

Ákos Dombi

Economic Growth and Development in Central and Eastern Europe after the Transformation

SUMMARY: This paper examines the direct sources of economic growth and development in 10 post-socialist Central and East European countries in the period from 1995 to 2012. We perform an empirical analysis relying on the methods of growth accounting and development accounting. The results of the growth accounting analysis demonstrate that the most important source of economic growth is the accumulation of physical capital, while the growth of labour productivity and that of multifactor productivity often have marginal effects only. These results are in line with those of development accounting, suggesting that the sluggish growth of the 10 countries compared to Germany in terms of GDP/hours worked can be attributed primarily to the low capital intensity of Central and East European economies, which offered considerable potential for the rapid accumulation of physical capital.

KEYWORDS: growth accounting, development accounting, Central and Eastern Europe

JEL CODES: O40, O11, O52

This paper explores the reasons for the economic growth and the relative development of 10 post-socialist countries in Central and Eastern Europe (CEE) in the period between 1995 and 2012. We perform an empirical analysis relying on the methods of growth accounting and development accounting. The countries included in the analysis are Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. The post-socialist growth path of these CEE countries can be divided into three periods: the period of the transformation crisis (1990–1994/1995); the period of robust growth and catching up (1995–2007); and the period of the current global economic crisis (2008–). Our analysis is focused on the last two episodes.

E-mail address: dombi@finance.bme.hu

The results of growth accounting demonstrate that in the period following 1995 the main source of economic growth in the region was capital accumulation, while the growth of labour productivity and multifactor productivity often had marginal effects only. Consequently, CEE countries have followed an extensive and investment-oriented growth model. The results of development accounting suggest that the sluggish growth of CEE countries compared to Germany in terms of GDP/working hour can be attributed primarily to their lower capital intensity and secondly, to their lower multifactor productivity. Labour quality, however, is roughly the same as in Germany. The results of growth accounting are in line with those of development accounting. The very low initial ratio of capital to GDP, coupled with investment rates

higher than those of developed countries, offered considerable potential for capital accumulation and hence, rapid economic growth.

This paper is structured as follows: first, it describes the stylised facts of economic growth and the relative development of CEE countries in the period elapsed since 1995. It proceeds to present the methodologies used for the empirical analysis, i.e. the decomposition formulas of growth accounting and development accounting. The next two chapters discuss the method of deriving the inputs required for the calculations. Finally, we explain the results of growth accounting and those of development accounting for the review period in respect of the countries under review. In the conclusions we draw lessons from the post-socialist growth paths of CEE countries and analyse their future prospects.

ECONOMIC GROWTH AND RELATIVE DEVELOPMENT IN CEE COUNTRIES: STYLISED FACTS

The growth path of the post-socialist Central East European countries can be divided into three phases. The first phase is the period of the transformation crisis, which started in 1990 and ended around 1994/1995. This period was characterised by a sharp decline in GDP and the employment rate, with the latter being extremely low in the Baltic countries (*Chart 1*)¹ The crisis was induced by the transition to a market economy, i.e. the irrevocable loss of human and physical capital, the collapse of external demand and the erosion of supplier and customer relations (Antal, 2004; Blanchard – Kremer, 1997).

The second phase is the period of robust economic growth, during which the CEE countries were among the most dynamically developing regions of the world (*Table 1*).

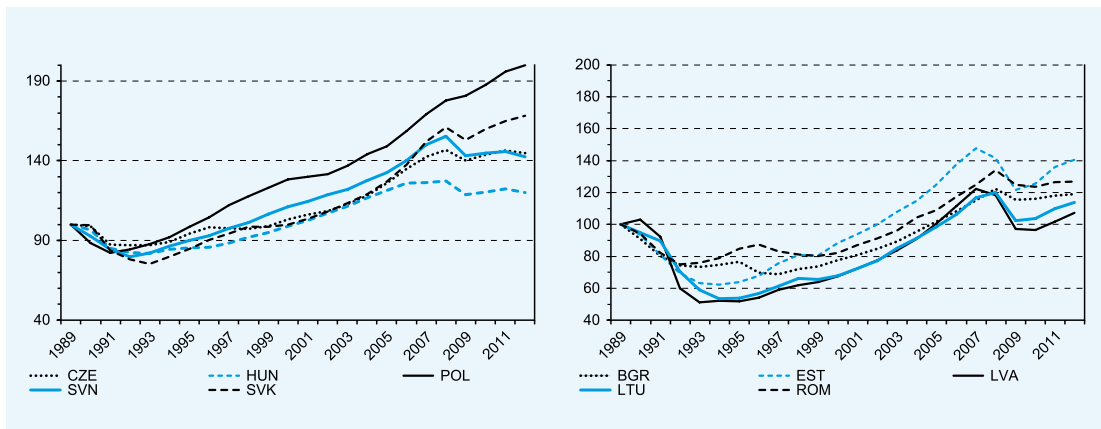
This phase can be split into two periods with marked differences in terms of the growth rate. Although the rate of growth, for the most part, was rather high during the first period (1996–2001) already, the most remarkable acceleration was observed during the second period (2002–2007), with the average annual growth rate exceeding 5 per cent in seven cases. These years may be considered as a kind of economic miracle. The extremely high growth rates recorded for over a decade allowed CEE countries to catch up with developed countries to a considerable degree (*see Chart 2*). Estonia and Lithuania boasted the highest performance in that regard: in respect of GDP per capita measured at purchasing power parity, they reduced the gap between their Charts and those of Germany by over 27 percentage points in the period between 1995 and 2007.

The third phase of the post-socialist growth path coincides with the current global economic crisis. During this period CEE countries (with the exception of Poland) were hit by recession to varying degrees. The steepest fall in GDP was recorded for the Baltic states in 2008/2009: the nearly 15–20 percentage point drop substantially exceeded the median value for Western Europe (Farkas, 2012). This third phase is characterised by the bitter fact that the recovery in the Central Eastern (*see Table 1*) European region appears to be much slower than in the other two regions in the process of catching up: Latin America and East-Asia.

Analysing the growth paths of CEE countries during the past two decades we can establish that the 10 countries can be divided into two groups in terms of the volatility of the growth rate. The first group is composed of the Visegrád-4 countries and Slovenia, while the second group includes the Baltic states, Romania, and Bulgaria. The growth rate of the first group was less volatile thanks to a more moderate GDP decline than in the

Chart 1

REAL GDP (1989=100)



Source: Author's own calculation on the basis of real GDP data from EBRD (1989–1995) and Eurostat (1996–2012).

Table 1

THE AVERAGE ANNUAL GROWTH RATE OF REAL GDP

	BGR	CZE	EST	HUN	LTU	LVA	POL	ROM	SVK	SVN	GER	CEE	EU-15	L-A	E-A
1996–2001	1.03	2.07	6.68	3.08	5.03	5.80	4.72	0.52	3.43	4.10	1.82	3.65	3.67	2.15	3.19
2002–2007	6.03	5.02	7.87	3.53	8.32	9.10	4.53	6.20	6.67	4.65	1.42	6.19	2.71	4.30	5.34
2008–2012	0.74	0.34	-0.70	-0.94	-0.18	-2.16	3.38	0.42	2.10	-0.98	0.78	0.20	-0.51	4.35	3.83

Note: EU-15: the 15 Member States of the European Union before 2004; L-A: Latin America (Argentina, Brazil, Chile, Ecuador, Mexico, Paraguay, Peru, Uruguay); E-A: East-Asia (Indonesia, South Korea, Malaysia, Philippines, Taiwan, Thailand).

As our analysis focuses on CEE countries rather than the CEE region itself, the growth rate for each region is calculated as the unweighted mathematical average of the growth rates of member countries.

Source: Eurostat; or, in case of L-A and E-A: IMF (World Economic Outlook, October 2012)

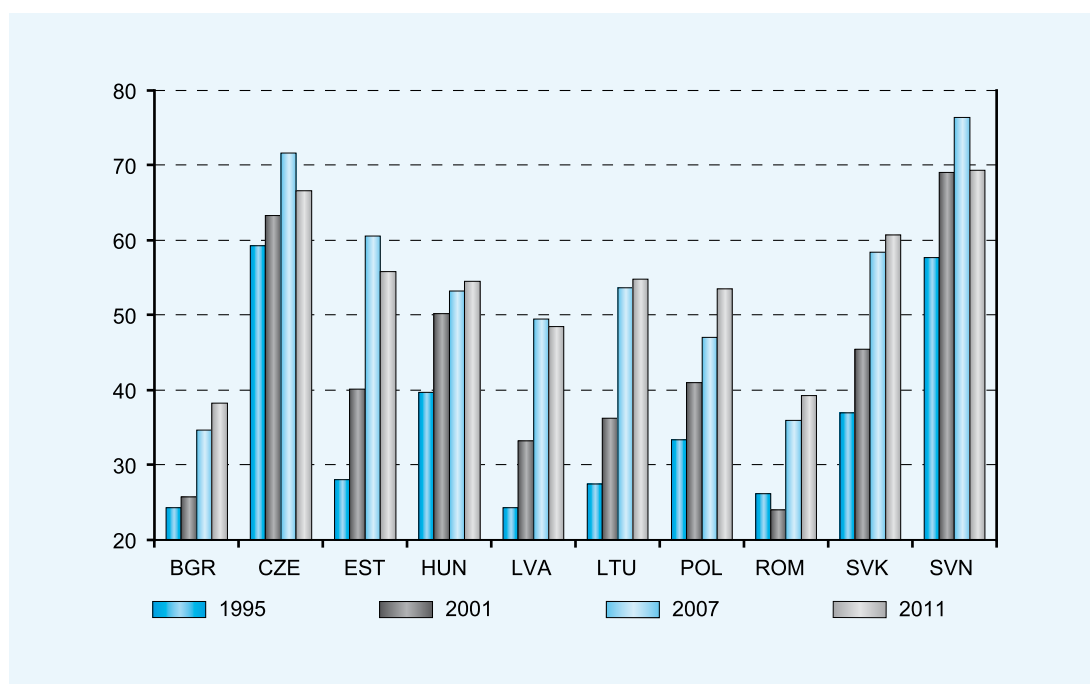
second group both during the transformation crisis and in the course of the current global economic crisis. The different extent of the spillover of the global economic crisis to the two groups of countries can be explained by the differences in the growth models followed after the transformation crisis. As pointed out by *Becker et al.* (2010), the growth rate surge in the Baltic states, Romania and Bulgaria, especially between 2002 and 2007, was fuelled by the excessive internal consumption spurred by lending and therefore, it went hand in hand with soaring external debt. The sustainability of that model was called into question by the

severe recession brought about by the global economic crisis. In contrast, the accelerated growth of the first group, excepting Hungary, was coupled with a prudent macroeconomic situation and sound FDI and export structures.

Another marked difference between the two groups is that, as a result of a more moderate transformation-related downturn, the Visegrád-4 and Slovenia reached the output level recorded for the last “year of peace” preceding the transition (1989) as early as the late 1990s, while it took until the early 2000s before the rest of the countries succeeded to do so.

Chart 2

VALUES FOR GDP PER CAPITA AT PURCHASING POWER PARITY (GERMANY = 100)



Note: Due to lack of data, for Romania, 1996 data stand for data pertaining to 1995, and 2010 data stand for data pertaining to 2011.

Source: Eurostat

Table 2

CHANGES IN INVESTMENT RATES AND SAVINGS RATES

%	BGR		CZE		EST		HUN		LTU		LVA		POL	
	I/Y	S/Y	I/Y	S/Y	I/Y	S/Y	I/Y	S/Y	I/Y	S/Y	I/Y	S/Y	I/Y	S/Y
1996–2001	14.8	13.8	29.2	26.0	26.9	21.6	23.1	20.0	21.3	12.8	21.8	16.3	22.5	19.9
2002–2007	23.3	14.8	26.5	23.7	32.6	22.5	22.5	16.3	23.4	15.5	29.1	19.0	19.1	17.5
2008–2012	25.6	20.4	24.7	21.1	23.5	23.6	19.1	19.0	18.7	15.3	22.9	23.4	20.7	17.6

%	ROM		SVK		SVN		FRA		GER		UK		USA	
	I/Y	S/Y	I/Y	S/Y	I/Y	S/Y	I/Y	S/Y	I/Y	S/Y	I/Y	S/Y	I/Y	S/Y
1996–2001	19.8	14.3	30.9	23.9	24.8	24.1	17.9	20.2	21.1	20.6	17.0	16.1	19.5	17.9
2002–2007	24.0	17.2	25.9	20.3	25.4	25.6	19.2	19.7	17.9	22.6	16.9	15.1	19.3	14.9
2008–2012	26.7	21.8	22.2	20.4	21.6	21.6	20.1	18.1	17.8	23.8	15.0	13.2	16.1	12.3

Note: I/Y= investment rate, S/Y= savings rate. I= Gross Fixed Capital Formation, S= Gross Savings, Y= GDP. For all the three variables, values are measured in national currencies and at current prices. In each period, fields highlighted in grey indicate, in case of I/Y, values that are lower, and in case of S/Y, values that are higher than the maximum value recorded for the four developed countries.

Source: Eurostat

Finally, let us examine developments in the investment rate and the savings rate in the 10 CEE economies and a number of developed countries after 1995. Table 2 shows the annual average Charts for each stage of the growth path. While there are significant differences in the two indicators as regards their value and their evolution both within the group of CEE countries and in the group of developed countries, three general trends can be clearly discerned. First, the investment rates of most CEE countries were higher than those observed in developed countries. Secondly, for the most part, developments in the savings rate values of CEE countries were similar to those observed in developed countries; however, in certain cases the former fell behind the latter significantly. The third trend is the direct consequence of the first two: in most cases, the investment rates recorded for CEE countries were considerable higher than their savings rates.

GROWTH ACCOUNTING VERSUS DEVELOPMENT ACCOUNTING

The purpose of growth accounting is to decompose the growth rate of GDP into contributions from the main production factors, i.e. capital, labour and technology. In contrast, development accounting decomposes the relative level of GDP (as compared to a benchmark country) into contributions from production factors.² As a starting point for obtaining the decomposition formulas, we use the following general production function:

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

where Y is the output (GDP),
 K is the physical capital input,
 L is the labour input and
 A is the residual factor.³

In the professional literature on growth theory, variable A is identified with the level

of technology. However, variable A does not only include the level of technology but also the effects of any other factors relevant to output which are ignored during the decomposition process. In development accounting, the unexplained portion of GDP – i.e. the residual – is called multifactor productivity (MFP).⁴ Likewise, in growth accounting the residual is the growth rate of the multifactor productivity.

In equation (1), variables K and L denote the production services of physical capital and labour, i.e. the capital input and the labour input. The production service of a factor depends on both its quantity and quality. For the labour, the number of hours worked (H) is used here as the measure of quantity, which is multiplied by the measure of quality (Q_L) to produce the composite for the labour input: $L = Q_L H$. For the capital input, the aggregate capital stock (K) is used as the measure of quantity. The calculation of the measure of quantity, however, is omitted due to a lack of data; in other words, the value of Q_K is calibrated to be 1: $K' = Q_K K = K$.⁵

In order to obtain the growth accounting formula, we first take the logarithm of equation (1) and then its derivative with respect to time:⁶

$$\frac{\dot{Y}}{Y} = \left[\frac{F_A A}{Y} \right] (\dot{A}/A) + \left[\frac{F_K K}{Y} \right] (\dot{K}/K) + \left[\frac{F_L L}{Y} \right] (\dot{L}/L)$$

where $F_j = \frac{\partial F(-)}{\partial j}$, and (2)

overdots are used to denote the time-dependent derivatives of variables. Accepting the standard assumptions used in literature, we can simplify equation (2) as follows:

$$\dot{Y}/Y = g_{MFP} + (1 - s_L) (\dot{K}/K) + s_L (\dot{L}/L), \tag{3}$$

where $g_{MFP} = \frac{F_A A}{Y} \frac{\dot{A}}{A}$, $s_L = \frac{wL}{Y}$

and w is wage (Barro, 1999).⁷ We must bear in mind that s_L is the amount of labour

income relative to GDP. As discrete data is used for our calculations, equation (3) must be written in the form of the differences of the variables:

$$\Delta \ln Y_t = \Delta \ln MFP_t + \frac{(1-s_{L,t})+(1-s_{L,t-1})}{2} \Delta \ln K_t + \frac{s_{L,t}+s_{L,t-1}}{2} \Delta \ln L_t \quad (4)$$

Equation (4) is the final decomposition growth accounting formula, defining the growth rate of GDP as the sum total of the growth rates for each factor.

Due to its complexity, we omit the explanation of how to obtain the development accounting formula. As to the underlying methodology, however, it is worth noting that, using the general production function (1) as a starting point, the decomposition formula is obtained based on the bilateral Törnqvist-index of the MFP:⁸

$$\ln \frac{Y_t}{Y_t^R} = \ln \frac{MFP_t}{MFP_t^R} + \frac{(1-s_{L,t})+(1-s_{L,t}^R)}{2} \ln \frac{K_t}{K_t^R} + \frac{s_{L,t}+s_{L,t}^R}{2} \ln \frac{L_t}{L_t^R} \quad (5)$$

Equation (5) presents how the difference in GDP against the benchmark country *R* can be divided into differences in capital, labour, and MFP (technology). In order to eliminate the distorting effect of the size difference between the reviewed country and the benchmark country, the subject of the analysis in empirical works is the relative GDP/hours worked. Therefore, by deducting $\ln(H/H^R)$ from both sides of equation (5), we can obtain the formula to be applied:

$$\ln \frac{Y_t/H_t}{Y_t^R/H_t^R} = \frac{(1-s_{L,t})+(1-s_{L,t}^R)}{2} \ln \frac{K_t/H_t}{K_t^R/H_t^R} + \frac{s_{L,t}+s_{L,t}^R}{2} \ln \frac{Q_{L,t}}{Q_{L,t}^R} + \ln \frac{MFP_t}{MFP_t^R} \quad (6)$$

To conclude this chapter, we wish to explain what the methodology can and

cannot be used for. As a simple mechanical decomposition, growth accounting and development accounting can be used for identifying the direct sources (components) of GDP growth and those of relative GDP, but they cannot be used for discovering any underlying fundamental factors (Barro, 1999; Hsieh – Klenow, 2010). With the assistance of growth accounting we can establish, for example, the amount of contribution from the accumulation of each factor (capital, labour, technology) to the rate of economic growth; however, we cannot receive any explanation to the specific causes of the accumulation of those factors.

WORKFORCE TRENDS

Representing the core elements of growth and development accounting, the factor inputs (*K*, *L*) must be measured accurately. This chapter addresses the measurement of the labour force, and the next chapter focuses on the measurement of the capital stock. Charts for the number of hours worked are obtained from the TED database.⁹

Factor Q_L is measured as the human capital per capita, which is calculated in professional literature as a function of the population's education level (Caselli, 2005). Based on the Mincer regressions, human capital per capita is the log-linear function of the average years of schooling (*sy*): $Q_L = e^{r \cdot sy}$, where *sy* and *r* are, respectively, the years of schooling and the return on them. Regression estimates suggest that return decreases in parallel with an increase in the years of schooling (Psacharopoulos, 1994). However, the actual value of *r* is surrounded by significant uncertainty. Based on a paper by *Psacharopoulos and Patrinos (2004)*, we use the following assumptions: $r=0,117$ if $sy \leq 4$; $r=0,097$ if $4 < sy \leq 8$; and $r=0,075$ if $8 < sy$.¹⁰

Data for the years of schooling are obtained from the most recent Barro – Lee (2010) database. The database includes observations made in five-year intervals; therefore, linear interpolation is used for producing data for any interim years and linear extrapolation for producing data for 2011 and 2012.

Chart 3 shows the calculated values for the efficiency multiplier of labour. Apart from the Czech Republic, the value of indicator Q_L improved continuously in all CEE countries, which can be attributed to the improving educational level of the workforce. In Hungary, for instance, the average years of schooling, which stood at 10.4 in 1995, rose to 11.65 by 2010.

DEVELOPMENTS IN CAPITAL STOCK

The physical capital stock is calculated by using the perpetual inventory method (PIM):

$$(7) \quad K_t = (1-\delta)K_{t-1} + I_t = (1-\delta)^t K_0 + \sum_{j=0}^{t-1} I_{t-j} (1-\delta)^j$$

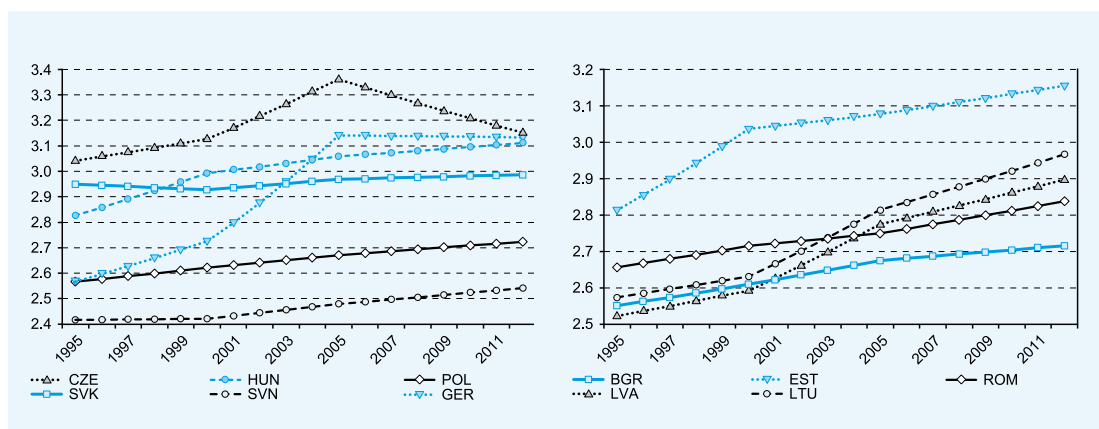
According to equation (7), the calculation requires three inputs: the initial capital stock (K_0), the rate of depreciation (δ) and the in-

vestments calculated at constant prices (I_t). Investments are identified as the values of gross fixed capital formation (GFCF) expressed in national currency at prices prevailing in 2005. The source of data is Eurostat.

The value of the depreciation rate is estimated to be between 3 and 6 per cent in professional literature.¹¹ However, this is not relevant to CEE countries: during the transformation and in subsequent years, capital goods generated before the transition depreciated at a higher rate (as they were progressively withdrawn from production) than those generated in the market economy after the transition. Thus the depreciation rate of CEE countries in the 1990s must have been higher and more volatile than those of developed countries. As regards the new millennium, we cannot make a fundamental statement like that, as the replacement of “old” assets had been concluded by then. Nevertheless, we assume that, mainly as a result of developments in the 1990s, the average depreciation rates of CEE countries between 1995 and 2012 were higher than 6 per cent, i.e. the upper limit characterising developed countries.

Chart 3

THE EFFICIENCY (QUALITY) MULTIPLICATOR OF LABOUR: $Q_L = e^{f \cdot sy}$



Source: compiled by the author

Accordingly, the value of δ is calibrated to be 8 per cent, in line with the depreciation rates used in the literature.¹²

The calculation of the capital stock is commenced from 1995, for two reasons. First, reliable data for investments in the period before the transition is available only for a few CEE countries. Secondly, only approximate assumptions are available to us as to the amount of the one-off depreciation of the capital stock which took place during the transformation phase (Doyle et al. 2001; Pula, 2003).¹³ The initial capital stock is calculated by using the ratio of capital to GDP in year 1995, as obtained from *Dombi's* paper (2013).¹⁴

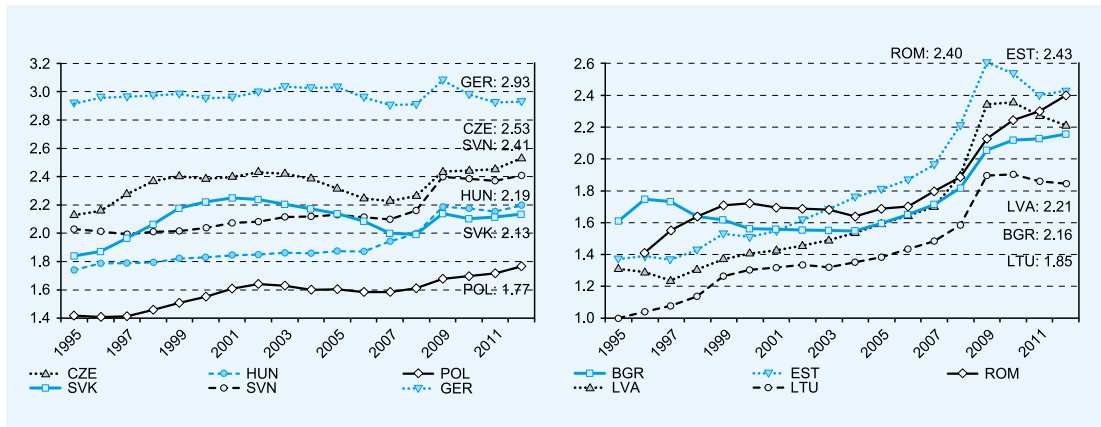
Changes in the calculated capital stock relative to GDP are shown by *Chart 4*. Clearly, starting from 1995, a significant capital accumulation process took place in most CEE countries. The Baltic states saw the highest increase in the ratio of capital to GDP up until 2007, which can be attributed to the low initial level of the ratio and a high investment rate. After the outbreak of the global economic crisis, a number of interesting processes can be observed. On the one hand, in 2009 there was a significant one-off surge in the K/Y indicator in each country. Obviously, this was triggered by a decline in GDP, rather than accelerated capital accumulation.¹⁵ Understandably, the highest jump in the capital/GDP ratio was observed in those countries which were hit by the most severe recession in 2008/09. On the other hand, starting from 2010, an “adjustment” was observed in the Baltic states (as opposed to the rest of the countries) which, once again, can be mainly attributed to the change in GDP rather than the accumulation of capital. After 2010, Estonia, Latvia and Lithuania produced a rapid growth at a rate of 5–6 per cent on average, “bouncing back” after hitting the bottom in the recession of 2009 (*Chart 1*).

ACCOUNTING DECOMPOSITION

In this chapter we explain the results of the growth and development accounting analyses performed based on equations (4) and (6) above. For making an accounting decomposition, in addition to labour force and capital stock we also need data on GDP (Y) and the amount of labour income relative to the GDP (s_t). The GDP data were provided by Eurostat, while labour share data derive from the AMECO database.¹⁶ For the purposes of growth accounting, we use a GDP Chart measured at constant prices (of 2005) and denominated in national currency, while for development accounting we use a GDP Chart measured at current prices and purchasing power parity, for the growth rate of real GDP is the focus of the first analysis, and the relative level of GDP at a given point in time is the focus of the second one. We proceed similarly for K . In the previous chapter, the capital stock was calculated at constant prices and measured in national currencies. In development accounting, the capital stock is to be measured at current prices and at purchasing power parity; therefore, it is obtained as the product of the capital/GDP ratio (*Chart 4*) and GDP measured at current prices and purchasing power parity.

In growth accounting, we analyse the period of 1995–2012 in three phases, in line with the stages of the post-socialist growth path. The first two periods (1996–2001 and 2002–2007) are associated with the stage of robust growth, while the third period covers the current global economic crisis (2008–2012). The decomposition made for each period of the average annual growth rate into contributions from capital accumulation, the growth of the labour force, and the growth of MFP are shown in *Charts 5, 6, and 7* below. To interpret the results we take the following example: Between 1996 and 2001,

DEVELOPMENTS IN CAPITAL STOCK/GDP (K/Y)



Source: own calculations. K/Y data for Germany are obtained from the AMECO database. The right-hand side of each figure indicate K/Y values for 2012.

the growth rate of GDP in Hungary was 3.03 per cent on average. The growth accounting decomposition result shows that the accumulation of capital, the growth of the labour force, and the growth of MFP contributed to this rate by 1.84, 0.98, and 0.2 percentage points, respectively. Apparently, more than 60 per cent of the growth originated from capital accumulation.

Hungary also reflects the most important overall result of the growth accounting analysis: apart from a few exceptions, the main source of the economic growth of CEE countries was the accumulation of capital in all three periods, far exceeding the contributions from the other two factors in many cases. The growth model of the CEE countries, therefore, is one based on the accumulation of capital. Another common feature of the three periods under review is that the contributions to growth from the MFP and the labour force were either moderate or, in many cases, only marginal. The three periods differ only in terms of the levels of the sources of growth and not in terms of their order of priority.

The degree of capital accumulation is considered high also in international

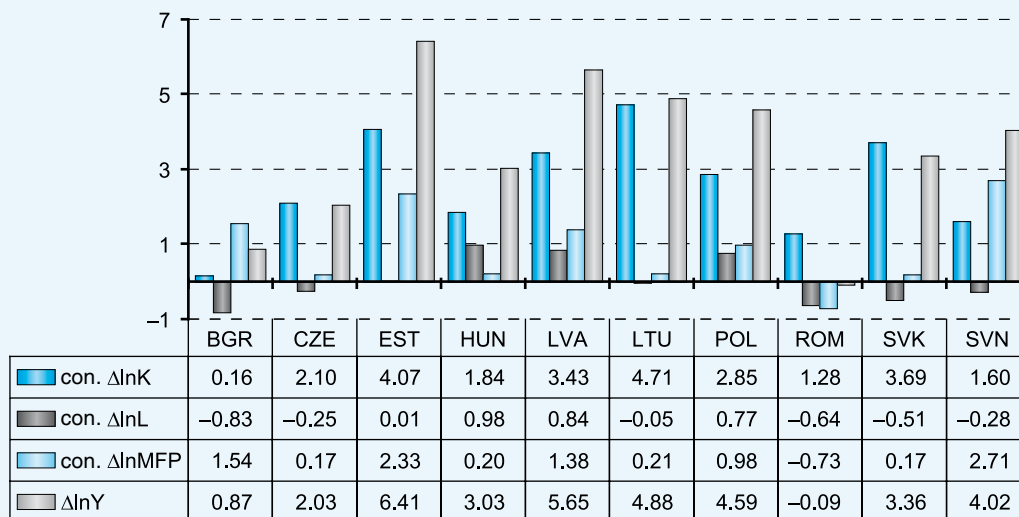
comparison. In Germany, for instance, capital accumulation contributed to annual growth by 1.32 percentage points between 1996 and 2001, and by 0.72 percentage points between 2002 and 2007 (EUKLEMS). The values observed in most CEE countries are much higher.¹⁷ This accelerated capital accumulation can be explained by two reasons: a low initial capital to GDP ratio in CEE countries (base effect), and a higher investment rate compared to developed countries.

The lessons drawn from the global economic crisis are worth a separate analysis. The growth accounting decomposition suggests that in the period of 2008–2012, the falling or stagnating GDP levels in CEE countries were attributable to declining MFP and workforce utilisation, while capital accumulation still represented a positive contribution dampening the impact of the recession.¹⁸ This result is in line with the relevant predictions of business cycle theories (Romer, 2006). We must mention, however, that in times of recession, growth accounting should be treated with some reservation as it cannot take into account changes in the utilisation rate of the physical capital stock. And in the period

Chart 5

DECOMPOSITION OF THE AVERAGE ANNUAL GROWTH RATE OF GDP BETWEEN 1996 AND 2001

percentage point

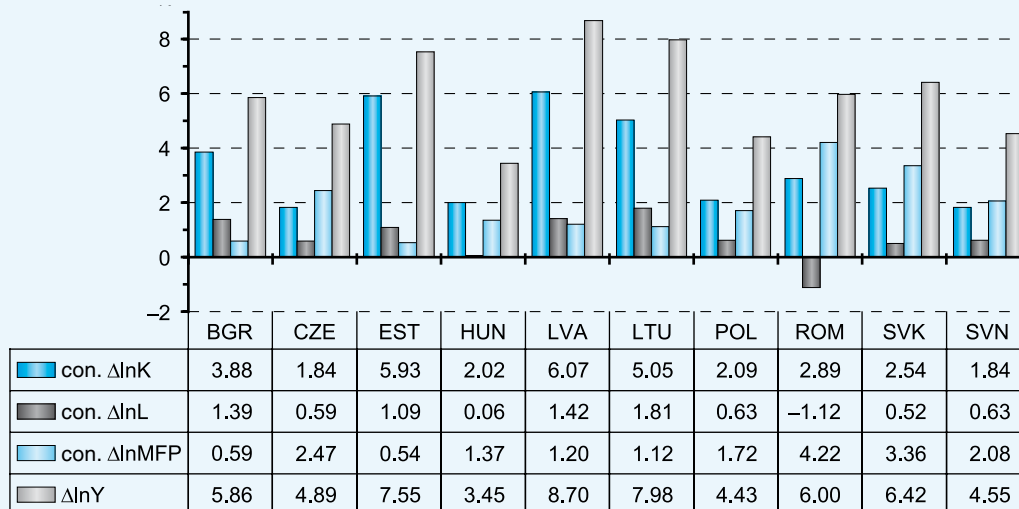


Source: own calculations

Chart 6

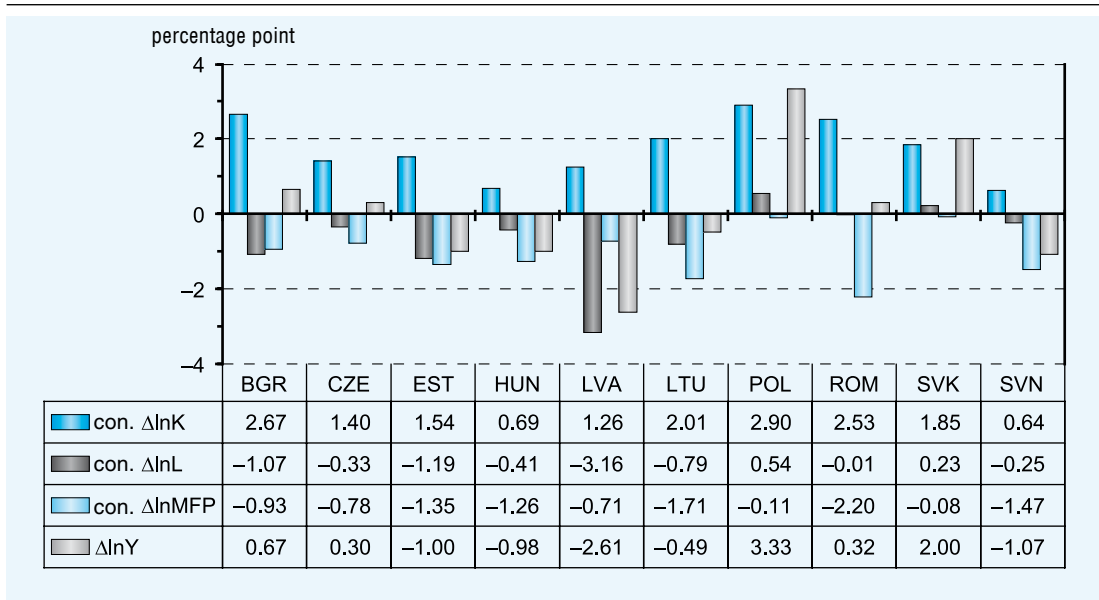
THE DECOMPOSITION OF THE AVERAGE ANNUAL GROWTH RATE OF GDP BETWEEN 2002 AND 2007

percentage point



Source: own calculations

DECOMPOSITION OF THE AVERAGE ANNUAL GROWTH RATE OF GDP BETWEEN 2008 AND 2012



Note to Figures 5, 6, and 7:

$$\text{con.}\Delta\ln K = \frac{\sum_{t=z}^u \frac{2-s_{L,t}-s_{L,t-1}}{2} \Delta\ln K_t}{u-z+1}; \text{con.}\Delta\ln L = \frac{\sum_{t=z}^u \frac{s_{L,t}+s_{L,t-1}}{2} \Delta\ln L_t}{u-z+1}; \text{con.}\Delta\ln MFP = \frac{\sum_{t=z}^u \Delta\ln MFP_t}{u-z+1}; \Delta\ln Y = \frac{\sum_{t=z}^u \Delta\ln Y_t}{u-z+1}$$

In Figure 5: $u=2001$; $z=1996$. In Figure 6: $u=2007$; $z=2002$. In Figure 7: $u=2012$; $z=2008$. Results are expressed in percentage points (*100).

“con.” is an abbreviation for contribution. Due to rounding error, the sum total of the three components of growth does not always correspond to the growth rates presented. For Romania, Figure 5 shows the results recorded for the period of 1997–2001, as the calculation of the capital stock could commence only from 1996 due to lack of data.

Source: Compiled by the author

of a major economic recession, factories and production lines are used in reduced shifts and thus the production service provided by the physical capital (K') will be lower even with unchanged capital stock (K) levels. Therefore, the negative impact of the latter on output will be manifested in the evolution of MFP, the residual factor. Accordingly, the decline in MFP between 2008 and 2012 did not come from the deteriorating technology used in CEE countries but from reduced capacity utilisation.

In the development accounting analysis, we selected Germany (the leading economy

of the European Union and also the most important trading partner of CEE countries) as the benchmark. To eliminate the distorting effect of size differences, we analyse the relative levels of the GDP/hours worked based on equation (6) above. In this case, we cannot apply an additive decomposition because in many cases, the values of the variables x for the CEE countries differ significantly from the values of Germany, and thus the logarithm of the differences ($\ln x - \ln x^R$) would provide very inaccurate estimations for the relative discrepancies ($x/x^R - 1$). Therefore, we carry out a multiplicative decomposition, for which we

obtain the formula by taking the exponent of both sides of equation (6) above.

We make the decomposition for the first and the last years of the review period, i.e. 1995 and 2012. The results are presented in *Chart 8* below. Relative GDP/hours worked is obtained as the product of contributions by relative capital intensity (cont. rel_K/H), relative labour efficiency (cont. rel_Q_L) and relative MFP (cont. rel_MFP). For instance, let us have a look at Hungary in 2012. GDP/hours worked was 47 per cent of the level in Germany. This relative development is derived as the product of the contributions from relative capital intensity (0.623), relative labour efficiency (0.996), and relative MFP (0.758).

Based on *Chart 8*, we can draw two important conclusions. First, although CEE countries still lag behind significantly in terms of GDP/hours worked, they demonstrate an undeniable trend of catching up. Secondly, the low value of the relative GDP/hours worked is attributable primarily to lower capital intensity and secondly to lower MFP levels. In terms of education level, however, the quality of workforce is nearly at the same level in Central and Eastern Europe as in Germany.¹⁹

CONCLUSIONS

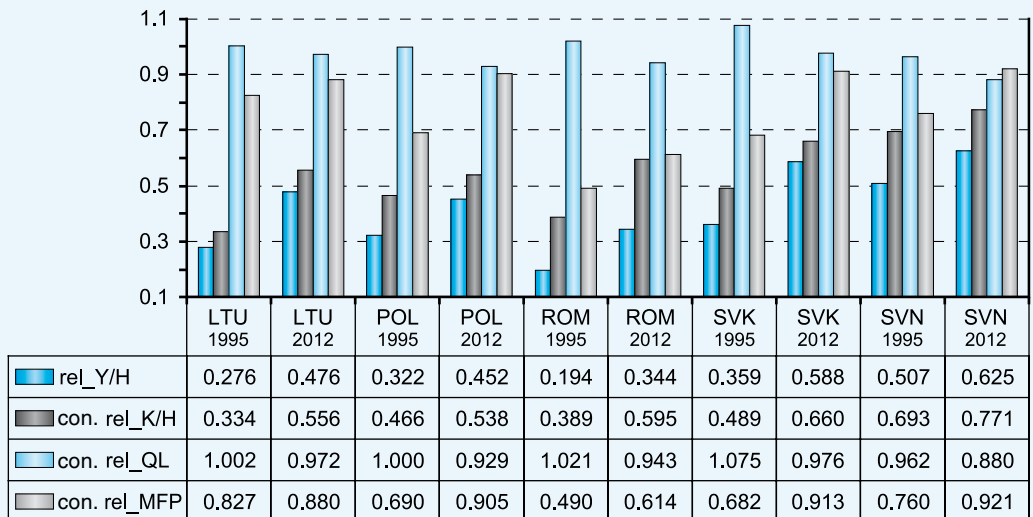
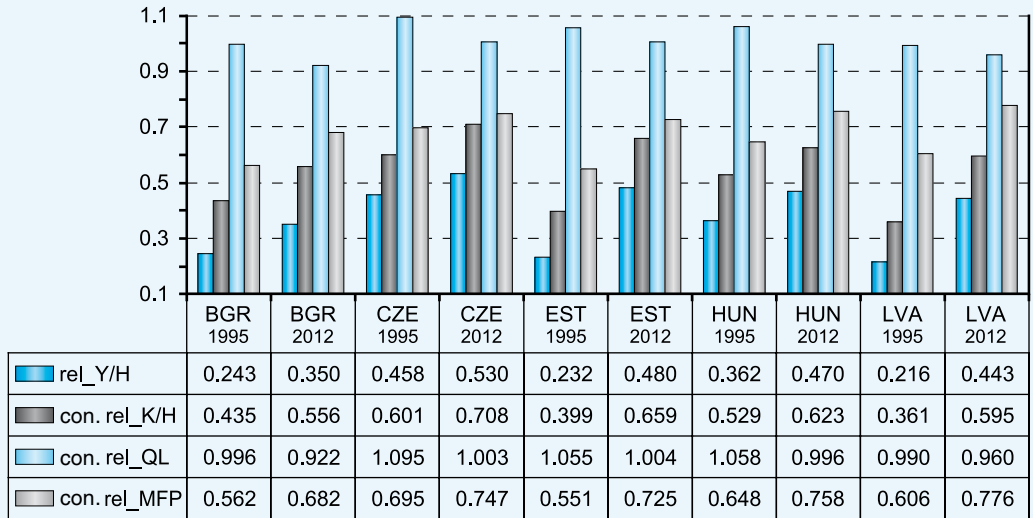
The growth path of the post-socialist Central East European countries can be divided into three phases. During the transformation crisis (1990–1994/1995), CEE countries experienced a major economic recession. Subsequently, however, they followed a robust growth path (1995–2007), and were among the most dynamically developing regions of the world. The economic miracle of the 2000s was ended by the current global crisis in 2008.

In this paper we explored the sources of economic growth and relative under-

development in the years after 1995. Our growth accounting results suggest that the main source of economic growth in the CEE countries between 1995 and 2012 was the accumulation of capital, substantially exceeding the contributions of multifactor productivity and the workforce in many cases. It should be stressed that it is owing to the capital accumulation that the decline in MFP and workforce utilisation has not resulted in an even steeper fall in GDP so far during the current phase of the global economic crisis. These growth accounting results are in line with the results from development accounting, which suggest that the sluggish growth compared to Germany in terms of GDP/hours worked, is primarily attributable to lower capital intensity and secondly to lower multifactor productivity. This is explained by the fact that the relatively low capital/GDP ratio, coupled with a higher investment rate than in developed countries, offered considerable potential for a rapid capital accumulation in the past two decades.

Most CEE countries were hit harder by the global recession than countries in Western Europe; in addition, their recovery from the crisis appears to be slower than the recovery of other catching-up regions worldwide. This raises the question whether we will witness the return of accelerated economic growth after the effects of the crisis fade away. In other words, to what extent was the robust growth path experienced before the crisis sustainable from a macroeconomic perspective? As each CEE country has numerous different features, it is difficult to find a universal answer to these questions. Nevertheless, there are some common aspects of the pre-crisis economic growth of these 10 countries in addition to the main source of growth (Becker et al. 2010). First, (net) foreign direct investment was exceptionally high even in historic comparison: in the region it peaked at 8–10

MULTIPLICATIVE DECOMPOSITION OF RELATIVE GDP/HOURS WORKED



Note: The decomposition formula was obtained by taking the exponent of both sides of equation (6) above.

$$rel_Y/H = \left[\frac{Y_t/H_t}{Y_t^G/H_t^G} \right], \quad con.\ rel_K/H = \left[\frac{K_t/H_t}{K_t^G/H_t^G} \right]^{\frac{2-s_{L,t}-s_{L,t}^G}{2}}, \quad con.\ rel_Q_t = \left[\frac{Q_{L,t}}{Q_{L,t}^G} \right]^{\frac{s_{L,t}+s_{L,t}^G}{2}}, \quad con.\ rel_MFP = \frac{MFP_t}{MFP_t^G}$$

where the index G denotes Germany, while hoz. and rel are abbreviations for contribution and relative, respectively.

per cent of GDP on average throughout the years before the crisis.²⁰ Secondly, high investment rates, exceeding those of developed countries in most cases, were coupled with low(er) savings rates of similar or lower levels than those observed in developed countries.

Therefore, the extensive economic growth (driven by the accumulation of capital) took place in CEE countries (with insufficient savings) mainly from substantial foreign funds, i.e. amid growing external indebtedness. As a consequence, these countries became vulnerable to external shocks and were predestined to fall in (more severe than average) recession in case of a regional or global crisis. Obviously, we should differentiate between the above defined two groups in terms of magnitude. The difference between the investment rate and the savings

rate was lower for the Visegrád-4 countries and Slovenia than for the Baltic states, Romania and Bulgaria. Therefore, the dilemmas related to external indebtedness and sustainability were not as relevant in their case as for others.

As far as future prospects are concerned, there is still considerable potential for an extensive growth in Central and Eastern Europe, as the capital/GDP ratios of these countries continue to lag behind those observed in Western Europe. However, we can draw an important conclusion from the experiences of the crisis and the characteristics of the pre-crisis growth path; namely, that any further capital accumulation should be based, as far as possible, on internal savings. Therefore, the current economic policy should promote private savings as a key objective.

NOTES

¹ The Charts and Tables of this paper include the following country codes: Bulgaria (BGR), Czech Republic (CZE), Estonia (EST), France (FRA), Germany (GER), Hungary (HUN), Latvia (LVA), Lithuania (LTU), Poland (POL), Romania (ROM), Slovakia (SVK), Slovenia (SVN), United Kingdom (UK), United States (USA).

² This paper is intended to explain only the basic relationships required for accounting decompositions. For a more detailed discussion of growth accounting and development accounting see, for example, Hulten (2009), Caselli (2005), and Inklaar–Timmer (2008).

³ For the sake of simplicity, the time index t is used only where needed for clarity.

⁴ MFP: multifactor productivity. Another frequently used synonym for MFP is TFP (total factor productivity).

⁵ The quality factor Q_K captures the composition of the aggregate capital stock. For its calculation (or more precisely, the calculation of ΔQ_K), time series values for the prices and quantities of investments are needed for each main asset category (see O'Mahony – Timmer, 2009). These values, however, are not available for each CEE country for the duration of the full period. Even though ignoring the changes in quality will inevitably distort the calculated value for the capital input, several papers tend to ignore them nevertheless (for example, Bosworth – Collins, 2003; Caselli – Tenreyro, 2005).

⁶ For simplifying the notations (and taking advantage of the calibration of Q_K), instead of the capital input (K), the capital stock (K) is included in equations (2)–(6).

⁷ Three assumptions are needed for equation (3) to be fulfilled: lack of externalities; the production

function has constant returns to scale in K and in L ; and factors are rewarded according to their marginal productivity. Please note: if variable A is used to denote the level of technology (exclusively) and is used in the production function Hicks-neutrally [$Y=F(K,L,A)=\tilde{A}\tilde{F}(K,L)$], then the growth rate of MFP will be equal to the rate of technological development:

$$g_{MFP} = \frac{F_A A}{Y} \frac{\dot{A}}{A} = \frac{\dot{A}}{A}.$$

⁸ For more details, see Inklaar – Timmer (2008).

⁹ TED: Total Economy Database (<http://www.conference-board.org/data/economydatabase/>)

¹⁰ According to research by Psacharopoulos and Patrinos (2004), the coefficient for the years of schooling in the Mincer regressions was 0.117 on average for Sub-Saharan African countries; 0.097 for the world as a whole; and 0.075 for the OECD countries; while the years of schooling were 7.3; 8.3; and 9.0, respectively. To test the robustness of our results, in the growth accounting analysis we also calculated Q_L on the basis of the corresponding returns in the paper of Psacharopoulos (1994), which is frequently used as a reference (e.g. Hall – Jones, 1999). The results of the accounting decomposition were robust for the changes in the value of r .

¹¹ See for example, Mankiw et al. (1992): 3 per cent; Nehru – Dahreshwar (1993): 4 per cent; Hall – Jones (1999): 6 per cent.

¹² Doyle et al. (2001), Rööm (2001), Pula (2003), IMF (2003, 2010), Vanags – Bems (2005)

¹³ The fact that the starting point is so close represents a serious problem, because the calculated capital stock and hence, the result of the accounting decomposition, will be sensitive to the value of K_ϕ , particularly at the beginning of the review period.

¹⁴ On the basis of calculations by Dombi (2013), the values of the K/Y ratio in 1995 are as follows: Bulgaria (1.61); Czech Republic (2.13); Estonia (1.37); Latvia (1.31); Lithuania (1.00); Poland (1.42); Hungary (1.74); Romania (1.41); Slovakia (1.84); Slovenia (2.03). These values are in line with the magnitudes indicated in the literature (Doyle et al. 2001; Rööm, 2001; Pula, 2003; IMF, 2003, 2010; Vanags – Bems, 2005).

¹⁵ Due to a lower investment activity, after the outbreak of the crisis the growth rate of the capital stock slowed down significantly in each country. The Baltic states, Hungary, and Slovenia were hit particularly hard by the recession, where the average growth rate of K dropped to one-quarter or one-third of the level recorded before the crisis. In Estonia, for instance, capital stock increased by 12.2 per cent on average between 2002 and 2007 on an annual basis, compared to only 3.3 per cent between 2008 and 2012.

¹⁶ Variable s_L is identified with the variable “adjusted wage share” (ALCD0) of the AMECO database. (http://ec.europa.eu/economy_finance/db_indicators/ameco/)

¹⁷ In the periods concerned, the main source of (moderate) growth in Germany was also the accumulation of capital (www.euklems.net).

¹⁸ Declining workforce utilisation (L) obviously implies a decrease in the number of hours worked, because the efficiency multiplier of labour continuously grew during the years of the crisis, as shown by Chart 3.

¹⁹ In addition, we performed both the growth accounting and the development accounting analyses for a capital stock calculated at a depreciation rate of 6 per cent, to test the sensitivity of results for the calibration of δ . As expected, the contribution of physical capital

(and thus the contribution of multifactor productivity) to growth and to relative development is sensitive to the values of the depreciation rate. However, the priority order of individual factors (capital, labour, MFP) does not change, i.e. the accumulation of physical capital

and its low level constitute the main source of growth and relative under-development.

²⁰ IMF (World Economic Outlook, October 2012, „Private financial flows, net” – Central and East Europe).

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