include both WDI and PWT income series. As we will discuss below, we are unable to exactly replicate some of Forbes' results using WDI data, but our results are close enough to hers for comparison purposes.

[10] This column repeats Column 5 of Table 4 in the original paper, which uses Deninger and Squire's (1996) high-quality data on income inequality. We were able to replicate these results exactly using the data provided by Forbes.

[11] Column 1 of the table reports results presented by Forbes although we were not able to exactly replicate these published results using the data supplied. In particular, the data sent to us contains only 162 observations as opposed to the claimed 180. Our results using her data and specification are close to those reported for the key variables, however, and are reported in column 2 of Table 5. We were, however, not able to replicate the Arellano-Bond results reported by Forbes, perhaps due to the difference in observations between the data that was sent to us and the results reported in the paper combined with the sensitivity of such estimators (see also Hank and Wacziarg, 2004, on the properties of Arellano-Bond estimators under measurement errors in exogenous variables) . We have, therefore not reported comparative results for these estimators. Professor Forbes has reported to us that due to the death of her research assistant she is unable to reconcile the differences in the data she sent to us and the data that was used in the final version of her paper.

IFS.[12] In the panel data estimates using five-year periods by country as the unit of observation, almost every coefficient differs across data sets with no consistent pattern. Given that the only difference across the columns in Tables 6 and 7 is replacing the dependent variable with supposedly the same measure drawn from a different data set, this fragility of results is both surprising and disturbing.

To the extent that a pattern to the differences exists, the most important finding is that growth rates derived from source-country national accounts show significant divergence over time as opposed to a pattern of convergence when other data is used. In addition, the link between inequality and growth that is the focus of Forbes's paper differs substantially according to which data is used to derive growth rates. In the OLS estimates, the negative relationship is more than twice as large in magnitude and of much greater statistical significance when native prices are used to compute growth rates. In the panel data estimates, where Forbes reports a positive and significant relationship between inequality and growth, there is no significant link using the other data sets.

**INSERT TABLES 6 AND 7 ABOUT HERE**

## B) Labor Force Quality and Growth

Hanushek and Kimko (2000) investigate the effect of labor-force quality as measured by international mathematics and science test scores on economic growth, finding a strong

[12] There are slight differences in year and country coverage between the data sets. We have, however, replicated Forbes' original estimates, restricting the sample to the countries and years available in the other data sets with no difference in results from those reported in her paper. These results are available at **http://home.cerge-ei.cz/hanousek/growth_data.** Thus, we are confident that the differences reported in Table 4 are due to the change of data used to derive the dependent variable rather than to differences in sample

positive and causal relationship. Key results are contained in Table 6 of the original paper.[13] Using data graciously provided by Hanushek, we have replicated the estimation in the original paper, substituting alternative measures of growth but retaining all other variables as in the original estimates. Results replicating column 5 of Table 6 in Hanushek and Kimko (2000) are presented in Table 8[14] Hanushek and Kimko use PWT data, and we were able to replicate their results exactly and report these results in column 1. Unfortunately, since the analysis starts in 1960, there is a significant loss of observations in the WDI and IFS data sets, reducing the number of countries available for analysis to 66 for the WDI data and 44 for the IFS data. In order to establish that any differences we find are due to the use of different growth measures rather than different samples, we first re-estimate the relationship using the Hanushek and Kimko's PWT growth measures but limiting ourselves to only the reduced sample of countries available in the alternative data sets. These results are shown in columns 2 and 3 of Table 8 and clearly establish that the pattern of results found by Hanushek and Kimko are invariant to reducing the samples. Columns 4 and 5 then reproduce the results in columns 2 and 3, replacing the PWT growth rates with those derived from the WDI and IFS data. While the WDI results are close to those derived using PWT data, the IFS results using source country growth rates as recommended by Summers and Heston do not find the evidence of convergence seen in the other data sets, the same differences seen in the

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coverage.

[13] This table report results using a data set that expands the original sample of 30 countries for which test scores are available by incorporating predicted values for an additional 50 countries. Although such a procedure introduces measurement error problems, we focus on the results using the full sample of countries because we lose a significant number of observations when shifting to alternative data sets to measure growth rates.

[14] Hanushek and Kimko use two alternative definitions of labor force quality, one that sets the world mean to 50 for each of the tests used and another that accounts for time trends using US time patterns. We report

replication of Forbes (2000) discussed above. In other differences, population growth seems to inhibit economic growth while the evidence for the effect of labor force quality on growth is reduced.[15] Once again the results are striking, with the use of more appropriate data providing no evidence of growth convergence, unlike results found using data that has been adjusted in pursuit of cross-section comparability in a given year.

**INSERT TABLE 8 ABOUT HERE**

## III. Conclusions

A recent summary of the state of the literature on convergence concluded with the observation that:

> Empirical research on growth and convergence of the recent period has heavily depended on the Summers-Heston [sic] data set. While this data has earned appreciation and is ubiquitous in terms of use, it has also been the target of considerable criticism. Part of the future research effort may also be usefully directed toward improving and generating data that are necessary for better understanding of convergence issues (Islam, 2003, p. 343).

We suggest that such better data is already available but widely ignored. More critically, we suggest that using data adjusted to achieve desirable cross-section properties

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replication results based on the second of these. Our conclusions are not influenced by which measure is used.

[15] The reported coefficient falls just short of statistical significance. We do not want to over-interpret this change, given the possibility of measurement error introduced by the imputed school quality variable. We note, however, that 48 percent of the observations in the IFS data set have actual test score measures as opposed to 40 percent in the original PWT data.

renders them inappropriate for panel techniques where the bulk of the growth analyzed is over time. Indeed, the fact that corrections for price behavior are greater for less developed countries will bias estimates of convergence parameters. This is supported by replications of two different studies where using domestic prices instead of prices adjusted to enable comparisons across countries in a single period results changes apparent convergence results such that no convergence is seen. This finding sends a strong signal that researchers ignore the caution against using PWT or WDI data in growth studies at considerable peril. The adjustments made to create cross-sectional comparability are complex and can seriously distort with-in country patterns over time.

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**Table 1 - Sample Characteristics**

| | Mean Growth Rate* | Standard Deviation | Minimum | Maximum | Correlation with PWT Growth | Correlation with WDI Growth | Correlation with IFS Growth |
|---|---|---|---|---|---|---|---|
| PWT | 1.021 | 0.058 | 0.667 | 1.483 | 1 | 0.74 | 0.59 |
| WDI | 1.020 | 0.055 | 0.571 | 1.768 | 0.74 | 1 | 0.76 |
| IFS | 1.022 | 0.062 | 0.541 | 1.821 | 0.59 | 0.76 | 1 |

*Reported as (1 + Growth Rate)/100

**Table 2 - Correlation of Growth Rates by Country Income**

| Income Group* | Number of Observations | Correlation between PWT and IFS Growth Rates | Correlation between WDI and IFS Growth Rates |
|---|---|---|---|
| Upper Income Countries | 839 | 0.57 | 0.69 |
| Upper Middle Income Countries | 615 | 0.64 | 0.77 |
| Lower Middle Income Countries | 775 | 0.76 | 0.91 |
| Low Income Countries | 834 | 0.45 | 0.68 |

*As determined by the World Bank using 2000 per capita Gross Nation Income. Breakpoints are $9,265, $2,995 and $755.

**Table 3 - Correlation of Growth Rates Over Time**

| Time Period | Number of Observations | Correlation between PWT and IFS Growth Rates | Correlation between WDI and IFS Growth Rates |
|---|---|---|---|
| 1961-1965 | 228 | 0.43 | 0.79 |
| 1966-1970 | 298 | 0.57 | 0.73 |
| 1971-1975 | 371 | 0.39 | 0.54 |
| 1976-1980 | 401 | 0.60 | 0.71 |
| 1981-1985 | 435 | 0.71 | 0.84 |
| 1986-1990 | 478 | 0.64 | 0.78 |
| 1991-1995 | 530 | 0.68 | 0.92 |
| 1996-1998 | 322 | 0.66 | 0.77 |

## Table 4 – Signs of IFS versus and WDI and PWT growth rates

**A. Upper income countries**

| | | WDI growth | | PWT (Laspeyres) growth | |
|---|---|---|---|---|---|
| | | **Positive** | **Negative** | **Positive** | **Negative** |
| **IFS growth** | **Positive** | 807<br>(82.01) | 19<br>(1.93) | 772<br>(82.66) | 27<br>(2.89) |
| | **Negative** | 31<br>(3.15) | 127<br>(12.91) | 32<br>(3.43) | 103<br>(11.03) |

**B. Upper-middle income countries**

| | | WDI growth | | PWT (Laspeyres) growth | |
|---|---|---|---|---|---|
| | | **Positive** | **Negative** | **Positive** | **Negative** |
| **IFS growth** | **Positive** | 510<br>(71.63) | 31<br>(4.35) | 445<br>(69.10) | 54<br>(8.39) |
| | **Negative** | 25<br>(3.51) | 146<br>(20.51) | 39<br>(6.06) | 106<br>(16.46) |

**C. Lower-middle income countries**

| | | WDI growth | | PWT (Laspeyres) growth | |
|---|---|---|---|---|---|
| | | **Positive** | **Negative** | **Positive** | **Negative** |
| **IFS growth** | **Positive** | 548<br>(68.07) | 34<br>(4.22) | 491<br>(62.31) | 84<br>(10.66) |
| | **Negative** | 25<br>(3.11) | 198<br>(24.60) | 46<br>(5.84) | 167<br>(21.19) |

D. **Low income countries**

| | | WDI growth | | PWT (Laspeyres) growth | |
|---|---|---|---|---|---|
| | | **Positive** | **Negative** | **Positive** | **Negative** |
| **IFS growth** | **Positive** | 496<br>(55.54) | 52<br>(5.82) | 388<br>(46.03) | 122<br>(14.47) |
| | **Negative** | 56<br>(6.27) | 289<br>(32.36) | 85<br>(10.08) | 248<br>(29.42) |

Note: Income groups are determined by the World Bank using 2000 per capita Gross Nation Income. Breakpoints are $9,265, $2,995 and $755.

**Table 5 - Difference Between IFS (Domestic Price) and WDI and PWT (International Price) Annual Growth Rates**

| | Total | High Income Countries | Upper Middle Income Countries | Lower Middle Income Countries | Low Income Countries |
|---|---|---|---|---|---|
| IFS Growth - PWT Growth | 0.09% | 0.21% | 0.15% | 0.003% | 0.006% |
| IFS Growth - WDI Growth | 0.13% | 0.32% | 0.12% | 0.05% | 0.01% |

**Table 6 - Sensitivity of OLS Relationship Between Inequality and Growth to Choice of Growth Measure**

| | Forbes (2000) As Reported | Using WDI Growth Rates | Using PWT Growth Rates | Using IFS Growth Rates |
|---|---|---|---|---|
| Inequality (Gini coef) | -0.0005*<br>(0.0003) | -0.0004<br>(0.0003) | -0.0005<br>(0.0003) | -0.0012**<br>(0.0005) |
| Income | -0.004<br>(0.003) | -0.006<br>(0.0036) | -0.0043<br>(0.004) | 0.011*<br>(0.006) |
| Male Education | 0.037***<br>(0.009) | 0.039***<br>(0.009) | 0.039***<br>(0.009) | 0.066***<br>(0.016) |
| Female Education | -0.034***<br>(0.009) | -0.033***<br>(0.009) | -0.035***<br>(0.009) | -0.064***<br>(0.017) |
| Market Distortions† | -0.0001<br>(0.0001) | -0.0001<br>(0.0001) | -0.0001<br>(0.0001) | -0.0004**<br>(0.0002) |
| Constant | 0.071**<br>(0.030) | 0.086***<br>(0.031) | 0.080**<br>(0.031) | 0.005<br>(0.053) |
| $R^2$ | 0.48 | 0.45 | 0.45 | 0.43 |

†Price level of investment measured as the PPP of investment/exchange rate relative to the United States taken from PWT.
***Significant at the 1% confidence level
**Significant at the 5% confidence level
*Significant at the 10% confidence level

**Table 7 - Sensitivity of Panel Data, Fixed Effect Relationship Between Inequality and Growth to Choice of Growth Measure**

| | **Forbes (2000) As Reported** | **Forbes As Replicated** | **Using WDI Growth Rates** | **Using PWT Growth Rates** | **Using IFS Growth Rates** |
|---|---|---|---|---|---|
| Inequality (Gini coef) | 0.0036** (0.0015) | 0.0045** (0.0014) | -0.0006 (0.0007) | -0.0007 (0.0008) | 0.0002 (0.0007) |
| Income | -0.076*** (0.020) | -0.079*** (0.019) | 0.029** (0.014) | 0.013 (0.017) | 0.015* (0.009) |
| Male Education | -0.014 (0.031) | 0.020 (0.033) | -0.0020 (0.014) | -0.003 (0.016) | -0.0006 (0.016) |
| Female Education | 0.070** (0.032) | 0.012 (0.036) | 0.0017 (0.001) | -0.0004 (0.017) | 0.0022 (0.017) |
| Market Distortions† | -0.0008*** (0.0003) | -0.0009*** (0.0003) | 0.0002 (0.0001) | 0.0003** (0.0001) | 0.0002 (0.0002) |
| $R^2$ | 0.67 | 0.68 | 0.25 | 0.22 | 0.25 |
| Observations | 180 | 162 | 165 | 160 | 157 |

†Price level of investment measured as the PPP of investment/exchange rate relative to the United States taken from PWT.

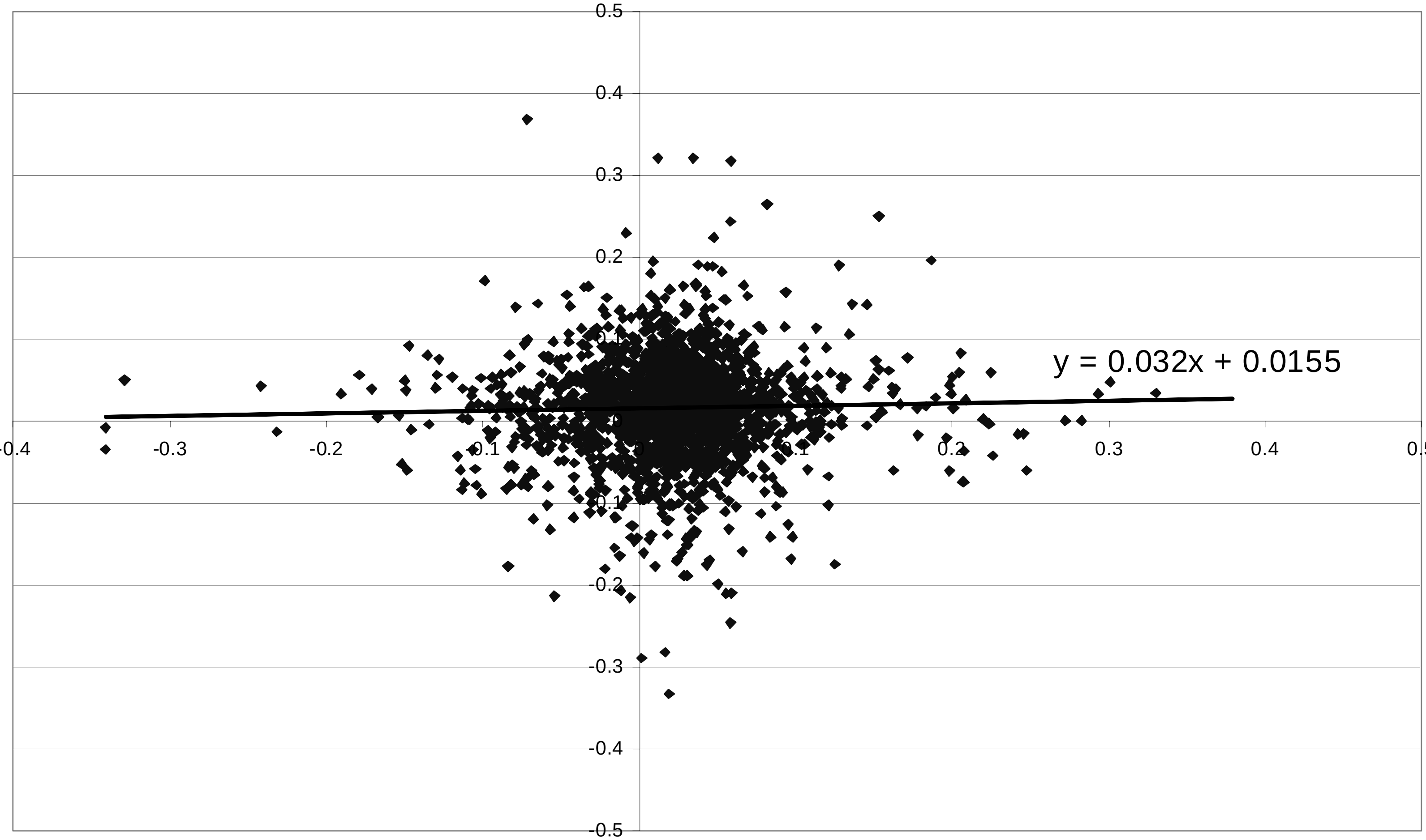
***Significant at the 1% confidence level
**Significant at the 5% confidence level
*Significant at the 10% confidence level

**Table 8 - Sensitivity of Impact of Labor Force Quality on Growth to Choice of Growth Measure**

| | **Hanushek and Kimko Using PWT Growth Rate (As Reported)** | **Replicated Using PWT Growth Rate but WDI Sample** | **Replicated Using PWT Growth Rate but IFS Sample** | **Replicated Using WDI Growth Rate** | **Replicated Using IFS Growth Rate** |
|---|---|---|---|---|---|
| Initial Income | -0.384***<br>(0.082) | -0.338***<br>(0.091) | -0.435***<br>(0.102) | -0.291***<br>(0.098) | -0.194<br>(0.220) |
| Quantity of Schooling | 0.103<br>(0.100) | 0.016<br>(0.107) | 0.114<br>(0.160) | -0.036<br>(0.121) | -0.462<br>(0.513) |
| Annual Rate of Population Growth | -0.161<br>(0.209) | -0.256<br>(0.226) | -0.260<br>(0.288) | -0.303<br>(0.253) | -0.919*<br>(0.525) |
| Labor Force Quality | 0.090***<br>(0.016) | 0.081***<br>(0.020) | 0.071***<br>(0.024) | 0.085***<br>(0.023) | 0.059<br>(0.038) |
| Constant | -0.869<br>(0.984) | -0.002<br>(1.150) | 0.549<br>(1.500) | 0.020<br>(1.340) | 5.28<br>(3.54) |
| $R^2$ | 0.41 | 0.34 | 0.38 | 0.30 | 0.09 |
| N | 80 | 66 | 66 | 44 | 44 |

***Significant at the 1% confidence level
**Significant at the 5% confidence level
*Significant at the 10% confidence level

**Figure 1**
**Penn World Table versus International Financial Statistics Growth Rates**



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