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# STYLISTED FACTS OF ECONOMIC GROWTH IN DEVELOPING COUNTRIES<sup>\*</sup>

Discussion Paper 08/2001

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## **Abstract**

This paper offers a concise survey on the literature of growth empirics applying to DCs. It is argued that there is a number of important stylised facts of economic growth relevant to DCs which are not included in the corresponding lists of Kaldor and Romer. In contrary to the usual procedure, the growth rates of per capita income are calculated by employing potential output, which is determined by the use of the Hodrick-Prescott-filter. Finally, three important conclusions resulting from the empirical observations are discussed in the last section.

*JEL classification:* O100; O400; O470

*Keywords:* Stylised Facts; Economic Growth; Developing Countries; Growth Empirics

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## 1. Introduction

If economic theory is designed to enhance our understanding of real phenomena, then a list of stylised facts relevant to the empirical problem of interest should be the indispensable point of departure for theoretical work. Romer (1989, p. 54) put this idea more concisely by stating:

*...without stylized facts to aim at, theorists would be shooting in the dark.*

Indeed, ever since Kaldor's (1961) seminal paper on economic growth it has been common to base economic theory in general and growth theory in particular on a summary of the basic empirical regularities. This methodological procedure is best described by Kaldor's (1961, p. 178) own words:

*..., the theorist, in my view, should be free to start off with a 'stylized' view of the facts - i.e. concentrate on broad tendencies, ignoring individual detail, and proceed on the 'as if' method, i.e. construct a hypothesis that could account for these 'stylized' facts,...*

It should be clear that the fulfilment of this requirement is by no means a substitute for the formal statistical testing of theories – this simply concerns another stage of the scientific process. In order to enable statistical tests, the theorist should be obliged to set forth the empirically refutable hypotheses, which are implied by the model in question. This requirement should be regarded as a necessary prerequisite if theories claim to be empirically meaningful.

With regard to economic growth, Kaldor (1961, pp. 178/179) proposes six stylised facts. Romer (1989) shows that two of them are implied by others and are thus redundant. Moreover, Romer enlarges Kaldor's list by five other prominent features of the data. This consolidated and enlarged list of stylised facts, however, mainly describes the growth process of mature or industrialised economies. As regards economic growth within the lower range of per capita income, there are special empirical regularities which are almost completely excluded by Romer's enlarged list.

If growth theory claims to explain the process of growth in general, then growth economists should also possess a list of stylised facts which summarises the growth experiences of DCs. This list reads as follows:<sup>1</sup>

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<sup>1</sup> Especially for developing countries (DCs) there are empirical regularities applying to the structure of the economy which are not considered here. For this, see Kuznets (1973), Reynolds (1983), and Wichmann (1997, chapter 3).

- (1) a considerable diversity in the growth rates of per capita income;
- (2) a positive correlation between the savings rate and the level of per capita income;
- (3) a positive correlation between the growth rate and the level of per capita income, i.e.  $\beta$ -divergence.
- (4) More generally, a number of studies have revealed  $\beta$ -divergence for the lower range of per capita income and  $\beta$ -convergence for the upper range of per capita income. Put differently, there appears to be a hump-shaped pattern of growth.

These empirical regularities have to be explained if we really aim to understand the process of growth in DCs. In sections 2 to 5 the list of stylised facts set up above is illustrated and discussed in terms of empirical evidence. In contrary to the usual procedure within the literature on growth empirics, the growth rates of per capita income are calculated by employing potential output, which is determined by the use of the Hodrick-Prescott-filter. This procedure appears clearly more appropriate than the use of data on actual output. Finally, three important conclusions resulting from these empirical observations are discussed in the last section.

## 2. Diversity in growth rates

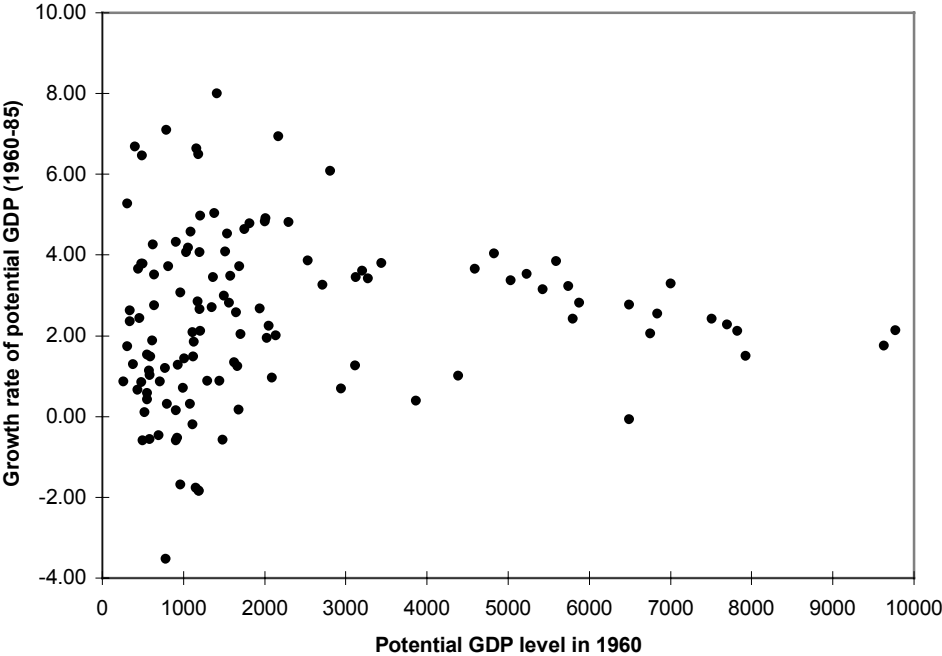
The first empirical regularity corresponds to Kaldor's (1961) sixth stylised fact. In the case of low-income countries this phenomenon is particularly marked as Lucas (1988, p. 4) observes. Pritchett (1998, section II) shows that the standard deviation of average annual growth rates from 1960-92 is twice as large for developing countries compared to developed countries. This point can be immediately visualised by means of the following diagram.

Figure 1 shows the average annual potential rates over the period from 1960 to 1985 based on Hodrick-Prescott (HP) filtered data (Hodrick and Prescott, 1980) on the vertical axis together with potential output (per capita) in 1960 on the horizontal axis.<sup>2</sup> The figure shows that there is still a considerable diversity in the potential rates including zero and even

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<sup>2</sup> The sample comprises a broad range of 121 countries taken from the Penn World Table (PWT 5.6), which is described in Summers and Heston (1991). Following Mankiw, Romer, and Weil (1992) oil-producing countries are excluded from the sample because a large part of recorded GDP for these countries represents the extraction of existing resources and one should not expect standard growth models to account for measured GDP in these countries.

negative growth although the HP-Filter smoothes the data. Also this pattern is especially marked for low levels of per capita income.<sup>3</sup>



Note: “Growth rate of pot. GDP (1960-85)”: real, per annum and per capita, HP-filtered data, in %.  
 “Potential GDP level in 1960”: real and per capita, HP-filtered data.  
 Source: Data taken from Summers and Heston, Penn World Tables 5.6.

Figure 1: Potential growth rates and potential GDP levels.

The scatter plot shown in Figure 1 is widely used within the empirical growth literature. Usually and somewhat surprisingly, however, the growth rates are calculated as actual growth rates, which are simply defined as the (relative) difference between final and initial per capita income of the period under consideration. This procedure only uses the information contained in the first and the last date of the time series. Macroeconomic shocks and business cycle effects nevertheless are likely to produce deviations from the trend path of output. Temple (1999) therefore proposes to employ the whole time series information by calculating least-square growth rates. This requires the estimation of a trend path by regressing (logarithmic) per capita income on a constant and a time trend; the least-square growth rates are the difference between the final and initial fitted values. On the one hand, this procedure amounts to calculating growth rates of potential output, which is clearly appropriate for growth

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<sup>3</sup> This observation could at least partly result from the fact that the low-income countries are much more heavily sampled than the high-income countries as (Romer, 1989, p. 64) observes.

considerations. On the other hand, the determination of potential output as linear time trend appears less favourable. Instead the more advanced and widely accepted HP-Filter should be applied. This technique allows the estimation of a non-linear time trend, which is less restrictive than the linear trend.

### 3. Positive correlation between the savings rate and per capita income

The empirical evidence in favour of a positive correlation between the savings rate and the level of per capita income is overwhelming. Thirlwall (1974, chapter 7) reviews the older and Reichel (1993) the more recent literature.<sup>4</sup> As an illustration of the cross-country evidence consider the following table.

Table 1: Average Savings Rates and average GNP per capita.

<i>Group of Countries<sup>a</sup> (number of countries)</i>	<i>Average GNP per person in 1985 \$</i>	<i>Average personal savings as fraction of GNP</i>
Low-income-countries (16)	1,324	11.2
Lower middle-income countries (16)	2,806	17.1
Upper middle-income countries (11)	6,166	19.5
High-income countries (15)	12,293	21.1

Source: Ogaki et al. (1996, pp. 44/45).

<sup>a</sup> Classification of economies according to World Bank (1994).

Table 1 shows a clearly positive relation between the average savings rate and the average level of per capita income. The positively sloped savings function seems to be a general pattern, which applies to the whole range of per capita income. The largest increase in the savings rate occurs, however, with the transition from low-income to lower middle-income countries. Put differently, the figures indicate a clearly non-linear relation, which appears to be concave.<sup>5</sup>

<sup>4</sup> For further empirical evidence see Rebelo (1992, pp. 31-37) and Ogaki, Ostry, and Reinhart (1996, pp. 43-47).

<sup>5</sup> Barro and Sala-i-Martin (1995, pp. 77-79) demonstrate that this pattern can be reproduced by the Ramsey-Cass-Koopmans model provided that the production function is Cobb-Douglas and the intertemporal elasticity of substitution is smaller than the equilibrium savings rate. On the other hand,

The fact that the positive correlation between the savings rate and per capita income is not contained in Romer's list emphasises that this list applies to developed countries. If one admits that there is a significant correlation especially within the lower range of per capita income, then this empirical regularity should clearly be part of theoretical explanations of growth in DCs. This statement is reinforced by the finding of Feldstein and Horioka (1980) according to which there is a strong correlation between the savings rates and the investment rates.

#### 4. $\beta$ -Divergence

A positive (negative) correlation between the growth rate and the level of per capita income is described as unconditional  $\beta$ -divergence ( $\beta$ -convergence). Furthermore, a rise (fall) in the dispersion of per capita income over time, usually measured by the standard deviation of per capita income, is described as  $\sigma$ -divergence ( $\sigma$ -convergence). For the following discussion it is important to notice that the occurrence of  $\sigma$ -divergence for a specific period of time necessarily requires  $\beta$ -divergence during that period.<sup>6</sup>

Empirical analyses of convergence are usually based on the entire sample of the Penn World Table (PWT) or sub-samples which predominantly consist of industrialised economies. On the other hand, empirical studies which exclusively analyse sub-samples of low-income countries are very rare: According to Baumol (1986), industrial countries appear to belong to one convergence club, middle-income countries to a less pronounced, separate convergence club, and low-income countries actually diverge in the course of time. Zind (1991) runs cross-country regressions based on a sub-sample of the PWT for 89 less developed countries (LDCs) for the time interval 1960-80. He finds (unconditional)  $\beta$ -divergence. Cho (1994) divides the PWT data set into two half-sized sub-samples with 48 LDCs and 47 developed countries. The correlation between the average growth rate and the initial level of per capita income is significantly positive for the lower sub-sample which indicates (unconditional)  $\beta$ -divergence.<sup>7</sup> Finally, Romer (1986, pp. 1008) demonstrates that there is a positive time

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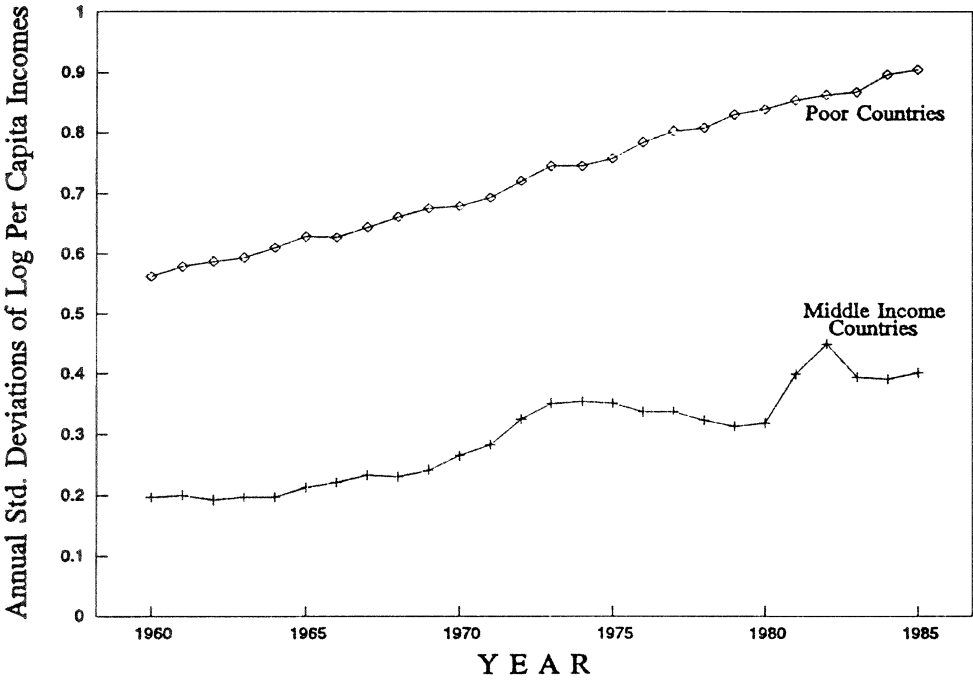
this stylised fact is a compelling property of growth models with subsistence consumption (Steger, 2000a).

<sup>6</sup> For the relation between the concepts of  $\beta$ -convergence and  $\sigma$ -convergence see Sala-i-Martin (1996).

<sup>7</sup> The convergence coefficient is, however, not significantly different from zero. In addition, see Baumol et al. (1989, pp. 302/303) who run a piecewise regression for the lower income group finding divergence as well.

trend in growth rates for 11 now developed countries using the long-run data set from Maddison (1979) which covers the time interval 1870-1978.

As has been noted above, the occurrence of  $\sigma$ -divergence for a specific time period necessarily requires  $\beta$ -divergence within this time period. With regard to  $\sigma$ -divergence, the empirical evidence can be illustrated very easily. The subsequent figure displays the evolution of the standard deviation of (logarithmic) per capita income over time for the group of ‘poor’ and ‘middle-income’ countries.<sup>8</sup>



Source: Ben-David (1994).

Figure 2:  $\sigma$ -Divergence.

Figure 2 illustrates two points: First, the degree of inequality is higher for the group of ‘poor’ countries compared to the group of ‘middle-income’ countries. Second, the disparity rose steadily over time, indicating continuous  $\sigma$ -divergence. Moreover, despite the fact that long-run data on national accounts are generally not available for DCs, Pritchett (1997) shows in an innovative study that  $\sigma$ -divergence in the world distribution of income has prevailed over the last 150 years. He determines a lower threshold for the level of per capita GDP below which survival is impossible. To show that  $\sigma$ -divergence has prevailed, he further combines

<sup>8</sup> The group of poor countries comprises 82 economies with per capita income smaller than \$2000 in 1960. The group of middle-income countries comprises 15 economies with per capita incomes ranging from 25 to 60 per cent of US income in 1960 (Ben-David, 1994, p. 5).



this information with current estimates of relative incomes across nations and historical growth rates of the now-rich nations.

The statement of  $\beta$ -divergence for the lower range of per capita income seems to contradict Romer's (1989) seventh stylised fact according to which the growth rate shows no variation with the level of per capita income. However, Romer's stylised fact refers to the broad sample of 115 market economies. In addition, one should bear in mind that this assertion was mainly in response to the neoclassical convergence implication and that its refusal was the main empirical motivation for endogenous growth theory.

## 5. Hump-shaped growth pattern

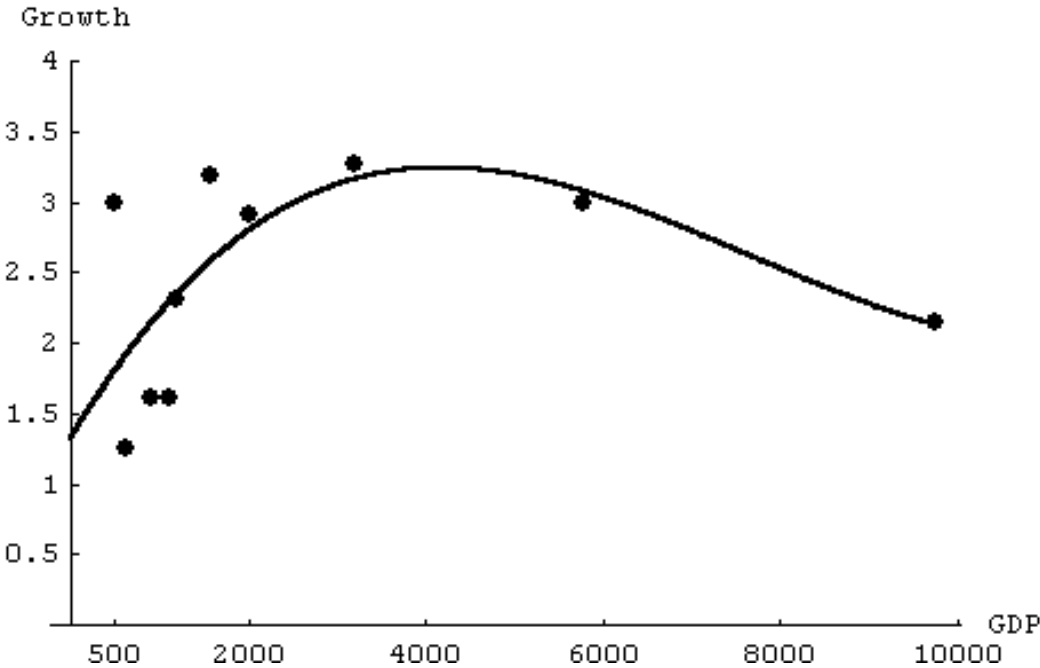
The empirical regularity of  $\beta$ -divergence for the lower range of per capita income appears to be a component of a more general pattern of growth. Indeed, a considerable amount of empirical evidence indicates that growth first accelerates as one moves from low- to middle-income countries and subsequently decelerates as one moves from middle- to high-income countries.

In order to check whether there is such a general pattern in growth rates Dollar (1992) divides the set of countries, taken from the PWT, into deciles based on 1960 level of income. Subsequently, he estimates an univariate non-linear regression with the average growth rate of per capita income as the dependent variable. Although the  $R^2$  is very low (about 0.1) this procedure appears sensible for summarising the data without stating a causal relation between the variables under consideration. Once again it is preferable to employ potential rates rather than actual growth rates. Accordingly, Figure 3 shows the result of the same procedure based on potential rates and potential output in 1960. The underlying non-linear regression is a polynomial of order 3, the coefficient of the squared potential output is significantly negative and the (adjusted)  $R^2$  is about 0.2. The figure illustrates that there is a tendency of (unconditional)  $\beta$ -divergence for the lower range and a tendency of (unconditional)  $\beta$ -convergence for the higher range of per capita income. It is worth noting that this result is compatible with the finding of convergence clubs among the richest countries (Baumol, 1986).

Further empirical evidence in favour of the hump-shaped growth pattern is available and is sketched for the sake of completeness: Easterly (1994) regresses the average annual growth rate of per capita income (1950-60) on, among other variables, the square of initial level of logarithmic per capita income. The influence of this variable is significantly negative and

therefore supports the hypothesis of a hump-shaped pattern of growth. Baumol et al. (1989) regress the ratio between the (logarithmic) per capita income in 1980 and in 1950 on the square of real GDP per capita in 1950, among other variables. The relevant coefficient is negative and significant. The authors conclude that (Baumol et al., 1989, p. 303):<sup>9</sup>

*[t]he results indicate divergence among the lower income countries in 1950 and convergence among the higher income ones.*



Note: “Growth”: Growth rate of pot. GDP (1960-85): real, per annum and per capita, HP-filtered data, in %.  
 “GDP”: Deciles of pot. GDP (1960), real and per capita, HP-filtered data.  
 Source: Data taken from Summers and Heston, Penn World Tables 5.6.

Figure 3: Hump-shaped growth pattern.

### 6. Conclusions

Three main conclusions can be drawn: The first concerns the nature of explanation of the growth process, the second demands for a theoretical identification of the different mechanisms of  $\beta$ -divergence and  $\beta$ -convergence, while the third bears important implications for empirical convergence analyses.

In the wake of endogenous growth theory, economic growth in DCs has been increasingly analysed by means of theoretical growth models. On this occasion, the growth process has

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<sup>9</sup> The same authors find a hump-shaped relation using a moving-average approach (Baumol et al., 1989, pp. 301/ 302). For further empirical evidence see Cho (1994, section II) and Pritchett (1998).

been mainly interpreted as balanced-growth dynamics (e.g. Azariadis and Drazen, 1990). These approaches are theoretically appealing because they demonstrate the possibility of multiple dynamic equilibria with strong implications for low-income countries (e.g. Benhabib and Gali, 1995). Therefore, the models provide a candidate explanation of stylised fact (1). On the other hand, these approaches do not offer a satisfactory explanation of stylised facts (2) to (4). In contrast, according to a fundamentally different approach, the process of economic growth can be interpreted as representing mainly transitional dynamics towards a (unique) balanced-growth equilibrium. This strand of growth models can potentially explain the specific aspects of growth in DCs listed above (e.g. Rebelo, 1992; Steger, 2000a).

Stylised facts (3) and (4) point to the interpretation that there are several mechanisms of  $\beta$ -divergence and  $\beta$ -convergence simultaneously at work in the course of economic development. The divergence mechanisms seem to dominate the convergence mechanisms at early stages of economic development while the reverse holds true for later stages. It would be clearly instructive to identify theoretically the different mechanisms of  $\beta$ -divergence and  $\beta$ -convergence. Put differently, it is undoubtedly of special interest to elaborate those mechanisms which induce a rise and those mechanisms which induce a fall in the growth rate of per capita income. Once more, this consideration implies that the analysis of transitional dynamics provides further insights into the process of growth.<sup>10</sup>

Finally, the correlation between the savings rate and the level of per capita income [stylised fact (2)] has important implications for the widely employed cross-sectional convergence analyses (Steger, 2000b). These approaches are crucially based on the concept of control variables, which are assumed to proxy the balanced-growth path. On account of the definition of the balanced-growth path, the control variables are usually considered as being constant in the course of economic development. However, at least a subset of the control variables – like the investment rates in physical and human capital – varies systematically with the level of per capita income. The explicit consideration of endogenous control variables has two important consequences. The first is purely econometric and concerns the choice of the appropriate estimation procedure in order to obtain unbiased and consistent coefficient estimates. The second affects the theoretical interpretation of the conditional convergence results. Accordingly, the variation of some of the control variables with the level of per capita income contains important information about the transition to the balanced-growth equilibrium rather than information about the balanced-growth equilibrium itself.

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<sup>10</sup> For explanations in this vein see Steger (2000a, 2002).

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