2. MODELLING THE ECONOMIC GROWTH OF THE COUNTRIES IN THE BALTIC SEA REGION

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Introduction

Economic growth — increase in the production of goods and services, usually measured by a rise in the gross domestic product (GDP) or in per capita GDP — is one of the most important economic phenomena describing economic development and improvement of material welfare. That is why countries want to achieve fast economic growth. However, in measuring the GDP only the produced amount of goods and services is taken into account. Production's negative externalities, such as social instability resulting from the possible increase in economic inequality (if economic growth benefits mainly people with high incomes) and effects on the environment are neglected. In the developed countries, the purpose is to achieve sustainable development, i.e. in parallel with increasing production, they try to avoid negative side-effects.

In the Baltic Sea region (BSR) we observe two groups of countries — transitional and industrial economies — which are at different levels of development. The transitional economies' GDP per capita is several times lower than that of industrial economies. In order to achieve similar living standards, transitional economies would need rapid economic growth. To accelerate economic growth, it is necessary to know the growth factors. In order to estimate how much the speed of development of the transitional countries differs from that of the industrial ones, we need to know whether the growth factors are different or whether their impact on the economic growth of those countries varies.

From these questions evolves the purpose of the current chapter: to analyze the factors that influence economic growth in the Baltic Sea region and to find the differences in the growth factors of the transitional and industrial economies in order to assess the BSR countries' prospects for growth and their means to accelerate economic growth.

The number of growth factors is large — in the empirical literature on economic growth more than 90 factors that are statistically significant in at least one growth regression have been found (Durlauf, 2001, p. 65). Therefore, it has to be carefully considered which factors a growth regression of the BSR countries should include. To choose the growth factors, exogenous and endogenous growth models and critique from the demand-side growth theory are introduced. The choice of variables is also based on the empirical results of Levine and Renelt (1992), Sala-i-Martin (1997), and Fernández, Ley and Steel (2001) who use different techniques for deciding which factors are significant in growth regressions. As a result of literature analysis, both supply and demand side growth factors are included in the model of the BSR countries. Specifically, on the supply side, these are, firstly, accumulation of physical capital, secondly, accumulation and growth of human capital, and thirdly, growth of labour force, while on the demand side the factors involve growth of foreign demand and growth of domestic investments.

For modelling the economic growth of the BSR countries, panel data analysis is used herein. In order to assess the differences, the models are estimated separately for the transitional and industrial economies. The estimation period is 1994–2000. A lot of attention is paid to the choice of indicators to provide consistency with the theoretical growth factors.

The chapter is structured as follows. First, the theoretical and empirical economic growth literature is reviewed. Next, the current level of economic welfare and economic growth during 1990–2002 of the BSR countries is described. After that, the economic growth model of the BSR countries is set up and indicators are chosen. Then the model is estimated and the results are discussed. The final section draws conclusions.

2.1. Literature on theoretical and empirical aspects of economic growth

2.1.1. Theoretical growth models

Interest in the aspects of economic growth is as old as economics (see Appendix 1 on the development of the theories of economic growth). Already Adam Smith in his "*Wealth of Nations*" talked about the growth of production: growth was achieved through the division of labour. John Stuart Mill in his "*Principles of Political Economy*" named labour, capital and land as the production factors. The growth of production was supposed to be achieved through the increase in the use and productivity of the production factors. Today, labour and capital are still included in the growth models (Abramovitz, 1989).

In the 20th century the most popular growth model was the neo-classical growth model developed by Solow and Swan in the 1950s. The grounding for the model was the neoclassical production function. According to the model, the steady-state economic growth rate depends only on the rate of technological progress and growth of population. Both of these are given in the model exogenously. If there is no technological progress, the model predicts the end of growth of per capita production. As the technological progress is not determined within the model, it is assumed that technological progress cannot be influenced by economic agents. The neoclassical growth model is an exogenous growth model, as the steady-state growth rate depends only on exogenously determined factors.

Since the mid-1980s, attempts have been made to determine technological progress explicitly within the model. Already at the beginning of the 20th century Joseph A. Schumpeter said that the main source of economic growth was conscious creation of innovation (Abramowitz, 1989). In the models of economic growth this view was disregarded for a long time. The first authors to model technological progress explicitly in a growth model were Kenneth Arrow and Eytan Sheshinski in 1960s, though innovations were assumed to be a side-product of production or investment, not consciously created (Barro and Sala-i-Martin, 1995). In the models of endogenous growth, set up in 1990s, innovations are the results of conscious activities, modelled as depending on the resources invested into research and development (R&D). Economic agents have to choose between larger production and consumption of final consumer goods today, giving up some of the current consumption to invest resources into R&D activities, in order to be able to produce and consume more in the future. If through these activities innovations are created, the increase in production can be achieved without increasing the use of classical inputs — capital and labour. In addition to models in which technological progress is modelled as a result of investment into R&D activities, such models have been elaborated in which a rise in productivity is achieved by means of learning-by-doing. In endogenous growth models capital is often understood as including also human capital, meaning that we could be in a world of increasing returns to scale.

From the endogenous growth models it is concluded that economic growth is not necessarily bounded, as there does not exist such a steady state as in the neoclassical growth model. Another difference is that the economic agents can influence the growth rate by changing the resources devoted to R&D activities.

The line between exogenous and endogenous growth is not clear. According to one definition, growth in a model is considered to be endogenous if technological progress is determined explicitly in the model, independent of whether the long-run growth can be affected by policy changes or not. In such a case, the growth "is endogenous in the sense that technological progress which generates long-run growth, results from R&D undertaken by profit-maximizing agents" (Jones, 1995, p. 760). Dinopoulos and Thompson (1999, pp. 159–160) call that kind of growth "Schumpeterian growth." According to the other, narrower definition, a growth model is an endogenous growth model only if the long-run growth rate can be affected by permanent policy changes (Ibid., p. 159).

The above-mentioned theories are based on aggregate production functions, assuming that economic growth is driven by supply-side factors. There are authors (e.g. McCombie, 2000–2001) who criticize the use of aggregate production functions and find that economic growth is caused by demand-side forces. These authors stress the importance of export and investment growth, as both of them result in the improvement of productivity (McCombie and Thirlwall, 1994; Cornwall and Cornwall, 2002).

One can distinguish between long- and short-run economic growth. Long-run growth is mainly influenced by supply-side factors, determining the development of potential output. Short-run deviations from that growth path are determined mainly by demand-side factors. Therefore, both supply- and demand-side factors matter for economic growth, especially if we look at it from a relatively short-term perspective.

2.1.2. Empirical growth models

Empirical research on economic growth started in the 1950s, when Simon Kuznets elaborated the conceptual basis for calculating national income and the system of national accounts (Abramovitz, 1989, p. 13). Empirical analysis of economic growth was activated after the publication of the database by Summers and Heston

(1988, 1991), which includes comparable data for a large number of countries.

The growth regressions are usually estimated in the following form:

(1) $$g_i = \beta_0 + \mathbf{X_i}\boldsymbol{\beta} + u_i ,$$

where

g_i — (average) economic growth during the period surveyed;
$\mathbf{X_i}$ — vector of independent variables, measured at the value of initial period or average value across the periods under inspection;
β_0 — the intercept;
$\boldsymbol{\beta}$ — vector of parameters corresponding to the independent variables;
u_i — stochastic disturbance term;
subscript *i* denotes cross sectional objects (countries or regions).

The number of variables that have been used in growth regressions and have been statistically significant at least once is large: for instance, Durlauf has found more than 90 of them (Durlauf, 2001, p. 65). Nevertheless, there exist variables that are included in almost any growth regression. According to Arora and Vamvakidis (2001, pp. 7–8), these and the indicators used as proxies for them are:

1) convergence (the logarithm of per capita GDP in the initial year of the period under consideration);
2) demographic development (population growth);
3) investment in physical capital (gross domestic investment as a percentage of the GDP);
4) human capital (secondary school enrolment);
5) macroeconomic policies (inflation, government consumption);
6) trade openness (the share of external trade in the GDP).

From these groups of variables, the most important are the first three or four originating from the neoclassical growth model (Durlauf, 2001, p. 65, Brock and Durlauf, 2001, p. 233). Additional variables are chosen according to the specific investigation question.

The large number of possible determinants of growth has induced several authors to analyze which of them actually matter. Appendix 2 summarizes the results from three articles of this kind.

The first to generalize the results of different growth regressions and to estimate in a complex way their robustness relying on statistical criteria were Levine and Renelt (1992). As their research method they used Leamer's extreme-bounds analysis (Leamer, 1983). The variables that Levine and Renelt always included in the model were the share of investments in the GDP, per capita GDP of the first year under investigation, and the average growth rate of population. They added a variable whose robustness was analyzed (the variable of interest) and up to three additional variables that are potentially important in explaining growth. If the parameter estimate of the variable of interest maintained its significance when the up to three extra variables had been included in the model at least at the 0.05 significance level, the variable was concluded to be robust. If the parameter was statistically significant without additional variables in the model, but appeared to be insignificant (or even changed the sign) if they were added, the variable was considered to be fragile. According to Levine and Renelt's results, none of the tested variables was robust and thus not strongly related to economic growth. Nevertheless, they found that some of the tested variables (ratio of exports to GDP, openness, trade distortions, revolutions and coups) might influence economic growth indirectly through the effect on the investments. From the variables that were always included in the regressions, the correlation of economic growth with population growth turned out to be fragile. Levine and Renelt concluded that the number of variables robustly correlated with economic growth is very small.

Sala-i-Martin (1997) and Fernández, Ley and Steel (2001), using other analysis techniques, came to a different conclusion: there are many variables that are significantly correlated with economic growth. Sala-i-Martin's technique was the following. He estimated a lot of growth regressions similar to those of Levine and Renelt's.

Taking into account all the results, he derived new density functions for the parameters. If at least 95% of the area under the parameter estimate's density function was at one side of zero, the variable to which the parameter estimate corresponded was concluded to be significantly correlated with economic growth. He tested the significance of 59 variables and concluded that 22 of them were significantly correlated with growth.

Fernández, Ley and Steel (2001) found four variables of high importance (coincide with the results of Sala-i-Martin), and 14 variables with moderate importance, from which 8 are more important (also coincide with the findings of Sala-i-Martin). Eight variables that Sala-i-Martin had found significant are unimportant according to Fernández et al. and five are rather unimportant. Fernández, Ley and Steel used Bayes' approach to analyze the significance of growth regressors, without constraining the models by determining *ad hoc* the number of variables or the variables always to be included in the model.

Though the described papers tried to determine the most important growth factors, it is still unclear which variables should always be present in a growth regression. In estimating growth models, it should be kept in mind that they tend to be sensitive — adding a new variable may change the estimates that earlier used to be statistically significant and consistent with theory to be insignificant or even conflicting theoretical views. This is largely the result of the fact that many growth factors are strongly correlated.

In addition to variables (and the corresponding indicators) to be included in the model, the type of data must be chosen. It is possible to analyze economic growth across countries, using averages over long periods, (Barro, 1991; Mankiw et al., 1992), in time for an individual country (Solow, 1957) or both in time and cross-sectional dimension (panel data, both averages over a number of years and yearly data have been used) (Senhadji, 2000; Islam, 1995; Arora and Vamvakidis, 2001). The choice depends on the purpose of the analysis and availability of data. For example, in the case of the transitional countries it is not possible to use averages over long time periods. In the current chapter, yearly panel data are used.

2.2. Economic growth in the Baltic Sea region and the set-up of the model

2.2.1. Economic growth in the Baltic Sea region

The countries of the BSR have different levels of development: while the industrial countries are among the most competitive and wealthy countries in the world, the transitional countries are lagging far behind (see Table 1 and Paas, 2004). The World Bank has classified all countries into four groups according to their incomes: high income, upper middle income, lower middle income and low income countries. From among the BSR countries Denmark, Finland, Germany, Norway and Sweden belong to the group of high income countries, Estonia and Poland have upper middle incomes, and Latvia, Lithuania and the Russian Federation are classified as countries with lower middle income (World Bank, 2003a). As can be observed from Table 1, the difference between the incomes of the transitional and industrial countries is multiple, being smaller if the incomes are adjusted for different price levels. The transitional countries can gain the welfare levels of the industrial countries only if they achieve faster economic growth than the industrial economies.

If the speed of growth of the industrial and transitional countries is compared, taking the year 1989 as the basis, one is inclined to conclude that the transitional countries' hope for catching up with the industrial countries is very slim: during 1989–2001 the economic growth of the industrial countries was a lot faster than that of the transitional countries (Figure 1). Poland was an exception, experiencing growth which was comparable to that of the industrialized countries. The reason is that their transition processes started earlier than those in the other transitional countries.

Table 1. Per capita gross national income of the BSR countries in 2002

Country	Current USD	Purchasing power parity USD
Denmark	30,290	29,450
Estonia	4,130	11,120
Finland	23,510	25,440
Germany	22,670	26,220
Latvia	3,480	8,940
Lithuania	3,660	9,880
Norway	37,850	35,840
Poland	4,570	10,130
Russian Federation	2,140	7,820
Sweden	24,820	25,080
Average of region (unweighted)	15,712	18,992

Source: World Bank (2003a).

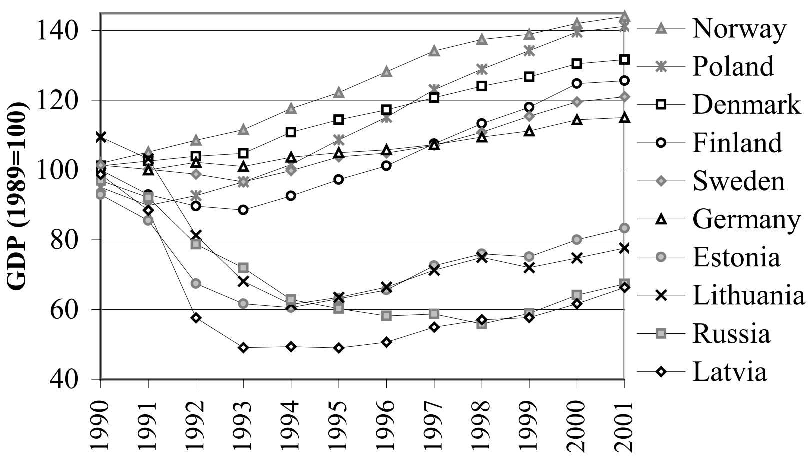

Figure 1. The GDP of the BSR countries compared to year 1989 (Germany compared to 1991) (data from World Bank (2000, 2003b)).

The picture of cumulative economic growth in Estonia, Latvia, Lithuania and Russia during the 1990s is distorted by the deep recession at the beginning of the decade. The extent of the fall has been thought to be overestimated (Szilágyi, 1997; Belkindas et al., 1999). Therefore, comparisons of the cumulative growth rates after the initial deep fall — since 1994 — might give a more accurate picture (Figure 2). This picture is more optimistic for most of the transitional economies: their growth has been faster than that of the industrial countries. The exceptions are Finland and Russia. Finland's fast growth can be explained by recovery from the recession at the beginning of the 1990s, when the Finnish economy was affected, like those of the transitional countries, by the collapse of the Soviet system. Finland was forced to restructure its economy and this resulted in fast economic growth.

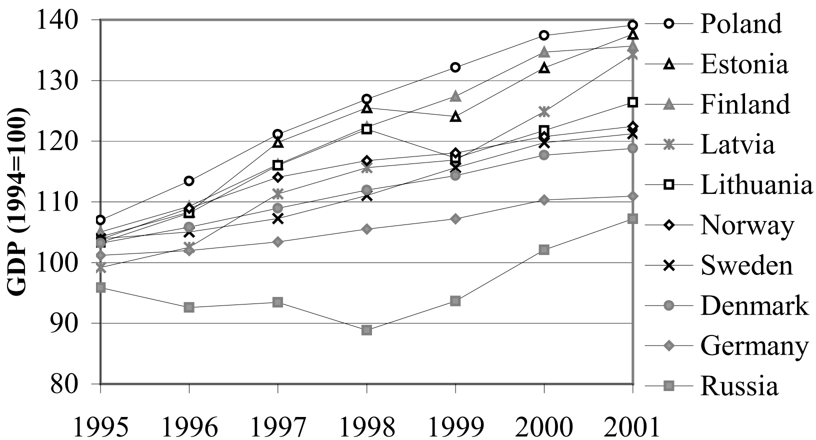

Figure 2. The GDP of the BSR countries compared to year 1994 (data from World Bank (2000, 2003b)).

The other exception's, Russia's economic growth has been the slowest in the region. The reason has been the slow progress of reforms: the economy and its institutions have not been restructured enough to be successful in the conditions of open world markets. Though Russia has experienced growth since 1999, its political and economic conditions are still unstable and future developments are difficult to assess.

2.2.2. The set-up of the model for estimating economic growth of the Baltic Sea countries

The set-up of the model of economic growth for the BSR is based on the theoretical views and empirical studies introduced in the first part of the chapter, and on the specific features of the BSR.

As was concluded in the first part of the chapter, the ground for models of economic growth usually comes from an aggregate production function. If the technology and thus productivity are not changing, it is necessary to increase the use of production inputs (physical and human capital and labour) in order to achieve growth of the output. Therefore, the accumulation of physical and human capital and labour is included in the growth model of the BSR countries. In addition to the supply-side growth factors, the demand-side factors (growth of investments and exports) that are considered to matter for economic growth in the demand-side growth theory are included in the model.

There is an on-going discussion among economists about whether we need faster growth or a larger per capita stock of human capital in order to achieve faster economic growth. On the one hand, in countries with more human capital the generation of new ideas and absorption of new technologies is easier. Therefore, in these countries economic growth should be faster than in those with less human capital. On the other hand, in order to accelerate economic growth, human capital should grow. As in the current chapter the growth model is estimated on the basis of panel data including both the in-country and between-countries effects, human capital is included both as a stock and a growth variable.

In setting up the growth model for the countries of the BSR, it has to be kept in mind that the starting point in 1990 was different for the transitional and industrial countries. During these ten years substantial changes have occurred in the transitional economies. This is indicated by the changes in the structure of the GDP (Table 2). Today's developed market economies experienced similar changes during decades. For example, Finland's GDP structure in 1960 was as follows: agriculture 18%, industrial production 39% and services 62% (World Bank 2000), thus being similar to the GDP structure of the transitional economies at the beginning of the 1990s. No sooner than 30 years later, in 1991, was the structure of the Finnish economy similar to that of the transitional economies in 1999: the share of agriculture less than 6%, industrial production around 32% and services around 62% (World Bank 2000). In the transitional countries, changes of similar extent took less than 10 years instead of 30 years.

Table 2. The structure of the GDP in the BSR countries in 1990, 1995 and 1999 (share in GDP, %)

Country	Agriculture			Industry			Services		
	1990	1995	1999	1990	1995	1999	1990	1995	1999
Denmark	4.3	3.6	2.7	26.7	24.9	24.2	69.0	71.5	73.1
Estonia	16.6	7.9	5.7	49.7	29.0	25.3	33.7	63.1	69.1
Finland	6.4	4.7	3.6	35.4	32.2	32.0	58.2	63.1	64.4
Germany		1.3	1.2		32.0	30.4		66.7	68.4
Latvia	21.9	10.8	4.0	46.2	33.2	27.6	31.9	56.0	68.4
Lithuania	27.1	11.7	8.6	30.8	33.2	31.2	42.1	55.0	60.2
Norway	3.2	2.8	2.2	31.2	33.4	34.5	65.6	63.9	63.3
Poland	8.0	7.0	4.9	48.3	39.2	36.4	43.7	53.8	58.7
Russia	16.6	7.2	6.9	48.4	37.5	37.8	35.0	55.3	63.3
Sweden	2.9	2.5	2.4*	33.8	29.8	30.5*	63.3	67.6	67.2*

Source: data for 1990 — World Bank 2000; data for 1995 and 1999 — UNECE 2001b, p. 117.
* 1998.

Nevertheless, the structure of employment has changed less in the transitional countries. For example, the share of workers employed in agricultural activities was in 2001 from 10–12% in the Baltic countries and Russia to 21% in Poland. In the industrial countries of the region, the corresponding share was as small as 2.5–5.5% (WRI 2003).

As the economic processes in the transitional and industrial countries have been different, the regression models will be estimated separately for the two groups of countries. Still, the starting specification is the same. Durlauf (2001) and Brock and Durlauf (2001) have also emphasized that for countries at different developmental levels the parameters of growth models are different. As most of the growth factors included in the model are from the supply side, it is probable that the estimation results are more consistent with theory in case of transitional countries, which — as explained above — have during a short time period undergone the processes that took decades in the current industrial countries.

In the model it has to be taken into account that the BSR countries have close foreign trade relationships (Paas and Tafenau, 2004). Also a large part of foreign direct investment to the transitional economies comes from the region's industrial countries. Due to the fact that most of the BSR countries are small open economies, it is probable that one of their important growth factors is the growth of foreign demand. As the share of exports going to the countries of the same region is large (especially in the case of the transitional economies) the demand for their goods should increase if there is economic growth in the other countries of the region.

Based on the previous discussion, the following variables will be included in the model:
- accumulation of physical capital,
- stock and accumulation of human capital,
- growth of labour,
- growth of investments,
- economic growth of the region.

All these factors are expected to be positively related to economic growth. The models will be estimated separately for the transitional and industrial economies.

2.2.3. Data

Choosing the proper proxies for measuring the growth factors is of crucial importance, as with improper indicators the results will be inaccurate. In addition to choosing proper indicators, it is necessary to pay attention to issues like simultaneity (variables to be included in the model may depend on the dependent variable and/or on the other right-hand-side variables) and the need to lag variables (the influence of a change in a growth factor may occur after a couple of years; an indicator measured in a period might rather describe the situation in future periods, especially in case of investment data).

In the current chapter economic growth is understood and measured as the growth rate of the GDP. The measures of independent variables and their sources are presented in Table 3. In choosing the proxies, their consistency with the content of theoretical variables, the data availability and the regional characteristics were considered.

Physical capital is understood as the stock of durable means of production, measured by the total value of fixed assets (machinery and equipment, buildings and infrastructure). Therefore, the physical capital could be measured by the total value of fixed assets in a country, but such data are not available. Summers and Heston (1991) estimated the stock of capital by the perpetual inventory method, summing the investments into producers' durables, non-residential construction and other construction from the previous periods, taking into consideration depreciation allowances. In the case of the transitional economies, application of this method is probably not justified, as the time series are short and the depreciation rates have varied a lot. Also the high inflation at the beginning of the 1990s causes problems: it is difficult to evaluate the initial capital stock. In the current chapter, the accumulation of the physical capital is proxied by the GDP share of investments into fixed assets (%), similarly to many articles where growth models are estimated. As yearly data are used, the indicator in the model will be with 2 or 3 period lag, in view of the time needed for employing the investment to its full extent.

Table 3. The proxies for the variables included in the model

Variable	**Proxy**	**Source**
Economic growth	Annual GDP growth rate (%)	World Bank (2000, 2003b)
Accumulation of physical capital	Share of gross fixed capital formation in nominal GDP (%)	IMF (2001b)
Stock of human capital	Tertiary school enrolment rate, gross (%)	World Bank (2000) UNICEF (2001)
Accumulation of human capital	Annual growth rate of tertiary school enrolment rate (%)	World Bank (2000) UNICEF (2001)
Growth of labour	Annual growth rate of employees (%)	UNECE (2001a)
Growth of domestic demand	Annual growth rate of gross fixed capital formation (corrected with GDP deflator) (%)	IMF (2001b)
Growth of foreign demand	Weighted average of the GDP growth rates of countries in the region (excluding the current country), weights are 1999 or 2000 export shares in the total export to the region from the current country (%).	World Bank (2000, 2003b), national statistical yearbooks

Human capital means capabilities, knowledge and skills and the possibility to use them productively. All these components of human capital are difficult to measure. That is why human capital has been considered to be one of the most difficult growth factors to measure. Islam (1995, p. 1150) has mentioned, “Measures of human capital have always been a weak spot in growth empirics.” As the measures of human capital have been used the average years of schooling in the total population over age 25, the share of literate people, primary school enrolment rate, etc. None of these is applicable for measuring human capital in the Baltic Sea region. The last two of the previously mentioned three indicators are unsuitable as in all the BSR countries they are close to 100%, having variation neither in time nor across countries. The number of average years of schooling is not applicable, as it does not change much during the short time period under investigation. Of course, the accumulation of human capital takes time, but for example, in the case of the transitional economies we should consider that human capital has been started to be valued more (see e.g., Philips, 2001). This process is reflected in the behaviour of people: more and more people want to obtain tertiary education. This is the reason behind choosing gross tertiary school enrolment as the proxy for human capital in the chapter.

Yet, several problems are associated with the indicator. First, rather than the current stock of human capital, it shows the accumulation of it. Nevertheless, it can be argued that in countries with more educated inhabitants, education is more highly valued: educated people wish their children to receive a good education, too. Therefore, the indicator gives an estimate to the valuation and application of human capital by society. Another problem is comparability of the indicators: tertiary education is defined differently by the countries involved. Also the rules for how long a student can be listed as a student differ. As the gross enrolment rates are used (therefore not excluding the people who are older than the age group of tertiary education level), the incomparability across countries may cause distortions.

The indicator for human capital is included in the model with a two-period lag. First, it helps to avoid the problem of simultaneity (if the wages rise with economic growth, more people can continue studies at a higher educational level). Second, it takes into consideration that many students do not work during their studies, but the closer the end of the studies, the more students are working.

Additionally, two groups of students graduate during two years. Thus, it is assumed that on average a current student will enter the labour market in two years' time.

Labour input can be characterized by indicators such as the number of workers, population, working hours, and the size of labour force. In theoretical growth models it is often assumed that the number of workers and population have the same growth rates and therefore, population growth rate could be the proxy for the growth rate of labour input. The assumption is justified if long period averages are used in the model, but in the case of the short-term data, the indicator should show more precisely the number of workers. In the current chapter, the growth rate of the number of employed people is used.

Growth of foreign demand is usually interpreted as economic growth of the countries that are the main importers of the goods from the country under observation. In empirical growth literature (Atesoglu, 1996; Arora and Vamvakidis, 2001) also the growth rate of the world economy or the United States has been used. As the countries around the Baltic Sea are closely related, the growth of foreign demand is measured by the weighted average economic growth of the region, using as weights the shares of export in the total export to the Baltic Sea region. Alternatively, it was considered to use the economic growth of the United States, European Union or OECD countries. The first of them was excluded because in most cases, the share of export to the BSR countries is larger than the share of export to the United States. If EU or OECD economic growth was used, there would arise the simultaneity problem as it is difficult to remove the impact of economic growth of the country observed.

In addition to foreign demand, domestic demand is included in the model. As the proxy for the growth of domestic demand, growth of investment into fixed assets is used. The choice of this indicator is based on the demand-side growth theory. Investing creates demand for investment goods and therefore, the production of these increases as does the overall output. Investments also express the expectations of producers: if they expect the demand for their products to increase in the future, they will invest in order to increase production capabilities or efficiency.

In estimating the model, data from nine countries are used. Russia is excluded from the sample, being incomparable to the other transitional countries with respect to its size and developments. Also the economic processes taking place in Russia are different from those occurring in the other transitional economies of the Baltic Sea region. However, Russia's data are included when measuring the growth of foreign demand. The data are from the period 1994–2000. The earlier years are excluded because of the disputable quality of the data.

2.3. Estimating the growth model for the countries of the Baltic Sea region

2.3.1. Methodology and set-up of the model

To estimate the model describing the economic growth of the countries of the Baltic Sea region, panel data analysis is used. When using panel data, it is possible to find within-group and between-group estimates, which enable distinguishing whether a growth factor has a different relationship with economic growth, depending on whether it is analyzed over time periods in one country or during one time period across countries.

The between-group estimates are found if the country averages of the variables are used in estimating the model. If a different intercept is allowed for each country (using fixed effects), the within-group estimates are obtained. If the model is estimated with a common intercept, the resulting parameter estimates are weighted combinations of within-group and between-group estimates. In the current chapter, the between-group estimates are not calculated, the number of cross-sectional units (countries) being too small (four transitional and five industrial economies), but the estimates from models with fixed effects and a common intercept are obtained. In order to decide whether fixed effects are needed, the Wald statistic is used. As the within-group and between-group effects may be different, the signs and significance of the parameter estimates may differ in models with common intercept and fixed effects.

The initial specification of the model is the following.

$$GY_{t,i} = \beta_{0,i} + \beta_1 \frac{I_{t-2,i}}{Y_{t-2,i}} + \beta_2 GH_{t-2,i} + \beta_3 H_{t-2,i} + \beta_4 H^2_{t-2,i} + \beta_5 GL_{t-1,i} + \beta_6 GREG_{t-1,i} + \beta_7 GI_{t-1,i} + u_{t,i}, \tag{2}$$

where

$GY_{t,i}$ — economic growth,

$\frac{I_{t-2,i}}{Y_{t-2,i}}$ — accumulation of physical capital ($I_{t-2,i}$ — investments, $Y_{t-2,i}$ — GDP) (in the second specification with a 3-period lag),

$GH_{t-2,i}$ — growth rate of human capital,

$H_{t-2,i}$ — stock of human capital,

$GL_{t-1,i}$ — growth rate of the number of employed people,

$GREG_{t-1,i}$ — economic growth of the region (excluding the *i*-th country),

$GI_{t-1,i}$ — growth rate of investments,

$\beta_0,\ldots,\beta_7$ — parameters of the model,

t — time period,

i — country.

When estimating the model, at first it is always tested whether there is heteroskedasticity in the model, using White's test. If heteroskedasticity is detected, weighted least squares are used.

Next it is tested whether a common intercept could be used instead of fixed effects. If necessary, the model is re-estimated. After that, the variables corresponding to the insignificant parameter estimates will be excluded from the model, starting from the least significant, until all the remaining parameter estimates are significant at least at significance level 0.1, or until all *t*-statistics are not less than 1.5, if removing a corresponding variable results in large changes in the other estimates or these turn insignificant. Finally, the model is tested once more for heteroskedasticity and the need for fixed effects. In case of different specifications, the sample size could differ a bit because of the different length of time series for some countries and variables.

2.3.2. Estimation results

The final estimates are presented in Tables 4 and 5 and the initial estimates in Appendixes 3 and 4.

As expected, the results for the transitional and industrialized economies are different. The models estimated on the basis of the transitional countries' data are more consistent with the theoretical views: the parameter estimates for factors that should accelerate economic growth are positive. On the other hand, in the industrialized countries' model the signs of most of the parameter estimates are converse to what was expected.

The factors that matter for growth thus appear to be different in the two groups of countries. In the transitional economies' model, most of the factors are statistically significant (the exceptions being physical capital accumulation and investment growth), but in the developed economies' model, exactly these two factors which are insignificant in the transitional countries' model, turn up as significant, in addition to the stock of human capital and economic growth of the region.

Table 4. The results of estimating the growth model for the transitional economies of the Baltic Sea region

Variable		Coef.	se
Intercept		48.48***	14.89
I_{t-2} / Y_{t-2}			
I_{t-3} / Y_{t-3}			
GH_{t-2}		0.136**	0.051
H_{t-2}		–2.670***	0.890
H^2_{t-2}		0.035***	0.012
GL_{t-1}		0.434*	0.235
$GREG_{t-1}$		0.729**	0.305
GI_{t-1}			
R^2		0.553	
Adjusted R^2		0.451	
F		5.44***	
RSS		207.81	
N		28	
White's test for heteroskedasticity	χ^2	4.7	
Wald's test for a common intercept	F	0.50	
	χ^2	1.50	

Source: author's calculations.

Notes. The models were first estimated with fixed effects (see Appendix 3). Then they were tested for heteroskedasticity which was not detected (significance level 0.05). Then, fixed effects vs. a common intercept were tested. After that, insignificant (significance level 0.1) variables were removed step-by-step, starting from the most insignificant ones. When all the remaining variables were found significant at least at 0.1 level, the models were tested once more for heteroskedasticity and fixed effects.

Coef. — coefficient estimate; se — standard error of the estimate.

* indicates significance at 0.1, ** at 0.05, *** at 0.01 significance level.

Yet interpreting these results requires caution. Both faster capital accumulation and growth of domestic demand should accelerate economic growth, but in the model for the developed economies the corresponding parameter estimates are negative. Assuming that the reason for this result is that implementation of new investments takes more time than initially assumed, we re-estimated the model with a three-period lag for the proxy of physical capital accumulation.

The paradoxical signs did not disappear, though the estimate grew. Apart from that, significant changes occurred in the model, the most important of them being the loss of the need for fixed effects in the industrialized countries' case. Also the variable for the growth of domestic demand turned insignificant. However, there were no changes in the final model for the transitional countries as the parameter estimate for physical capital accumulation remained insignificant.

Human capital appears to be positively related to economic growth both in the models for the transitional and industrialized economies. In the transitional countries' case, the parameter estimates are significantly positive both for the stock and growth of human capital, but in the industrialized economies' model, only the stock variable has sufficient significance. In the case of transitional economies, the parameter estimate for the stock of human capital in linear form is negative, but when accounting also for the quadratic term and the fact that the current tertiary enrolment rate in the transitional countries is above 40%, it can be concluded that there is a positive correlation between economic growth and the stock of human capital.

The growth of labour is significantly correlated with economic growth only in the case of the transitional countries. The growth of labour in the industrialized economies has been very stable during the years examined, while in the transitional countries remarkable fluctuations have occurred. In interpreting the transitional economies' model, it should be kept in mind that the number of workers has decreased due to emigration, negative natural growth and loss of jobs. Therefore, economic growth has been slower than it could have been with a more stable labour input.

Table 5. The results of estimating the growth model for the industrial economies of the Baltic Sea region

Variable		**Model 1**		**Model 2**	
		Coef.	se	Coef.	se
Intercept				4.94^{**}	1.82
I_{t-2}/Y_{t-2}		-0.886^{***}	0.198		
I_{t-3}/Y_{t-3}				-0.176^{**}	0.068
GH_{t-2}					
H_{t-2}				0.054^{***}	0.016
H^2_{t-2}		0.0010^{***}	0.000		
GL_{t-1}					
$GREG_{t-1}$		-0.406^{***}	0.131	-0.506^{***}	0.122
GI_{t-1}		-0.092^{**}	0.037		
Intercept (Denmark)		18.64^{***}	3.36		
Intercept (Finland)		16.21^{***}	2.77		
Intercept (Germany)		20.70^{***}	4.08		
Intercept (Norway)		20.56^{***}	3.81		
Intercept (Sweden)		15.68^{***}	2.73		
R^2		0.764		0.549	
Adjusted R^2		0.686		0.502	
F		9.73^{***}		11.75^{***}	
RSS		17.66		33.84	
N		33		33	
White's test for heteroskedasticity	χ^2	3.83		10.89	
Wald's test for a common intercept	F	4.32^{***}		0.79	
	χ^2	17.26^{***}		3.17	

Source: author's calculations.

Notes. See notes to Table 4 (for the estimation results of the initial models see Appendix 4). The difference between model 1 and model 2 is the different order of lag for variable *I/Y* (2 and 3, respectively).

The parameter estimate for growth in foreign demand — economic growth of the region — is significant both in the case of transitional and industrial economies, but in the regression for the latter, the sign is negative. The share of the Baltic Sea region in total exports of the industrialized economies is not as large as that of the transitional countries. Therefore, the proxy is seemingly not good enough for indicating foreign demand for the industrialized countries. A better proxy could be the economic growth of the OECD countries, but as said earlier in the chapter, the use of this indicator is inhibited by difficulties with removing the share of the country under observation.

The influence exerted on the economic development of the BSR transitional economies by the other countries of the region is remarkable. Hence they should be interested in the fast development of the whole region. Fast development can be achieved for example, through cooperation in evolving and implementing new technologies, as well as in the educational sector. Though in the case of the industrialized countries the parameter estimate for the region's growth is negative, they should be interested in cooperation, too, as it is easier to achieve the goals in a larger group of countries (e.g. in the European Union) if there is a shared understanding of the problems in the region. Additionally, the development of the transitional countries will stabilize the economic environment of the region and will make further developments more easily predictable, thus reducing risk of investment.

The growth of domestic demand measured by the growth of investments, is statistically significant only in the model of the industrialized countries. In view of the problems discussed above, it can be concluded that the specification of the model is not suitable for describing the economic growth of the industrialized countries, because in modelling their economic growth on the basis of yearly data more factors influencing economic growth in a short run should be included.

The results of our regression analysis indicate that the growth prospects are better for the transitional countries. After the initial recession at the beginning of the 1990s, their economic growth has been faster than that of the industrialized economies. However, it will take a lot of time for them to catch up with the industrialized countries. For example, Rajasalu (2001) has calculated that it would take 36 years for Estonia to achieve the average per capita GDP of the European Union, if the yearly economic growth of Estonia was 3 percentage points higher than that of the European Union, or 27 years, if the difference of growth rates was 4 percentage points. As the industrialized countries of the Baltic Sea region are among the wealthiest members of the European Union, it will take even longer to achieve the GDP level comparable to them.

On the basis of the model estimated in the current chapter, it can be expected that the yearly economic growth of the BSR transitional countries will be 4.5–7%, assuming that the tertiary school enrolment rate is around 50%, the economic growth of the region 2% (taking into account the slow growth rate of Germany, the largest economy in the region), and the number of workers continues to drop by 1–2% per year. Taking into consideration that the model describes only slightly over 50% of the variation in economic growth of the transitional countries, the actual economic growth may be different from the prediction, especially because of short-term fluctuations. For the industrialized countries, no prediction was calculated as the model was concluded to be unsuitable for describing their economic growth.

It follows from the above model that the transitional economies need to improve the quality of human capital and enlarge employment in order to accelerate their economic growth. In the conditions of market economy, enterprises do not increase their labour input if the additional workers are not productive enough. Therefore, a lot of attention should be paid to retraining the unemployed, including discouraged people, in order to help them to return to the labour market.

Conclusions

Both theoretical and empirical literature on economic growth is vast. Different authors have proposed several potential factors of economic growth. In the current chapter the choice of variables was based on the more acknowledged theoretical views, taking into consideration the characteristics of the available data (especially the short length of the time series).

The dependent variable, economic growth, was understood as the growth rate of the GDP. As the exogenous variables, physical capital accumulation, the stock of human capital and its growth, changes in the number of employed people, growth of foreign and domestic demand were included in the model. In choosing the appropriate proxies, data availability, consistency with theory and the characteristics of the Baltic Sea region (especially in the case of human capital and foreign demand) were considered. For physical capital accumulation, the proxy was the share of investments in fixed assets in the GDP, the stock of human capital and its growth were measured by the tertiary school enrolment rate and its growth. Changes in the input of labour were proxied by the growth rate of the number of employed people, the growth of domestic demand by the growth of investments into fixed assets, and the growth of foreign demand by the economic growth of the Baltic Sea region.

The models were estimated separately for the transitional and industrial economies. As expected, the growth factors proved to be different in the two groups of countries. The results obtained for the transitional economies were consistent with the theoretical viewpoints. Both the demand and supply side factors turned out to be statistically significantly correlated with economic growth.

To be more specific, the stock and growth of human capital, growth of labour, and growth of foreign demand are statistically significantly correlated with the economic growth of the transitional countries. On the basis of the model, it can be concluded that it is necessary to improve the quality of human capital, create new jobs, train unemployed people and cooperate at the regional level to accelerate economic growth. If these suggestions are followed, the growth prospects of the transitional countries are good.

The model for the industrialized economies was different from what could be expected on the basis of growth theories. Capital accumulation, the stock of human capital, the growth of domestic and foreign demand were statistically significantly correlated with economic growth, but instead of positive parameter estimates expected from theoretical understanding, the parameter estimates were negative, except for the stock of human capital. Therefore, the model is not suitable for describing the economic growth of the industrial countries.

The chosen approach for modelling the economic growth of the BSR countries is therefore applicable for the transitional, but not for the industrial countries of the region. The main reason for this result is the fact that most of the independent variables included in the model stem from long-term growth theories. During the short period observed (1994–2000), the transitional countries experienced changes that had taken decades in the current industrialized countries. The industrial economies are more stable and are not as dynamic as the transitional economies. Therefore, processes characteristic of long run were revealed in the growth model for the transitional economies, but not for the industrial economies. To explain the economic growth of the industrial countries in a short-term period, more variables describing short-run economic processes should be included in the model.

In future analyses of economic growth, more attention should be paid to annual country-specific economic (and political) processes, and the influence of technological changes and institutions should be taken into consideration. Also theoretical growth models need to be revised.

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Appendix 1. Development of the research of economic growth

Author	**Main innovation**	**Main conclusion**	**Importance**
Smith (1776)	Division of labour	The larger the market and the quantity of means of production, the faster economic growth. Production has increasing returns to scale.	Beginning of the research of economic growth
Mill (1848)	Production factors are labour, capital and land. Growth of wealth has a limit.	The sources of growth are social product accumulation and its productive investment.	The finalising of the viewpoints of classical economists.
Schumpeter (1911, 1942)	The central source of growth is innovation — technological development.	Growth is faster, if there is some extent of monopoly power in the economy.	Ideas have been applied in the theories of endogenous growth.
Ramsey (1928)	Intertemporal optimisation of the behaviour of households.	Method for endogenising saving rate.	Later an important component in growth models.
Harrod (1939), Domar (1946)	Keynesian analysis of economic growth.	Capitalistic system is unstable; achieving equilibrium is exceptional.	One of the first ones applying formal analysis to economic growth.
Solow (1956), Swan (1956)	Applying neoclassical production function.	Conditional convergence. Productivity growth depends only on the technological progress.	The basic form of neoclassical growth model, which has been later developed further.
Cass (1965), Koopmans (1965)	Ramsey's intertemporal optimisation added into the neoclassical growth model.	Same conclusions as in Solow and Swan's model.	Finish the neoclassical approach to economic growth: in following models technological progress is endogenous.

Author	Main innovation	Main conclusion	Importance
Arrow (1962), Sheshinski (1967)	Endogenous innovations as byproducts of production or investment.	Conclusions did not change compared to the basic neoclassical model.	Describe the genesis of innovations in growth models. Two production sectors.
Romer (1986), Lucas (1988), Rebelo (1991)	The marginal product of capital (incl. human capital) is not decreasing. Consider the possible positive externalities of human capital.	Endogenous economic growth that can last infinitely.	Restarted research on economic growth, resulted in endogenous economic growth theory.
Romer (1987, 1990), Aghion and Howitt (1992), Grossman and Helpman (1991)	Innovations are the result of conscious research and development activities. Imperfect competition. Production technology has increasing returns to scale.	Endogenous growth. Government can influence economic growth in long run.	Employing the framework of imperfect competition. First time when innovations are results of conscious activities.
Young (1998), Dinopoulos and Thompson (1999)	Endogenise the variation of products and their quality. Assume that production of innovations gets more and more difficult.	Endogenous growth with constant returns to scale production technology. The government's possibilities to influence long run growth are limited.	Because of constant returns to scale avoid the main shortcoming of endogenous growth model — infinitely lasting growth.

Source: author's summary based on Abramovitz (1989, pp. 4–11), Barro and Sala-i-Martin (1995, pp. 9–13), Young (1998), and Dinopoulos and Thompson (1999).

Appendix 2. Indicators used in growth models and their importance

Variable	Levine and Renelt (1992)	Sala-i-Martin (1997)	Fernández, Ley and Steel (2001)
Investment share of GDP	+		
Real GDP per capita in the initial period	–	!	#
Growth of population	0		%
Secondary school enrolment rate	+		
Government consumption share of GDP	0		
Ratio of total government expenditure to GDP	1		
Government consumption less defence and education share of GDP	2		
Ratio of central-government deficit to GDP	1		
Export share of GDP	0		
Import share of GDP	0		
Overall trade openness	0		
Overall trade intervention	0		
Black-market exchange-rate premium	0		/
Standard deviation of black-market exchange-rate premium	3	–	%
Average inflation of GDP deflator	0		
Standard deviation of inflation of GDP deflator	0		
Growth rate of domestic credit	0		
Standard deviation of the growth of domestic credit	3		
Number of revolutions and coups per year	0	–	%
Life expectancy		!	#
Primary school enrolment rate		!	/
Sub-Saharan Africa dummy		–	//
Latin America dummy		–	/
Absolute latitude		+	%
Rule of law		+	//
Political rights		+	%
Civil liberties		+	/
War dummy		–	%
Fraction Confucian		+	#
Fraction Buddhist		+	/
Fraction Muslim		+	//
Fraction Protestant		–	//
Fraction Catholic		–	/
Fraction Hindu			%

Variable	Levine and Renelt (1992)	Sala-i-Martin (1997)	Fernández, Ley and Steel (2001)
Fraction Jewish			%
Real exchange rate distortions		–	%
Equipment investment		+	#
Non-equipment investment		+	//
Fraction of primary products in total exports		–	%
Fraction of GDP in mining		+	//
Number of years an economy has been open between 1950 and 1990		+	//
Degree of capitalism		+	//
Former Spanish colony dummy		–	%
Size of labour force			%
Higher education enrolment			%
Ethnolinguistic fractionalisation			%
Age			%
Fraction speaking foreign language			%
Fraction of population speaking English			%
Former French colony dummy			%
Former British colony dummy			%
Ratio workers to population			%
Outward orientation			%
Public education share			%
Area (scale effect)			%

Source: author's summary based on Levine and Renelt (1992, pp. 947, 951, 954, 956), Sala-i-Martin (1997 p. 181), and Fernández, Ley and Steel (2001 p. 569).

Notes. Levine and Renelt: "+" — the indicator has significant positive correlation with economic growth, "–" — the indicator has significant negative correlation with economic growth, "0" — the indicator is not correlated significantly with economic growth in the basic regression, "1", "2", "3" — the correlation of the indicator and growth gets insignificant, if one, two or three additional indicators are added into the model, respectively.
Sala-i-Martin: "!" — the indicator is always in the model, "+" — the indicator has significant positive correlation with economic growth, "–" — the indicator has significant negative correlation with economic growth.
Fernández, Ley and Steel: "#" — very important growth factor, "//" — relatively important growth factor, "/" — rather unimportant factor for growth, "%" — unimportant factor for growth.

Appendix 3. The initial estimation results of the growth model for transitional countries

Variable		Model 1		Model 2	
		Coef.	se	Coef.	se
Intercept					
I_{t-2}/Y_{t-2}		–0.674	0.413		
I_{t-3}/Y_{t-3}				0.362	0.698
GH_{t-2}		0.214**	0.075	0.171*	0.087
H_{t-2}		–4.658**	1.736	–3.675*	1.741
H^2_{t-2}		0.065**	0.025	0.048*	0.025
GL_{t-1}		0.703*	0.363	0.539	0.355
$GREG_{t-1}$		0.782*	0.42	1.051**	0.483
GI_{t-1}		–0.031	0.074	–0.025	0.077
Intercept (Estonia)		96.7**	33.7	57.2	36.2
Intercept (Latvia)		89.0***	30.5	58.7*	30.9
Intercept (Lithuania)		96.9**	34.5	58.8	37.0
Intercept (Poland)		92.2***	31.3	59.1*	32.9
R^2		0.621		0.611	
Adjusted R^2		0.385		0.352	
F		2.62**		2.36*	
RSS		164.8		165.4	
N		27		26	
White's test for heteroskedasticity	χ^2	5.68		6.18	
Wald's test for a common intercept	*F*	1.08		0.156	
	χ^2	3.23		0.467	

Source: author's calculations.
Notes. The difference between model 1 and model 2 is the different order of lag for variable *I/Y* (2 and 3, respectively).
Coef. — coefficient estimate; se — standard error.
* indicates significance at 0.1, ** at 0.05, *** at 0.01 significance level.

Appendix 4. The initial estimation results of the growth model for industrial countries

Variable		Model 1		Model 2	
		Coef.	se	Coef.	se
Intercept					
I_{t-2}/Y_{t-2}		–1.041***	0.217		
I_{t-3}/Y_{t-3}				–0.399	0.284
GH_{t-2}		0.071	0.065	0.071	0.092
H_{t-2}		–0.224	0.147	–0.060	0.199
H^2_{t-2}		0.003**	0.001	0.001	0.002
GL_{t-1}		–0.015	0.257	–0.163	0.445
$GREG_{t-1}$		–0.289	0.170	–0.261	0.240
GI_{t-1}		–0.109**	0.052	–0.014	0.067
Intercept (Denmark)		27.0***	6.09	12.5	7.56
Intercept (Finland)		24.6***	5.88	13.3	7.80
Intercept (Germany)		29.7***	6.73	12.7	8.37
Intercept (Norway)		30.0***	6.76	13.8	8.51
Intercept (Sweden)		23.4***	5.66	10.9	7.10
R^2		0.804		0.617	
Adjusted R^2		0.697		0.407	
F		7.48		2.93**	
RSS		14.62		28.62	
N		32		32	
White's test for heteroskedasticity	χ^2	10.10		13.62	
Wald's test for a common intercept	F	4.98***		0.87	
	χ^2	19.9***		3.48	

Source: author's calculations.

Notes. The difference between model 1 and model 2 is the different order of lag for variable *I/Y* (2 and 3, respectively).

Coef. — coefficient estimate; se — standard error.

* indicates significance at 0.1, ** at 0.05, *** at 0.01 significance level.