Convergence across transition countries. Bulgaria and Bulgarian districts as a case study.

By
Pavel Dokov

Submitted to
Central European University
Department of Economics

In partial fulfillment of the requirements for the degree of Master of Arts

Supervisor: Professor Alessia Campolmi

Budapest, Hungary
2008

Abstract

Convergence is a topic that is quite popular in development economics. There has been a great deal of research on this issue and specifically on convergence between and within post communist countries. This thesis has the aim to investigate the case of external (to the West) and internal (convergence of districts) convergence in Bulgaria. There is evidence of faster convergence for transition countries, compared to the developed ones in Europe. Results were also obtained for the convergence of the relative share of some GDP structures in Bulgaria. Positive trend of convergence was found for the gross value added of the following GDP structures: government expenditure, investments and gross value added of services, industry and agriculture and forestry. Neither convergence, nor divergence was found in the personal consumption GDP structure. For the Bulgarian districts was found divergence between the districts in the Southwest region (the one with the capital) and the other districts in Bulgaria.

Table of Contents

1. Introduction

Convergence is a topic that is quite popular in development economics. It is not only related to the problem of catching-up of poor economies to rich ones, but also to different growth models and their validity and application in the real world. The study of convergence can give answers to key economic questions, like: what force is driving the faster growth of poorer countries? Or what are the necessary conditions for a country to achieve higher growth and converge to its richer neighbors?

There has been a great deal of research on this issue and specifically on convergence between and within post communist countries. Authors present different results depending on the methods they use. Barro (1996), for example, investigates the convergence of Eastern German regions and found that the three quarters of the gap will diminish in almost 70 years. Varblane and Vahter, on the other hand, using similar methodology, estimate that the gap for transition countries will be filled for forty five years in the worst case. Fischer, Sahay and Vegh found that the transition countries will need at most thirty four years.

Other authors, on the other hand, do not find convergence and even in some cases they conclude that the transition countries are actually “falling behind.” Such authors base their work on the cointegration approach. Estrin and Urga found little evidence of convergence between the transition countries (they formed “economic block”) and no evidence of convergence to the West. Similar results of non-convergence between the transition countries and the West are found by Brada, Kutan and Zhou.

As it is obvious from the enumerated literature, much has been said and done in the convergence theory to an extent in which it seems there is nothing left to write about. Naturally, the present work steps on the shoulders of major works in the field.

However, this thesis has the aim to investigate the case of external (to the West) and internal (convergence of districts) convergence in Bulgaria. Similar research, on the convergence to EU, is made by Stattev and Raleva (2006). Nonetheless, this research is made for the years from 1997 to 2003. In this paper the research comprise four more years – till 2007 and answers the question if there is a positive development of the Bulgarian economy over this four more years. The main point is that since 2003 Bulgaria has managed to absorb efficiently most of the funding received from EU and to fulfill the EU membership requirements. This research aims to investigate the development during these four years.

Internal convergence has been made before – in the Economic Report for the President of the Republic of Bulgaria in year 2006. Nonetheless, the authors compare districts on the basis of output of industries, agriculture and services. It is natural that some districts will be more advanced in services, others in agriculture, etc. This paper aims to investigate the overall economic performance of the districts.

The methods used are based on the work of Barro and Sala-i-Martin. Firstly, analysis of the convergence of a few transition countries relative to developed ones in Europe is presented. Secondly, the case of Bulgaria is considered. The methodology used here is based on the work of Sherwood-Call. Finally, the internal convergence of Bulgaria is analyzed. The method used is again based on the work by Barro and Sala-i-Martin.

In the larger context, this paper has the intent to serve as a contribution to the dialogue of convergence between and within transition countries.

The paper continue as follows: the next section is literature review. Papers that outline the basic methodology are given and also some relevant literature is cited. In section three is given a brief sketch of the theoretical framework on the basis

of which is derived the method used. In section four, the methodology and data used is explained. Section five contains the results from the analysis and Section six gives the basic conclusions.

2. Literature Review

This section reviews the different methods for estimating convergence used in the literature. A great deal of research has been made in past and recent years on this topic and there is a big controversy on the different estimation techniques for convergence. An evaluation is given for the different methods and the methods used in the present research are shown. Also, the relevant literature is described.

Quite popular nowadays is the time series approach, based on cointegration. Brada, Kutan and Zhou, 2002 argue that many authors using the upper method come to divergent conclusions. They propose a new technique of rolling cointegration approach in order "to obtain time-varying estimates of the convergence of macroeconomic variables within the EU and between transition economies and the EU." The idea in their method is that if there is convergence there will be cointegration between the macroeconomic variables of transition countries and EU. The problem is that conventional tests for cointegration will be biased toward rejecting cointegration (convergence). That is why they use rolling cointegration. Brada et al. focus on monetary convergence and monetary policies, but they also "examine real convergence by investigating cointegration of EU and transition-economy industrial output data." The authors find that cointegration for transition economies is not evident. They also conclude that transition countries should retain some policy autonomy to deal with productivity shocks. Actually their results are consistent with the theory. The basic problem with the cointegration approach is not the one that the authors claim it is – that conventional tests are biased toward rejecting cointegration. The problem is that cointegration means that the variables show similar trends over time. Thus, if there is cointegration, this does not mean that the variables are converging in their values over time. Cointegration captures parallel

movement of the variables. This, of course, does not mean that cointegration can not capture convergence, but using this method will give rather imprecise and uncertain results.

From 1950s till mid-1980s the theory of convergence was based on the Solow-Swan neoclassical growth model. In this model it is assumed that countries are the same in their characteristics except for their initial level of output/income per capita and propensity to save. Since there is diminishing return to investment in the physical capital the economies converge to a steady state. Poor countries will have higher capital productivity that will allow them to grow faster and converge to the rich ones. The work of Barro and Sala-i-Martin is based on this model. In their 1992 paper they prove that the neoclassical growth model implies conditional, but not absolute convergence. They examine both income and product convergence and conclude that their rates are similar – just that the output converges in a slightly faster manner. The authors use data from U.S. states and from 98 countries and they claim that the gap between richer and poorer regions/countries diminishes at a rate of 2% per year. This, of course, is true only in a conditional sense – if some variables (proxies for the steady state value of output and rate of technological process) are held constant. In their book, Economic Growth (1995), they perform the same tests for Japanese prefectures and European regions and they obtain similar results. The authors in their other paper (1991) demonstrate that human capital movement (migration) does not affect the obtained results.

Another important result is that there is a negative relationship between the logarithm of the initial level of product/income and the growth rate. This means that the poorer is the economy the faster it grows – since, it is further from its steady state it moves faster towards it. Barro and Sala-i-Martin, 1992 claim that the presence of a

global capital market speeds up convergence. The authors “break” the convergence into three components:

1. Diminishing returns to capital;
2. The effects of labor and capital mobility across economies and
3. The effects caused by “the gradual spread of technology.”

An important conclusion reached by Barro (1991) is that: “A poor country tends to grow faster than a rich country, but only for a given quantity of human capital; that is, only if the poor country’s human capital exceeds the amount that typically accompanies the low level of per capita income.” The present research is based on the work by Barro and Sala-i-Martin. Their methodology is adopted and modified to comply with the needs here.

Some other variables such as political and economic stability and adequate institutional framework should be held constant when estimating conditional convergence. This is proposed by Sachs and Warner, 1995. They argue that: “Economic growth, and therefore economic convergence, requires reasonably efficient economic institutions.” The authors use 117 countries to prove their point. They divide the countries in qualifying and non-qualifying. They have two tests – the property rights test and the openness test. If a country fails one of the tests it is ranked non-qualified. After performing a regression analysis the authors note that there is evidence of unconditional convergence for qualifying countries and not for non-qualifying; qualifying countries grow faster; poor policies hinder growth and poor trade policies affect the rate of accumulation of physical capital. Sachs and Warner conclude that convergence is possible for all countries, if they “follow a reasonable set of political and economic policies, including civil peace, basic adherence to political and civil rights, and (most decisively) an open economy, through the

absence of trade quotas, export monopolies, or inconvertible currencies." Interesting is that seven of the non-qualifying countries perform growth at a high rate, which means that the criteria proposed by the authors are not necessary for growth. Similar research is performed by Keefer and Knack, 1997. The authors argue that poor countries do not catch up, because of "an inadequate legal, political and regulatory framework – the institutional environment."

Keefer and Knack use the Barro and Sala-i-Martin specification and add measures of institutional quality. The authors conclude that despite the low-cost access of technology in poor countries and the diminishing returns to investment in rich ones, convergence of undeveloped countries is hindered by poor institutional framework. The conclusion from both papers accords with the theory of economic history – poor property rights and institutions are a barrier to private initiative and investment.

The previous two papers presented here, extend the Barro and Sala-i-Martin method. They note that the importance of adequate institutions and management play important role for estimating conditional convergence. A proxy variable capturing this is included in one of the regression here.

It is important to model conditional convergence and take into account the trade. Ben-David (1993) asserts that trade liberalization among countries might lead to convergence. His research is focused on the reforms toward freer trade in European Economic Community (EEC) and concludes that with trade liberalization incomes in EEC began to converge at rates similar to those of the U.S. states. He also analyzed countries out of EEC and found that incomes do not converge (except for U.S and Canada), due to lack of free trade. That fact is interesting and a proxy for market integration in EU is used to capture this effect.

Major critiques to the Barro and Sala-i-Martin method are given in the papers by Quah, 1996 and Hall and Ludwig, 2006. Quah argues that there are two dimensions of economic growth – the push back (growth) and the catch up (convergence) mechanisms. The former mechanism means that agents push back technological and capacity constraints, while the catch up mechanism is related to the relative performance of rich and poor economies. The author claims that this distinction must be taken seriously and that it is important to examine how countries perform relative to each other and not relative to their own history. He develops a model that studies the dynamics of cross section distribution of countries. The author concludes that formation of convergence clubs is taking place – a "twin peaks" of rich and poor. His main critique is that Barro and Sala-i-Martin predict absolute convergence and that is not true. The research developed by the authors predicts conditional convergence. Nonetheless, this type of convergence does not exclude the possibility of convergence club – Barro and Sala-i-Martin (1992) showed that actually the results from unconditional convergence across homogenous countries/regions (rich versus poor countries) are similar to some extent to the results from conditional convergence.

Hall and Ludwig have a different critique. The authors argue that the predicted by Barro and Sala-i-Martin "subsequently introduce serious estimation errors for German regional convergence" and use "spurious assumptions about the forces driving an interregional movement of capital." The problem in their paper is that these serious estimation errors are not noted. Another important thing is that all theoretical and practical work rests on some assumptions. Of course, all assumptions are spurious to some extent, because they are introduced to simplify the world and that alters reality in a way. Hall and Ludwig do not present solid facts to show the

problems of Barro and Sala-i-Martin's approach. Their main argument rests on the fact that "the eastern German region fails to exhibit a secular trend in the growth of per capita income or product that would lead to convergence with the western region over time." Of course, the predictions made for east Germany are based on the performance it exhibited until the moment of research. These predictions are fully based on future similar development of the economy in east Germany. No guarantees are made. The authors criticize thoroughly the conditional convergence hypothesis, but they do not present an alternative.

Another approach to measure convergence is based on correlation of GDP expenditures and production. Stattev and Raleva, 2006 use approach based on the β-convergence and panel modeling. The method is simple – the GDP is "broken" down into its comprising components and the resulting variables are compared with their counterparts from developing countries. These variables are expected to move faster for poor countries than they do for richer ones. The authors compare Bulgaria, Czech Republic and the Eurozone. They conclude that unlike Czech Republic Bulgaria does not converge to the Eurozone in respect of fluctuations in real values of consumption, investment and government purchases. The components that Bulgaria converges in are agriculture and forestry, industry and services. The method they use to estimate the convergence of this GDP structures is based on the divergence index developed by Sherwood-Call in her 1988 paper. The conclusions, that Stattev and Raleva reach, are based on data from 1997 till 2003. In the present paper, this method is adopted and used with data for four more years. The purpose is to estimate if there is a change and if this change is for the better.

Relevant study on transition countries is made by Fischer, Sahay and Végh, 1998. The coauthors follow the framework developed by Barro and Sala-i-Martin, but

also estimate effects of the distance from Europe (Brussels) on the convergence of transition countries. They conclude that the farther the country is for Brussels the longer time it would need to catch up. Fischer et al. also estimated that the central and eastern European countries “gave away about one generation worth of income during the 40 or more years of socialism.” They also calculated the years necessary for the convergence of these countries – it ranged between fifteen and thirty years.

It is interesting that when another method for the speed of catching up process is used (Varblane and Vahter, 2005:36) the results are quite different. In their paper Varblane and Vahter compare new and old members of the European Union before and after the accession. The authors use both conditional and unconditional convergence methods. Though the time horizon they obtain for convergence is longer, they are optimistic that “the creation of newly enlarged market will allow better use of economies of scale with a lasting positive effect on growth” and transition countries will be able to catch up faster.

The next section gives a brief description of the theoretical framework on which the estimation technique used is based.

3. Theoretical Overview

In the light of the previous chapter and the methodology chosen for the estimations this section will give the theoretical background and some explanations of the methods used.

3.1 The neoclassical growth model

The neoclassical growth model assumes that countries are similar in everything else but their per capita physical and human capital and their propensity to save. The production function takes the following form:

$$Y(t) = F(K(t), L(t), t) \tag{1.1}$$

where K is capital and L is labor and t is time. The function depends on time in order to capture the effects of technological progress – the same amount of capital and labor will yield more output after 10 years, if the technology then is superior.

This function is neoclassical if it fulfills the following three properties:

1. For all K and L > 0 it exhibits positive and diminishing marginal products with respect to each input;
2. The function exhibits constant returns to scale;
3. The marginal product of both capital and labor approaches infinity as capital/labor approaches 0 and the opposite. These three properties are called Inada conditions.

If the constant returns to scale property is used the function can be written in the following manner(divided by $L(t) = Le^{xt}$):

$$\hat{y} = f(\hat{k}) \tag{1.2}$$

Equation (1.2) is called the intense form of the production function. The change in capital stock over time is given by the following equation:

$$\dot{K} = s \cdot F(K, L, t) - \delta K$$

Here s is the saving rate and δ is the capital depreciation rate that are assumed to be constant. When the upper equation is divided by labor gives the first step in analyzing the dynamic behavior of the economy:

$$\dot{K} / L(t) = s \cdot f(\hat{k}) - \delta \hat{k}$$

Here, $\dot{K} / L(t)$ can be written as a function k following the condition:

$$\dot{\hat{k}} = \frac{d(\dot{K} / L(t))}{dt} - x\hat{k} - n\hat{k}$$

$$\therefore \dot{\hat{k}} = s \cdot f(\hat{k}) - (\delta + x + n)\hat{k} \qquad (1.3)$$

Where n is the growth rate of labor/population and x is the rate of exogenous, labor-augmenting technological progress. Equation (1.3) is the fundamental differential equation of the Solow-Swan model.

The steady state in this model corresponds to $\dot{\hat{k}}$ = 0 in equation (1.3), which means that the various quantities grow at constant rates. The value of $\hat{k}$ for which the economy is in steady state is $\hat{k}^*$. So the equation becomes:

$$s \cdot f(\hat{k}^*) = (n + x + \delta) \cdot \hat{k}^* \qquad (1.4)$$

Since, $\hat{k}$ is constant, $\hat{y}$ and $\hat{c}$ are also constant at the following values $\hat{y}^* = f(\hat{k}^*)$ and $\hat{c}^* = (1 - s) \cdot f(\hat{k}^*)$ (savings is nothing else, but what is not consumed from the output). In the steady state of the neoclassical model, the per capita quantities $\hat{k}$, $\hat{y}$ and $\hat{c}$ do not grow. This means that the levels of the variables grow in the steady state at the rate of the population growth n.

The transitional dynamics of the model show how the per capita income converges towards the steady state. When equation (1.3) is divided by $\hat{k}$ the growth rate of the physical capital (denoted by ϕ_k) is obtained:

$$\phi_k = \dot{\hat{k}} / \hat{k} = s \cdot f(\hat{k}) / \hat{k} - (n + x + \delta) \tag{1.5}$$

From here, the growth rate of output per capita can be derived:

$$\phi_y = \dot{\hat{y}} / \hat{y} = f'(k) \cdot \dot{\hat{k}} / \hat{k} = [\hat{k} \cdot f'(\hat{k}) / f(\hat{k})] \cdot \phi_k \tag{1.6}$$

The expression in the brackets on the right is called the capital share – each unit of capital receives a rental equal to its marginal product ($f'(k)$) and the capital return per person is $\hat{k} \cdot f'(\hat{k})$ - this divided by the total output gives the share of the capital income in the total income per capita.

The next subsection explains how these facts are connected to the convergence theory.

3.2 Conditional and Unconditional Convergence

The derivative of ϕ_k with respect to k is negative, which means that smaller values of $\hat{k}$ are associated with bigger values of ϕ_k. The question that arise from here is if this means that economies with less physical capital tend to grow faster per capita – is there convergence across the economies?

If a group of closed economies with similar characteristics and the same n, δ, x and production function are considered, then these economies will have the same steady state to converge to. If the only difference is in the initial level of capital $\hat{k}(0)$ and output $\hat{y}(0)$, then poorer economies will converge faster to the steady state

– they will have higher growth rates of both capital and output (ϕ_k and ϕ_y). This means that the poorer economies will catch up to the richer ones – their per capita growth is faster. This hypothesis is called unconditional (absolute) convergence, because the growth rates do not depend on the other characteristics of the economy. In the literature this hypothesis has been tested for both heterogeneous and homogenous countries/regions. Unconditional convergence was tested for a number of countries by both Baumol (1986, 1994) and Barro, Sala-i-Martin (1992). Baumol (1986) found evidence of absolute convergence, but in his work in 1994 using evidence from 70 countries the author did not conclude convergence. Baumol (1986) argued that the validity of the unconditional convergence hypothesis depends on the method used. Barro and Sala-i-Martin (1992) found that absolute convergence is found only among homogeneous regions/countries – in their case the US states. In later research on conditional convergence as dependant variables were included human capital, investment, innovation, proxies for political stability and fertility. When these variables were included in the equation, convergence across countries was found (Barro and Sala-i-Martin, 1992, 1995).

If the assumptions do not hold – the economies have different characteristics and different steady states – then the concept of conditional convergence is introduced. The neoclassical model predicts that each economy converges towards its own steady state and that the further is this economy from its steady state the faster it moves towards it. Form here can be concluded that actually the neoclassical model predicts conditional convergence. This concept can be illustrated algebraically – if the saving rate is expressed from the steady state condition and plugged in equation (1.5) then the following result is obtained:

$$\phi_k = (n + x + \delta) \cdot [\frac{f(\hat{k}) / \hat{k}}{f(\hat{k}^*) / \hat{k}^*} - 1] \quad (1.6)$$

This means that the growth rate of capital raises with reduction of the current value of $\hat{k}$ for a given steady state value $\hat{k}^*$. This means that if the current physical capital is not far from its steady state, then the economy (regardless if it is rich or poor) is converging at a small pace. The same can be analogically shown for the growth rate of output. So, if the different steady states for different countries/regions are accounted for, the relation between the growth rate and the initial values can be estimated. It is important to be noted that poor economies tend to grow faster if their initial conditions (per capita income for example) are lower relatively to their steady state. This does not imply that the dispersion of the initial condition between economies will decline.

In the original Solow-Swan model, the economies are assumed to be initially the same. That is why, many people confuse conditional and unconditional convergence hypothesis. From this fact stem the basic critiques to Barro and Sala-i-Martin approach.

3.3 Speed of Convergence

In this subsection an explanation is given on how an estimate how fast different countries converge is acquired.

If a Cobb-Douglas production function is used, from equation (1.5) a measure of the speed of the transitional dynamics can be obtained. In this case the growth rate of capital becomes:

$$\phi = sA(\hat{k})^{-(1-\alpha)} - (n + x + \delta) \quad (1.7)$$

The log-linear approximation of equation (1.7) yields:

$$\phi_{\hat{k}} = \frac{d\log(\hat{k})}{dt} = -\beta \cdot \log(\hat{k} / \hat{k}^*), \text{ where}$$
$$\beta = (1-\alpha)\cdot(x+n+\delta) \tag{1.8}$$

The coefficient β gives the speed of convergence around from $\hat{k}$ to $\hat{k}^*$. This also applies for the growth rate of output – it has the same convergence coefficient β. The convergence coefficient shows in what speed the gap between the current and the steady state value of output per person diminishes. For example, if $\beta = 0.1$ per year, this means that the gap diminishes with 10% in one year. It is important to note that the speed of convergence (β) does not depend on the saving rate s. The reason is that higher saving rate not only leads to higher investment and faster convergence, but also leads to higher steady state value of the physical capital. These two effects negate each other, which is why saving rate does not affect the convergence coefficient.

The equation for the growth rate of output per capita is (analogical to equation (1.8)):

$$\phi_y = -(1-\alpha)\cdot(n+x+\delta)\cdot\log(\hat{y}/\hat{y}^*) \tag{1.9}$$

This equation is a differential equation with the following solution and the growth rate over an interval between two points in time 0 and T are:

$$\log(\hat{y}(t)) = (1-e^{-\beta t})\cdot\log(\hat{y}) + e^{-\beta t}\cdot\log(\hat{y}(0))$$
$$\frac{1}{T}\log[\frac{\hat{y}(T)}{\hat{y}(0)}] = x + \frac{1-e^{-\beta T}}{T}\cdot\log[\frac{\hat{y}^*}{\hat{y}(0)}] \tag{1.10}$$

The model implies that the higher the convergence coefficient the higher the convergence to the steady state. Since, the model infers conditional convergence it can be seen that the growth rate is higher the lower is the initial value of output per capita.

The important result is that since, β is not affected by saving rate and technology, the convergence coefficient might be similar across economies with difference in their levels of per capita product, depending on the technology differences.

This gives the basic economic framework of the methods used. The next section gives explanation of the methodology and data used.

4. Methodology and Data

4.1 Methodology

In the light of previous section, where the theoretical framework is provided, the present paper continues with explanation of the methodology used. It is based on equation (1.10) and on the conditional convergence hypothesis.

Equation (1.10) is modified a little because the steady state values are not known. It becomes:

$$\frac{1}{T}\cdot\log(\frac{y_{i,T}}{y_{i,0}}) = \alpha + \gamma\cdot\log(y_{i,0}) + \sum \lambda_{i,t}\cdot x_{i,t} + u_{i,t} \qquad (2.1)$$

Where

$$\gamma = -(\frac{1-e^{-\beta T}}{T})$$

The coefficient of the logarithm of the initial level of y is supposed to be negative since there is a negative relation between the initial and the current level of y .Since, γ depends on the interval T, it means that the further is the variable from its initial value, the smaller the effect of the initial value and the opposite. The other variables that are included (x_i) serve to approximate the different steady state values of y . In this case, it is important to state that β s might be similar for different countries since β is not affected by technology and the other characteristics of the economies are kept constant through the independent variables. If β >0 this means that the poor economies tend to grow faster than rich.

It is important to note that $[(1-e^{-\beta T})/T]\cdot\log(\hat{y}^*)$ is not excluded. Since the speed of convergence, steady state value and the time period are constant, this part of equation (1.10) becomes part of the constant term in the regression.

In the paper, both unconditional and conditional convergences are estimated and the results received are compared.

Another approach is used to estimate convergence of Bulgarian GDP production structures. A divergence index is estimated for the different GDP structures on the following basis:

$$DIV_i = -\frac{(E_{BGi} - E_{EU15i})^2}{E_{EU15i}} \qquad (2.2)$$

Where E_{BGi} and E_{EU15i} are relative shares of GDP for variable *i* for Bulgaria and European Union 15 countries. The *DIV* index measures the extent to which the given variable in Bulgaria differs from it counterpart in the European Union. If Bulgarian macroeconomic variable is identical to that in the European Union, then *DIV*=0. If *DIV* is negative, it means that Bulgarian variable deviates (diverges) from those of the European Union. In this research the trend of *DIV* is followed. If *DIV* increases (decreases in absolute value) over time, it means that the given macroeconomic variable (GDP production structure) converges towards the EU. In other words, Bulgarian output composition tends to be the same as in EU, in case *DIV* tends to zero. If that is true than the economy develops in a way it should – at least as EU economies are. The dynamics of the *DIV* index is followed and a conclusion if there is structural convergence is given.

4.2 Data

In this section a short description of the data is provided. The data for Bulgarian districts is acquired from the National Statistical Institute website (www.nsi.com). It is annual data for the whole 28 districts for the years 1999 to 2005.

The dependent variable in this case is GDP per capita in Bulgarian currency. It is deflated for year 2005 in the institute. As independent variables in the regression are included the coefficient of economic activity (percentage of people between 16 and 64 that are working), number of students in educational institutions (human capital), population growth, registered unemployed and human capital movement. The human capital movement is depicted by the difference between people that left and people that settled in the district. In this case some measurement error might occur, because not all the people register if they change they current place of residence. Same kind of measurement error might occur for the population growth, coefficient of economic activity and the registered unemployed (in the latter two cases the problem occurs with people that have not signed a labor contract and/or register as unemployed). Another interesting variable added in the regression is the number of lodgings for thousands of people. The point here is that in the last 8 years there has been a huge construction building offensive in Bulgaria. This is viewed as one of the corner stones in the development of the economy. Of course, there has been industry and business construction, but since there is no data, the lodgings are considered as kind of a proxy for the construction.

The data on European countries is acquired from Eurostat. The dependent variable here is also GDP per capita in power purchasing standards. The data is for 12 consecutive years starting from 1996. This year is chosen as starting, because most transition countries experienced macroeconomic shocks between 1989 and 1996. These shocks might affect the estimation negatively. Since 1996 transition countries developed some macroeconomic stability, which allows the conduct of the following study. In the regression are included population growth, unemployment rate, inflation, labor productivity, imports/exports, investment, proxies for human

capital, etc. Almost all European countries are included in the regression, except for the ones for which no data was found, the data acquired was incomplete or not in the desired form[1] (Albania, Montenegro, Andorra, etc.).

The data used for the estimation of the *DIV* index is acquired from Eurostat and the website of the Bulgarian national statistical institute. The macroeconomic variables for which the *DIV* index is estimated are agriculture, fishing and forestry; industry; services – the gross value added of this variables as shares to GDP – these are the production components. Also three other macroeconomic variables are used – private consumption; investment and government expenditure. The data for these variables are quarterly for the period from 1998 to 2007.

[1] The main variable is GDP per capita in power purchasing standards, so the comparison among countries is easily and correct. If GDP is not available in this form, it can not serve as a correct measure.

5. Results

This section presents the results obtained while using the formerly described methodology and data. First, convergence for all European countries is estimated and the obtained results give a comparison between transition and developed countries. Next, Bulgarian GDP structures are analyzed, in order to check their resemblance to those of EU. This kind of research is important, because the output composition indicates the stage of economic development. Finally, Barro and Sala-i-Martin method is applied for Bulgarian districts. The purpose is to analyze the internal economic mechanisms and development in a transition country.

5.1 Convergence across European countries

In this section, convergence across European countries is estimated. A comparison between developed and transition countries and the convergence to their steady states is presented.

The regression follows equation (2.1). This equation gives the average growth between the starting and the ending period. The convergence is estimated both in conditional and unconditional sense. Both regressions are estimated for all European countries and only for the developed ones (the 9 transition countries in the sample are excluded). First, is presented the unconditional convergence in Table 1.

	All European Countries		Developed Countries	
	coefficient	p-value	coefficient	p-value
LN_GDP(-11)	-0.020997	0.0000	-0.010693	0.1649
C	0.104598	0.0000	0.054715	0.1328
R-squared	0.456140		0.098962	
Speed of Convergence	2.39%		1.13%	

Table 1. Unconditional convergence for all European and developed countries
Description of the variables is given in the Appendix

The claim is that countries that are farther from their steady states (in this case, transition countries) grow faster than those, which are closer to their steady state. As it can be seen from Table 1, indeed the speed of convergence when transition countries are added in the sample is higher than this of the developed ones. When unconditional convergence is used, the developed European countries on average show speed of convergence of approximately 1%. In other words they converge towards their steady state more slowly than when the transition countries are added in the regression. All countries in Europe show average growth of almost 2.5%. It is important to note that the coefficient of growth for the developed countries is not significant, while this for all countries is.

Barro and Sala-i-Martin (1992) estimate the speed of convergence for 20 OECD countries for 26 year interval (from 1960 to 1985). The authors found that the speed of convergence is 0.95%. Their result is consistent with the result obtained here – developed countries grow at the speed of approximately one per cent. The problem here is that the same steady state is assumed for all countries in both regressions. While it might be true to some extent for the developed countries – there might be some homogeneity among them – this can not be concluded for all European countries. Conditional convergence regression is needed.

	All European countries		Developed countries	
	coefficient	p-value	coefficient	p-value
LN_GDP(-11)	-0.080574	0.0000	-0.066334	0.0000
C	0.201030	0.0000	0.165901	0.0000
Lab_prod_worker	0.000913	0.0000	0.000669	0.0000
In_out_fdi	-0.000938	0.0000	0.000086	0.0000
Gerd_ind	0.000310	0.0000	---	---
Sc_tech_grad	0.000658	0.0000	---	---
Empl_rate	0.001615	0.0000	0.001089	0.0000
Empl_gr	-0.002518	0.0000	---	---
Bus_invest	-0.000463	0.0011	---	---
Eu_patents	0.000050	0.0000	---	---
transition	-0.002293	0.0638		
R-squared	0.998992		0.999241	
Speed of Convergence	19.7%		11.9%	

Table 2. Conditional Convergence for all European and developed countries

In the results from the conditional regression equation the speed of convergence is quite high. For all European countries it is 19.7% and for only the developed ones is 11.9 %. This result is not consistent with what is found by other authors on the topic. Similar case of high speed of convergence is reported by Barro and Sala-i-Martin (1995). When estimating the speed of convergence for Japanese prefectures they found convergence of 6.6 per cent for the period of 1970 to 1975. Their explanation was that in 1973 there was an oil shock that had "an especially adverse impact on the rich industrial areas". In their research they had a variable that accounted for this shock, but still the authors got high values for the speed of convergence. In this research it is not taken into account that oil prices have more than quadrupled since 2002. If this fact is taken into account the speed of convergence might not be that high. The idea is that with the increase of oil prices (imported inflation), there is a proportionate increase in the costs and prices for most industries (most industries use oil as input – at least for transportation). This, on the other hand, will increase their profits (in nominal, not real values), which will increase the GDP per capita. So, the growth presented here is rather exaggerated, since the role of imported inflation is not taken into account.

Basically, the results obtained in this chapter are in compliance with the theory – countries further from their steady state converge at higher rate than those closer to it. It is shown that under both conditional and unconditional convergence, the speed of convergence of all European countries is higher than this when transition ones are excluded.

A short description of the independent variables and their coefficient is given. For obvious reasons the labor productivity, employment rate, education variable, gross expenditure for research and development in the industry and EU patents

applications (proxy for invention and innovation) have a positive effect on the GDP growth. What occurs as a problem is that inflows to outflows of foreign direct investments, employment growth and business investments have negative effect – their coefficients have signs opposite to what is usually expected. Possible explanation for the negative effect of the foreign direct investment ratio is that in the last year FDI for transition countries has decreased rapidly and since it is not proportional to the growth that these countries exhibit, the coefficient is negative. Similar explanation might be given for the business investment variable. This variable is actually the gross fixed capital formation – investment by enterprises in fixed capital assets. A quick look at the data shows that on average these values are higher for the developed countries (at least for the year 2007). Since transition countries show higher growth and lower values of gross fixed capital formation, the fact that the coefficient is negative is not that stunning. Unfortunately, the same explanation is not valid for the employment growth. On average the values for transition countries are higher than those for the developed ones. The explanation is that the employment rate is also added to the regression. Its coefficient seems to have a lesser value but the range of the two variables is quite different. Employment growth ranges to 4.4% (for Poland), while employment rate is over 70% for some countries. When employment rate is excluded from the regression, employment growth has positive coefficient.

It is interesting to note that other variables were also included in the conditional regression, but they were found insignificant. Such variables are imports to exports of goods and of services ratio, etc. Interesting fact is that the population growth variable was also insignificant. A lot of authors consider population growth and the education variable (as proxies for human capital formation) important and

even inseparable part of the convergence equation. Unfortunately, in this case population growth and, in the case for developed countries, the education variable (science and technology graduates) were found statistically insignificant. Another proxy was added for education, but in both cases it was insignificant. This proxy is the percentage of people between 16 and 24 who attend some form of schooling. Interesting is that the proxy for institutional stability was found insignificant. One explanation is that in the late years transition countries have achieved a rather good quality of institutional framework, which does not harm the economic development.

5.2 Bulgarian Convergence to EU in terms of GDP components

In the previous section was shown that Bulgaria (as well as the other transition countries) converges faster than the developed countries to its steady state. In this section the dynamics of the *DIV* index are followed. This study is performed in order to be checked if Bulgarian economic characteristics are developing as the economies of the initial EU 15 countries. For this purpose are used the previously described GDP components.

The first GDP production component analyzed is the gross value added of the agriculture, forestry and fisheries. The dynamics of the *DIV* index for this variable are given in Figure 1 in the Appendix. There is a strong positive trend shown in the figure. It means that Bulgaria is converging to the EU in this sector. Nevertheless, there is big variance in the index, especially in the first five years of the sample. This is due to the low initial value and improper management. It is a good thing that the variance decreases from 2004 to 2006 and actually in 2007 the variance is quite low. One explanation for this rapid decrease in the variance is that since 2006 there was a burst in development in this sector, especially with the proper management of

SAPARD. Hopefully, in future years there the variance will decrease even more and this component will converge fully towards the EU.

Next is the *DIV* index for the industry (Figure 2). It also shows convergence. The variance is higher than that of the agriculture, forestry and fishery index and it seems to be more persistent and it is definitely not decreasing. A lot more effort should be put in the Bulgarian industry if it is to converge.

Interesting case is the *DIV* index for the services sector. After 1996 (a total break down of the Bulgarian economy) there was a rapid development in the services sector and since year 2000 this sector composes great part of Bulgarian GDP. The problem here is that the services sector converged and than diverged again, but in opposite direction. This can be clearly seen in Figure 7. Also, Figure 7 shows that after 2001, when the services sector started diverging from EU 15 in the opposite direction, it shows consistency – it fluctuate around the same values. Still, there is a lot of variation in the relative share of services sector to GDP – it is obvious the proportion has not settled to a steady value.

Next, is discussed the government expenditure as a part of GDP – Figure 4. It also shows great variation, but nonetheless it is converging. Interesting is the case with the investment variable. The situation here is similar with the services sector. Although on Figure 5 it shows convergence, again the values for investment in Bulgaria surpass those in the EU15 – this can be seen on Figure 8. Since, Bulgaria is a fast growing country with cheap labor supply (compared to EU15) there is a lot of investment in the private and public sector. It is not just that there is higher return to capital, but there are also the EU funds, which sole purpose is for the country to converge. Investment in Bulgaria is exhibiting good growth and if it continues like that, this will advance the economy in future.

The last variable studied is the private consumption. Again there is a lot variation both in the *DIV* index and in the variable. The difference here is that there is neither divergence nor convergence shown on Figure 6. The DIV index shows that the percentage of private expenditure to GDP is relatively constant over time. The explanation is that, still the salaries in Bulgaria are not rising proportionally to the economic growth. The reason is that the wages are kept artificially low, because of the currency board agreement – a rapid increase in personal income will lead to tension in the economy and this might cause harmful inflation.

In conclusion, five out of the six variables, used in this study, show convergence. Nonetheless, these variables exhibit great variation over time. Basically, these variables have not settled to a steady value (in this case steady proportion of GDP). This might induce that it is still early to come to a solid conclusion about their movement. It is important to note that before being seasonally adjusted, the variables showed much greater seasonality than their counterparts for EU15. They showed rapid decreasing during the summer months and the winter holidays. This leads to the conclusion, that the production process is interrupted for summer and winter holidays – something that is not noticed for the EU 15 countries (at least not to such extent).

Stattev and Raleva found that Bulgarian economy is diverging in terms of consumption, investment and government purchases. Four years later, using the same method, it was concluded that actually, investments and services diverge in the opposite direction and that in terms of government expenditure, the economy is converging. Also, a change was found in the private consumption – it is not converging but at least it is not diverging.

Bulgaria showed very positive development for the last four years, in terms of GDP structures.

5.3 Convergence across Bulgarian districts

In this section is estimated the convergence across Bulgarian districts. The estimation follows equation (2.1). Again, convergence is estimated in both conditional and unconditional sense. The results from this analysis are reported in Table 3.

	Unconditional		Conditional	
	coefficient	p-value	coefficient	p-value
LN_GDP(-6)	-0.010133	0.6026	-0.074767	0.0062
C	0.175690	0.2530	0.578292	0.0063
Lodgings_th_ppl	---	---	0.000185	0.0010
Population_growth	---	---	0.000012	0.0202
H_cap_movement	---	---	0.000032	0.0173
Reg_unempl	---	---	-0.002256	0.0053
Educ_instit	---	---	0.000342	0.0015
NW	---	---	0.037900	0.0019
NC	---	---	0.020581	0.0336
NE	---	---	0.021456	0.0546
SC	---	---	0.018717	0.0299
SE	---	---	-0.009010	0.3868
R-squared	-0.010572		0.790200	
Speed of Convergence	1.05%		9.08%	

Table 3. Conditional and unconditional convergence across Bulgarian districts
Description of the variables is given in the Appendix

The variables used in the conditional estimations are described shortly. It is of no surprise that the population growth, the human capital movement (estimated as people settled minus people who left the given district), number of educational institutions have positive effect in the equation and the number of registered unemployed has negative effect. Explanation for the lodgings for thousand of people is needed. In the last 7 years there has been a great deal of construction in Bulgaria – of public, private and business buildings and of course, hotels, motels, etc. All this construction provides vacancies for workers not only in the corresponding sector, but

also in the services sectors and production sector. That is why this variable was included in the regression. Other variables were also counted in, but they proved to be insignificant. In the regression are included also regional dummies (Bulgaria is divided in 6 regions and 28 districts).

In the unconditional regression, the speed of convergence is 1.05%. Here, again the problem is that the same steady state is assumed for all districts. Actually, as it can be seen from Figure 9, all have similar trend in their GDP per capita and 5 of the regions have similar values. The Southwest region is the most developed region (the capital of the country is there). As it can be seen from Figure 9, the Southwest district has higher levels of GDP per capita then the other districts. Figure 9 shows that the average initial value for the Southwest region (five districts) is a little less than the ending ones of the other regions. In the regression, this causes the estimator to be biased, which is the reason for the low speed of convergence.

The same regression is estimated again twice, but without Southwest region and without Sofia capital district. The unconditional convergence is given in Table 4.

	No Southwest region		No Sofia Capital District	
	coefficient	p-value	coefficient	p-value
LN_GDP(-6)	-0.041459	0.1000	-0.046912	0.0574
C	0.417182	0.0373	0.460806	0.0188
R-squared	0.123551		0.136974	
Speed of Convergence	4.77%		5.5%	

Table 4. Unconditional Convergence for Bulgarian districts without Southwest region and without Sofia capital district

Here, it can be seen that when Southwest region is excluded the districts are converging with the speed of 4,8% towards their steady state. Figure 10 from the Appendix implies that when Sofia capital district is excluded from Southwest district the regions have similar trend and growth in their GDP per capita. In this case (the second column of Table 4) the speed of convergence is 5.5% - with 0.7% higher than

the case when Southwest region is excluded. That leads to the conclusion that the districts in Southwest region are converging faster towards their steady state (in case Sofia capital is excluded) – these districts are further away from their steady state. The latter fact and that the regions show similarity in their GDP per capita values and growth implies that the districts from the Southwest region are surpassing the other districts in their development.

Next, the conditional convergence is discussed. In Table 3 second column are given the result from all the districts in Bulgaria if is used conditional convergence. The speed here is 9.1%. Since, there was a problem with the unconditional convergence for the inclusion of Sofia Capital, the regression is estimated again in the manner it was for the unconditional convergence. The results are presented in Table 5.

	No Southwest region		No Sofia Capital District	
	coefficient	p-value	coefficient	p-value
LN_GDP(-6)	-0.061409	0.0296	-0.075071	0.0043
C	0.533956	0.0191	0.572862	0.0061
Lodgings_th_ppl	0.000056	0.4677	0.000199	0.0060
Population_growth	0.000014	0.0180	0.000011	0.0714
H_cap_movement	0.000002	0.6815	0.000002	0.9825
Reg_unempl	-0.002424	0.0237	-0.002608	0.0544
Educ_instit	0.000286	0.0059	0.000350	0.0053
NW	0.064529	0.0002	0.038871	0.0158
NC	0.040159	0.0093	0.020526	0.0741
NE	0.031453	0.0114	0.025196	0.0869
SC	0.031793	0.0223	0.020433	0.0774
SE	---	---	-0.006040	0.6700
R-squared	0.782848		0.780833	
Speed of Convergence	7.66%		9.16%	

Table 5. Conditional Convergence for Bulgarian districts without Southwest region and without Sofia capital district

The speed of convergence is as follows: for the districts without the Southwest region, it is 7.66%, for the districts without Sofia capital it is 9.16%. If these values are compared, a logical conclusion would be that actually the districts converging at the highest speed are the ones in the Southwest region except for Sofia capital. The

explanation is simple. The speed of convergence gives the average speed for a number of countries/regions. The fact that when the four Southwest districts are added to the conditional convergence regression (Table 5, column 2) the speed increases with 1.5%, means that these districts are growing faster than the others. Again, if the result from Table 5, column 2 is compared with the ones from Table 3, column 2, then it can be seen that with the addition of Sofia capital to the regression the speed decreases with 0.08%. This might only mean that Sofia Capital is growing at a smaller pace than the 4 other districts in the Southwest region (not much smaller, but still). Nonetheless, if the districts in the other 5 regions grow at a smaller pace this means that they are closer to their steady state than their counterparts in the Southwest region. This and the fact depicted in Figure 9 (their lower GDP per capita values) imply that there is actually divergence between the two groups of districts

It is interesting to note that the two variables human capital movement and lodgings per thousand of people became insignificant in the equation presented in Table 5 column 1.

Here, again the problem with high speed of convergence is faced. Possible explanation might be given with the rapid increase of oil prices since 2002. Nonetheless, the conclusions reached in this subsection are valid.

6. Conclusions

The empirical results received in this study suggest that there is convergence in the sense that economies farther from their steady state tend to grow faster in their GDP per capita position. There is evidence of faster convergence for transition countries, compared to the developed ones in Europe. This complies with the theoretical hypothesis that poorer countries grow faster than rich ones. Nonetheless, it is not necessary that these countries will catch-up. The catching-up process depends on the steady states of the given poorer countries. If there is shift in the overall steady states of transition countries due to increase in savings, investment, etc., there might be catching-up with the developed countries.

Most authors estimate how many years, a transition country will need in order to converge towards the West. In this research, such estimation is not proposed. There are many economic factors that should be taken into account in order for such a prediction to be valid and accurate.

Results were also obtained for the convergence of the relative share of some GDP structures in Bulgaria. Positive trend of convergence was found for the gross value added of the following GDP structures: government expenditure, investments and gross value added of services, industry and agriculture and forestry. Neither convergence, nor divergence was found in the personal consumption GDP structure. In the last 3 years, there was a divergence in the opposite direction for investments and services. All the 6 variables show great variation and seasonality. Nonetheless, in a research conducted four years ago, Stattev and Raleva found that there was no convergence in the GDP expenditure structures of government expenditure, investment and personal consumption. The results obtained in this study suggest that

there has been a positive development in the Bulgarian economy during the last four years.

For the Bulgarian districts was found divergence between the districts in the Southwest region (the one with the capital) and the other districts in Bulgaria. Similar was the situation with Spain before accession to European Union. After Spain started receiving EU structural funds, its regions exhibited convergence. Future research is suggested, to check if the districts in Bulgaria will converge after the first 3 or 4 years of EU structural funds grants. Nonetheless, all the districts in Bulgaria show convergence to their steady states and relatively high growth.

References

Barro, Robert J. and Sala-i-Martin, Xavier, “Convergence,” Journal of Political Economy,1992

Barro, Robert J. and Sala-i-Martin, Xavier, “Economic growth in cross section of countries,” The Quarterly Journal of Economics, Vol. 106, No. 2, May 1991

Barro, Robert J. and Sala-i-Martin, Xavier, “Convergence across States and Regions,” Brookings Papers Econ. Activity, 1991

Barro, R. “Getting It Right: Markets and Choices in a Free Society”, Cambridge, MA, MIT Press, 1996

Barro, Robert J. and Sala-i-Martin, Xavier, “Economic Growth,” MIT Press,1995

Baumol, William J, “Productivity, growth, and welfare: what the long run data show?” The American Economic Review, Vol. 76, No. 5, December 1986

Ben-David, Dan, “Equalizing exchange: trade liberalization and income convergence,” Quarterly Journal of Economics, August 1993

Bernard, Andrew B. and Durlauf, Steven N., “Convergence in international Output,” Journal of Applied Econometrics, vol 10, 1995

Brada, Josef C., Kutan, Ali M. and Zhou, Su, “Real and Monetary convergence within the European Union and the candidate countries: A rolling cointegration approach,” William Davidson Working Paper Number 458, April 2002

Den Hahn, Wouter J. and Marcet, Albert, “Solving stochastic growth model by parametrizing expectations,” Journal of Business and Economic Statistics, Vol. 8, No. 1, January 1990

Dowrick, Steve and QUiggin, John, “True measures of GDP and convergence,” The American Economic Review, March 1997

Dunford, Mick and Smith, Adrian, “Catching up or Falling behind? Economic performance in the ‘New Europe’,” Economic Geography, Vol.76, No. 2, April 2000

Hall, John B. and Ludwig, Udo, “Economic convergence across German regions in the light of empirical findings,” Cambrige Journal of Economics, March 2006

Economic Report for the President of the Republic of Bulgaria, “Convergence and European Funds,” Bulgarian National Bank Publications, 2006

Elmslie, Bruce and Criss, Antoinette James, “Theories of convergence and growth in the classical period: The role of science, technology and trade,” Economica 66, 1999

Estrin, Saul and Urga, Giovanni, “Convergence in output in transition economies, Central and Eastern Europe, 1970-1995,” working paper, Feb. 1997

Fischer, Ronald D. and Serra, Pablo J, “Income convergence within and between countries,” International Economic Review, Vol. 37, No. 3, August 1996

Fischer, Stanley, Sahay, Ratna and Vegh, Carlos A., “How far is Easter Europe from Brussels,” IMF working paper, 1998

Galor, Oded, “Convergence? Inferences from theoretical models,” The Economic Journal, July 1996

Garofalo, Gasper A. and Yamarik, Steven, “Regional Convergence: Evidence from a new state-by state capital stock series,” The Review of Economics and Statistics, Vol. 84, No.2, May 2002

Keefer, Philip and Knack, Stephen, “Why don’t poor countries catch-up? Across national test of an institutional explanation,” Economic Inquiry, Vol. XXXV, July 1997

Quah, Danny T, “Twin peaks: growth and convergence in models of distribution dynamics,” The Economic Journal, July 1996

Sherwood-Call, Carolyn, “Exploring relationship between national and regional flunctuations,” Federal Reserve Bank of San Francisco, Summer 1988

Stattev, Statty and Raleva, Stela, “”Bulgarian GDP structures – convergence with the EU,” South-Eastern Journal of Economics 2, 2006

Tamura, Robert, “Income convergence in and endogenous growth model,” Journal of Political Economy, Vol. 99, No.33, 1991

Varblane, Urmas and Vahter, Priit, “An analysis of the economic convergence process in the transition countries,” Tartu University Press, 2005

Warner, Andrew M. and Sachs, Jeffrey D, “Economic convergence and economic policies,” NBER Working paper No. 5093, February 1995

Appendix

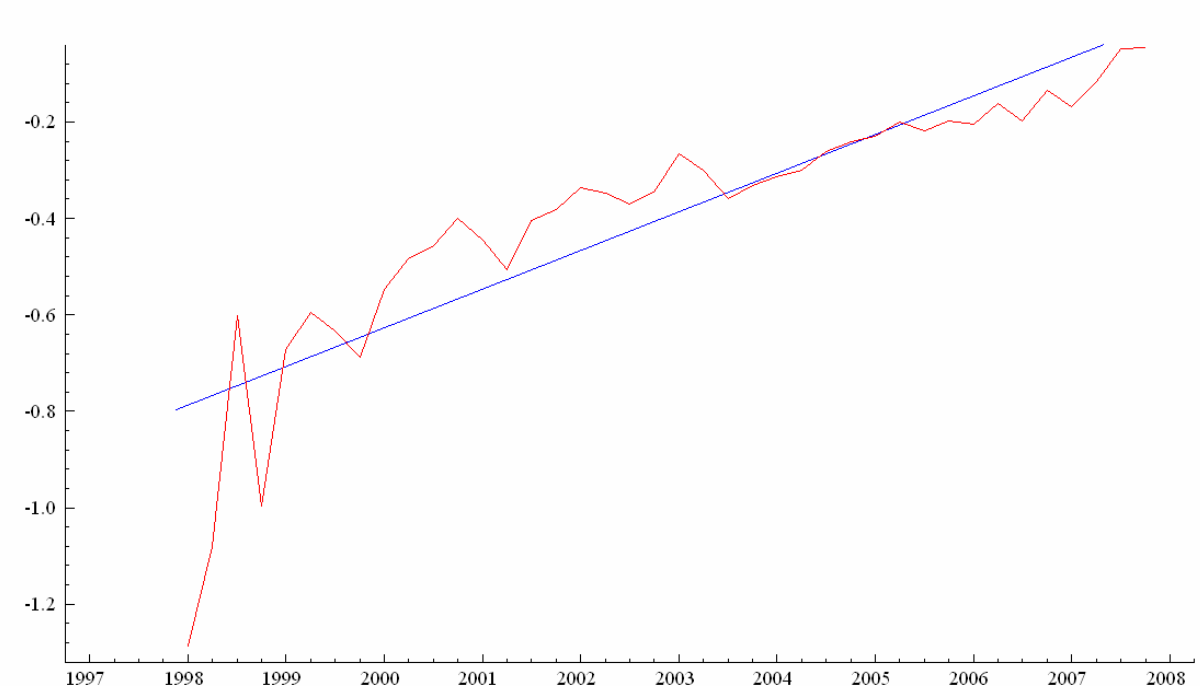

Figure 1. Agriculture, Forestry and Fisheries – Divergence Index

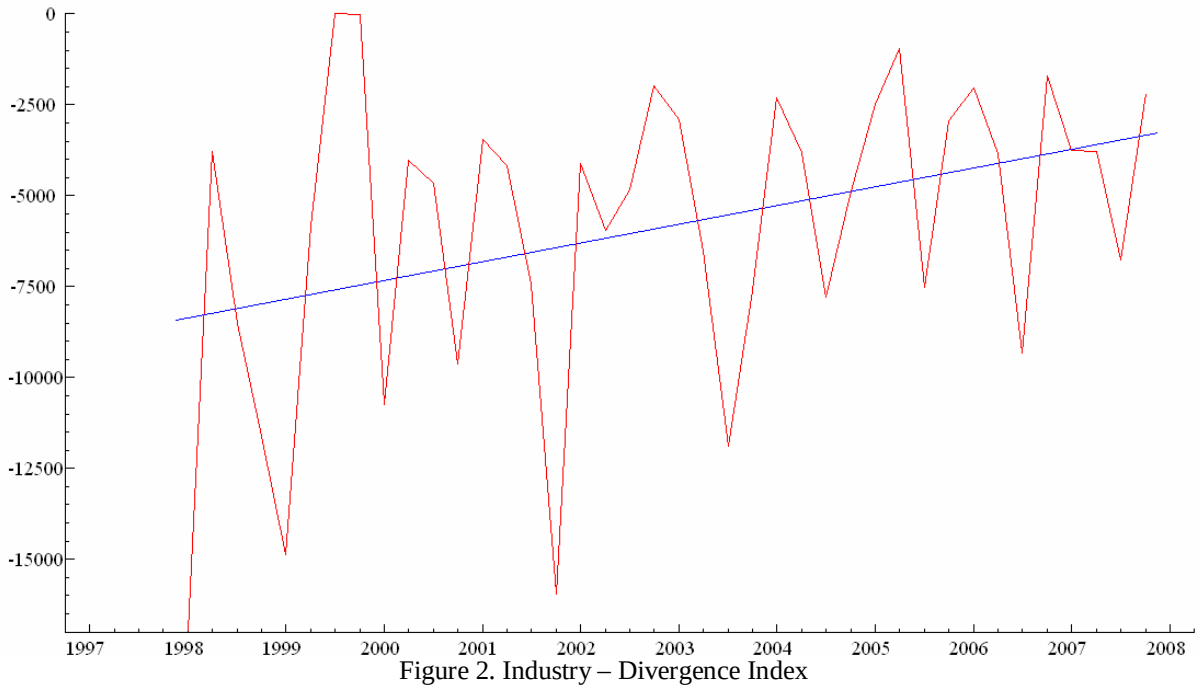

Figure 2. Industry – Divergence Index

Figure 3. Services – Divergence Index

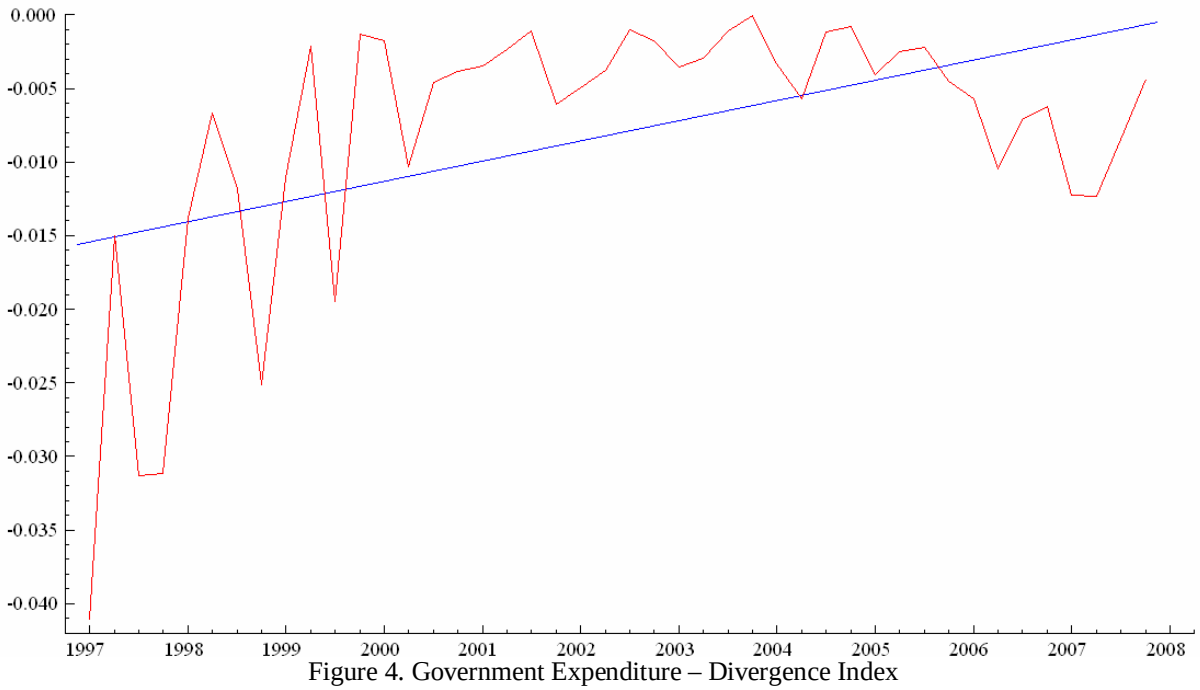

Figure 4. Government Expenditure – Divergence Index

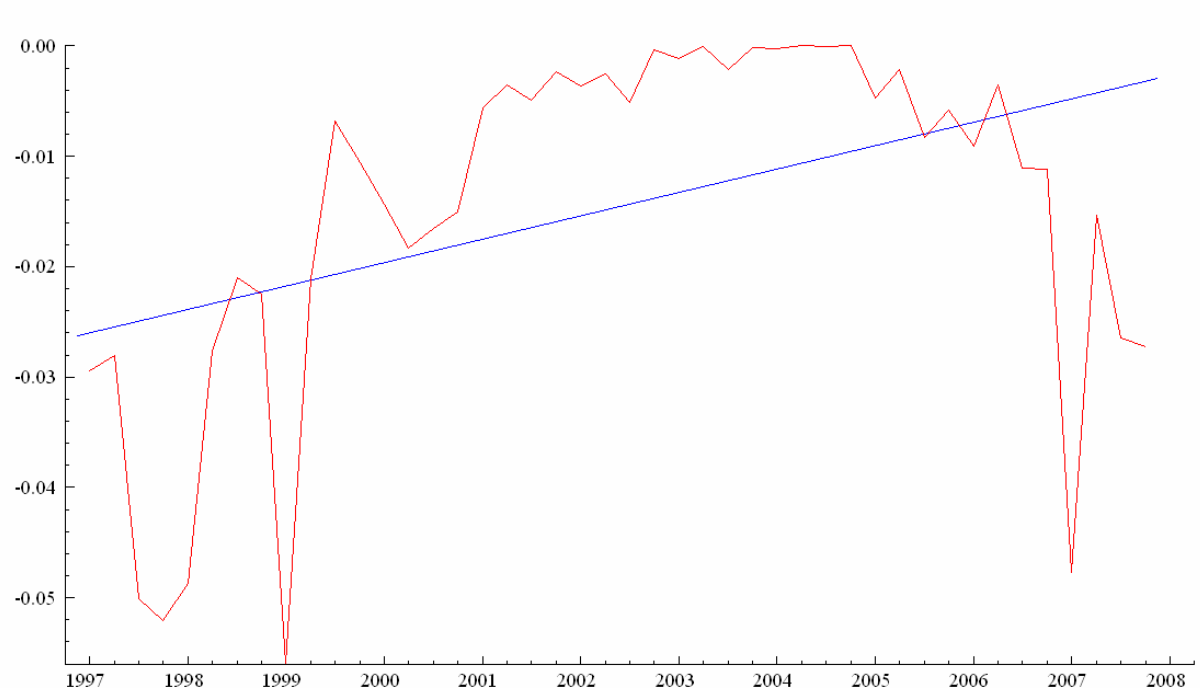

Figure 5. Investments – Divergence Index

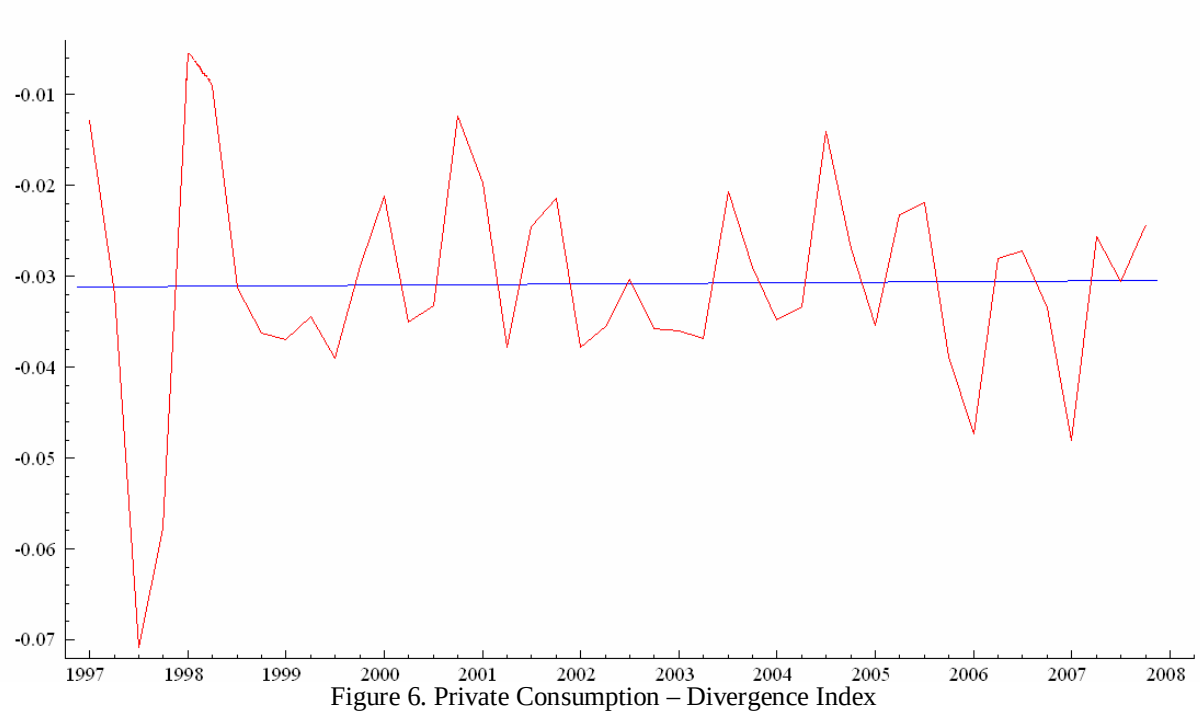

Figure 6. Private Consumption – Divergence Index

Figure 7. Service in Bulgaria and EU15 as shares of GDP

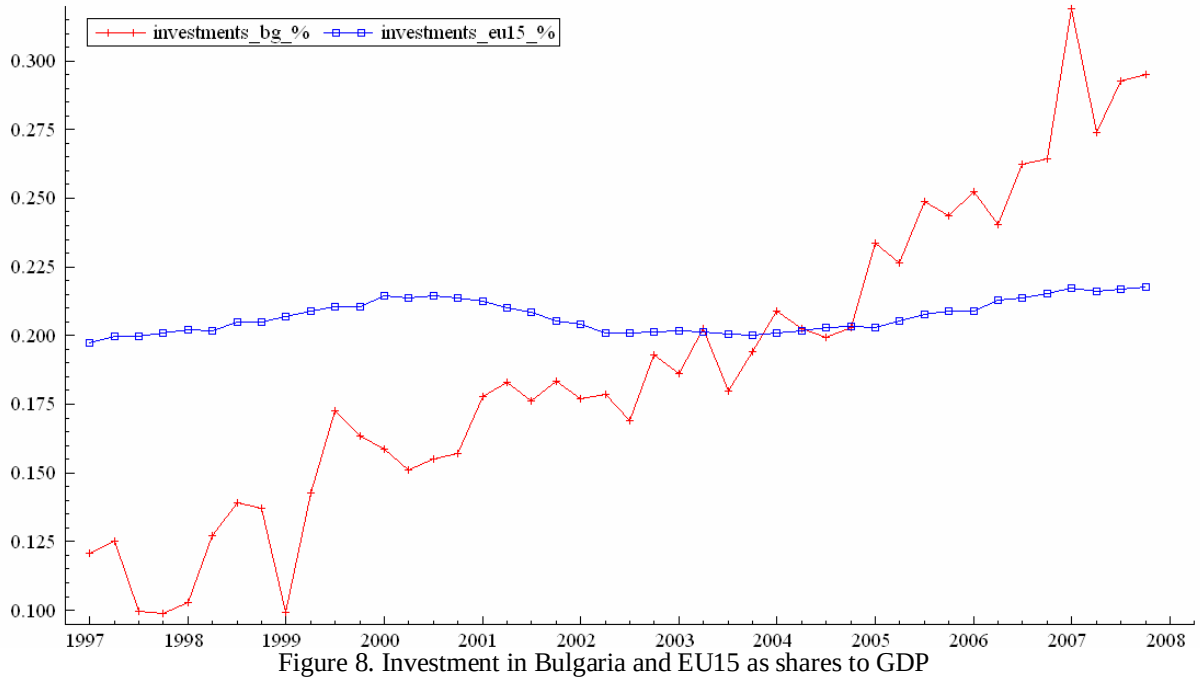

Figure 8. Investment in Bulgaria and EU15 as shares to GDP

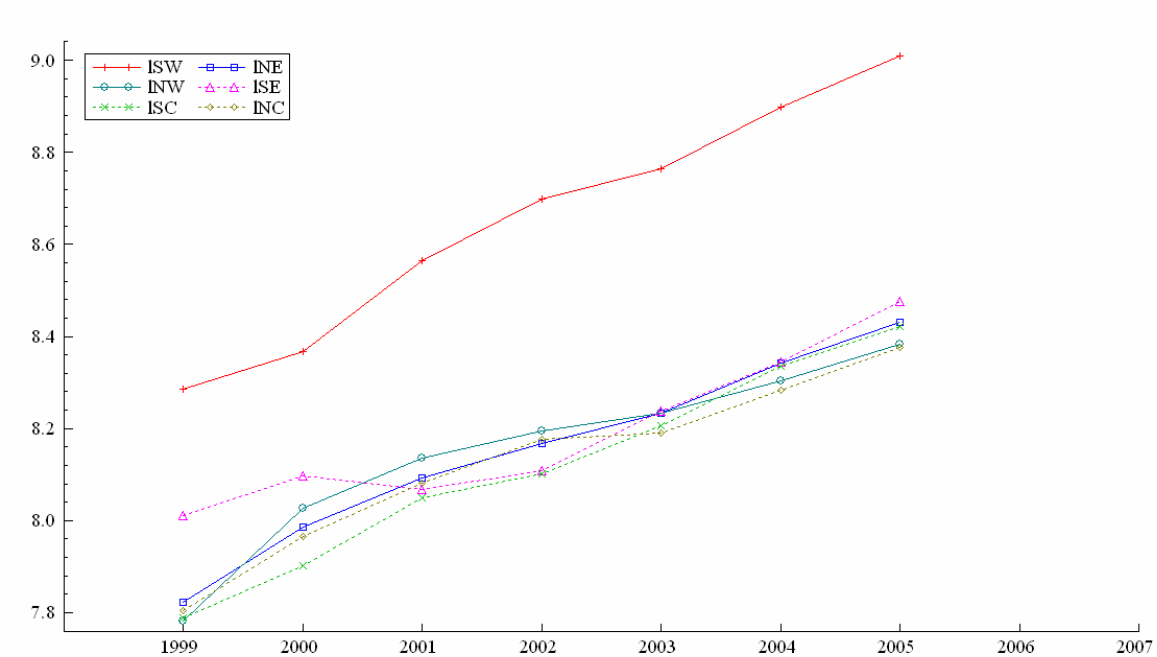

Figure 9. Logarithm of GDP per capita in the six Bulgarian regions

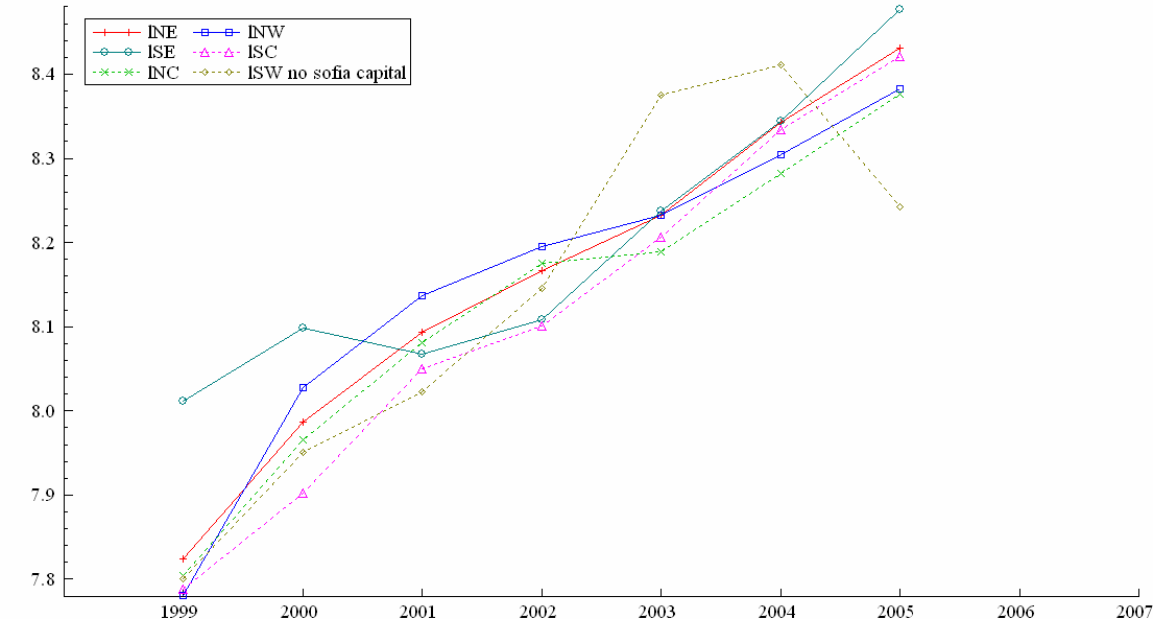

Figure 10. Logarithm of GDP per capita in the six Bulgarian regions, when Sofia capital district is excluded from the Northwest region

Description of the variables used	
Variable name	Description
For Section 4.1	
Lab_prod_worker	GDP in Purchasing Power Standards (PPS) per person employed relative to EU-27 (EU-27 = 100)
In_out_fdi	Average share for inward to outward FDI for a given country
Gerd_ind	Percentage of Gross Domestic Expenditure on research and development financed by industry
Sc_tech_grad	Tertiary graduates in science and technology per 1000 of population aged 20-29
Empl_rate	Employment rate for a given country
Empl_gr	Employment growth for a given country
Bus_invest	Gross fixed capital formation for a given country
Eu_patents	Application for patents to European Patent Office
transition	Boolean variable that indicates transition country
For Section 4.3	
Lodgings_th_ppl	Lodgings per thousand of people
Population_growth	Population growth
H_cap_movement	Human capital movement – obtained as the difference between people settled and people who left a given district
Reg_unempl	Registered unemployed
Edu_instit	Number of educational institutions
NW, NC, NE, SC, SE	Boolean variables indicating the region a certain district is in

Table 6. Description of the used variables