Absolute Convergence across Time and Space: *New Empirical Evidence for an Old Debate*

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Abstract

This paper contributes to the ongoing convergence debate in two ways: First, using the recent Penn World Table's database (PWT 6.1), ranging from 1960 to 2000, it shows the absence of the so-called absolute convergence across the world economy at large in the past four decades. While the decade- by- decade regressions indicate similar results, things seem to have worsened in the 1980s and 1990s. One of the primary suspects in this regard is the debt and financial crises. Second, a separate regression for developing countries alone indicates the absence of unconditional (absolute) convergence across this group of countries. However, once we split countries into groups with similar political, economic and institutional parameters (OECD and EU, for instance), it appears that there is an evidence for unconditional convergence.

Introduction

Economists have always been concerned with variations in income and living standards across time and space. One way of measuring the speed at which countries are moving not only towards their own steady states but also towards the income per capita of other countries goes back to Solow's (1956) growth framework. In this framework, countries with high savings rate and low population growth are predicted to experience higher per capita income than those in the opposite camp (Solow, 1956), *ceteris paribus*. This seminal work was quickly picked up by other economists and has therefore been the subject of constant extension.

In general convergence in the context of economic growth is said to occur in a cross – section of economies, if there is a negative relationship between the growth rate of income and the initial level of income (Barro, 1991; Sala-i-Martin,

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1994 and 1996a and 1996b, Barro and Sala-i-Martin, 1995). In other words, convergence takes places, in a cross-section of economies, if poor economies tend to grow faster than wealthy ones, implying that the poorer the economy the more quickly it will tend to grow over a long time horizon, and vice versa. Similarly, Baumol (1994) defines convergence as a tantamount diminishing in the degree of economic inequality among countries. Though the above defini-tions remain valid throughout this paper, it turns out that there are significant disputes among growth scientists regarding the theory of economic growth and convergence.[1]

Although economists have been interested in investigating whether poor economies remain poor for many years, while rich countries remain rich for generations, this was hampered by absence of long-run time series data until the mid-1980s that the convergence debate drew the attention of not only mainstream macroeconomic theorists but also econometricians. There are mainly two reasons for the growing concern in the convergence debate (Sala-i-Martin, 1996b, p. 1019):

- First, the existence of convergence across economies was proposed as the main test of the validity of modern theorists of economic growth. Moreover, estimates of the speeds of convergence across economies were thought to provide information on one of the core parameters of growth theory: the share of capital in the production function.
- Second, in the mid-1980s, a data set on internationally comparable GDP levels for a large number of countries (the Penn World Tables) became available and this new data set enabled empirical economists to compare GDP level across time and space.

The convergence debate is also vital as it is concerned with the gaps in living standards between countries, i. e, whether these gaps are narrowing or rather widening across countries and over time (Pritchett, 1996). Sala-i-Martin (1996), and Barro and Sala-i-Martin (1995), using β -convergence and σ -convergence concepts, elaborate the convergence debate more broadly.[2] Sala-i-Martin (1996, p. 1025) points out that the lack of convergence means that the degree of cross--country income inequality not only fails to disappear, but rather tends to increase over time (σ -divergence); and that economies (nations) which are predicted to be richer a few decades from now are the same countries (nations) that

[1] Advocates of the endogenous growth model and other development economists in fact reject the hypothesis of convergence.

[2] β -convergence occurs if economies that are poorer are predicted to grow faster that richer ones. On the other hand, σ -convergence occurs if the dispersion of income per capita across countries declines overtime. The two concepts are broadly discussed later in the paper.

are rich today (β -divergence).[3] Moreover, despite the persisting disputes among economists on the determinants of long-run growth, the convergence debate has also enormous policy implications for policy makers both in the developed and developing countries. One of the key questions in this regard is to what extent external aid and debt helped countries to achieve accelerated economic growth, hence allowing them manage narrowing the living standard gaps between the richest and poorest part of the world.

The objective of this paper is to empirically test whether the income gap between poor and rich countries of the world has narrowed or rather widened in the past four decades. Particular attention will be given to the position of the heavily indebted poor countries (HIPCs) in the process of convergence (diver-gence) in the past four decades, with especial emphasis on the last two decades, which capture the periods of debt and financial crises and other spillover effects of the process of globalization. To translate this aim into reality, I used both the absolute and conditional convergence hypotheses and a fresh international data set (The Pen World Tables (PWT 6.1)) by A. Heston, R. Summers, and B. Aten covering the period 1960 to 2000.

The remainder of the paper is organized as follows: part 2 presents the summary of the neoclassical production function and the distinction between the absolute and conditional convergence hypotheses. This part also discusses the empirical specification of the growth model. Part three discusses previous empirical studies in this area. Part four will briefly introduce the data and samples. Part five presents the regression results and discussions before part six concludes.

2. The Solow-Swan Model and the Convergence Debate: A Theoretical Review

Almost all recent empirical researches on economic growth kick off from the Solow growth framework. This paper will also first summarize the basic model before an empirical counterpart to it is presented.

The Solow model is a closed economy framework, where output (Y) is a function of input variables, such as labor (L) and capital (K). This can formally be written as:

$$Y = F(K, L) \tag{1}$$

There are three basic assumptions that are linked to this model:

[3] See, Sala-i-Martin (1994, 1996) and Barro and Sala-i-Martin (1995) for the detailed distinguishing between sigma and beta convergence.

1. The production function in eq. (1) assumes positive and marginal products with respect to each input variables.

$$\frac{\partial F}{\partial K} \succ 0, \frac{\partial F}{\partial L} \succ 0; \frac{\partial^2 F}{K^2} \prec 0, \frac{\partial^2 F}{\partial L^2} \prec 0 \tag{1.1}$$

Equation (1.1) indicates that while each input variable contributes positively towards boosting the output that is produced, its marginal productivity falls over time as more and more of it is added, *ceteris paribus*.

2. The production function exhibits constant returns to scale, indicating a proportionate increase in output as the result of changes in all input variables. This can formally be written as:

$$F(\lambda K, \lambda L) = \lambda . F(K, L), \text{ for all } \lambda \succ 0 \tag{1.2}$$

3. The third assumption is referred to as the so called „Inada conditions".

$$\begin{aligned} \lim_{K \to 0}(F_K) &= \lim_{L \to 0}(F_L) = \infty \\ \lim_{K \to \infty}(F_K) &= \lim_{L \to \infty}(F_L) = 0 \end{aligned} \tag{1.3}$$

The Inada conditions expressed in eq. (1.3) state that while production with the absence of input variables is impossible, their excess abundance also make their marginal product diminished over time, *ceteris paribus*. The assumption of constant returns to scale in eq. (1.2) is also consistent with the balanced growth path along which capital and effective labour grow at the same rate. It is also helpful to rewrite the production function in eq. (1) in its intensive form:

$$Y = F(K, L) = L\left(\frac{K}{L}, 1\right) = Lf(k) \tag{1.4}$$

where:

$$k = \frac{K}{L} = \text{capital} - \text{labour ratio; and}$$

$$y = \frac{Y}{L} = \text{per capita income}$$

Now, the production function in eq.(1) can be written in its intensive form:

$$y = f(k) \tag{1.5}$$

The change in the capital stock with a constant savings rate:

$$\dot{K} = I - \delta K = s.F(K, L, t) - \delta K \tag{1.6}$$

$$\frac{\dot{K}}{L} = s.f(k) - \delta k \tag{1.7}$$

$$\dot{k} \cong \frac{\partial\left(\frac{K}{L}\right)}{\partial t} = \frac{\dot{K}}{L} - nk$$

$$\dot{k} = s.f(k) - (n+\delta).k \tag{1.8}$$

Finally, the growth rate of k can be approximated as:

$$\gamma_k = \frac{\dot{k}}{k} = s.f(k)/k - (n+\delta) \tag{1.9}$$

Following Barro and Sala-i-Martin (1995, p. 22), the long-run growth rates in the Solow-Swan model are determined entirely by exogenous factors. The fundamental conclusion about long-run growth, therefore, is negative, simply because the long-term growth rates are independent of the savings rates and the level of the production function. Nevertheless, the model is very important in providing us with sound information about the transitional dynamics of growth, which indicates the per capita convergence of an economy towards its own stead-state value or to the per capita incomes of a cross-section of economies (Barro and Sala-i-Martin, 1995).

2.1. The Absolute and Relative Convergence Hypotheses

2.1.1. The Absolute (Unconditional) Convergence

Following Barro and Sala-i-Martin (1995), eq. (1.9) implies that the derivative of γ_K with respect to k is negative:

$$\frac{\partial \gamma_k}{\partial k} = s.\left[f'(k) - f\left(\frac{k}{k}\right)\right]/k \prec 0 \tag{1.10}$$

This implies that, ceteris paribus, smaller values of k are linked to larger values of its corresponding growth (γ_K). This suggests (provided that countries have similar rate of savings (s), growth of population (n), rate of depreciation (δ) and production function) that all economies have the same steady state values of k^* and y^*. Then, if the only difference across countries is the initial capital per capita (k), the model predicts that countries with less capital per capita tend to grow faster than those with relatively higher level of capital per capita. There-

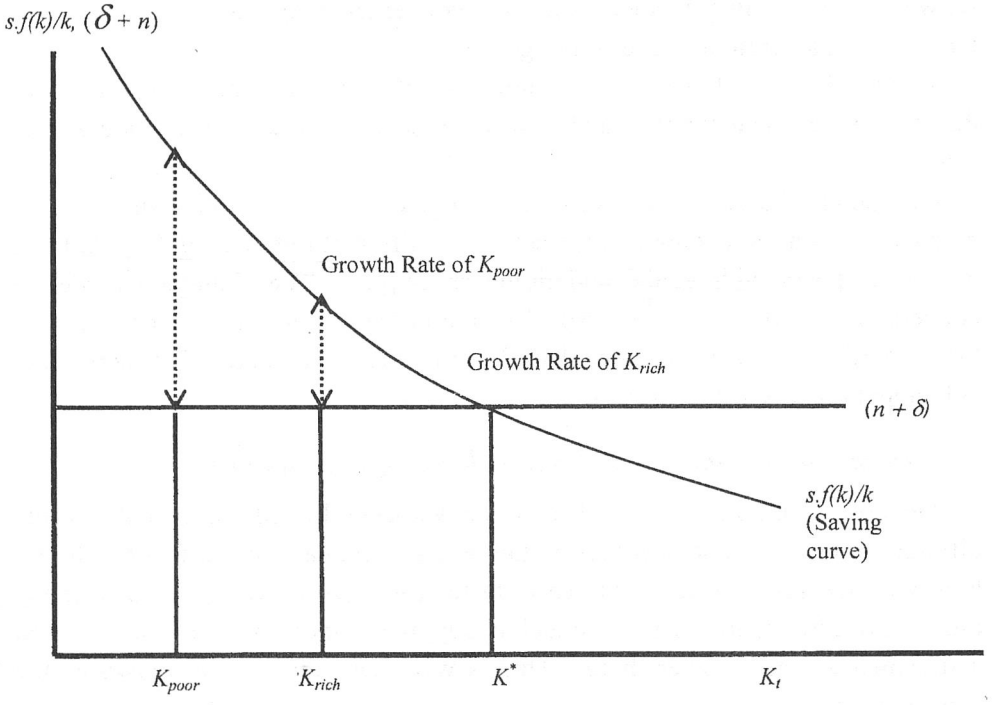
fore, the hypothesis that nations with lower capital per capita tend to grow faster than those with higher capital per capita without putting any restriction is referred to as absolute (unconditional) convergence (Barro and Sala-i-Martin, 1995).

To show eq. (1.8) in the context of absolute and conditional convergence, the diagram may be used to make the argument more readable. (See, Figure 1). There are basically two equations in eq. (1.8): While the horizontal function line $(\delta + n)$ represents the curve for the rates of depreciation and growth rate of the population, the downward slopping curve attached to $s.f(k)/k$, represents the savings curve. From eq. (1.8) and diagram (1), it implies that the growth rate is rewarded by the savings rate while it is punished by the elements that constitute the depreciation curve.

Assumption (1.1) discussed earlier also indicates that the saving curve is downward slopping, whereas, the Inada conditions (equation (1.3)) ensure that the saving curve is vertical at $k = 0$ and it approaches the horizontal axis as k tends to infinity.

Figure 1

Absolute (Unconditional) Convergence



Source: Sala-i-Martin (1996, p. 1343. In: Menbere, 2000).

Diagram (1) shows the absolute (unconditional) β-convergence hypothesis. The assumption is that countries or economies under consideration are moving to the same steady states (k^*). If the only difference among these countries is the initial capital stock (real GDP per capita), then poor regions are predicted to grow faster than rich economies ($\Delta k_{poor} > \Delta k_{rich}$). In other words, the growth rate of the poor towards the steady state is predicted to be faster than the growth rate of the rich.

Reasons in favour of the absolute convergence hypothesis include (Menbere, 2000):

- The first reason is that introduced by Baumol (1986), where he argues that there is a common-force mechanism which assumes that at some stage circumstances inherent in the growth process, a set of variables influences a number of economies and drives them all in the same general direction. „It is as though a common terminal point (the steady state) is equipped with something analogous to a magnet that draws toward itself all economies whose histories it affects." Following Baumol (1994), „the unusual thing about this magnet is that it exerts the greatest force not on the economies closest to the terminal point but on those that are farthest from it". Hence, convergence occurs- the economies initially farthest from the terminal (k_{poor}) are derived to move toward it most rapidly, which is a defining characteristics of a convergence hypothesis (in Baumol's terminology, a common-force convergence).
- Since k_{poor} has lower level of initial capital (capital-labor ratio), any additionnal investment would quickly push these economies towards the steady state.
- Although the above two reasons are based on the assumption that all economies have similar economic parameters but different initial capital stock, there is a third reason without the underlying assumption: The contagion model of convergence predicts that because of contagion (say, imitation of production), the laggards tend to grow faster than those in advanced stage of economic development (Baumol et al., 1994).

Some arguments against the absolute β-convergence hypothesis:

The core assumption of the absolute convergence hypothesis is that the sole difference between nations is their initial levels of capital. The real world shows, however, that this is just not the case. In fact, nations are different in so many other things, including the level of technology, the propensity to save and natural endowments, among other things. This is what has come to be known as the „absolute convergence fallacy".

2.1.2. The Relative (Conditional) Convergence Hypothesis

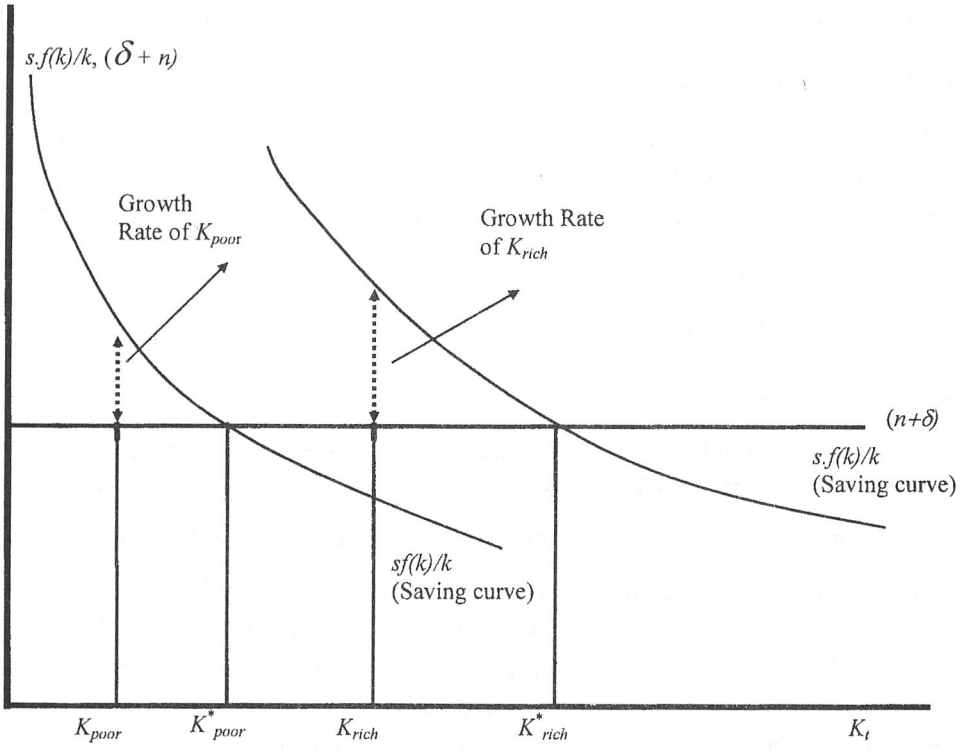
The absence of broader empirical evidence in favor of absolute convergence across economies makes the traditional absolute convergence hypothesis fruitless in terms of measuring the speed of transition towards the steady state. Therefore, the idea of conditional convergence has been introduced.[4]

As depicted in diagram (Figure 2) just below, if a rich economy has higher saving rate relative to a poor economy (an assumption more realistic than the previous one), then the rich economy might be proportionately further from its steady state position.

Under such circumstances, it should be the rich rather than the poor economy that is predicted to grow faster towards its own steady state.

Figure 2

Conditional (Relative) Convergence



Source: Sala-i-Martin and Barro (1995. In: Menbere, 2000).

[4] Conditional β -convergence exists if the partial correlation between growth and initial income is negative. In contrast, a set of economies displays absolute β -convergence if the coefficient on initial income is negative in univariate regression (Sala-i-Martin, 1996, p. 1330).

There are some additional reasons against the absolute convergence hypothesis (or in favour of the conditional convergence hypothesis) (Menbere, 1998, 2000):

- Poor economies have lower savings rate (due to lower income) compared to rich ones and therefore, have lower rate of investment, and poor subsequent economic growth.
- Rich countries as opposed to their poor counterparts have high growth rates, despite their high initial capital-to-labor ratio, due to innovation.
- Capital is not moving from economies where it is abundant to those where it is scarce, as was predicted by the contagion model of convergence, due mainly to risk and uncertainty in most poor nations.
- Finally, scarce qualified human capital in poor countries caused by both lack of education as well as human capital flight (brain drain) makes the possible transfer of technology and expertise from rich to poor countries slow and difficult.

2.2. Empirical Specifications

The β-convergence hypothesis

The Solow-Swan growth model that allows measuring the coefficient of β, whose value determines weather or not convergence has occurred in a cross-section of economies, could be summarized as follows (see, Sala-i-Martin, 1996, p. 1334):

$$\frac{1}{T}\left[\frac{\ln\left(Y_{i,t}\right)}{\ln\left(Y_{i,t-1}\right)}\right] = \alpha + \left[\frac{-\left(1-e^{-\beta T}\right)}{T}\right] * \ln\left(Y_{i,t-1}\right) + \mu_{i,t}, \qquad (1.11)$$

where:

α and β – constants,

$0 \prec \beta \prec 1$, and $\mu_{i,t}$ – the error term with, and is assumed to have mean zero, same variance (σ_{μ}^{2}) for all economies and is independent over time and across economies. Then convergence occurs if $\beta>0$ and is statistically significant, as this implies the inverse relationship between the annual growth rate ln ($Y_{i,t}/Y_{i,t-1}$) and the initial level of real per capita income ln ($Y_{i,t-1}$). Following Sala-i-Martin (1996), the coefficient on the initial per capita level $(1-e^{-\beta T})/T$, which is the slope of the initial GDP per capita level, is an expression that declines with the length of the time interval T for a given β. In other words, if the linear relation between the growth rate of real GDP per capita and the initial GDP per capita level are estimated, then the coefficient is predicted to be smaller the longer the time period over which the growth rate is averaged. The reason is that the growth rate

declines as income increases. To calculate the β-coefficient from the regression, one may linearize the model as follows:

$$b = -\left(\frac{1 - e^{-\beta T}}{T}\right) \tag{1.11a}$$

The implied β that measures the speed of convergence may then be computed using the following approximation (eq. 1.11b):

$$\beta = -\frac{\ln(1 + bT)}{T} \tag{1.11b}$$

The σ-convergence hypothesis

The second model has been developed to measure the cross-sectional dispersion of income using sample variance of the log of income (σ-convergence)

$$\sigma^2 = \frac{1}{n}\sum_{i=1}^{N}\left[\ln(Y_{i,t}) - \mu_t\right]^2 \tag{1.12}$$

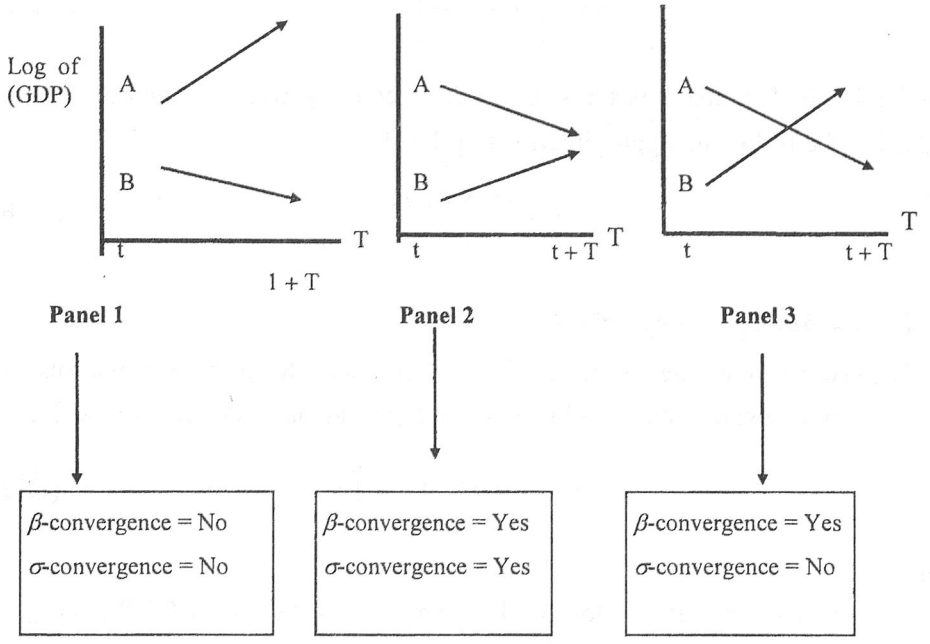
where:

μ_t – the sample mean of log of ($Y_{i,t}$), and $Y_{i,t}$ is the log of GDP per capita level of country i at time period t. The main argument here is that if countries are converging in terms of income per capita, the cross-sectional dispersion of their income should fall over time. At the outset of the empirical test for the convergence hypothesis, there was a heated debate regarding the relationship between β-convergence and σ-convergence (apparently first introduced by Sala-i-Martin). The central point of controversy was the presumption that β-convergence be a necessary prerequisite for σ-convergence. The intuition behind is that if there is convergence, the growth rate should fall over time (because when an economy is getting richer, the predicted growth rate to be much smaller and vice versa).

However, later it was acknowledged that β-convergence is a necessary but not a sufficient condition for σ-convergence to take place. This is because of either overtaking or divergence. The first panel of diagram 3 indicates the absentce of both β-convergence and σ-convergence across economies, which implies that countries are diverging in terms of their income per capita gap and this gap is increasing over time. In the second panel, it is possible to notice that there is a decline in the income per capita gap between countries and this was accompanied by a decline in the dispersion of income per capita across-countries and over time. The last panel seems to suggest overtaking or polarization, in which case the middle class may vanish as Quah (1996) argues (more in a moment).

Figure 3

Absolute versus Relative Convergence in the Solow-Swan Model



Source: Xavier Sala-i-Martin (1996b), The Economic Journal, 106, p. 1021.

3. Review of Previous Empirical Research

Baumol (1986) has been the first growth economist to examine convergence across 16 industrialized countries (1870 – 1979) using Madison's 1982 data. The results of the regression suggest that there were perfect convergence across these groups of economies, especially after World War II. De Long (1988) and Romer (1986) (in Sala-i-Martin, 1996b) demonstrate, however, that Baumol's attempt in measuring convergence was downplayed due mainly to the following:

- The first dispute is related to sample selection whereby historical data are constructed retrospectively, the economies that have long data series are naturally those that are more industrialized.
- Secondly, following the first reason, Baumol has been accused of biasedness. For example, Quah (1996) criticizes the traditional empirical analysis growth and convergence for overemphasizing physical capital and deemphasizing endogenous technological progress and externalities that are main determinants of growth and convergence.

Similarly, Sala-i-Martin (1994, and 1996a), shows that β -convergence across the U.S., Japan, and five European nations is strikingly similar (about 2 per cent per year).[5] Based on the above results, the author reaches two conclusions:

- first, the speeds of convergence are surprisingly similar across data sets, and
- second, as the result of the first conclusion, since the degree to which national governments use regional cohesion policies is very different, and the fact that the speeds of convergence are very similar across countries implying that public policy plays a very small role in the overall process of regional convergence. This has obvious been the subject of criticism by development economists and others.

Nevertheless, as it is usual in economics, there is an ongoing serious dispute to the whole debate of both the absolute and conditional convergences hypotheses. One of the most serious criticisms comes from Danny T. Quah. Quah (1996a) interprets the neoclassical definition of convergence as a „basic empirical issue, one that reflects – among other things – polarization, income distribution, and inequality" (p.1 354). In an oversimplified way, Quah links the convergence debate to the question of whether poor economies are incipiently catching up with those already richer or instead they are caught in poverty trap. In this regard, there are criticisms against the traditional convergence hypothesis, which concludes that there exists a surprisingly similar 2 per cent annual rate of con-vergence across different countries.

Quah (1996a) argues that β -convergence is uninformative as it is interested only in comparison of mean growth across countries but not in income distribution, and that cross-section regressions can represent only average behaviour, not the behaviour of the entire distribution (p. 1365). Moreover, Quah is concerned about the overall mission of the convergence debate, according to him, as it fails to inform for instance „if the poorest 10 per cent of the world are catching up with the richest 10 per cent of the world". He added that studying an average economy or representative one gives little insight into the empirical behaviour of the entire cross-section. He believes that for such cross-section dynamics to be

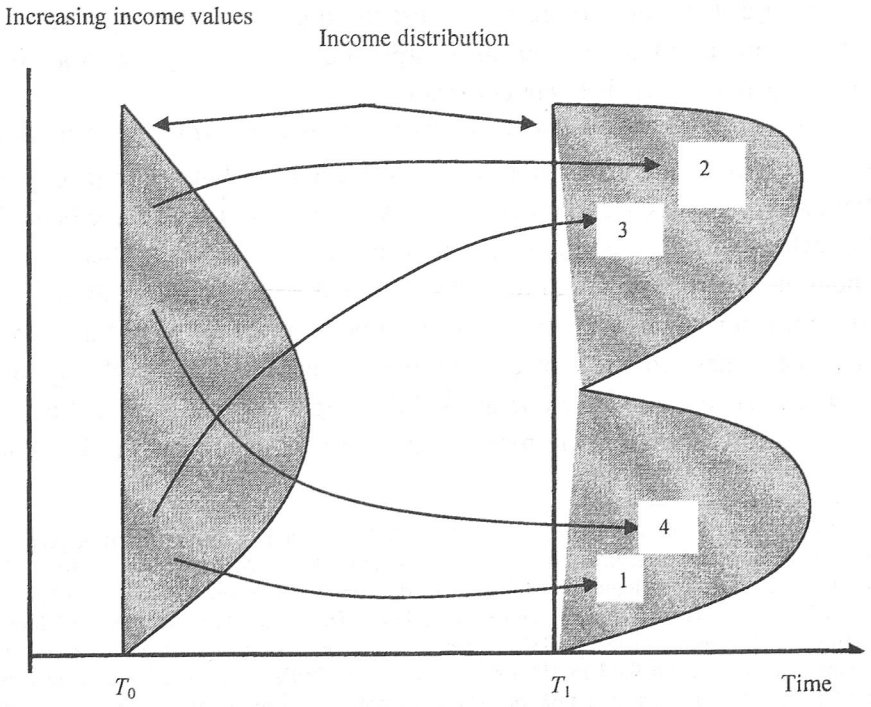
[5] The results for 48 U.S. states from 1880 – 1920 indicate that dispersion of per capita personal income net of transfers declined from 0.54 in 1880 to 0.33 in 1920, then rose to 0.40 in 1930 due to the adverse shock to agriculture in 1920's. The dispersion continued declining to 0.35 in 1940 and to 0.24 in 1960, to 0.17 in 1970 and 0.14 in 1976. The same observation for 47 Japanese prefectures for the period (1955 – 1987) of per capita income, shows that the dispersion of personal income increased from 0.47 in 1930's to 0.63 in the 1940's which was caused by explosion in military expenditure during that period. The cross-prefectual dispersion has decreased substantially since 1940: It fell to 0.29 by 1950, to 0.25 in 1960, 0.23 in 1970 and it hit a minimum of 0.12 in 1978. However, income dispersion was observed to constant since then (Sala-i-Martin, 1996, p. 1338).

interpretable, one needs a theoretical model that makes predictions on them (p. 1368). His model then makes predictions on cross-section dynamics by taking three observations (p. 1368): Countries endogenously select themselves into groups, and thus, do not act in isolation; specialization in production allows exploiting economies scale; and ideas are an important engine of growth.

From Quah's hypothesis, two key results emerged: First, coalitions (convergence clubs) – form endogenously – the model delivers prediction on coalition membership across the entire cross-section of economies, and secondly, different convergence dynamics are generated depending on the initial distribution of characteristics across countries. In this potential dynamics explicit convergence clubs can be characterized as (Quah, 1996, p. 1368): Polarization – the rich getting richer while the poor getting poorer and the middle class vanishing (see also figure 4 below); stratification – when more than two coalition form (multiple modes in the income distribution across countries); and overtaking and divergence – two economies initially on roughly equal footing, separated over time so that one eventually becomes wealthier than the other.

Figure 4

Evolving Distributions, Tending Towards Bimodal



Source: Danny T. Quah (1996), European Economic Review, *40* (p. 1369), Numbers (1 – 4) added for explanation purposes.

Figure (4) provides the following interpretation of convergence:

• Number (1) and (2) show how countries that were poor at time T_0 remain poor at time T_1, while those that were rich at time T_0 get even richer at time T_1. This shows the poverty trap or what Quah calls *polarization.*

• Number (3) and number (4) indicate how the middle class get vanished: Those who are lucky moving towards the rich (3), while those who are unlucky rushing deep down to join the poor (4).

Galor (1996), in his part, argues in the same line with Quah. He classifies convergence into three groups: The absolute convergence hypothesis, which is convergence of per capita income across countries regardless of their initial conditions; the conditional convergence hypothesis, which assumes convergence in per capita income across countries with identical structural parameters and regardless of their initial situation; and finally the 'club convergence hypothesis' (predicts polarization, persistent poverty, and clustering), in which case there is per capita income convergence across countries with identical structural parameters provided that these countries also have similar initial conditions (p. 1056).

Bernard and Jones (1996) also dispute the current convergence debate on the ground that it neglects to take into account the role of technology in the process of convergence.[6] Although there are plenty of essential points addressed by those who dispute the convergence debate, particularly regarding the claim of the „magic 2 per cent" convergence, there is a bulk of empirical literature that proved the existence of conditional convergence in a cross-section of economies, controlling for other factors that determine long-run economic growth.

4. Data Description and Samples

No researcher on empirical issues on developing countries can ever enjoy the luxury of choosing the number of countries he wishes to investigate. The number of countries is rather dictated by data availability. The data for GDP per capita is taken from the Penn World Table (PWT 6.1), an expanded set of international comparisons, 1960 – 2000. Following the authors, „this data displays a set of national accounts economic time series covering many countries. Its expenditure entries are denominated in a common set of prices and in a common currency (USD) so that real quantity comparison can be made, both between countries and over time". More information about the definitions and sources of the variables

[6] There cross-country analysis on dispersion of labour productivity and dispersion in technology for 14 OECD countries indicates that: First, countries are heterogenous in their level of technology, and secondly, the change in the dispersion of labour productivity overtime matches with closely with the dispersion of technology (p. 1041)

that are used in the regression are in table (1). Table (2) presents the descriptive statistics for the cross-sections of all observations. Table (3) shows annual growth rate of real GDP per capita for various groups. Table (4) presents regression results for various decades and groups (β-convergence). Finally, Table (5) shows the results for the variances in real income per capita across regions (σ-convergence).

5. Results for Cross-section Regression and Discussion

The results of the regression for absolute β-convergence are summarized in Tables (4). The results for σ-convergence are in Table (5). Table (3) presents annual growth rate of real GDP per capital. The regression results in Table (4) suggest that there was a substantial divergence across the world economy at large in all the periods under consideration when all countries were included in the regression (the values of β being negative and statistically significant) indicating that there is a linear relationship between Log of GDP per capita growth and initial Log of GDP per capita). (See also graph 1.) In other words, countries that were already rich in each initial period had also high annual growth rate over the period in which it is averaged. This is consistent with the results of other empirical studies including Sala-i-Martin (1991, 1996a and 1996b) and Barro and Sala-i-Martin (1995), among others. Moreover, there is an evidence for σ-divergence (the dispersion of income per capita increasing over time) during all the decades under consideration. When all countries are included, the variance of income per capita captured by σ^2 increased from 0.778 in 1960 to 0.948 in 1970; to 1.253 in 1980; to 1.483 in 1990; and to 1.704 in 2000. (See Table 5.) When SSA countries were excluded from the regression, the implied β-convergence become positive (except for the 1970 – 2000 period) though remains statistically insignificant, an indication of the absence of drastic divergence across other developing countries relative to OECD countries. As one would expect, Asia seems to have done quite well in narrowing the income gap with OECD, though the situation worsened in the period 1990 – 2000, which obviously is linked to the financial crisis many of the countries in the region have experienced during this period. This can also be seen from statistically significant coefficient of β, though things worsened in the 1990s, and slightly declining dispersion in income per capita (σ-convergence).

In contrast, there is a magnificent income divergence between SSA and OECD with the strongest statistically significant values for β in all the periods that have been investigated in this study. This is also supported by the poorest

annual growth performance of SSA (table 3) and high and increasing variance in income (an evidence for σ-divergence). The income dispersion across OECD and SSA is drastic: the variance of per capita income increased from 1.164 in 1960 to 1.416 in 1970; to 1.916 in 1980s; to 2.315 in 1990; and to 2.679 in 2000.

Though Latin America is slightly better than SSA, it has not either managed to narrow its income gap relative to OECD. The regression results for developing countries alone suggest that there was divergence of per capita income particularly in the last two periods (1980 – 2000 and 1990 – 2000) (see graphs 1 and 2). This is mainly attributed to the presence of outliers (East Asian coun-tries) on the one hand, and the severe external shocks Latin America and SSA have experienced during these periods, on the other hand. As one would expect, there was a substantial progress in narrowing the income gap across OECD countries, though the situation worsened during the period (1980 – 2000) (see graphs 3 and 4). This again is linked to the recessions in most OECD countries in the 1980s and the 1990s.

Conclusion

The empirical results indicate the following conclusions:

- Although there are disputes among economists regarding the measurement of the speed at which the growth rates of different economies are approaching to each other, there is no doubt that convergence has been a real world phenomenon in regional groups with similar economic, institutional and political conditions and convergence criteria (OECD and EU).
- The intensified divergence of the developing nations, notably those in Sub-Saharan Africa, Latin America and South Asia may imply the failure of the process of globalization to generate a proportionate benefit both for poor and rich countries in the past two decades.
- The divergence of Sub-Saharan Africa implies, among other things, that since 33 of the 41 countries characterized by the World Bank and IMF as HIPCs are in Sub-Saharan Africa, this may also suggest that the external shocks negatively impacted on the region's long term economic growth and overall development. Having said that, however, since the quality of data for Sub-Saharan Africa has been ranked by Heston, Summers, and Aten as poor, the results of the regression should be interpreted with caution.
- Finally, although the neo-classical growth model predicts convergence in the sense that countries with lower initial capital-labor ratio are predicted to have higher growth rates, it appears that this is only valid for moderately backward countries that belong to a relatively advanced convergence club (poorer members

of OECD and EU) or for those countries that are well integrated into the global economy through foreign trade and investment (East Asia). This may also imply that low income per capita is not a guarantee for convergence to come into force.

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Table 1

Definitions of Variables and Sources

Variables	Definitions	Sources
GDPG	Growth rate of the logarithm of GDP per capita (PPP-adjusted)	The Penn World Tables (6.1)
LGDP	The logarithm of GDP per capita (PPP-adjusted) (initial period value)	The Penn World Tables (6.1)

Table 2

Descriptive Statistics for All Observations (1960 – 2000)

Variable	Observations	Mean	Std. Dev.	Min	Max
LGDP60	113	7.714	0.882	5.948	9.607
LGDP70	114	8.008	0.973	5.811	9.924
LGDP80	114	8.180	1.119	4.018	10.192
LGDP90	114	8.268	1.218	3.614	10.630
GDPG6069	113	2.835	2.268	–3.163	8.881
GDPG7079	113	2.252	2.776	–6.296	10.772
GDPG8089	114	0.909	2.554	–4.412	10.489
GDPG902000	114	1.356	2.541	–7.056	10.012
GDPG602000	113	1.688	2.058	–10.483	6.131
GDPG702000	114	1.319	2.447	14.987	6.105
GDPG802000	114	1.117	2.016	–4.655	6.257

Table 3

Annual Growth Rate of Real GDP Per Capita (1960 – 2000)

Region (group)	1960–1969	1970–1979	1980–1989	1990–2000	1960–2000	1970–2000	1980–2000
All countries	2.83	2.25	0.90	1.35	1.68	1.31	1.11
OECD+SSA	2.73	1.66	0.69	0.72	1.13	0.74	0.65
OECD+ASIA	3.66	3.18	2.36	2.31	2.90	2.63	2.40
OECD+LA[1]	3.14	2.51	0.77	1.92	2.11	1.76	1.40
SSA+ASIA+LA	2.45	2.09	0.50	1.23	1.39	1.04	0.83
OECD	3.82	2.48	1.91	1.84	2.52	2.19	1.96
SSA[3]	1.94	1.13	0.05	0.04	0.41	–0.07	–0.05
HIPCs[2]	1.50	0.56	–0.75	–0.45	–0.25	–0.80	–0.67

Source: Own calculations based on PWT (6.1).

1. LA = Latin America. 2. Heavily indebted poor countries 3. SSA = Sub-Saharan Africa.

Table 4

Regression Results for Cross-sections of Countries

Countries	Period	No. Obs.	β	R^2	t-value	Probability
All	1960 – 2000	113	–0.06	0.026	1.75	0.08
	1970 – 2000	113	–0.08	0.023	1.65	0.10
	1980 – 2000	114	–0.12	0.100	3.57	0.00
	1990 – 2000	114	–0.18	0.063	2.75	0.00
OECD	1960 – 2000	75	0.04	0.008	–0.91	0.36
and	1970 – 2000	75	–0.04	0.007	–0.22	0.29
Non-SSA	1980 – 2000	75	0.11	0.005	–0.59	0.59
	1990 – 2000	75	0.07	0.024	–1.64	0.10
OECD	1960 – 2000	62	–0.08	0.059	2.45	0.00
and	1970 – 2000	63	–0.10	0.082	2.10	0.03
SSA	1980 – 2000	63	–0.14	0.252	4.71	0.00
	1990 – 2000	63	–0.20	0.143	3.09	0.00

Continue from Table 4

OECD and ASIA	1960 – 2000	40	0.06	0.064	–1.61	0.11
	1970 – 2000	41	0.07	0.070	–1.99	0.05
	1980 – 2000	41	0.09	0.125	–2.28	0.02
	1990 – 2000	41	0.11	0.107	–2.11	0.04
OECD and Latin America	1960 – 2000	42	–0.07	0.041	1.46	0.15
	1970 – 2000	43	–0.07	0.034	1.29	0.20
	1980 – 2000	43	–0.02	0.143	2.73	0.00
	1990 – 2000	43	0.21	0.021	–1.08	0.28
AFRICA, ASIA, and Latin America	1960 – 2000	89	–0.01	0.001	0.38	0.70
	1970 – 2000	89	–0.03	0.002	0.46	0.64
	1980 – 2000	89	–0.12	0.061	2.54	0.01
	1990 – 2000	89	–0.21	0.070	2.61	0.01
OECD	1960 – 2000	23	0.10	0.631	–5.49	0.00
	1970 – 2000	24	0.17	0.325	–3.08	0.00
	1980 – 2000	24	0.15	0.149	–1.82	0.08
	1990 – 2000	24	0.30	0.249	–2.58	0.01

Table 5

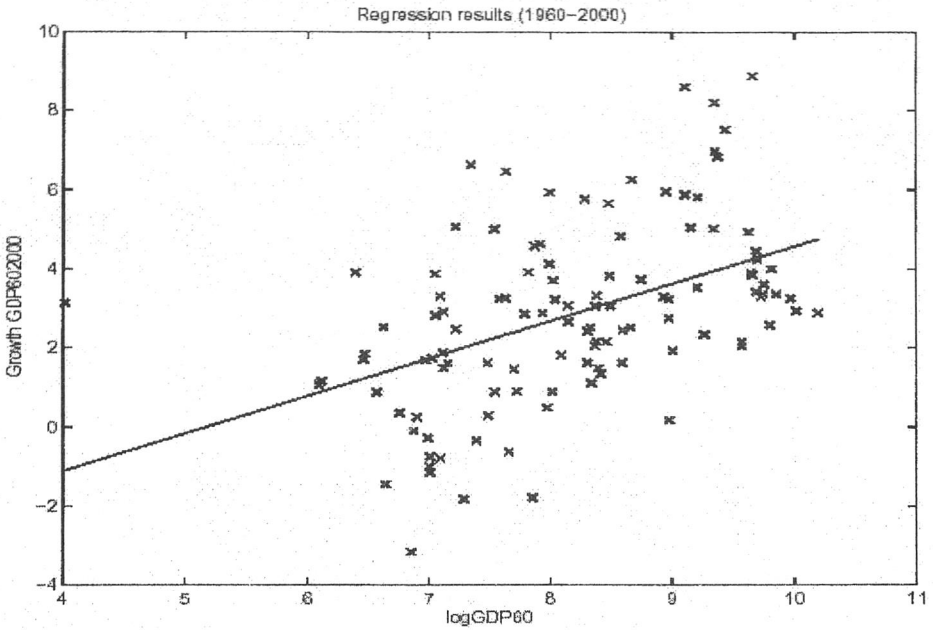
Variance of GDP Per Capita (σ- convergence)

Regions	Years	Variance (σ^2)	Regions	Years	Variance (σ^2)
All	GDP60	0.7788	**OECD & Non-SSA**	GDP60	0.6345
	GDP69	0.9117		GDP69	0.7093
	GDP70	0.9480		GDP70	0.7227
	GDP79	1.0574		GDP79	0.7462
	GDP80	1.2532		GDP80	0.7755
	GDP89	1.4259		GDP89	0.8322
	GDP90	1.4839		GDP90	0.8556
	GDP2000	1.7045		GDP2000	0.8752
OECD&SSA	GDP60	1.1649	**SSA**	GDP60	0.3520
	GDP69	1.3679		GDP69	0.4008
	GDP70	1.4160		GDP70	0.4256
	GDP79	1.5798		GDP79	0.4598
	GDP80	1.9168		GDP80	0.7107
	GDP89	2.2139		GDP89	0.8618
	GDP90	2.3153		GDP90	0.9022
	GDP2000	2.6796		GDP2000	1.1105
OECD and ASIA	GDP60	0.9051	**AFRICA, ASIA, and L. America (LA)**	GDP60	0.4377
	GDP69	0.9756		GDP69	0.5239
	GDP70	0.9748		GDP70	0.5497
	GDP79	0.9548		GDP79	0.6565
	GDP80	0.9887		GDP80	0.8414
	GDP89	0.9569		GDP89	0.9557
	GDP90	0.9816		GDP90	0.9945
	GDP2000	0.9267		GDP2000	1.2208
OECD and Latin America	GDP60	0.5102	**OECD**	GDP60	0.1502
	GDP69	0.6282		GDP69	0.0824
	GDP70	0.6265		GDP70	0.0725
	GDP79	0.6398		GDP79	0.0499
	GDP80	0.6734		GDP80	0.0614
	GDP89	0.8465		GDP89	0.0540
	GDP90	0.8865		GDP90	0.0702
	GDP2000	0.8739		GDP2000	0.0532

Source: Own calculations using the PWT (6.1) data base.

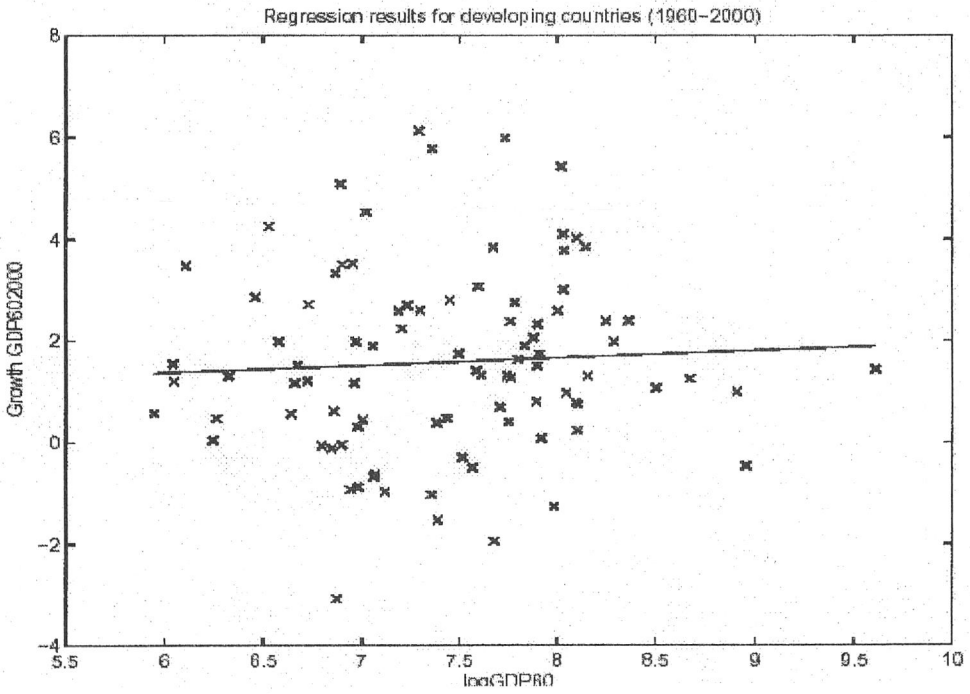
Graph 1

Absolute Divergence Across the World Economy (all countries)

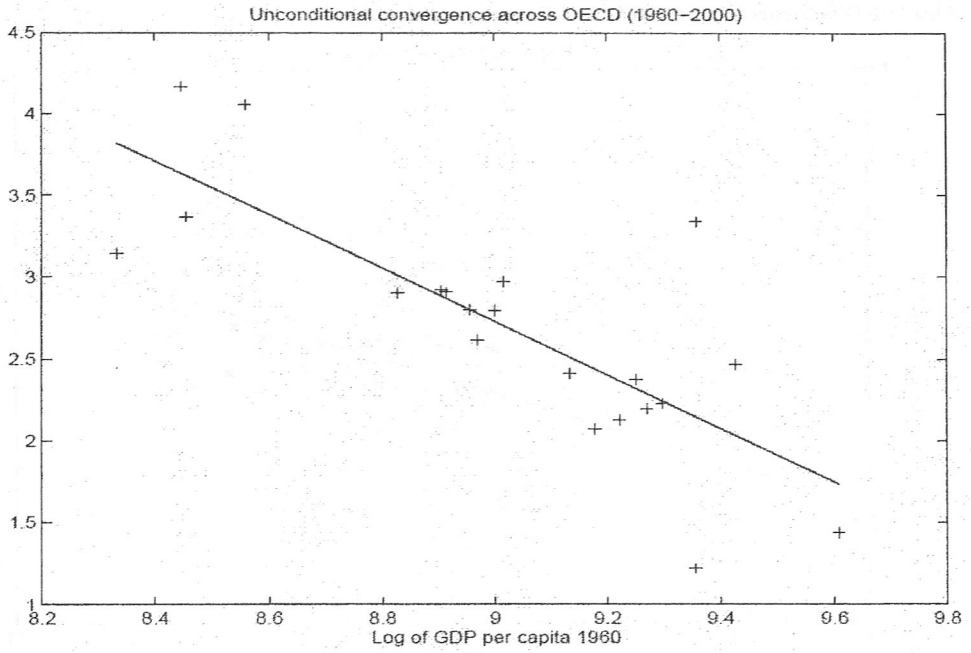


Graph 2

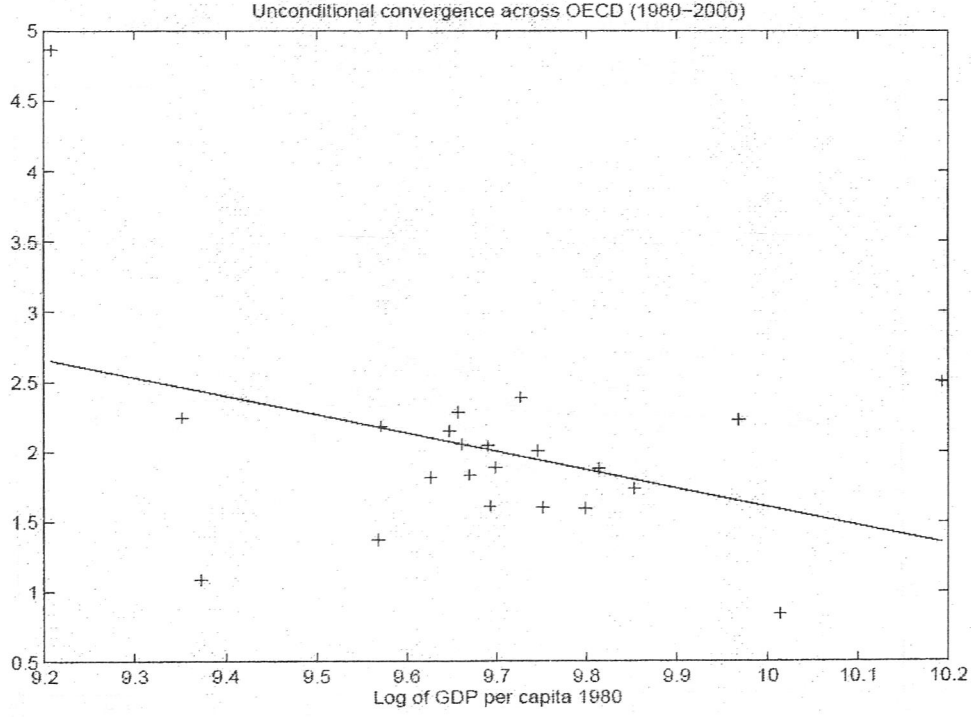
Absence of Unconditional Convergence across Developing Countries (1960 – 2000)



Graph 3



Graph 4



ABSOLÚTNA KONVERGENCIA V ČASE A PRIESTORE: NOVE EMPIRICKÉ DÔKAZY PRE EXISTUJÚCE TEÓRIE

MENBERE WORKIE

Hoci ekonómovia mali záujem sledovať a merať stupne približovania sa jednotlivých ekonomík sveta, do polovice 80. rokov to nebolo možné kvôli nedostupnosti kompatibilných údajov svetovej ekonomiky. Z pohľadu teórie, o absolútnej konvergencii hovoríme vtedy, ak chudobnejšie krajiny rastu rýchlejšie ako bohatšie krajiny. Inými slovami, ak z prierezových regresií vyplýva, že dochádza k inverznému vzťahu medzi rastom reálneho HDP na obyvateľa a jeho počiatočným stavom.

Teória konvergencie z hľadiska ekonomického rastu poskytuje dve veľmi dôležité informácie. Prvou je tá, že z analýzy konvergencie je možné kvantifikovať podiel kapitálu v produkčnej funkcií. Druhou je, že táto analýza dáva odpoveď, do akej miery ekonomická úroveň svetovej ekonomiky konverguje alebo diverguje.

V tejto práci sme sa pokúsili o nové empirické dôkazy pre absolútnu konvergenciu svetovej ekonomiky za posledne štyri dekády (1960 – 2000). Na základe údajov Penn World Table, verzia 6.1, a prierezovej regresie vyplýva, že vo svetovej ekonomike ako celku došlo k divergencii, to znamená, že chudobné krajiny rástli pomalšie ako bohatšie krajiny sveta. Z analýzy tiež vyplýva, že táto divergencia bola výraznejšia v 80. rokoch, a čiastočne v 90. rokoch, čo súvisí s dlhovými a finančnými krízami a inými negatívnymi vplyvmi procesu globalizácie svetovej ekonomiky.

Zaujímavý je na tom fakt, že ani v rámci rozvojových krajín nedošlo k absolútnej konvergencii, z čoho vyplýva, že samotné rozvojové krajiny rovnako neprofitovali z procesu gloabalizácie a existuje značná heterogénnosť medzi týmito krajinami. Naproti tomu, empirické dôkazy v tejto práci poukazujú na to, že ak rozdelíme krajiny podľa politických, ekonomických a inštitucionálnych kritérií (napr. OECD a EÚ), zistíme, že životná úroveň medzi jednotlivými krajinami týchto zoskupení sa priblížila.

Z uvedených analýz vyplýva, že hoci neoklasický model ekonomického rastu predpokladá, že chudobné krajiny rastu rýchlejšie ako bohaté krajiny, platí to iba pre krajiny, ktoré sú mierne chudobné, a zároveň sú členmi bohatého klubu, alebo pre rozvojové krajiny, ktoré sú aktívne integrované do svetového obchodu.