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Real Economic Convergence

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REAL ECONOMIC CONVERGENCE*

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Real convergence is an essential objective of Romania's integration into the EU. Bridging the development gaps between Romania and the EU as soon as possible cannot be achieved exclusively through market forces, since they rather tend to cause divergence and polarization. For this purpose, special tools and mechanisms are required; e.g., cohesion. The study deals with the economic convergence of the European countries, and especially the convergence of the CEE countries, including Romania. Models are used to assess the economic growth, approximate the period of real convergence of Romania to the EU, as well as to estimate the σ- and β-convergence, and the main shortcomings of the last indicator.

Keywords: *Real convergence, divergence, cohesion, club convergence, polarization, regression method, return to capital, σ-convergence, β-convergence.*
JEL: C21; E22; O41; O47

1. Introduction

The question of real economic convergence is not a recent issue. Almost all great economists dealing with long-run economic development have taken into consideration the problem of real convergence in their studies. But many of them have only approached this issue implicitly, when analysing the role of the production factors – capital, labour, natural resources, technological progress, human capital – in the long-run economic development. Also implicitly, they have dealt with the real convergence when referring, on the one hand, to economic development and, on the other hand, to the evolution of some categories of complex economic activities or/and branches with major economic and social impact (industries based on medium and high technologies, services, IT&C), as

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well as to the economic institutions and mechanisms (market structure, economic outcome distribution – rent, profit, wages, etc. – considered a form of economic stimulation).

The explicit and systematic study of real convergence began with the development of the neoclassical models of economic growth and, especially, with the econometric application of such models, as well as of other improved growth models. Furthermore, the issue of the real convergence has been taken into consideration by the applied research in the European integration field, as well as by the EU decision-makers involved in the management and monitoring of the integration process. At the same time, positive results were obtained in the field of statistics. Thus, cross-country comparable data of some indicators used for the analysis of real convergence have been calculated and published. Also, various indicators used for the measurement of convergence or of some of its fields and factors have been created and/or used.

Since, at present, there is a significant diversity of approaches and studies on real convergence and a whole array of calculation methodologies, we dedicate Section 2 to some general comments on a number of approaches and categories of models concerning the issue of catching up with the developed countries. In Section 3, we present applications of some indicators and convergence models based on Romania's economy and on other less developed economies and evaluate the prospects of reducing the development gap between Romania and the EU15 average. Here, the intention is to draw round: a) the calculation of the required time to fill the gap in the economic development; b) the evaluation of the general trend of convergence. Section 4 is dedicated to point out some trends of the rate of return to capital and in Section 5 we draw some short conclusions.

2. Approaches to real convergence and their shortcomings

Solow's scientific contributions (1956) were used intensively in discussing the principles and methodological issues concerning convergence. As part of the neoclassical model group, Solow's model was widely discussed, developed and criticized for half century. In spite of the relaxation of the assumptions and hypotheses on which the initial model was based and the development of new model alternatives (Lucas, Barro, Sala-i-Martin, Quah, etc.) in order to bring the new alternatives closer to the real conditions of the economy and in spite of all innovations brought about by the new scientific contributions, many of the new models could not become fully independent of the neoclassical model.

2.1. Real convergence reflected in Solow's neoclassical model

In the economic literature, especially in that dealing with globalisation and European integration, there are three ways to understand real convergence and reveal the causes and the trend of the process:

- The first way considers real convergence a natural process, based exclusively on the market forces: the larger, more functional and less distorted the market is, the safer and faster the convergence is for all categories of countries.
- The second way denies real convergence between the poor countries and the rich ones and supports increasing polarisation and deeper divergences and inequalities between centre and periphery.
- The third way considers convergence necessary and possible in a competitive market by implementing economic policies able to compensate for the negative effects of the inequalities or divergences, at least until the maturity of the economic systems, that is until reaching the so-called critical mass for a self-supporting real convergence.

The first way of understanding real convergence exclusively by the market forces pertains to the neoclassical theory of economic growth. The characteristic feature of the neoclassical model is the exclusive investment in physical capital for achieving convergent economic growth. Assuming that the economic outcome (GDP per capita) is due to the contribution of several factors of production (capital, labour, natural resources, technological progress), the neoclassical model assumes the dependence of convergence (filling the gaps) on the specific features of the rate of return to capital, on its general decreasing trend. Increases in capital will bring about smaller than proportional returns. More precisely, at the same rate of saving (investment), the marginal rate of return diminishes, so the poor countries with a low amount of capital per capita reach a rate of return to capital higher than that of the rich countries with a higher physical capital per capita. The conclusion was that poor countries could catch up with the rich ones as regards the income per capita. Solow's neoclassical model of economic growth proves this possibility.

The fundamental non-linear equation that describes the economy path to the equilibrium state in Solow's model is the following:

$$\dot{k} = sAf(k) - (\delta + n)k \tag{1}$$

where:

$\dot{k}$ - increase in the stock of capital per labour unit;

$f(k)$ – production function[1];
s – rate of saving;
n – growth rate of the population and, implicitly, of the labour force;
δ - capital rate of depreciation;
A – effects of the technological progress, endowment with natural factors, economic policies, etc.

This differential equation, that depends only on k and describes the dynamic behaviour of capital, shows that economies start from a k_0 capital level per capita and reach the steady state k_t^*.

To make poor and rich economies converge (towards a single steady state), it is necessary to meet the requirements concerning the following:

- diminishing returns to the physical capital;
- constant and equal rates of saving of the countries and constant and equal rates of capital depreciation and population growth.

Dividing both sides of equation (1) by k, we get the growth rate of the capital stock:

$$\dot{k}/k = sAf(k)/k - (\delta + n) \tag{2 a}$$

or

$$g_k = sAf(k)/k - (\delta + n) \tag{2 b}$$

Equation (2b) has three components:

- g_k – growth rate of the capital stock per effective labour unit;
- $sAf(k)/k$ – saving curve;
- $(\delta+n)$ – depreciation curve.

The steady state k^* is reached when the growth rate of the capital per labour unit is equal to zero. In this case, the relation (2b) becomes:

$$sAf(k)/k=\delta+n. \tag{3}$$

To achieve the convergence of all (poor and rich) countries, it is necessary that the poor economies with low levels of GDP and physical capital per capita attain a growth rate higher than that of the rich economies with higher levels of the GDP and capital per capita.

The above relations and reasoning are graphically presented in Figure 2.1.

The graph shows the trajectories (curves) of the two functions:

[1] Denoting by: Y – output (e.g., GDP), K – capital, L – labour, A – effects of the technological progress, endowment with natural factors, etc., the production function may be expressed as follows: $Y = AF(K,L)$. Dividing it by L, we get: $y = Af(k)$. The Cobb-Douglas production function becomes $Y=AK^{\alpha}L^{1-\alpha}$, where α is the share of the effects of the physical capital in total output, and $1-\alpha$, the share of the effects of the labour in total output. Dividing this function by L we get: $y = Ak^{\alpha}$.

- The depreciation *(δ+n)* by the horizontal line, also called the depreciation curve;
- The saving *(sAf(k)/k* or $sAk^{\alpha-1}$*)* by the descending curve also called the saving curve[2].

The differences between the two curves in different points of their evolution express the growth rates, that are in a reverse ratio in relation to the level of physical capital endowment and, therefore, to the development level. Due to the higher growth rates in the poor countries against the rich ones, there is a gradual approach of the saving curve to the depreciation one until their intersection. At the point of intersection of the two curves, where the growth rate becomes zero (g_k=0), the steady state k^* is attained.

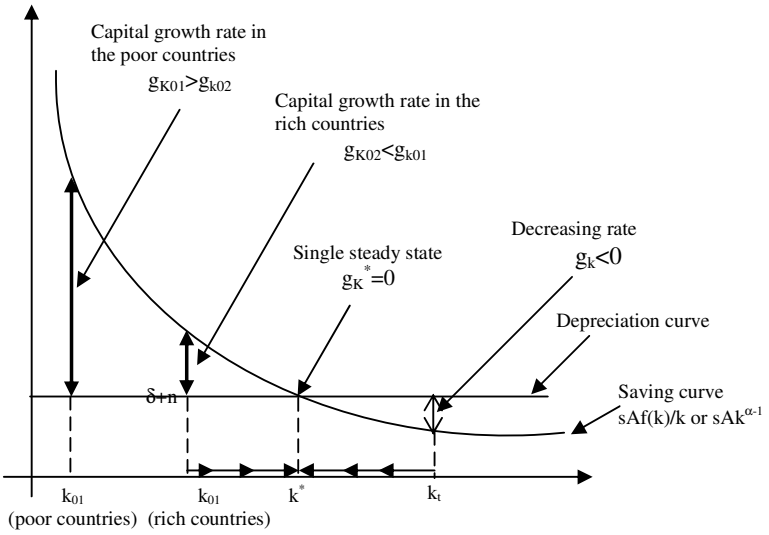


Figure 1. The neoclassical model of convergent growth.

The above case covers the so-called conditional convergence, that is the alternative implying that all economies with differences in the initial stock of capital per capita have the same saving rates *(s)*, similar technologies (the same parameters *A* and *δ*), as well as the same population (labour) growth rates (*n*).

[2] Due to the diminishing returns to capital, each additional unit of the capital stock of the less developed countries (with a lower capital stock) generates a production surplus higher than an additional unit of capital of the developed countries. As against the depreciation curve, which has constant values (horizontal line), the savings curve may take all positive values from zero to infinite, with distance variations between the two curves, including their intersecting.

Unless such requirements are met, the equilibrium points of the rich countries differ from those of the poor countries, and the convergence cannot take place.

Since rich countries have an investment capacity higher than that of poor countries, the saving curves of the rich countries are usually different from those of the poor countries (Figure 2.2). As a consequence, also the equilibrium points of the capital stocks per capita are different, and the growth rates of these stocks must not necessarily be lower in the rich countries.

Due to the significant differences between the two categories of countries in relation to the saving curves (expressing, in fact, different investment power), the real opportunity for all categories of countries to achieve economic convergence is doubtful.

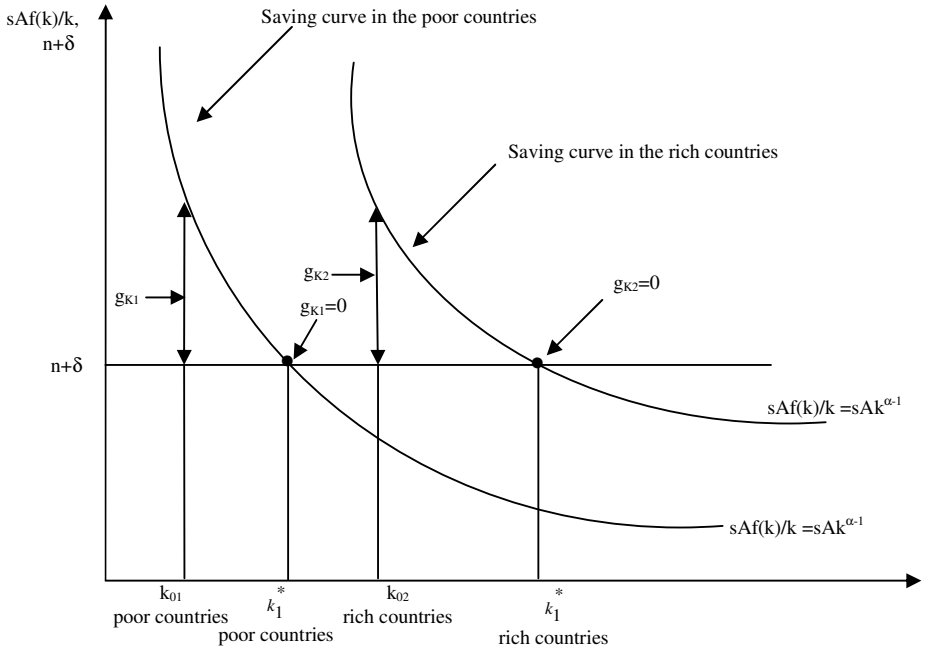


Figure 2. The neoclassical model of divergent growth.

2.2. Divergence and polarisation-Perenial effects of the competitive market forces

The numerous empiric research studies carried on in the last two decades to test the validity of the neoclassical growth model and of other more elaborate models have shown that in most cases the hypothesis of diminishing returns to

capital and the hypothesis of equal and constant saving rates in all countries, and consequently, the real convergence of the poor and rich countries (regions) are not valid. It is impossible to explain the international gap in the present development level by the initial difference in the endowment with factors (Thirlwall, 2001). What really counts today is to reveal the possible obstacles against the poor countries' development and to see whether the mechanisms of the unequal advantages between the rich and the poor countries are perpetuated or not.

As pointed out above, what we intend by the reforms implemented during the lead-up to the accession and integration into the EU is to develop a functional market economy and improve *the capacity to cope with the competition pressure and market forces in the EU.*

By means of the concept of circular and cumulative causation of the economic processes, first used by Myrdal, one may explain the increasing international differences in the development level as compared to similar initial conditions. The movement of capital, the migration of human capital and labourforce, the exchanges of goods and services perpetuate and even increase the international and regional inequalities in the development level. By the free trade mechanisms, without tariff or non-tariff barriers, the less developed countries lacking human capital and scientific and technological capability are forced to specialize in the production of goods, especially primary ones, characterized by non-elastic demand (low elasticity) in relation to price and income.

What makes the inequalities between countries increase is the tendency of polarisation (clustering) – not only interregionally, but also internationally – especially in the context of the economic and monetary integration. Since there are no obstacles to the movement of goods, services and production factors, some countries and regions become strong attraction poles that cause disequilibria in the countries with major differences in the income per capita. The developed countries and regions, endowed properly with factors, become attraction poles that absorb increasing amounts of capital and high quality labourforce from the less developed countries and regions.

Even if during the accession process major efforts are made for the implementation of economic and institutional reforms and for the achievement of a stable economic development, in the real life there is a natural tendency with universal validity, that is the polarisation of the processes causing the deepening of the divergences in development between countries and regions. Myrdal states that, in the context of development, the economic and the social forces alike generate tendencies towards disequilibria and the economic theory hypotheses that disequilibrium tends towards equilibrium are false (Myrdal, 1957; Thirlwall, 2001; Kornai, 1974). If it were not real, then how could the international differences in the standard of living be explained? Since this question cannot be answered,

Myrdal replaces the stable state (convergence) assumption with what he calls the circular and cumulative cause assumption or, briefly, the cumulative cause assumption which causes divergences. By this hypothesis one may explain why the international and interregional differences in the development level may persist and even deepen over time.

Myrdal's hypothesis is based on a multiplicator-accelerator-type mechanism, that causes the income increase at higher rates in the so-called favoured countries and regions, namely more developed, endowed with more modern infrastructure, with scientific and technological ascendancy, with inflows of physical and human capital and scientific and technological inflows, which are more and more attractive for the physical and human capital, and for the workforce from the less developed areas. Free trade in goods and services and the full freedom of movement of the production factors among countries and regions showing significant differences in the development level mean increasing polarisation: on the one hand, the countries and regions becoming richer enjoy major economic growth and significant attractiveness for the high quality production factors, on the other hand, the declining or stagnant countries and regions with a backward and unattractive basic infrastructure, with decreasing income and tax base, which cause the decrease in the demand for goods and services.

Under these circumstances, one cannot even consider economic convergence. Such approaches and analyses initiated by Myrdal, Prebisch, Seers and others created a way of thinking focused on the concept of *divergence,* which is concentrated on polarisation and the divergent relations between centre and periphery.

The influence of this approach was felt on two large levels: 1) the practical one, strongly reflected in the projects for the European construction by adopting mechanisms and tools of economic policy for supporting convergence; 2) the analytical one, strongly reflected in two directions: a) the reconsideration of the construction and interpretation of the economic growth models by returning to the economic and social relations (it refers to the development and modification of the construction of the neoclassical models and, especially, the development of endogenous models and their econometric testing); b) new approaches to the geographic economy (regional economy) by taking into account real processes, such as: regional gaps, agglomerations or development poles, role of infrastructure, transaction costs.

2.3. Cohesion – An important tool to support the real convergence in the EU

When the Treaty of Rome – as the first constitution of the integration – stipulated the first two economic objectives, "the harmonious development of economic activities" and "a continuous and balanced expansion", it took into account both the structural divergence and the widening gap between the increase in the income per capita between the backward and the advanced regions of the Common Market.

In order to achieve real convergence, initially, the Treaty was based implicitly and exclusively on the market mechanisms. Noticing some failures in the market mechanisms concerning the catching up process, the EU gradually adopted tasks and measures for *cohesion and solidarity* in order to facilitate the real convergence of the backward countries and regions with the developed ones by granting to the former significant financial aids, to improve their economic performance.

The adoption of the principle of cohesion was mainly caused by the accession to the EU of the countries with major gaps in the income per capita as compared to the EU average (Greece, Portugal and the CEE countries). The principle of cohesion, applied by means of specific tools (the Cohesion Fund and the Structural Funds), is widely used inside the EU to fill the income and productivity gaps among countries and regions by increasing the investment power of the less developed countries and regions[3].

The most important step taken for adopting the principle of cohesion consisted in explicitly introducing three economic objectives focused on convergence in the Maastricht Treaty, namely: (1) harmonious and sustainable development of the economic activity; (2) high level of convergence of the economic performance; (3) economic and social cohesion and solidarity between the member countries. These objectives, focused on real convergence (by means of cohesion) of the economic performance, were included in the Amsterdam Treaty, with some rather formal amendments. To implement the above principle, the Cohesion Fond was set up only for the countries (not for the regions) with a GDP per capita below 90% of the EU average. Structural Funds were set up and used for diminishing the disparities among regions and countries. As for regions, the maximum threshold for granting the Structural Funds is 75% of the EU average and their utilisation is meant to improve the performance of the backward regions.

[3] The following measures were taken to achieve cohesion: in 1968 the Agricultural Structural Fund was created to promote agriculture modernisation. Later, the Fund was explicitly assigned the role to promote the economic capability of the rural areas. In 1975, the Regional Development Fund was set up for financing the infrastructure of the underdeveloped regions. The Social Fund was directed towards training in the regions undergoing restructuring, with high unemployment rates (Jacques Pelkmans, 2003, p. 299).

The Cohesion Fund and the Structural Funds (which support directly real convergence) account for 35.2%, and funds for agriculture and rural development totals 44.5% of the overall EU Budget (which represents 4% of all national budgets).

The first eligible countries that benefited from the Cohesion Fund for project financing were Greece, Spain, Portugal and Ireland. Later, the countries that joined the EU in 2004 and 2007 were added. The countries receive money from the Cohesion Fund as long as they do not exceed 90% of the European average GDP per capita.

According to some evaluations of the period between 1986-1996, the Cohesion Fund and the Structural Funds ensured real convergence (by reducing disparities) in a proportion of about 1/3.

2.4. New methodological approaches to convergence and its determinants

We have underlined above the limits and shortcomings of discussing convergence on the basis of the neoclassical theory as well as the need for a new approach based on indicators and models able to express the real processes, like the fact that economic growth should be the result of the economic system itself, not just the mechanical result of some independent and natural forces that act from outside the system.

Moderating the old hypothesis of the diminishing return to capital and other assumptions or constraints that cannot be proved, the new theory is focused on the types of models able to consider the effects as spillovers caused to the system by some major production factors – physical capital, human capital, RD&I, etc., as well as models for finding out the real causes and mechanisms of the long-term disparities (through cross-section analysis or long time series), by correlating the growth rate of production and income per capita at national or/and regional level with several economic, social and political variables that could be either the engine or the brake of economic growth.

The new approaches to real convergence are based on analyzing the effects caused by the intangible factors (including those concerning economic policies). The new variants or generations of convergence models take into account as distinct factors the human capital, the technological programme and the institutional state and their effects on the economic system. These effects spillover the economy in a special way, that is over other than the direct producers. The effects are greater than the inputs necessary to produce them or than the amount of their compensation.

Usually, the intangible, non-quantifiable factors (knowledge, professional abilities or skills, technological and managerial competence, information, innovation, know-how, etc.) are spread as spillovers and embodied in quantifiable tangible production factors. Such spillovers seem to be generated by investments in

physical capital (Arrow, 1962) or by investments in human capital (Lucas, 1988) or by both types of investment (Romer, 1986). According to Romer, if the spillovers are strong, the marginal product of the physical and human capital could stay permanently above the discount rate (Romer, 1986; Thirwall, 2001). Economic growth could be supported by the continuous accumulation (investment) that generates positive spillovers (Grossman and Helpman, 1994), associated with the formation and development of the human capital (education and training or qualification) or of the RD&I, which prevent the decrease in the rate of return to capital or the increase in the specific capital (capital-output ratio – COR).

The new approaches to convergence have enlarged the area of research and the methods and tools of scientific investigation. First, the contribution of the human capital and technological progress, besides the physical capital, to convergence was emphasized. Second, the application of various methods for econometric testing of the hypotheses of various models (including the modified or improved neoclassical ones) was extended.

The realistic interpretation of the trends in the evolution of the economies towards the state of convergence and the rate at which the economies achieve convergence demanded the proposal and econometric testing of the new calculation tools and models, such as the β and σ indicators (Sala-i-Martin, 1996), the augmented dynamic neoclassical model (Mankiw, Romer, Weil, 1992; Islam, 1995; Bassanini, Scarpetta, 2001), the stochastic convergence model (Lee *et al.*; 1997), etc. The economic parameter β shows the speed of the convergence when the parameter is negative and σ shows the convergence or divergence trend, as this factor shows respectively the narrowing or the expansion of the dispersion of the sample of analysed data.

There are authors who conducted empiric research on convergence using the modified and augmented dynamic neoclassical model that involved the human capital and technological progress besides the physical capital. For example, Mankiw, Romer and Weil (1992), and Islam (1995) revealed, by the new variants of models, that the economies with an initially low level of the income tended to increase faster than those with initially high level of the income after they had introduced in the model the saving rate and the population growth rate, as control variables. Additionally, Barro, Sala-i-Martin, Blanchard and Hall (1991) considered the capital mobility, labour migration, etc.[4]

The counter-reaction to such empiric studies was an opposition literature that, on the basis of alternative econometric methods, stated that the cross-section growth model is inconsistent with convergence and consistent with the variety of endogenous growth mechanisms (Durlauf, 1995, 1996; Quah, 1996). Among the most important ideas concerning this area we find those referring to the formation,

[4] Generally speaking – as Villaverde Castro (2004) points out – the presence of the convergence is considered a valid test in favour of the neoclassical growth model as opposed to the endogenous models that imply divergence in most cases. (José Villaverde Castro, *Indicators of Real Economic Convergence. A Primer*, W-2004/2, United Nations University).

behaviour and evolution of the so-called convergence clubs. The first to mention such a process was Baunmol (1986). Later, the idea was taken on and developed theoretically and researched empirically by Quah, Bernard and Durlauf, Galor (1996), Mihăescu (2003), etc. For example, Quah states that the conventional (neoclassical) theory of convergence and the results of the empiric research based on this theory conceal the presence of the convergence clubs and the polarisation of the countries in rich and poor ones.

A spreading opinion is that convergence is not and cannot be a unitary process in all countries and regions, but a multipolar one. Placing the real convergence assumptions in a very controversial area, Galor (1996) shows that the empiric research focused on testing the validity of new competitive hypotheses, especially on that concerning the convergence clubs (polarisation, clusters, etc.). This hypothesis states that the incomes per capita of the countries which have similar structural features (preference, technology, population growth rate, government policies, etc.) converge in the long-run only if their initial conditions are similar as well.

This hypothesis can be associated with that concerning the conditional convergence, since – as Galor points out – both originate in the neoclassical model (modified and developed, I would add, A.I.) by including some significant variables in the structure and adding other elements such as spillovers, market distortions, etc.. All of them strengthen the validity of the convergence clubs hypothesis, as opposed to the conditional convergence hypothesis.

What distinguishes between the two competing hypotheses is that in one (the conditional convergence hypothesis) convergence takes place independently of the initial conditions and in the other (the convergent club hypothesis) convergence occurs if the initial conditions are similar or close from the technological, cultural and preference point of view.

The analysis of the main aspects of the real convergence reveals not only the high complexity of the topic, but also the major steps made by the economic research for the clarification of many problems in this field. It also points out the scientific and practical opportuness for Romania to achieve convergence with the EU countries.

The latest empiric research for the validation of several convergence assumptions proves that there is not and cannot be a compliance of all countries with unconditional convergence. What is verified and confirmed by the economic and social reality of the countries and regions, is the club convergence viewed in its dynamics, in relation to the factors of influence acting within the economic system. Under the present circumstances, the factors that decide the dynamics of the rich economies are the development of the human capital and the intensification of knowledge and its application to various fields. The two factors cause still high growth rates in these countries. Thus, the chance of some countries, like Romania, to achieve a real convergence with the EU is closely linked not only with the increase in the stock of physical capital, but also with the stimulation of the development of the two factors–knowledge and human capital–with their increasing contribution to the achievement of higher growth rates.

Would Romania and other countries of the same group and other less developed groups succeed in eliminating the barriers from convergent growth? In the following section we try to give partial answers that are rather conditioned than firm.

3. Evaluation of the opportunity to achieve a real convergence of Romania and the EU

For such evaluation it is necessary to point out Romania's place among the EU countries and in the world by the GDP per capita. Second, we should define and evaluate Romania's advance speed towards convergence with the developed countries or groups of countries, also taking into account the advancing speed of the developed countries or groups of countries.

3.1. Romania's place in the EU and the world by the growth level and pace

From an economic point of view, Romania is still in a marginal position if compared with the European developed countries. For example, if compared to the EU 25 average of 2004, Romania's GDP per capita calculated by the exchange rate was 8.1 times lower, and that calculated by the purchasing power parity (PPP) was 3.1 times lower. If compared to the average of the ten countries [5] that acceded to the EU in 2004, Romania's GDP per capita in 2004 was, according to the two calculation alternatives, 2.35 and 1.75 times lower[6].

Among the 28 member and candidate countries in 2004 (EU27+Turkey), Romania is ranked the 26th (before Bulgaria and Turkey) by the GDP per capita calculated by PPP in euros.

If we go beyond the European area when analysing Romania's place by the average income per capita, we find out that this country holds a better position. Still, the gap between the extreme cases seems to be more dramatic than on the European level. Among the 208 countries and independent territories, Romania is placed by the GDP per capita calculated according to the two alternatives (the exchange rate and the PPP in US dollars) farther from the extreme levels, but above the average world level (Table 1).

[5] The group of ten countries includes: Cyprus, Czech Republic, Estonia, Lithuania, Latvia, Malta, Poland, Slovakia, Slovenia, Hungary.

[6] Based on the Eurostat data.

Table 1

Romania's relation to the EU 25 and EU 15 average level, the world's extreme levels and the world's average GDP per capita in euros and US dollars, at the exchange rate and PPP, in 2004

	GDP per capita calculated by the exchange rate (EUR and USD)	GDP per capita calculated by the PPP (EUR and USD)
Relation to the average EU 25 level	> 8.1 times (lower)	> 3.1 times (lower)
Relation to the average EU 15 level	> 9.1 times (lower)	> 3.4 times (lower)
Relation to the world's average level	< 1.3 times (higher)	< 1.25 times (higher)
Relation to the world's poorest country	< 32.8 times (higher)	< 15.1 times (higher)
Relation to the world's richest country	> 17.5 times (lower)	> 4.8 times (lower)

Source: Based on the World Bank's data, *2006 World Development Indicators*.

To answer the question whether Romania succeeds to achieve convergence with the EU and the world's top countries as regards the GDP per capita, we have to compare Romania's progress and the progress made by the other countries or groups of countries. If we define the progress by the annual average growth rate of the GDP per capita* and analyse Romania's rate in relation to other countries or groups of countries (Table 2) over as long periods of time as possible, we conclude that, in fact, Romania's convergence is a mere illusion. Not only it is impossible to be achieved, but the gaps become broader, since (see the table) Romania's annual average rate was much slower between 1990 and 2004 or even negative in the period 1980-2003.

Table 2

Annual average growth rate of the GDP per capita: comparison between Romania and other developed countries and groups of countries (%)

	1980-2003	1990-2004	2001/2000	2002/2001	2003/2002	2004/2003
Romania	-0.6	1.3	6.2	5.5	5.5	8.7
Developed economies	2.1	1.9	0.7	0.7	1.5	1.9
EU 15	1.9	1.8	1.4	0.7	0.5	1.9
France	1.6	1.5	1.7	0.8	0.0	1.9
Germany	1.8	1.2	0.7	0.0	-0.2	1.5
USA	2.1	2.2	-0.2	0.9	2.1	3.2
Poland	1.8	4.1	1.1	1.4	3.9	5.4
Hungary	1.0	2.7	4.1	3.8	3.2	4.5

Source: UNCTAD, *Handbook of Statistics*, 2005.

* GDP calculated on the basis of the PPP.

Although the analysis and forecast calculations require long series of data, we consider it is unreasonable to use for Romania the 1980-2000 data, since the two decades are non-typical as regards the economic continuity and stability. In that period Romania's economy was in a profound and long crisis, when, on the one hand, the centralized system showed (in the 1980's) inefficiency and no capability to innovate and adapt and, on the other hand, the transition to a new system (in the 1990's) consisted in a general profound restructuring of the entire economy (the technological and organizing system, the property system, the economic and social management, the institutions, etc.), which caused a major failure of the national economic system. The changes began to produce good results since 2000, when the stability and functioning of the economy were achieved on the basis of the new principles[7]. Therefore, we firmly support the idea that for the convergence scenarios and calculations one should consider, in the case of Romania, the growth rates from 2000 on, as they are significant and credible for the future evolution of Romania's economy, when it began a normal development.

3.2. The assessment of the time required for convergence

The most frequent question concerning the economic growth convergence refers to the length of the process. Specifically, when we analyse the convergence of the real economies of Romania and the EU, the first thing to be clarified is the length of the period necessary to achieve the future balance between Romania's annual average income per capita (Y_R) and the EU15 one (Y_E).

The initial level of the GDP per capita (expressed by the PPP in euros) of the two entities (Y_{oR} and Y_{oE}) is characterized by a significant difference. In 2004, the ratio of Y_{OR} to Y_{OE} was 1 : 3.4. The balance may occur in a reasonable period of time, only if Romania is able to achieve annual average growth rates per capita ($\overline{r_R}$) much higher than those achieved by the EU ($\overline{r_E}$), that is $\overline{r_R} > \overline{r_E}$.

To assess the convergence period we start with the simple relations concerning the GDP per capita growth of the two entities with different initial levels and annual average growth rates:

$$Y_{tR} = Y_{OR}(1+\bar{r}_R)^t \tag{4}$$

$$Y_{tE} = Y_{OE}(1+\bar{r}_E)^t . \tag{5}$$

[7] Once again M. Olson's thesis that national economic systems naturally follow long life cycles is confirmed. After a long functioning period, the institutions, the mechanisms and the social relations become rigid and do not respond to changes, which seriously affects the efficiency of the economic processes. The institutional restructuring offers the opportunity for changing the economic growth by adaptation and innovation (Mancur Olson, 1982, *The Risk and Decline of Nations, Economic Growth Stagflation and Social Rigidities*, Yale University Press, New Haven).

The convergence is achieved when the values of the two relations become equal according to the relation (6):

$$Y_{OR}(1+\bar{r}_R)^t = Y_{OE}(1+\bar{r}_E)^t \quad (6)$$

And the curves Y_{tR} and Y_{tE} meet in the balance point t^* (steady state), according to Figure 3:

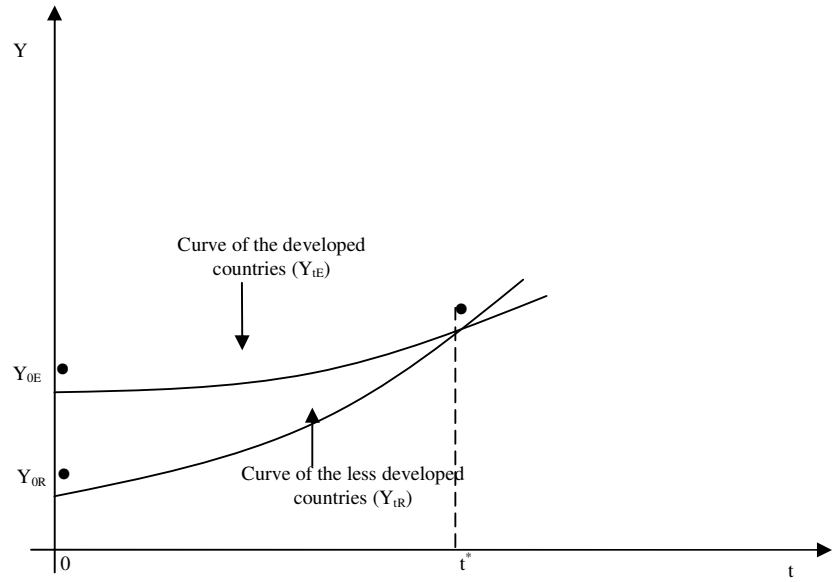


Figure 3. The convergence of the economic growth curves of the developed countries (Y_{tE}). and the less developed countries (Y_{tR}) in the balance point t^*.

By logarithmating and rearranging the terms, one may assess the period of time (t) when the convergence (balance) of the GDP per capita of the two entities is achieved:

$$t = \frac{log\, Y_{OE} - log\, Y_{OR}}{log(1+\bar{r}_R) - log(1+\bar{r}_E)} \quad (7)$$

Using this formula, we may calculate the period of time (in years) when Romania can catch up (as regards the GDP per capita calculated by the PPP in euros) with the EU 15 and two EU leaders: France and Germany. Catching up with the developed countries is achieved due to the higher growth rates in 2000-2004, namely when the restructuring effects occurred and the system began to function on the basis of the new principles and in the new external context.

Table 3 includes the data used in the calculation formula (initial GDP per capita and the annual average growth rates) and the results representing the number of years required to achieve convergence with the EU 15, France (Fr) and Germany (Ge), in relation to Romania's annual average growth rates, considered as alternatives ($\bar{r}_{R1} = 4\%$; $\bar{r}_{R2} = 5\%$; $\bar{r}_{R3} = 6\%$; $\bar{r}_{R4} = 7\%$; $\bar{r}_{R5} = 8\%$), similar in size to the 2001-2004 ones.

Table 3

Forecasting the number of years to achieve the convergence of Romania and the EU 15, France and Germany in relation to the GDP per capita calculated by the PPP in euros

Initial GDP per capita (2004)		Annual average growth rates of the EU 15 and EU countries (France and Germany)*), 1990-2004	Number of years(t) to achieve the convergence of alternative annual average growth rates in Romania** ($\bar{r}_{R1}$.....$\bar{r}_{R5}$)				
UE 15 and leading countries (France and Germany)	Romania		4%	5%	6%	7%	8%
$Y_{OUE} = 24600$	$Y_{0R} = 7300$	$\bar{r}_{UE} = 1.8\%$	57	39	30	24	20
$Y_{OFr} = 24800$	$Y_{0R} = 7300$	$\bar{r}_{Fr} = 1.5\%$	50	36	28	23	18
$Y_{OGe} = 24600$	$Y_{0R} = 7300$	$\bar{r}_{Ge} = 1.2\%$	45	33	26	22	16

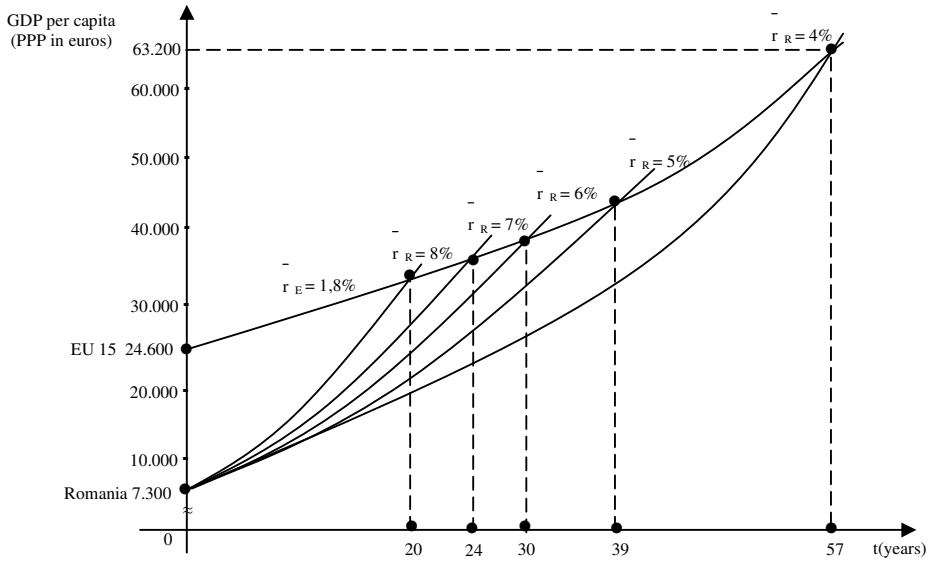
*) The annual average growth rates of the GDP per capita between 1990-2004.

**) As regards Romania, the five rate alternatives (4%; 5%; 6%; 7%; 8%) are within the variation range of the same over the period 2000-2004.

Source: Calculation based on Eurostat and UNCTAD data, *Handbook of Statistics*, 2005.

According to the Table data, at an annual average growth rate of 4%, Romania would need 57 years to reach the EU 15 level, 50 years to reach France's level, and 45 years to reach Germany's level. At a growth rate of 7%, the number of years to achieve convergence would diminish to less than half, *i.e.*, 24 years with EU 15, 23 years with France and 22 years with Germany, and at a rate of 8%, convergence requires 20 years with EU 15, 18 years with France and 16 years with Germany.

The dynamics of the GDP per capita points of convergence of Romania and the EU 15 in relation to Romania's average growth rates as against the EU rate is shown in Figure 4, where the abscissa contains the time (number of years) necessary to achieve the convergence, and the ordinate indicates the evolution of the GDP per capita in Romania, as given by the five alternatives of annual average rates.



Source: Own calculation based on the 3 tables and Eurostat data.

Figure 4. The dynamics of convergence between Romania and the EU, in relation to the GDP per capita by size of the annual average growth rates in Romania

At a 4 percent growth rate of Romania's economy and the 1.8 percent one of the EU 15, the convergence point (curve intersection) of the two entities will be achieved at a GDP per capita of about 63200 euros, that is 57 years, and a rate of 8% for Romania and 1.8% for the EU 15, the convergence of the two entities will be achieved at a GDP per capita of about 34500 euros, that is 20 years.

3.3. The σ-convergence

The measurement of convergence may be made by means of analytical tools and indicators, able to reveal the difference diminution (dispersion of the phenomenon) as against the average, or the gradual diminution in the difference between two or more time series:

$$lim_{t\to\infty}(x - y) = a \tag{8}$$

The diminishing difference between the two variables is measured by either the stochastic principle or the non-stochastic one.

A frequently used indicator for the convergence measurement is the variation coefficient of the GDP per capita denoted by σ and calculated as follows:

$$\sigma_t = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(X_{it} - \overline{X}_t)^2} \,/\, \overline{X}_t \qquad (9)$$

This indicator is also known as σ-convergence[8], first used by Sala-i-Martin, along with β-convergence. It may be used to characterize the convergence level by measuring the dispersion of the GDP per capita in a year, by means of the cross-section series (countries and regions). In this case, the relevance of the convergence indicator occurs only when comparisons are made. To characterize the convergence evolution (trend), time series (a discrete time interval, t and $t+T$) are used. When the phenomenon dispersion decreases over a period of time (when the indicator value diminishes over time), it means that convergence takes place, $\sigma_{t+T}<\sigma_t$, and when the dispersion increases, it means that divergence takes places, $\sigma_{t+T}>\sigma_t$.

We used this indicator in our study to measure the level and evolution of the real convergence of the EU member countries by the three groups, EU 25, EU 15 and EU 10[9] – and the two GDP expressing alternatives: purchasing power parity and exchange rate. Due to the non-availability of data on some countries included in the panel (especially those which joined the EU recently), the time series was reduced to 12 years (1995-2006), of which the 2006 data are estimated.

Table 4 includes the results of the calculations by the two modes of expression (PPP and exchange rate) and the three groups of countries, EU 25, EU 15 and EU 10 in relation to the σ-convergence indicator. The alternative calculated by the PPP in euros is presented graphically in Figure 5.

To express visually the tendency of the analysed phenomenon, we present graphically (Figure 6) the primary data used to calculate the σ-convergence, namely, the evolution of the dispersion of the GDP per capita (expressed in PPP in euros) for 27 EU countries. The graph excludes Luxembourg and includes Romania, Bulgaria and Turkey beginning with the years on which data expressed in PPP in euros (1999 for Romania) are available.

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[8] In their papers, Barro and Sala-i-Martin used for the measurement of the convergent σ indicator the standard deviation calculated by the formula: $\sigma = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left[\log\left(\frac{y_i}{y^*}\right)\right]^2}$, $\log y^* \equiv \frac{1}{n}\sum_{i=1}^{n}\log y_i$ (Karl-Johan Dalgaard, Jacob Vastrup, "On the measurement of σ-Convergence", *Economics Letters*, 70 (2001) 283-287). Other authors use either the variation coefficient (e.g., Milton Friedman, *Do Old Fallacies Ever Die*, JEL, 30, 4, 1992), or both indicators.

[9] It consists of the ten countries that joined the EU in 2004.

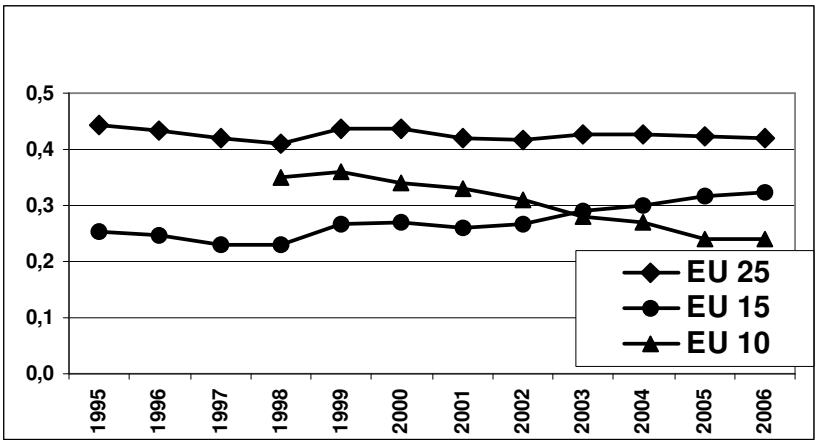
Table 4

The numerical evolution of the σ-convergence (the variation coefficient of the GDP per capita), EU 25, EU 15 and EU 10

Years	Calculated by PPP			Calculated by exchange rate		
	EU 25	EU 15	EU 10	EU 25	EU 15	EU 10
1995	0.44	0,25	.....	0.71	0.38	.....
1996	0.43	0.25	.....	0.68	0.36	.....
1997	0.42	0.23	.....	0.65	0.33	.....
1998	0.41	0.23	0.35	0.64	0.33	0.81
1999	0.44	0.27	0.36	0.66	0.35	0.86
2000	0.44	0.27	0.34	0.65	0.35	0.77
2001	0.42	0.26	0.33	0.63	0.34	0.67
2002	0.42	0.27	0.31	0.63	0.35	0.66
2003	0.43	0.29	0.28	0.63	0.36	0.69
2004	0.43	0.30	0.27	0.63	0.36	0.64
2005	0.42	0.32	0.24	0.62	0.37	0.55
2006[x)]	0.42	0.32	0.24	0.62	0.39	0.51

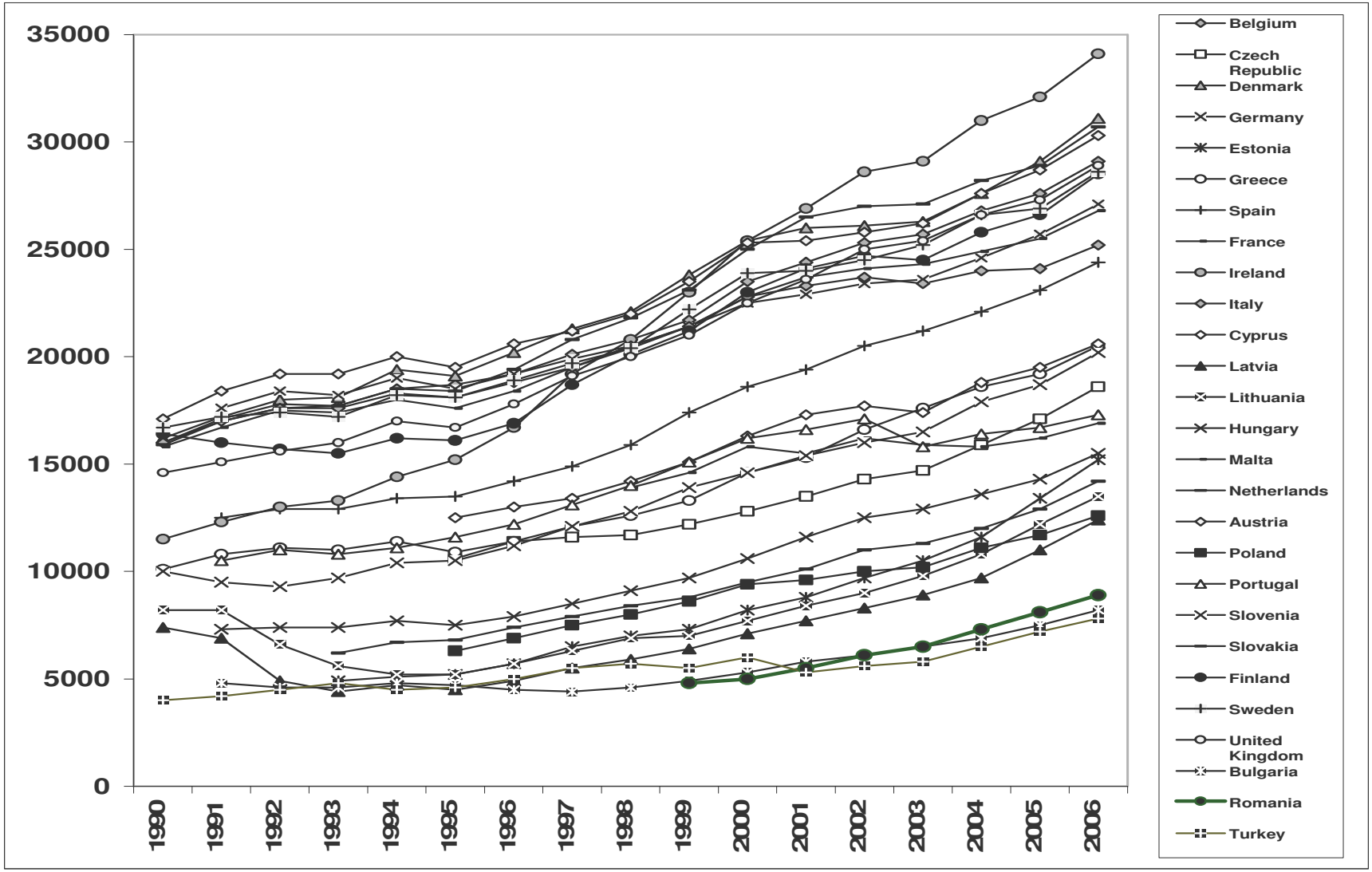
[x)] Estimated data.

Source: Based on Eurostat data.



Source: Based on Eurostat data.

Figure 5. The σ-convergence (the variation coefficient) calculated by the GDP per capita (PPP in euros).



Source: Based on Eurostat data.

Figure 6. The evolution of the GDP per capita (PPP in euros) of the twenty-eight EU member and applicant countries, 1990-2006.

Analysing the data from Table 4 concerning the numerical evolution of the σ-convergence, as well as the curves drawn in Figures 5 and 6, we may draw some important conclusions:

(1) The evolution of the indicator concerning the variation coefficient of the GDP per capita of the EU 15 countries (σ) shows some growth for both calculation alternatives (PPP and exchange rate), which means an ascending trend in the divergence of this group of economies.
(2) As for the enlarged group, EU 25, we find a slight decrease in the variation coefficient for both calculation alternatives (PPP and exchange rate), that is, as a whole, a convergent growth owing to the EU 10 group.
(3) There is a significant difference between EU 25 and EU 15 in the level of the variation coefficient of the GDP per capita calculated by the exchange rate, as against the level of the same indicator calculated by the PPP. It means that the less developed EU member countries, especially those that joined the EU in 2004, had and still have significantly underappreciated national currency, which strongly influence the high dispersion degree of the economies. The appreciation of the national currency along with the integration significantly diminishes the dispersion degree, calculated by the exchange rate, that is the diminution from 0.71 in 1995 to 0.62 in 2006 and, implicitly, in the difference between the two types of expression.
(4) The evolution of the dispersion of the GDP per capita (Figure 6) for 27 countries shows the formation, within the enlarged EU, of three groups of countries, each with specific features , but also the real opportunity for the less developed countrys to achieve higher development levels. Considering the growth rate in the last five years and the available resources, Romania is one of the most dynamic European economies, able to achieve the convergent growth.

3.4. The β-convergence

Besides the σ indicator expressed by the variation coefficient or standard deviation, there were strong concerns to develop the methodological apparatus for the study of the convergence. Among them, it is worth mentioning the econometric research of various statistical cross-section or time series to reveal, by means of the regression equations and estimated trend, the convergence or divergence trend in the evolution of the economies in the world, EU and OECD.

A major role in the econometric research is played by the estimation and interpretation of the β parameter of the regression equation of economic growth.

3.4.1. Conceptual and methodological aspects

Although contested by some economists (Friedman, 1992; Quah, 1993) for being irrelevant for the real convergence of economic growth[10], the concept of β-

[10] Friedman points out that, according to the definition, the indicator of the β-convergence could be replaced with the variation coefficient of the distribution of the GDP per capita among countries/regions, that takes into account the inter-temporal changes in the GDP per capita among the countries. Quah shows that this indicator is subject to Galton's failure. He stresses that the convergence analysis is just what the dynamics of the income distribution reveals. Quah's

convergence plays a significant role in the literature. It is even indispensable as an econometric calculation and analysis tool for the description of this process when it is considered either in its simple initial form (absolute β-convergence) or the developed form (conditional β-convergence).

The determination of the β-convergence indicator does not exclude or replace the σ-convergence indicator. They are linked or related and, as we shall see, they verify one another.

If, according to the neoclassical theory of the decreasing rate of return on capital, we agree with the idea that poor economies tend to grow faster than rich ones, it means, on the one hand, a gradual diminution in the dispersion coefficient of the GDP per capita ($\sigma_{t0+T}<\sigma_{t0}$) and, on the other hand, a reverse relation between the rate of the GDP per capita growth within a time interval (t_0 and t_0+T) and the initial level of the GDP per capita (year t_0).

$$\frac{1}{T}log\left(\frac{y_{i,t_0+T}}{y_{i,t_0}}\right)=a-\left(\frac{1-e^{-\beta T}}{T}\right)log(\,y_{i,t0}\,)+\varepsilon_{i,t_0,t_0+T} \tag{10}$$

This relation is a theoretical hypothesis that is to be econometrically tested on the basis of the statistical data on a representative sample of countries.

The tendency of the poor countries to catch up with the rich ones is reflected both by the diminution in the dispersion degree of the GDP per capita among the countries and by the negative sign of the annual rate of *β*-convergence of the GDP per capita of the sampled countries, as they reach the steady state[11] at the same time.

Following the testing, between the two indicators, *σ* and *β,* the following three combinations (C) may occur during period *T*:

C_1	**C_2**	**C_3**
$\sigma_{t0+T} < \sigma_{t0}$ (convergence)	$\sigma_{t0+T} > \sigma_{t0}$ (divergence)	$\sigma_{t0+T} \gtrless \sigma_{t0}$ (divergence, standstill, convergence)
- β (convergence)	+ β (divergence)	± β (divergence or convergence)
Decreasing distance between the development levels of the economies in period T	Increasing distance between the development levels of the economies in period T	Within period T, the decrease and increase in the distance between the development levels of the economies may take place successively

convergence test, using Markov's chain for the intertemporal transition model of the income distribution, could control the dynamics of the entire distribution of the income of all countries. Friedman and Quah show that the regression model could wrongly indicate the presence and expansion of the β-convergence (G.E. Boyle and T.G. McCarthy, "A Simple Measure of β-Convergence", *Oxford Bulletin of Economics and Statistics*, 59, 2 (1997), p. 257-258).

[11] The negative sign of the β parameter is the expression of the reverse relation between the annual average growth rate of the GDP per capita over the period *T* and the initial level of the GDP per capita in the year t_0.

In the case of the combination C_3 within the period T, oscillations or even reversals of the levels of the GDP per capita may occur in relation to the poor (S) and rich countries (B) included in the panel (Figure 7).

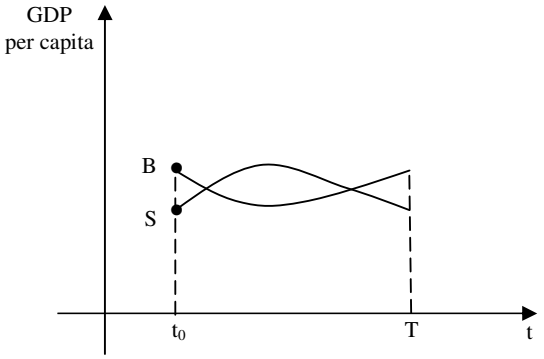


Figure 7. Possible evolution of the GDP per capita of the poor countries (S) in relation to the rich ones (B) in period T.

Considering the above-mentioned comments on the relations between the σ and β indicators, we may conclude: 1) A necessary condition for convergence is the existence of the β-convergence; 2) Although necessary, the β-convergence is not a sufficient condition for the σ-convergence.

The β indicator, estimated by the regression equation, expresses the rate of convergence of the countries towards the steady state. It considers the income mobility within the same distribution (dispersion) which is considered by the σ-convergence in relation to their evolution over time[12].

The concept of β-convergence, generated by the analysis of the regression of the development level of the countries/regions, may take three basic forms, depending upon the depth of the analysis and the degree of compliance with the economic realities within the range allowed by the neoclassical model of convergent growth: 1) absolute β-convergence; 2) β-convergence clubs; 3) conditional β-convergence.

Briefly speaking, these forms consist of the following:

1) *The absolute (unconditional) β-convergence* is the alternative that only takes into account the assumption of the high growth rates of the poor countries as against the rich ones, irrespective of the differentiated evolution of the sample countries regarding the determinants of growth over the entire period of time (*T*) of the data used for the regression calculation. Since in this period of time there are significant technological, institutional, behavioural

[12] Xavier Sala-i-Martin, "Regional Cohesion: Evidence and Theories of Regional Growth and Convergence", *European Economic Review*, 40 (1996), p. 1326; G.E. Boyle and T.G. McCarthy, *op. cit.*, p. 258.

discrepancies between countries/ regions that affect the results, it is necessary to find those solutions that are based on realities, but not exceeding the limits of the neoclassical methodological area.

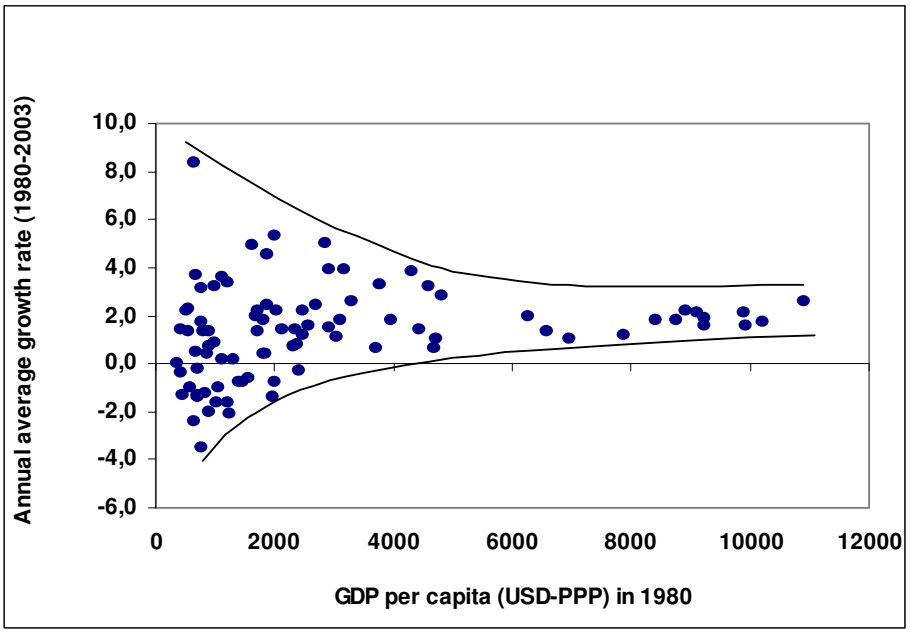
2) The easiest solution is *the β-convergence clubs,* which include in the studied panel the countries/regions that show some technological, institutional and economic policy homogeneity, etc. The key assumption accepted for this solution requires that the same group should not show significant initial differences among the countries/regions of the club as regards the GDP.

3) Another solution is the *conditional β-convergence,* that takes into account the vector of the determinants of the growth as additional variables that define the differences among the economies that stand proxy for the achievement of the steady state by introducing in the regression equation some variables that keep a constant balance of the economies.

Further, we try to test the first two forms of convergence. The third form, the conditional β-convergence, will be discussed in a separate study. Since the neoclassical model of convergence, on which the (especially, absolute) β-convergence is based, takes into account the assumption concerning the decreasing rate of return to capital, in the final part of our study we try to test this hypothesis by calculating the relation between the investment rate of return and the countries' development level. It is an important scientific factor that requires the testing of this key hypothesis validity in the present economic realities, to see to what extent we may count on the neoclassical model of the absolute (unconditional) β-convergence and why the model should be reviewed or modified.

3.4.2. Econometric estimations

The empiric research helps us test the β-convergence assumption. Considering the controversies regarding this indicator, we try to improve the sample by increasing the number of cases to 93 countries, extending the data series on the annual average growth rates to 23 years (1980-2003), and taking into account the initial value of the GDP per capita in 1980. To ensure the data comparability among countries, we opted for the expression of the GDP per capita in USD-PPP for all countries. The regression equation calculation (10) is based on the data of Annex 1 concerning the annual average growth rates of the GDP per capita according to the UN statistics (UNCTAD, *Handbook Statistics 2005* - Chapter 7.2) and the GDP per capita of 93 countries expressed in USD-PPP, according to the World Bank Statistics. To see how the two indicators are correlated in the regression equation, we drew up the chart in Figure 8, where the ordinate includes the annual average growth rates between 1980-2003, and the abscissa includes the initial GDP per capita of the countries (1980).



Source: Based on Annex 1. data.

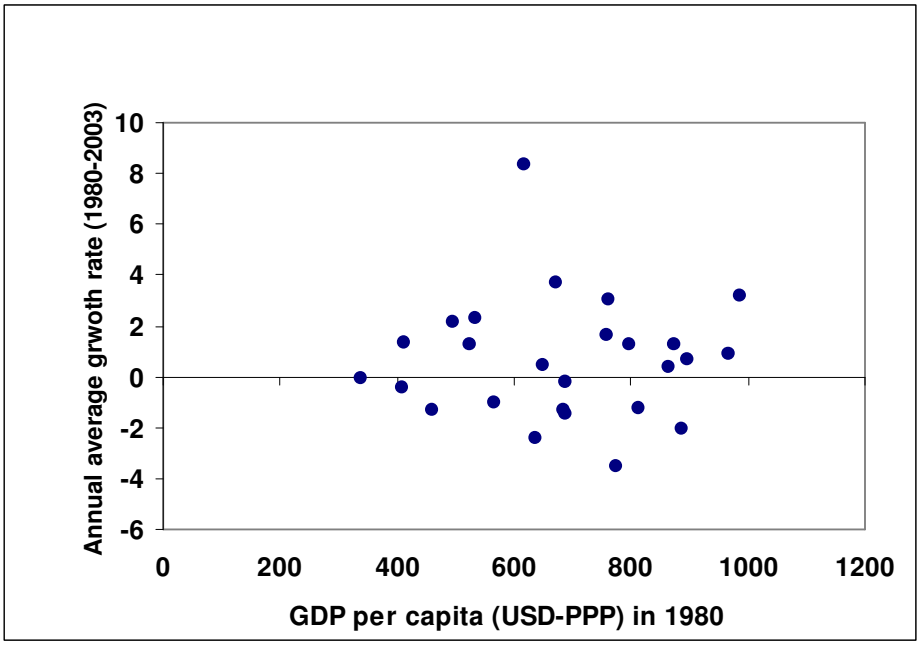
Figure 8. The annual average growth rate of the GDP (1980-2003) and the initial development level of the countries (1980).

The points where the two categories of indicators intersect are dispersed in a hardly definable way. They do not follow the trend implied by the neoclassical theory hypothesis concerning the higher rate of growth achieved by the poor countries. The data reveal a situation contrary to the expectations. For example, the regression calculation produced a β parameter of the initial explanatory variable with a positive sign (Table 5, column 1). The sign shows the absence of any convergence trend in the considered economies, which can be directly seen by the way the 93 points are distributed in Figure 8. Anyhow, the result is not surprising at all, if we take into account the significant discrepancies between the poor countries and rich ones as regards the presence and capability of the economic growth factors (physical and human capital, technological progress, institutional system, etc.) to generate higher economic growth rates, as well as the capability of the rich economies to absorb the foreign direct investments and to generate and assimilate new technologies[13].

[13] Even if the explanatory variable of the initial GDP per capita is replaced with a variable from the middle or the end of the series, the dispersion does not undergo any modification that might change the conclusions (Danny Quah, "Galton's Fallacy and Tests of the Convergence Hypothesis", *Scandinavian Journal of Economics*, 95(4), 1993, p. 433).

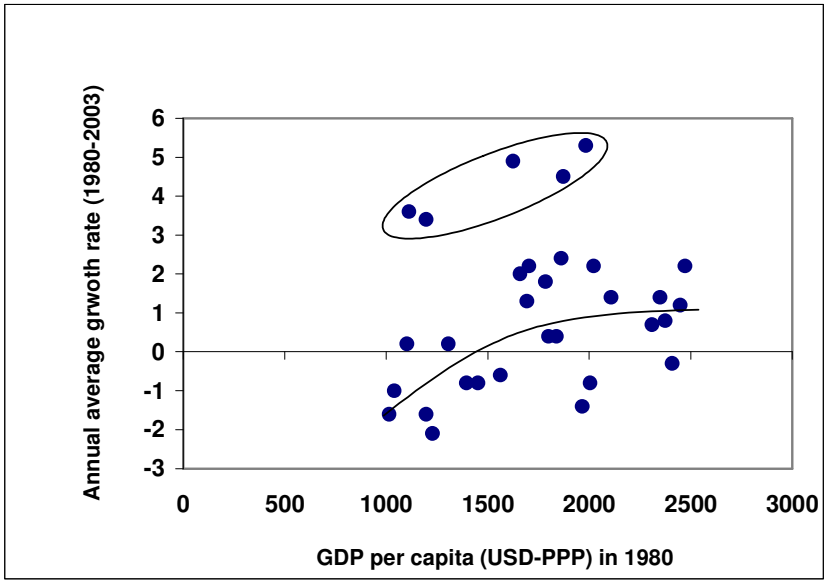
Although convergence of the countries as a whole is almost impossible to achieve, the convergence of countries/regions pertaining to groups of homogeneous economies with similar or close economic, technological and institutional structures is attainable. Following this hypothesis, we classified the countries by the size of the GDP per capita (1980), including the geographic criterion (in the case of the European countries), as follows: 26 countries with 340-1000 USD-PPP; 33 countries with 1001-2500 USD-PPP; 18 countries with 2501-5000 USD-PPP; 16 countries with 5001-13000 USD-PPP; 13 European countries. The data for the countries of each group concerning the annual average growth rates in 1980-2003, as well as the initial GDP per capita of 1980 are shown in Annex 1.

The data were used to draw up charts (Figures 9-13) revealing, for each panel, the distribution of the points as well as the trends described by the curves calculated and drawn on the same charts. Also, the same data and the regression equation (10) were used to calculate, also for each panel, the β parameter of the explanatory variable (the initial level of the GDP per capita in 1980), as well as other parameters. This parameter defines the β-convergence indicator.



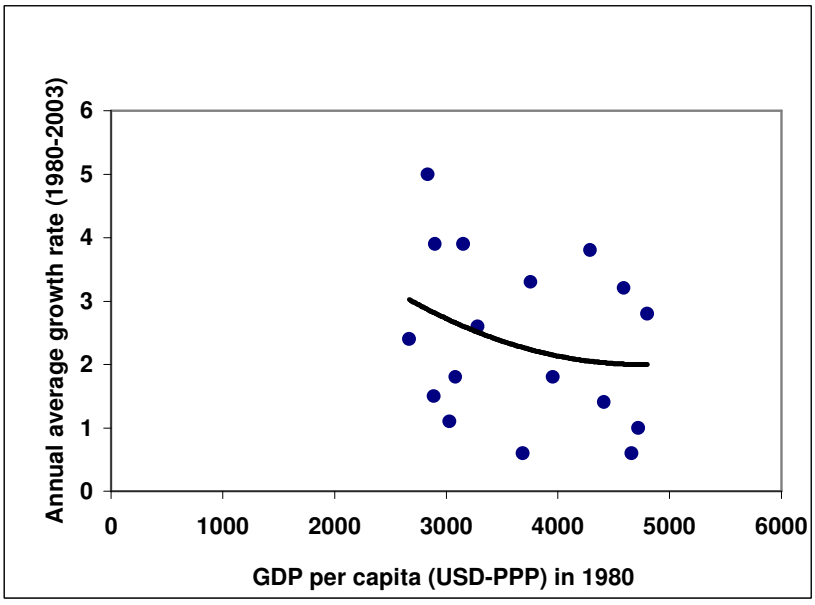
Source: Based on Annex 1. data.

Figure 9. The annual average growth rate of the GDP per capita (1980-2003) and the initial development level of the poorest country group, with a GDP per capita of 340-1000 USD-PPP (1980).



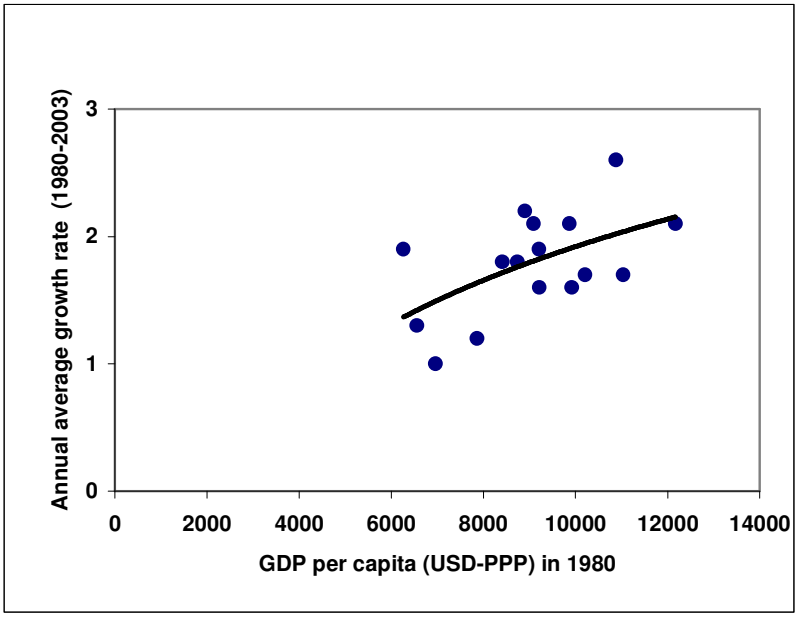
Source: Based on Annex 1. data.

Figure 10. The annual average growth rate of the GDP per capita (1980-2003) and the initial development level of the group of countries with a GDP per capita of 1001-2500 USD-PPP per capita (1980).



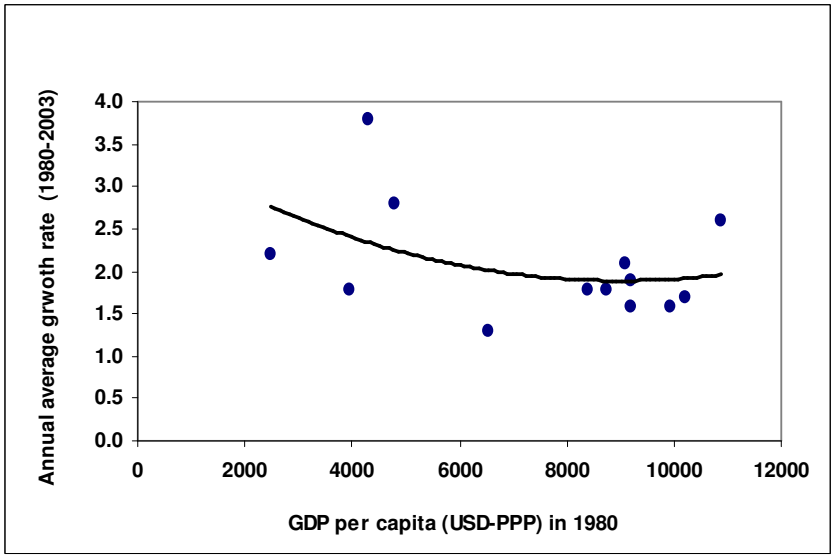
Source: Based on Annex 1. data.

Figure 11. The annual average growth rate of the GDP per capita (1980-2003) and the initial development level of the country group with a GDP per capita of 2501-5000 USD-PPP (1980).



Source: Based on Annex 1. data.

Figure 12. The annual average growth rate of the GDP per capita (1980-2003) and the initial development level of the country group with a GDP per capita of 5001-13000 (USD-PPP) (1980).



Source: Based on Annex 1. data.

Figure 13. The annual average growth rate of the GDP per capita (1980-2003) and the initial development level of some European countries (EU members, Norway and Turkey) (1980).

The β indicator as well as other estimated parameters are included in Table 5.

Table 5

The results of the regression calculation for all countries and groups of countries

Parameters	Total countries 93	of which:				
		26 countries, 340-1000 USD-PPP per capita	33 countries, 1001-2500 USD-PPP per capita	18 countries, 2501-5000 USD-PPP per capita	16 countries 5001-13000 USD-PPP per capita	13 European countries
A	1	2	3	4	5	6
β	0.584	0.256	1.876	-1.184	1.184	-0.548
Constant	-3.127	-1.002	-12.915	12.031	-8.985	6.925
R^2	0.084	0.001	0.068	0.040	0.302	0.146
r	0.289	0.030	0.261	0.199	0.549	0.382
t for β	2.852	0.148	1.458	-0.813	2.459	-1.373
St. Dev.	1.838	2.456	1.929	1.299	0.349	0.638

Source: Based on Annex 1. data.

Out of all six panels calculated and introduced in the table, only those referring to the group of European countries (column 6) and the country group with an initial GDP per capita of 2501-5000 USD-PPP (column 4) have a negative β parameter. The other four panels have a positive β parameter, which proves a divergent trend.

4. The rate of return to capital and the question of convergence

The regression calculation made above did not confirm the automatic convergence even in the panel case by virtue of the theoretical assumptions, according to which the less developed countries would reach in a natural way the more developed ones.

In the previous section, we found out that, following the econometric testing, the hypothesis concerning the β-convergence was not confirmed in most cases, when the same panel included the less and the more developed countries together. The first question to be answered in relation to the cause of the lack of convergence is whether the hypothesis of the decreasing rate of return to investment is confirmed. That is why we intend to test below the veracity of the assumption concerning the existence, under the present conditions, of the decreasing rate of return to capital or, in other words, the existence of the correlation between the rate of return to capital (investment in physical capital) and the countries' development level (per capita GDP). There are two categories of indicators for testing the world trend:

- Δ GDP, representing the per capita GDP growth in 2004 as against the previous year (2003), expressed in USD-PPP.
- The value of the investments in physical capital, per capita in 2003.

To ensure the calculation accuracy, the investment indicator has two alternatives dependent on the scope, namely:

- *gross investment per capita* resulted from saving (from accumulation and depreciation[*]);
- *total investment per capita,* consisting of gross investment to which the investment in physical capital from the international aid, investment from structural (solidarity) funds and FDI inflows should be added.

As investments produce effects with some delay, for the series of the two indicators – investment and production – a lag of one year, between 2003 and 2004, was considered.

The rate of return to the gross investment (RRGI) is defined as the per capita GDP increase per one physical capital growth unit (per one monetary unit of gross investment):

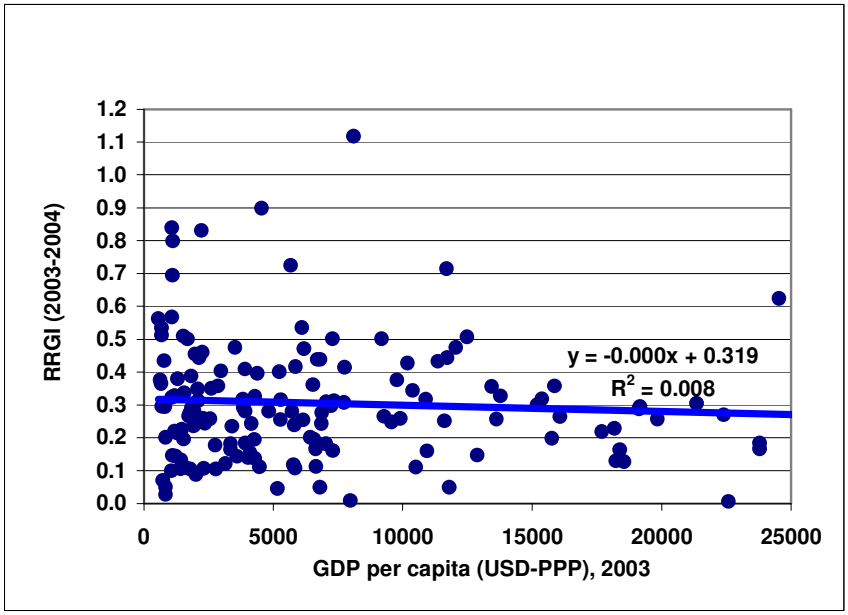
$$RRGI = \Delta \text{ GDP per capita/gross investment per capita}$$

To test econometrically the hypothesis concerning the descending trend of the rate of return along with the economic growth, we correlated the data regarding the indicator of the rate of return to the gross investment with the data regarding the indicator of the GDP per capita for a larger number of countries (Annex 2). The data concerning the two indicators specified in the above annex were used to draw up six charts, where the abscissa includes the GDP per capita (USD-PPP) of the countries in 2003, and the ordinate includes the rate of return of the gross investment calculated by the ratio of the GDP per capita in 2004 as against 2003 to the gross investment per capita from internal sources (accumulation and depreciation) in 2003 (RRGI).

To see to what extent the rate of return trend could be influenced by the specific policies and institutions of the countries, we drew up charts of the groups of countries selected by the level of the GDP per capita and geographical criteria:

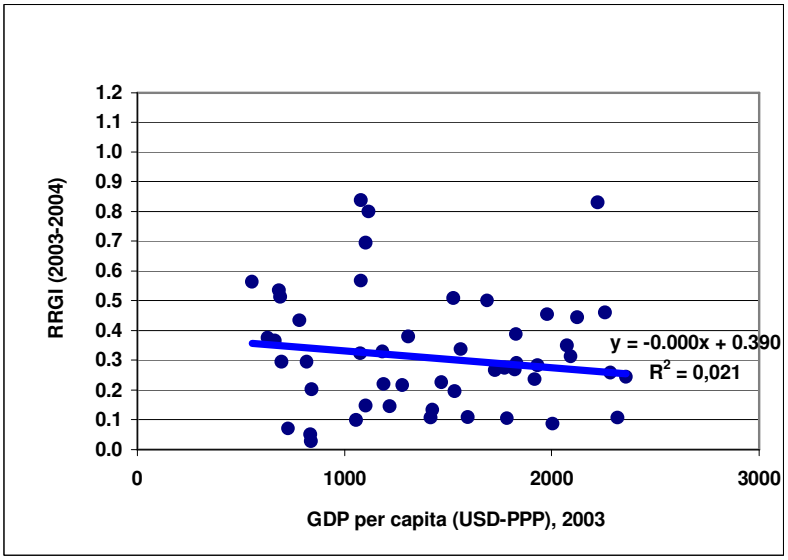
- A chart including all 180 countries on the UNO's and World Bank's records (Figure 14);
- Four charts of the countries grouped by the GDP per capita (Figures 15-18);
- Two charts of the European countries (Figure 19) and the EU member countries (Figure 20).

[*] This indicator corresponds to the notion of gross capital formation.



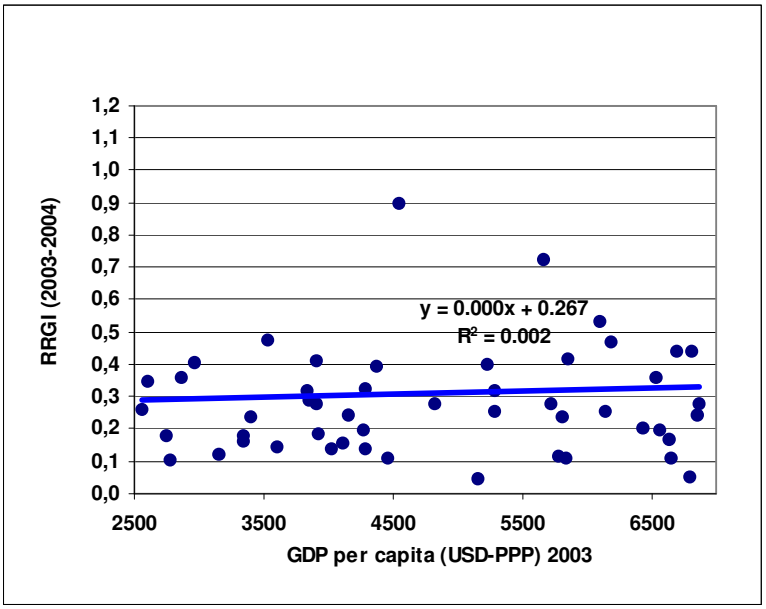
Source: Based on Annex 2. data.

Figure 14. The rate of return to the gross investment (RRGI) by the development level of the economies.



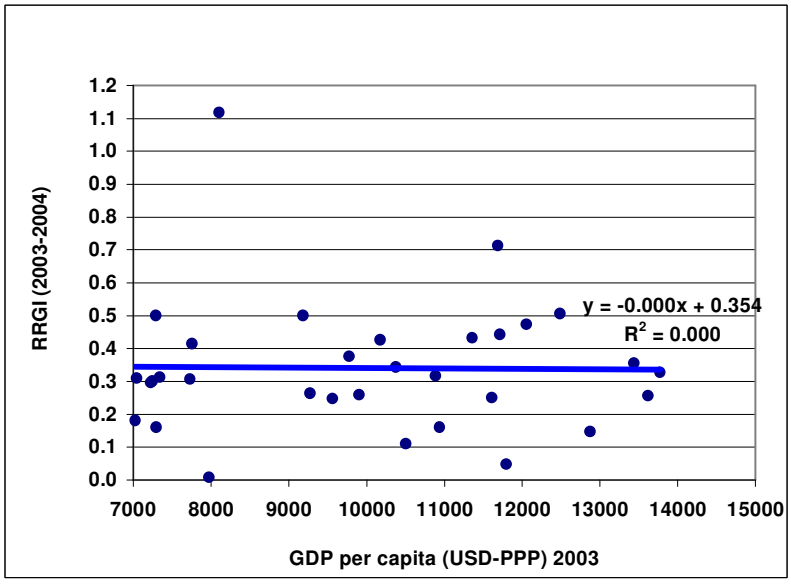
Source: Based on the Annex 2. data.

Figure 15. The rate of return to the gross investment (RRGI) of the countries with a GDP per capita of 550-2500 USD-PPP.



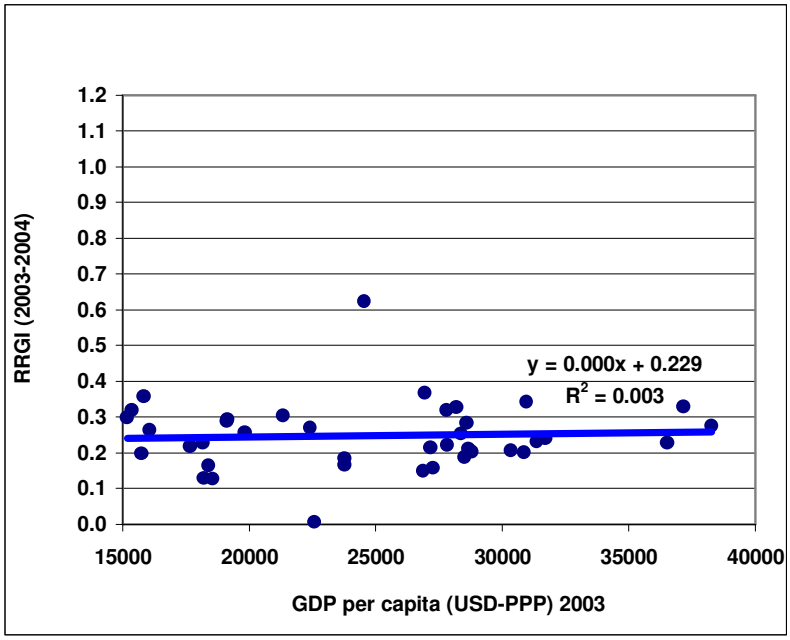
Source: Based on the Annex 2. data.

Figure 16. The rate of return to the gross investment (RRGI) of the countries with a GDP per capita of 2501-7000 USD-PPP.



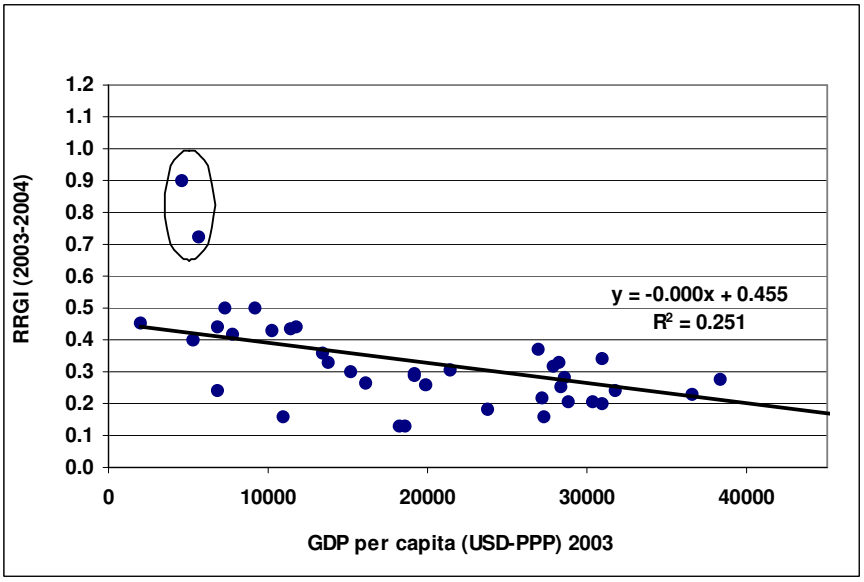
Source: Based on the Annex 2. data.

Figure 17. The rate of return to the gross investment (RRGI) of the countries with a GDP per capita of 7001-15000 USD-PPP.



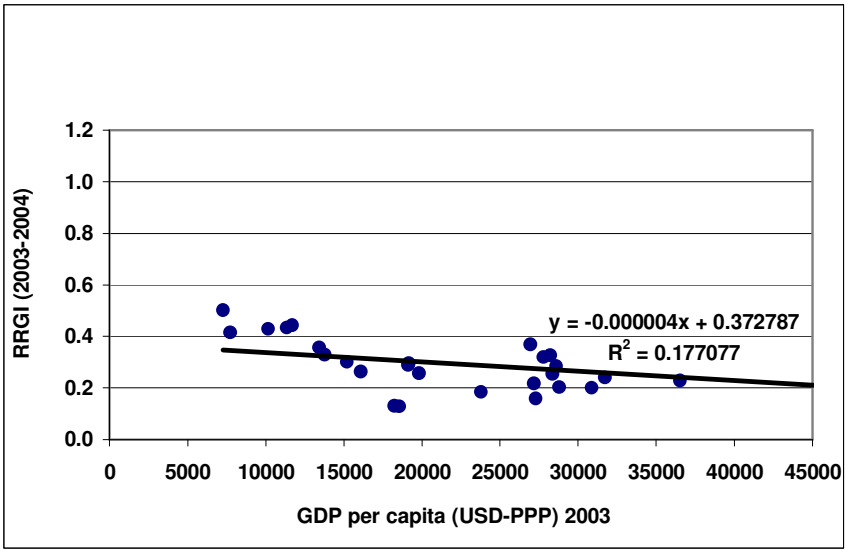
Source: Based on the Annex 2. data.

Figure 18. The rate of return to the gross investment (RRGI) of the countries with a GDP per capita of 15001- 40000 USD-PPP.



Source: Based on the Annex 2 data.

Figure 19. The rate of return to the gross investment (RRGI) of the European countries.



Source: Based on the Annex 2. data.

Figure 20. The rate of return to the gross investment (RRGI) of the EU member countries.

Each graph includes also the estimated parameters of the simple regression equations.

The graphical presentation and estimated parameters do not confirm for all panels the decreasing rate of return hypothesis. As for the European countries, with a slight decreasing trend of the return, the results should be viewed with a certain caution, since the less developed countries of this group, in 2003-2004, enjoyed an economic boom (high growth rates) after a deep recession.

The trend in the rate of return to the gross investment of the groups of countries with a higher GDP per capita (Figures 16-18) is ascendant, which, on the one hand, contradicts the old hypothesis of the neoclassical theory and, on the other hand, confirms the new hypothesis of the endogenous theory according to which the effects of the technological progress and human capital are stronger. Therefore, Romer (1986) and Lucas (1988) were right in their argumentation.

In the real economic life of the countries, the investments are not limited to the internal resources. There are also investments from foreign sources, such as the aid as investment in the physical capital granted to the poor countries by international organisations, investments in the solidarity or/and structural funds, as well as the FDI inflows received, in principle, by all countries, but, practically, in larger amount by the countries that offer comparative economic opportunities to investors and institutional, economic and political stability.

To see the extent to which these categories of investments influence in a way or other the above rate of return to capital trend, we considered the contribution of all investments from the two (internal and foreign) sources. On the basis of all investments, we calculated a new more comprehensive indicator called *the rate of*

return to the total investment (RRTI). This indicator, as an independent variable, is correlated with the development level of the countries (expressed as GDP per capita), as a dependent variable.

To compare the results obtained by the two ways of expressing the rate of return to capital, we drew up tables of the data series and the related charts, including all 180 countries and the groups of countries classified by the size of the GDP per capita and, separately, the European countries and the EU member countries.

The charts are based on the Annex 3 data. The results obtained by the rate of return to the total investment (RRTI) and included in Annexes 4-10 do not change significantly the results based on the above rate of return to the gross investment (RRGI), excepting European countries and EU member countries (see Figures 19-20).

5. Conclusions

Both the unconditional β-convergence and the decreasing returns to the physical capital are hypotheses concerning different growth rates, higher in the poor countries and lower in the rich ones, which ensure the proximity of the two categories of countries to one another and their joint transition to the steady state. Both hypotheses pertain to the neoclassical model that postulates the joint achievement of the convergence by the competitive market tools and places the investment in physical capital at the centre of the convergent economic growth.

What one should note is that the initial differences among countries refer not only to the GDP per capita and the physical capital stock, specified above, but also to the human capital and, especially, to its quality, to the scientific and technological stock, as well as to the institutional and cultural frameworks, and their evolution. The study of convergence should take into account these differences in the factors that, on one hand, require special costly investment that only a small number of countries (especially, the rich ones) may afford and, on the other hand, may cause stronger effects than the additional stock of physical capital may do. Moreover, one should also consider that, along with the market liberalisation and globalisation, there is an increasing mobility of the production factors (investment flows, scientific and technological competence, etc.) and, at the same time, their contribution to the economic growth increases, especially in the countries that have a higher economic, scientific and technological potential, are actively included in these international flows and take advantage of them.

In the EU case there is an explicit policy and practical actions to achieve real economic convergence by means of the cohesion funds set up for the less developed member and applicant countries less developed, and the structural funds for the elimination of the disparities among the EU regions.

As against the new general processes, the model of the unconditional β-convergence is not quite relevant, since the new requirements for the application of the model do not entirely cope with the above realities. Therefore, suitable convergence models are required to cope with the new realities.

ANNEXES

Annex 1

The annual average growth rate of the GDP per capita (1980-2003) and the initial GDP per capita

Country	Annual average growth rate of the GDP per capita (1980–2003)	GDP per capita (USD–PPP) in the initial year of the series (1980)
Guinea–Bissau	–0.6	338
Malawi	–0.4	406
Burkina Faso	1.4	411
Burundi	–1.3	457
Nepal	2.2	493
Mali	1.3	524
Bangladesh	2.3	532
Rwanda	–1.0	565
China	8.4	617
Haiti	–2.4	636
Benin	0.5	650
India	3.7	670
Madagascar	–1.3	683
Niger	–1.4	686
Kenya	–0.2	687
Pakistan	1.7	757
Lesotho	3.1	762
Sierra Leone	–3.5	773
Mozambique	1.3	797
Togo	–1.2	810
Senegal	0.4	862
Ghana	1.3	872
Zambia	–2.0	885
Nigeria	0.7	894
Mauritania	0.9	967
Sri Lanka	3.2	984
Congo	–1.6	1015
Sao Tome and Principe	–1.0	1040
Gambia	0.2	1102
Indonesia	3.6	1113
Cameroon	–1.6	1196
Cape Verde Islands	3.4	1197
Comoros	–2.1	1228

Honduras	0.2	1306
Angola	−0.8	1395
Zimbabwe	−0.8	1451
Côte d'Ivoire	−0.6	1563
Thailand	4.9	1625
Egypt	2.0	1659
Jamaica	1.3	1693
Granada	2.2	1704
Guyana	1.8	1785
Bolivia	0.4	1800
Philippines	0.4	1838
Santa Lucia	2.4	1862
Saint−Vincent and The Grenadines	4.5	1872
Nicaragua	−1.4	1965
Botswana	5.3	1984
Jordan	−0.8	2005
Dominica	2.2	2022
Papua New Guinea	1.4	2107
Guatemala	0.7	2310
Salvador	1.4	2350
Guinea	0.8	2375
Paraguay	−0.3	2409
Columbia	1.2	2449
Turkey	2.2	2473
Fiji	1.6	2568
Tunisia	2.4	2671
Saint−Kitts and Nevis	5.0	2834
Panama	1.5	2892
Malaysia	3.9	2903
Iran, Islamic Rep.	1.1	3027
Costa Rica	1.8	3081
Chile	3.9	3152
Belize	2.6	3283
Brazil	0.6	3687
Seychelles	3.3	3754
Poland	1.8	3957
Cyprus	3.8	4289
Uruguay	1.4	4412
Antigua and Barbuda	3.2	4593
Mexico	0.6	4660
Hungary	1.0	4718
Portugal	2.8	4801
Israel	1.9	6260

Greece	1.3	6557
Trinidad and Tobago	1.0	6960
New Zealand	1.2	7863
Italy	1.8	8413
Finland	1.8	8739
Japan	2.2	8903
Austria	2.1	9091
Belgium	1.9	9210
France	1.6	9214
Australia	2.1	9870
Sweden	1.6	9920
Denmark	1.7	10203
Norway	2.6	10879
Canada	1.7	11034
USA	2.1	12170

Source: IMF database (www.imf.org).

Annex 2

Rate of return to the gross investment (RRGI) of the national economies

Country	GDP per capita (USD–PPP) 2003	GDP per capita (USD–PPP) 2004	Δ GDP per capita (USD–PPP) (2004–2003)	Gross investment per capita, from internal sources (2003)	RRGI = ΔGDP per capita / Gross investment per capita (3 : 4)
(A)	(1)	(2)	(3)	(4)	(5)
Afghanistan	1079	1158	80	140	0.57
Albania	4105	4422	317	2053	0.15
Algeria	6431	6833	402	1994	0.20
Angola	2223	2463	240	289	0.83
Antigua and Barbuda	10508	11100	592	5359	0.11
Argentina	11688	12940	1253	1753	0.71
Armenia	3525	3943	418	881	0.47
Australia	28519	29859	1341	7130	0.19
Austria	30867	32232	1365	6791	0.20
Azerbaijan	3402	3810	408	1735	0.24
Bahamas	18386	19171	785	4780	0.16
Bahrain	17685	18576	892	4068	0.22
Bangladesh	1773	1890	117	426	0.28
Barbados	15860	16825	965	2696	0.36
Byelorussia	6105	6988	883	1648	0.54
Belgium	28603	30142	1539	5435	0.28
Belize	7228	7615	387	1301	0.30
Benin	1103	1135	32	221	0.15
Bhutan	3348	3629	280	1540	0.18
Bolivia	2607	2707	101	287	0.35
Bosnia Herzegovina	5232	5631	399	994	0.40
Botswana	9903	10674	771	2971	0.26
Brazil	7727	8202	475	1545	0.31
Brunei	23787	24143	356	2140	0.17
Bulgaria	7756	8464	708	1706	0.41
Burkina Faso	1191	1238	47	214	0.22
Burundi	664	701	36	100	0.37
Cambodia	2092	2256	164	523	0.31
Cameroon	2284	2361	77	297	0.26
Canada	31347	32798	1451	6269	0.23
Cape Verde Islands	5777	5968	191	1617	0.12
Africa Central	1077	1098	21	65	0.32

Chad	1104	1434	330	475	0.70
Chile	10379	11166	787	2283	0.34
China	5720	6425	705	2517	0.28
Columbia	6874	7216	342	1237	0.28
Comoros	1785	1828	43	411	0.11
Congo (Rep. Democrat)/Zaire	685	729	44	82	0.53
Congo (Republic)	1218	1258	41	280	0.14
Costa Rica	9566	10040	474	1913	0.25
Côte d'Ivoire	1415	1433	18	170	0.11
Croatia	10941	11469	527	3282	0.16
Cyprus	19135	20129	994	3444	0.29
Czechoslovakia	16074	17220	1146	4340	0.26
Denmark	31714	33239	1525	6343	0.24
Djibouti	1919	1991	72	307	0.24
Dominica	5809	6184	375	1568	0.24
Dominican Republic	6654	6841	187	1663	0.11
Ecuador	3844	4158	314	1076	0.29
Egypt	3911	4098	187	665	0.28
Salvador	4291	4391	100	730	0.14
Guinea Equatorial	12487	16536	4049	7992	0.51
Eritrea	835	850	16	317	0.05
Estonia	13440	14926	1485	4167	0.36
Ethiopia	691	769	78	152	0.51
Fiji	5858	6200	342	820	0.42
Finland	28199	29952	1752	5358	0.33
France	27175	28288	1113	5163	0.22
Gabon	6801	6902	101	2040	0.05
Gambia	1821	1914	93	346	0.27
Georgia	2971	3258	288	713	0.40
Germany	28356	29581	1225	4821	0.25
Ghana	2359	2498	138	566	0.24
Greece	19836	21161	1325	5157	0.26
Granada	7973	8007	35	3986	0.01
Guatemala	3920	4028	108	588	0.18
Guinea	1934	1988	55	193	0.28
Guinea−Bissau	696	723	27	90	0.30
Guyana	4460	4634	174	1561	0.11
Haiti	1798	1744	−54	234	−0.23
Honduras	2750	2887	137	770	0.18
Hungary	15196	16336	1140	3799	0.30
Island	30953	33072	2119	6191	0.34

India	2860	3095	236	658	0.36
Indonesia	3907	4163	256	625	0.41
Iran, Islamic Rep.	7027	7488	461	2530	0.18
Ireland	36538	38547	2009	8769	0.23
Israel	21347	22388	1041	3416	0.30
Italy	27274	28097	823	5182	0.16
Jamaica	4026	4195	169	1208	0.14
Japan	27811	29288	1476	6675	0.22
Jordan	4287	4609	322	986	0.33
Kazakhstan	6701	7464	763	1742	0.44
Kenya	1307	1372	65	170	0.38
Kiribati	2358	2339	−19	189	−0.10
Korea, Republic	18180	19430	1250	5454	0.23
Kuwait	15756	16038	282	1418	0.20
Laos, Popular Democrat Republic	1832	1966	133	458	0.29
Latvia	10177	11396	1219	2850	0.43
Libya	6146	6601	454	1782	0.25
Lesotho	2006	2083	77	883	0.09
Lithuania	11713	12856	1143	2577	0.44
Luxembourg	62554	66546	3992	13136	0.30
Macedonia, FYR	6860	7195	334	1372	0.24
Madagascar	817	856	38	131	0.29
Malawi	553	581	28	50	0.56
Malaysia	9778	10552	773	2053	0.38
Maldives	7048	7637	589	1903	0.31
Mali	1055	1082	26	264	0.10
Malta	18555	19100	545	4268	0.13
Mauritania	2124	2275	151	340	0.44
Mauritius	11609	12310	701	2786	0.25
Mexico	9272	9788	516	1947	0.27
Moldova, Republic	1978	2184	207	455	0.45
Mongolia	1828	2048	220	567	0.39
Morocco	4152	4394.499	243	996	0.24
Mozambique	1183	1288	105	319	0.33
Burma	1525	1610	86	168	0.51
Namibia	6633	6886	254	1526	0.17
Nepal	1532	1610	78	398	0.20
Holland	28788	29957	1169	5758	0.20
Dutch Antilles	22581	22617	37	5419	0.01
New Zealand	22402	23794	1391	5153	0.27

Nicaragua	3346	3516	171	1037	0.16
Niger	838	842	4	134	0.03
Nigeria	1080	1144	63	76	0.84
Norway	38273	40177	1903	6889	0.28
Oman	15379	16162	784	2461	0.32
Pakistan	2256	2432	176	384	0.46
Panama	6537	6986	449	1242	0.36
Papua New Guinea	2318	2365	47	440	0.11
Paraguay	4264	4431	166	853	0.20
Peru	5293	5611	318	1006	0.32
Philippines	4380	4674	295	745	0.40
Poland	11359	12293	934	2158	0.43
Portugal	18237	18782	544	4195	0.13
Qatar	28678	30566	1888	8890	0.21
Romania	7291	8132	841	1677	0.50
Russia	9183	10150	967	1928	0.50
Rwanda	1280	1329	50	230	0.22
Samoa	5835	6087	252	2333	0.11
Sao Tome and Principe	1425	1491	66	499	0.13
Saudi Arabia	13616	14281	665	2587	0.26
Senegal	1561	1661	100	297	0.34
Serbia and Montenegro	4543	4992	449	500	0.90
Seychelles	11796	11907	111	2241	0.05
Sierra Leone	782	840	58	133	0.43
Singapore	24536	26832	2296	3680	0.62
Slovakia	13775	14904	1129	3444	0.33
Slovenia	19161	20574	1413	4790	0.29
Solomon Islands	1727	1819	92	345	0.27
South Africa	10888	11476	589	1851	0.32
Spain	23788	25014	1226	6661	0.18
Sri Lanka	3829	4097	268	842	0.32
Saint Kitts and Nevis	12878	13771	893	6053	0.15
Santa Lucia	5281	5578	297	1162	0.26
Saint Vincent and the Grenadines	6566	7004	438	2232	0.20
Sudan	2075	2220	145	415	0.35
Suriname	5162	5363	201	4388	0.05
Swaziland	4826	5029	203	724	0.28
Sweden	26937	28524	1587	4310	0.37
Switzerland	30327	31583	1256	6065	0.21

Syria, Arab Republic	3604	3723	119	829	0.14
Tajikistan	1118	1261	143	179	0.80
Tanzania	629	674	45	120	0.38
Thailand	7344	7918	575	1836	0.31
Togo	1596	1635	39	351	0.11
Tonga	7299	7569	270	1679	0.16
Trinidad and Tobago	12057	13087	1030	2170	0.47
Tunisia	7246	7770	524	1739	0.30
Turkey	6807	7494	687	1566	0.44
Turkmenistan	6184	7321	1137	2412	0.47
Uganda	1468	1541	73	323	0.23
Ukraine	5667	6571	904	1247	0.72
United Arab Emirates	26871	27799	928	6180	0.15
United Kingdom	27789	29294	1505	4724	0.32
USA	37173	39377	2204	6691	0.33
Uruguay	8104	9282	1178	1054	1.12
Uzbekistan	1689	1833	144	287	0.50
Vanuatu	3146	3249	103	849	0.12
Venezuela	4815	5709	894	481	1.86
Vietnam	2553	2784	231	894	0.26
Yemen	728	736	8	109	0.07
Zambia	841	885	44	219	0.20
Zimbabwe	2776	2737	−38	−361	0.11

Source: UNCTAD Handbook of Statistics, 2005; *2006 World Development Indicators*, The World Bank; *World Development Report 2006, Equity and Development*, The World Bank and Oxford University Press; *Human Development Report 2005*, UN, Development Programme; International Monetary Fund, *Data and Statistics* (www.imf.org).

Annex 3

The rate of return to the total investment (RRTI) by the development level of the economies

Country	GDP per capita (USD–PPP) 2003	GDP per capita (USD–PPP) 2004	Δ GDP per capita (USD–PPP) (2004–2003)	Total investment per capita (USD), 2003	$RRTI = \frac{\Delta GDP\ per\ capita}{Total\ investment\ per\ capita}$ (3 : 4)
(A)	(1)	(2)	(3)	(4)	(5)
Afghanistan	1079	1158	80	140	0.568
Albania	4105	4422	317	2613	0.121
Algeria	6431	6833	402	2045	0.196
Angola	2223	2463	240	610	0.393
Antigua and Barbuda	10508	11100	592	7149	0.083
Argentina	11688	12940	1253	1803	0.695
Armenia	3525	3943	418	1373	0.305
Australia	28519	29859	1341	7483	0.179
Austria	30867	32232	1365	7698	0.177
Azerbaijan	3402	3810	408	2316	0.176
Bahamas	18386	19171	785	5270	0.149
Bahrain	17685	18576	892	4806	0.186
Bangladesh	1773	1890	117	467	0.251
Barbados	15860	16825	965	2890	0.334
Byelorussia	6105	6988	883	1682	0.525
Belgium	28603	30142	1539	8521	0.181
Belize	7228	7615	387	1494	0.259
Benin	1103	1135	32	327	0.099
Bhutan	3348	3629	280	1541	0.182
Bolivia	2607	2707	101	495	0.203
Bosnia Herzegovina	5232	5631	399	1545	0.258
Botswana	9903	10674	771	3267	0.236
Brazil	7727	8202	475	1606	0.296
Brunei	23787	24143	356	7163	0.050
Bulgaria	7756	8464	708	2176	0.325
Burkina Faso	1191	1238	47	376	0.126
Burundi	664	701	36	501	0.073
Cambodia	2092	2256	164	789	0.207
Cameroon	2284	2361	77	400	0.192
Canada	31347	32798	1451	6470	0.224

Cape Verde Islands	5777	5968	191	1645	0.116
Central Africa	1077	1098	21	93	0.226
Ciad	1104	1434	330	672	0.491
Chile	10379	11166	787	2557	0.308
China	5720	6425	705	2564	0.275
Columbia	6874	7216	342	1317	0.260
Comoros	1785	1828	43	412	0.105
Congo (Democrat Rep.) / Zaire	685	729	44	255	0.172
Congo (Republic)	1218	1258	41	464	0.087
Costa Rica	9566	10040	474	2054	0.231
Côte d'Ivoire	1415	1433	18	261	0.069
Croatia	10941	11469	527	3800	0.139
Cyprus	19135	20129	994	4708	0.211
Czech Rep.	16074	17220	1146	4609	0.249
Denmark	31714	33239	1525	6823	0.223
Djibouti	1919	1991	72	321	0.226
Dominica	5809	6184	375	1768	0.212
Dominican Rep.	6654	6841	187	1780	0.105
Ecuador	3844	4158	314	1224	0.256
Egypt	3911	4098	187	668	0.279
Salvador	4291	4391	100	824	0.121
Equatorial Guinea	12487	16536	4049	10854	0.373
Eritrea	835	850	16	742	0.021
Estonia	13440	14926	1485	5004	0.297
Ethiopia	691	769	78	320	0.244
Fiji	5858	6200	342	849	0.403
Finland	28199	29952	1752	5992	0.292
France	27175	28288	1113	5872	0.190
Gabon	6801	6902	101	2272	0.044
Gambia	1821	1914	93	610	0.152
Georgia	2971	3258	288	1016	0.283
Germany	28356	29581	1225	5151	0.238
Ghana	2359	2498	138	881	0.157
Greece	19836	21161	1325	5217	0.254
Granada	7973	8007	35	4836	0.007
Guatemala	3920	4028	108	629	0.172
Guinea	1934	1988	55	313	0.175
Guinea−Bissau	696	723	27	282	0.095
Guyana	4460	4634	174	1598	0.109
Haiti	1798	1744	−54	286	−0.188

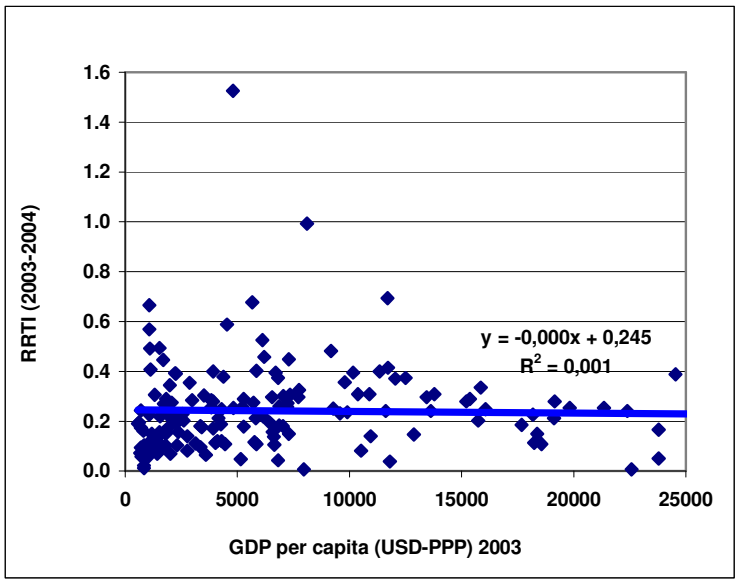
Honduras	2750	2887	137	989	0.139
Hungary	15196	16336	1140	4093	0.278
Iceland	30953	33072	2119	7251	0.292
India	2860	3095	236	667	0.353
Indonesia	3907	4163	256	639	0.400
Iran, Islamic Rep.	7027	7488	461	2544	0.181
Ireland	36538	38547	2009	15491	0.130
Israel	21347	22388	1041	4122	0.253
Italy	27274	28097	823	5465	0.151
Jamaica	4026	4195	169	1507	0.112
Japan	27811	29288	1476	6724	0.220
Jordan	4287	4609	322	1292	0.249
Kazakhstan	6701	7464	763	1930	0.395
Kenya	1307	1372	65	211	0.306
Kiribati	2358	2339	−19	189	−0.099
Korea, Republic	18180	19430	1250	5531	0.226
Kuwait	15756	16038	282	1392	0.203
Laos, Popular Democrat Republic	1832	1966	133	461	0.289
Leetonia	10177	11396	1219	3087	0.395
Libya	6146	6601	454	2067	0.220
Lesotho	2006	2083	77	1107	0.070
Lithuania	11713	12856	1143	2750	0.416
Luxembourg	62554	66546	3992	195246	0.020
Macedonia, FYR	6860	7195	334	1821	0.184
Madagascar	817	856	38	238	0.162
Malawi	553	581	28	147	0.190
Malaysia	9778	10552	773	2170	0.356
Maldives	7048	7637	589	1950	0.302
Mali	1055	1082	26	443	0.059
Malta	18555	19100	545	5003	0.109
Mauritania	2124	2275	151	704	0.214
Mauritius	11609	12310	701	2914	0.241
Mexico	9272	9788	516	2058	0.251
Moldova, Republic	1978	2184	207	600	0.345
Mongolia	1828	2048	220	915	0.240
Morocco	4152	4394	243	1139	0.213
Mozambic	1183	1288	105	702	0.150
Burma	1525	1610	86	174	0.493
Namibia	6633	6886	254	1841	0.138
Nepal	1532	1610	78	500	0.156

Holland	28788	29957	1169	6958	0.168
Dutch Antilles	22581	22617	37	5419	0.007
New Zealand	22402	23794	1391	5779	0.241
Nicaragua	3346	3516	171	1778	0.096
Niger	838	842	4	280	0.013
Nigeria	1080	1144	63	95	0.665
Norway	38273	40177	1903	7715	0.247
Oman	15379	16162	784	2707	0.289
Pakistan	2256	2432	176	451	0.391
Panama	6537	6986	449	1513	0.297
Papua New Guinea	2318	2365	47	458	0.103
Paraguay	4264	4431	166	891	0.187
Peru	5293	5611	318	1098	0.290
Philippines	4380	4675	295	781	0.378
Poland	11359	12293	934	2333	0.400
Portugal	18237	18782	544	4825	0.113
Qatar	28678	30566	1888	9783	0.193
Romania	7291	8132	841	1875	0.448
Russia	9183	10150	967	2011	0.481
Rwanda	1280	1329	50	497	0.100
Samoa	5835	6087	252	2339	0.108
Sao Tome and Principe	1425	1491	66	569	0.117
Saudi Arabia	13616	14281	665	2751	0.242
Senegal	1561	1661	100	454	0.220
Serbia and Montenegro	4543	4992	449	764	0.588
Seychelles	11796	11907	111	2821	0.039
Sierra Leone	782	840	58	616	0.094
Singapore	24536	26832	2296	5902	0.389
Slovakia	13775	14904	1129	3650	0.309
Slovenia	19161	20574	1413	5055	0.280
Solomon Islands	1727	1819	92	341	0.269
South Africa	10888	11476	589	1903	0.309
Spain	23788	25014	1226	7350	0.167
Sri Lanka	3829	4097	268	939	0.285
Saint Kitts and Nevis	12878	13771	893	6053	0.147
Santa Lucia	5281	5579	297	1672	0.177
Saint Vincent and the Grenadines	6566	7004	438	2782	0.157
Sudan	2075	2220	145	525	0.276
Suriname	5162	5363	201	4198	0.048

Swaziland	4826	5029	203	801	0.254
Sweden	26937	28524	1587	4453	0.356
Switzerland	30327	31583	1256	8366	0.150
Syria, Arab Republic	3604	3723	119	1808	0.066
Tajikistan	1118	1261	143	350	0.408
Tanzania	629	674	45	231	0.195
Thailand	7344	7918	575	1876	0.306
Togo	1596	1635	39	416	0.093
Tonga	7299	7569	270	1799	0.150
Trinidad and Tobago	12057	13087	1030	2781	0.370
Tunisia	7246	7770	524	1917	0.273
Turkey	6807	7494	687	1842	0.373
Turkmenistan	6184	7321	1137	2483	0.458
Uganda	1468	1541	73	535	0.136
Ukraine	5667	6571	904	1333	0.678
United Arab Emirates	26871	27799	929	6188	0.150
United Kingdom	27789	29294	1505	5066	0.297
USA	37173	39377	2204	6885	0.320
Uruguay	8104	9282	1178	1187	0.992
Uzbekistan	1689	1833	144	322	0.447
Vanuatu	3146	3249	103	924	0.112
Venezuela	4815	5709	894	586	1.526
Vietnam	2553	2784	231	1013	0.228
Yemen	728	736	8	135	0.057
Zambia	841	885	44	427	0.103
Zimbabwe	2776	2737	–38	–467	0.082

Source: UNCTAD Handbook of Statistics, 2005; *2006 World Development Indicators*, The World Bank; *World Development Report 2006***,** *Equity and Development,* The World Bank and Oxford University Press; *Human Development Report 2005*, UN, Development Programme; International Monetary Fund, *Data and Statistics* (www.imf.org).

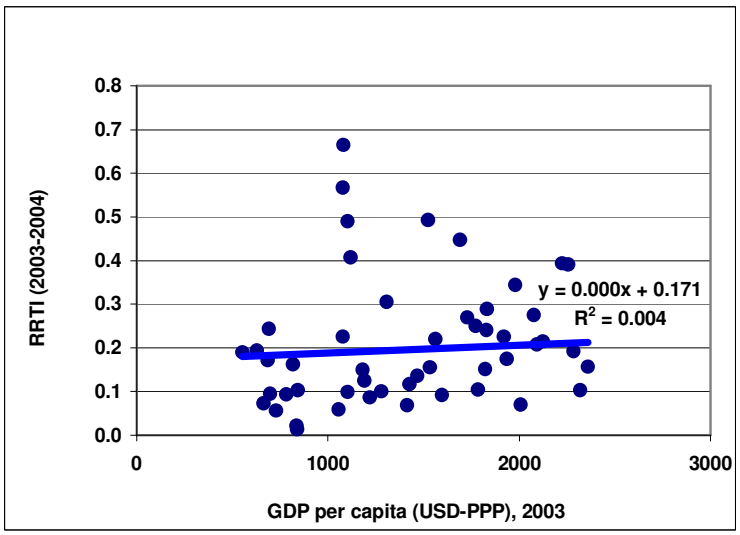
Annex 4



Source: Based on the Annex 3. data.

Figure 21. The rate of return to the total investment (RRTI) by the development level of the economies.

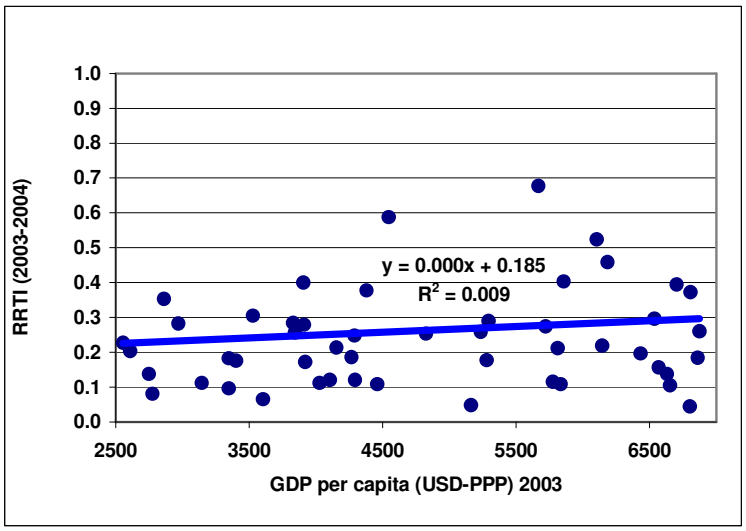
Annex 5



Source: Based on the Annex 3. data.

Figure 22. The rate of return to the total investment (RRTI) of the countries with a GDP per capita of 550-2500 USD-PPP.

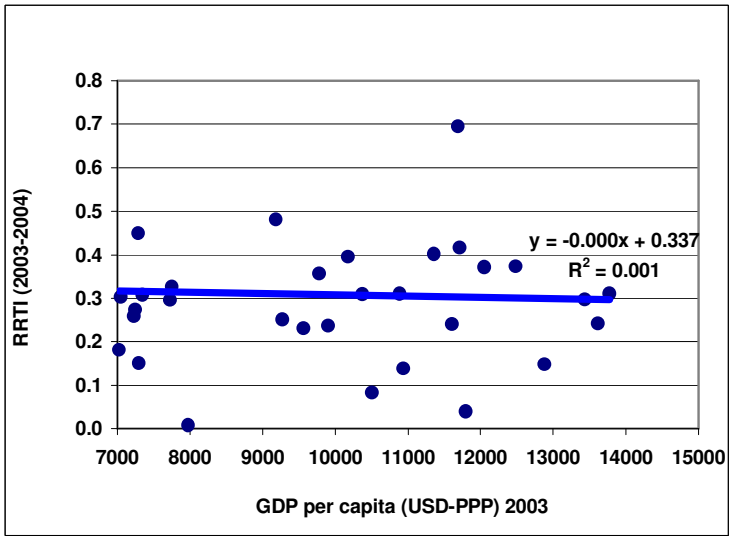
Annex 6



Source: Based on the Annex 3 data.

Figure 23. The rate of return to the total investment (RRTI) of the countries with a GDP per capita of 2500-7000 USD-PPP.

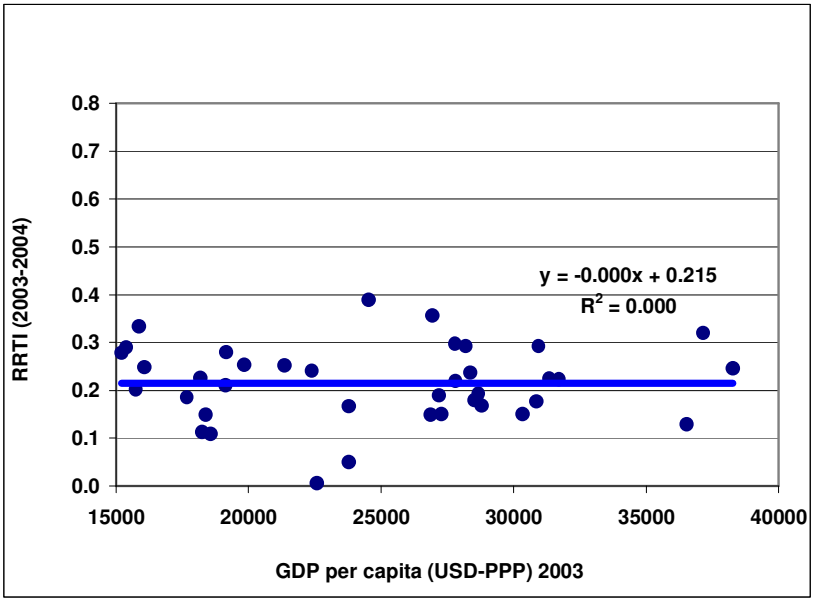
Annex 7



Source: Based on the Annex 3. data.

Figure 24. The rate of return to the total investment (RRTI) of the countries with a GDP per capita of 7001-15000 USD-PPP.

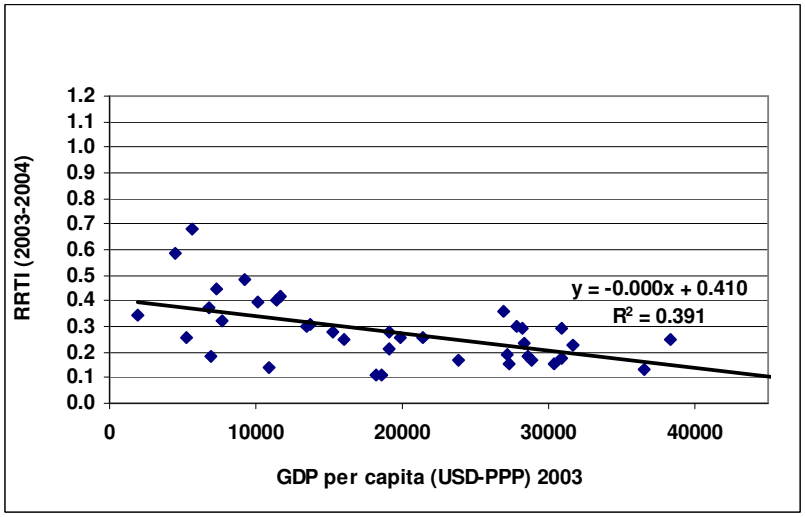
Annex 8



Source: Based on the Annex 3. data.

Figure 25. The rate of return to the total investment (RRTI) of the countries with a GDP per capita of 15001-40000 USD-PPP.

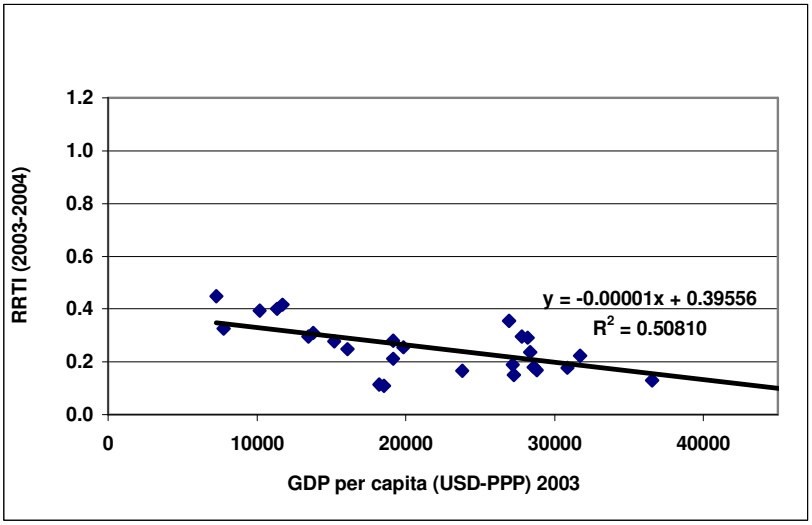
Annex 9



Source: Based on the Annex 3. data.

Figure 26. The rate of return to the total investment (RRTI) of the European countries.

Annex 10



Source: Based on the Annex 3. data.

Figure 27. The rate of return to the total investment (RRTI) of the EU member countries.

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