Growth acceleration in the Baltic States: What can growth accounting tell us?

Report by BICEPS

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1. Introduction

The Baltic states emerged from their transitional recession around 1995 and since then real GDP growth has been quite remarkable. Cumulative real GDP growth for the period 1996 to 2003 has been 51% for Estonia, 59% for Latvia and 52% for Lithuania. The growth rates for the first half of 2004 show no signs of a slowdown – in fact quite the opposite. These are the highest growth rates in Europe, considerably in excess of other former communist countries and among the highest in the world. Indeed, if it were not for the slowdown in 1999 following the Russian crisis, all three countries would already be examples of a sustainable growth acceleration as defined by Hausmann, Prichard and Rodrik (2004) with 8 or more years of growth in excess of 3.5%

The aim of this study is to examine what growth accounting can tell us about the proximate causes of the recent growth in the Baltics and to consider what this might imply for future growth. In order to do this we report for each of the three Baltic countries growth accounting exercises at both aggregate and sectoral levels. It turns out that the experience of the three countries is rather similar with capital accumulation accounting for between 50 and 60 per cent of growth – depending on the exact period chosen. By contrast labour growth makes a negative contribution in Estonia and Lithuania and a positive but small one in Latvia. This leaves total factor productivity growth (TFP) with a contribution varying between 45% and 60% (note the labour contribution can be negative). This split between the role of capital accumulation and TFP is in line with what is found for many multi-country studies eg Bosworth and Collins (2003).

A comparison with other countries suggests that recent growth in the Baltic states looks much more like that of the major European countries during the Bretton Woods era than that of the East Asian 'tigers' in their initial growth acceleration. Comparison with the CEEs is mixed, with Poland in its post- 'transitional recession' phase looking most like the Baltics.

The sectoral analysis shows that TFP has contributed more to growth in the traded sector than in the non-traded one. The traded sectors in all three countries have been characterized by large negative labour contributions reflecting significant labour shedding. By contrast in the non-traded sector labour made a small but positive contribution in all three countries but capital accounted for 60% or more of sectoral growth with the latter effect reflecting the need for investments in new sectors such as banking or sectors which have experienced major structural changes such as wholesale and retail trade.

We further investigate the traded/non-traded split by looking at the experience of individual sectors – manufacturing; trade; construction; and transport. Separate growth accounting exercises for each sector indicate that the contribution of TFP to sectoral growth increases with the 'tradability' of the sector. This suggests that the efficiency gains of the traded sector originate in the pressures of competing in world markets.

We also consider the issue of sustainability of recent growth. The logic of growth accounting implies that output growth depends on what is expected to happen to input growth and to TFP growth. The clearest evidence on future input growth concerns labour where the demographics of the Baltic state point to quite significant medium term falls in the working age population. Investment shares in the Baltic are high but not unusually so. Hence it seems that sustainability at close to current growth rates depends on the continued growth of TFP. Historical evidence suggests that TFP growth at current Baltic rates extending for 20-30 years, which is what would be needed for real convergence of living standards to EU-15 levels, is not common but is by no means unprecedented.

The structure of the paper is as follows. Section 2 presents the basic facts on recent output and input developments in the three Baltic countries; section 3 presents the theoretical framework used for the growth accounting exercises: in section 4 we discuss measurement of data inputs, assumptions about parameter values, and present the growth accounting results for the aggregate economy. In this section we also consider the sensitivity of results to different assumptions and offer some international comparisons. Section 5 deals with the sectoral growth accounting exercises; firstly for traded and non-traded sectors, and then for disaggregation into sectors ranked by tradability. Section 6 considers future growth prospects.

2. Basic facts

Figure 1 illustrates developments over the period 1994 to 2003 in real GDP, employment, and investment as a share of GDP in each of the three Baltic countries. In Estonia and Lithuania 1995 marks the resumption of real growth after the transitional recession, and except for 1999 when output fell slightly because of the Russian crisis, output growth has been uninterrupted ever since. In Latvia positive growth started in 1994, but was briefly reversed in 1995 by the banking crisis of that year, but since then has remained positive, even in 1999.

By contrast employment declined dramatically in the early 1990s (not shown in Figure 1 but very clear Table A3) but since 1995 has been flat or declining until the early 2000s when modest increases have been recorded in the last two or three years. The employment data are mainly obtained from the Labour Force Surveys (LFS) in each country. For Estonia the LFS is available for the whole of the period and covers persons aged 15-74.[1] In Latvia and Lithuania LFS data is available only starting with, respectively, 1996 and 1997; therefore for these two countries official employment growth estimates have been used for earlier years[2].

Figure 1 also shows that the investment share has been consistently high in Estonia, but in Latvia was rather low until 1998 when it exceeded 20% for the first time, but since

[1] Prior to 1997, persons aged 15-69.

[2] This substitution should not affect the results, since for the years when LFS results are available in parallel with official employment estimates, labour growth trends in the two employment series are very similar and since only growth rates of employment (rather than levels) are used in the growth accounting exercises there should be little difference.

then has been in excess of 25%. For Lithuania the investment share was actually rather high in the early to mid 1990s and has since stabilized at about 20%.

These ‘basic facts’ at once inform us that labour has not been a driver of growth in the Baltic countries except possibly in the form of human capital accumulation.

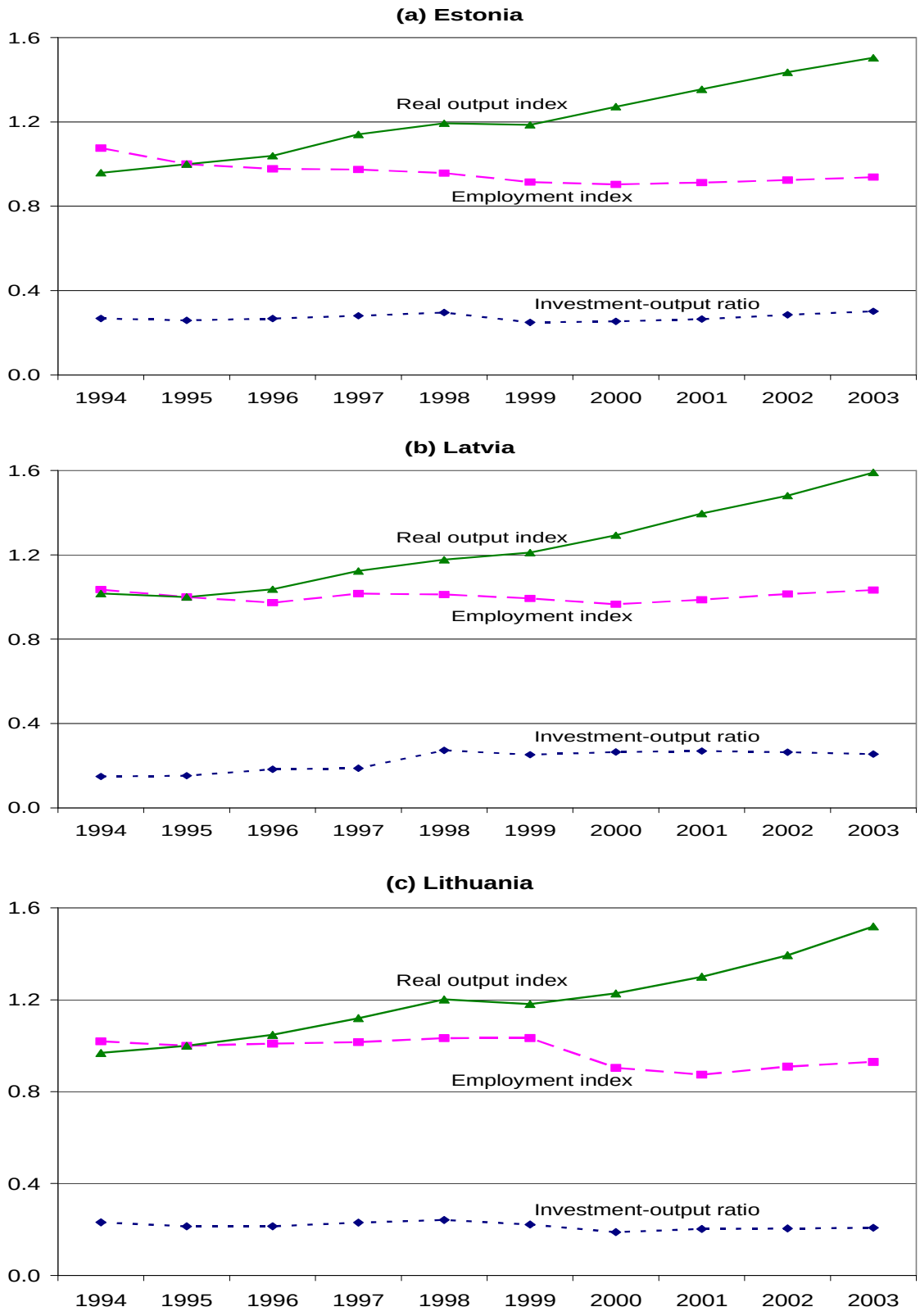

Figure 1: Output, employment and investment trends in the Baltic states

3. Theoretical framework

Assuming a standard neoclassical production function

$$Y_t = A_t F(K_t, L_t), \tag{1}$$

with (i) constant returns to scale and (ii) competitive factor markets, output growth can be decomposed into the following components

$$\ln\left(\frac{Y_{t+1}}{Y_t}\right) = \ln\left(\frac{A_{t+1}}{A_t}\right) + \theta_{t+1}\ln\left(\frac{K_{t+1}}{K_t}\right) + (1-\theta_{t+1})\ln\left(\frac{L_{t+1}}{L_t}\right), \tag{2}$$

where $\theta_t \in (0,1)$ is the capital income share. Defining $\ln X_t = x_t$ the decomposition can be rewritten as

$$y_{t+1} - y_t = (a_{t+1} - a_t) + \theta_{t+1}(k_{t+1} - k_t) + (1-\theta_{t+1})(l_{t+1} - l_t), \tag{3}$$

The term on the left hand side of (3) represents output growth, the first term on the right hand side represents TFP growth, and the second and the third terms represent changes in capital and labour inputs weighted by income shares.[3] Since TFP cannot be measured directly, the growth accounting exercise amounts to obtaining values for the remaining three terms in (3) from the data and measuring TFP growth as a residual. In line with equation (3), all growth rates reported in the remainder of this paper are logarithmic rather than geometric.

4. Growth accounting for the aggregate economy

We start the investigation with a baseline growth accounting exercise for the aggregate economy in each of the three countries. In the benchmark exercise we make certain assumptions about the measurement of the key inputs – capital and labour, and about the key parameters – the factor income shares, θ and 1-θ, and the depreciation rate, δ. Section 4.1 below offers an extensive discussion of the measurement issues and the considerations underlying the choice of parameters. This is followed by the results of the benchmark case and by a sensitivity analysis. We then attempt to locate these results with what is a large literature in this field and offer a comparison with some selected countries.

4.1. Input data and parameter values

The raw data inputs for the aggregate economy growth accounting may be found in Table A1 in the Appendix, which presents developments in real output (GDP), employment, and gross fixed capital formation for Estonia, Latvia and Lithuania over the investigation period.

[3] The income share weights could alternatively be taken as $(\theta_t + \theta_{t+1})/2$.

Labour

Throughout the analysis employment has been chosen as the labour input This implicitly assumes that hours worked, as well as other characteristics of labour input such as human capital are constant for the period of investigation. Note that, given the nature of the exercise, errors in the measurement of labour input cannot affect the results for the contribution of capital to output growth. Rather, any adjustments in labour input must show up as a corresponding change in the contribution of TFP. Bearing this in mind, we now consider possible adjustments to the labour input data

We start by looking at hours worked. For the Baltic states such data is available from 1996 in Latvia and 1997 in Estonia and Lithuania.[4] During the period for which data is available, hours worked, measured as actual working hours per week in the main job, have decreased in all three countries. In Lithuania in 2002 hours worked were 4.3 percent below their 1997 level, in Estonia during the same period the decrease was 2.5 percent. In Latvia during 1996-2002 hours worked decreased by 5.4 percent. Thus, changes in hours worked suggest that labour inputs may be lower than implied by employment figures by up to perhaps just over 5%. If an adjustment were made for hours worked this would have the effect of 'increasing' the contribution of TFP in all three countries.

Next we consider possible changes in the quality of labour input. The normal adjustment for labour quality is to use average years of schooling to construct a human capital scaling factor. For example, Bosworth and Collins (2003) define human capital adjusted labour input as

$$L^A = (LH)$$

where L is the raw labour input and H is the human capital adjustment factor. Given the return to a year of schooling, (r), this yields:

$$H = (1+r)^S$$

where S is average years of schooling of the working population.

We do not have time series for mean years of schooling in the Baltics over the relevant period. However, in general this indicator develops slowly over time. For example for Hungary, Poland, Slovakia and Slovenia where we do have data[5] the average number of years of schooling increased by between 0.2 and 0.3 between 1995 and 2001. If we assume that in the Baltics average years of schooling also increased by 0.3 over the period and if we apply a rate of return of 10% (the Latin American rate of return according to Bosworth and Collins (2003)), then we get a value for H of very nearly 1.03. In other words, on these assumptions, the human capital component of the labour supply

[4] Data is for November of each year.
[5] http://devdata.worldbank.org/edstats/cd.asp

would have increased by 3% between 1995 and 2001 and by perhaps a little more up to 2003. Thus an adjustment in labour input for plausible changes in the years of schooling would not be quite enough to offset the effect of shorter hours.

However years of schooling does not really capture what has happened to human capital in the Baltics during the transition. There is a huge gap in terms of operating in a market economy between those who were educated and grew up in the former Soviet Union and younger people. In an attempt to take this into account we examined the age structure of the labour force, on the assumption that the human capital of older workers may have become obsolete and that younger workers would be more productive. So changes in the age structure of the population could be a proxy for changes in labour quality. By using aggregate employment as the labour input, we implicitly assumed that during the 1996-2002 period there were no notable changes in the age structure of the labour force. The evidence on high labour flows in the Baltic states, as noted for example in Haltiwanger and Vodopivec (2002), suggests that age structure of employment may have changed considerably.

In practice, the data (see Table A9 in the appendix) indicates very little change in the age structure of the employed. In each of the Baltic states the weight of the '15-25' age group has decreased, by between 1.7-3.1 per cent, with a roughly equivalent increase in the '50+' age group. For Lithuania, there is also an increase the '39-50' age group. These changes are partly the effect of demographic factors (fewer young people) and the buoyant economies which have had the effect of drawing more older people into employment. Overall, the available data suggests that the assumption of a constant age structure of the labour force during 1996-2002 period is acceptable for all three countries.[6]

Taking all the above factors into account points to the conclusion that the rather small adjustments that might be made on account of hours worked and labour quality tend to offset one another. Hence we have chosen unadjusted employment as the measure of labour input.

Capital

Measuring capital is fraught with difficulties. In the first place, ideally we would wish to use the flow of services generated by the capital stock in each period (e.g., machine hours). Since such data is not available, we assume that the volume of services generated is proportional to the capital stock. But this is standard.

More importantly, no official capital stock estimates are available for any of the Baltic states. Therefore we have been obliged make our own estimates.

To obtain capital stock data we first estimate capital stock for a particular year and then for the other years of interest the capital stock is calculated using

[6] The same can also be said about changes in gender composition of the labour force.

(4) $$K_{t+1} = (1-\delta)K_t + I_t$$

In (4) it is assumed that each year the capital stock depreciates at a constant rate δ. In the baseline exercise we assume that δ=0.08. I_t represents new investments in constant prices, which are obtained from the gross fixed capital formation data of the National Accounts as reported in Table A1.

The difficulty here is to obtain an estimate of the initial[7] capital stock, or, equivalently an initial capital output ratio, since we have relatively good data for GDP and once the capital output ratio is known the corresponding capital stock may be inferred. We have used several approaches to arriving at what we regard as a reasonable estimate of the initial capital stock ie in 1995. The first is what might be called the direct approach and consists of estimating the capital stock as a sum of fixed tangible and intangible assets of enterprises in each of the Baltic states. A second approach uses estimates from the literature, and a third approach invokes the steady state formula for the capital output ratio.[8]

Direct approach

The two main components of the capital stock are (i) the fixed tangible and intangible assets of enterprises and (ii) the residential housing stock. The latter needs to be included in the capital stock because GDP includes imputed rents that are assumed to accrue to owners of residential housing.

For Latvia data on enterprise fixed assets is available from 1995 and covers all sectors of the economy. For Estonia data is also available starting from 1995, but coverage excludes agriculture, financial intermediation, mining and quarrying, public administration, health and social work as well as other community, social and personal service activities. Estonian data is not available after 1999. For Lithuania data is available from 2000 and excludes agriculture and financial intermediation sectors. The available data, including the implied capital-output ratios for the part of economy covered by the fixed asset data, can be found in Table A2.

There are several reasons why using reported enterprise fixed assets data may underestimate the total capital stock of the economy. Firstly, enterprise fixed asset data does not include residential housing stock, which constitutes a significant part of the total capital stock of an economy. Pula (2003) estimates that the size of the residential housing stock in Hungary in early 90s was 30-50 percent of GDP. Based on PWT 5.6 data for Poland, Bems and Jonsson (2003) estimate that in 1993-94 the size of residential housing stock in the Baltic states was between 40% to 50% of GDP.

[7] The capital stock estimate does not have to come from 1995 – in order to use equation (4) we need an estimate for any one year.

[8] Another approach would be to use capital stock data for late eighties and then adjust it for the one-time effect of the collapse of Soviet Union. We do not pursue this approach, since in some cases there is no investment data available for 1989-92 period, and when such data is available, it is of very low quality.

It is also likely that the fixed assets of enterprises are undervalued. Their value was dramatically deflated during the hyperinflation of early 1990s and for tax reasons companies have had incentives not to re-value their assets in subsequent years. For similar reasons new investments are underreported in the fixed asset data.

To assess the degree of asset underreporting after 1995, Table A2 includes net investment data as implied by the data about fixed assets. This can be compared with net investment data from national accounts, also reported in Table A2.[9] In Latvia over the 1996-2002 period cumulative net investments based on enterprise fixed asset data are 30 percent below net investments implied by the national accounts data. In Lithuania during 2001-2002, cumulative fixed asset data underreports investments by 14 percent.

For Estonia we appear to have a different story with cumulative net investments from enterprise fixed asset data exceeding net investments from the national accounts by 30 percent.[10] This may be the result of an initial undervaluation of assets and subsequent re-valuation. For example, re-valuation of asset values explains the very high Estonian ratio of net investments to national accounts data observed in 1998 (see Table A2). A more detailed examination of the Estonian data reveals that the large increase in the value of fixed assets in 1998 was mainly due to adjustments in one sector – real estate and business services. If this sector is excluded from the data, enterprise fixed asset data in Estonia, as in Latvia and Lithuania, underreport investments, as compared with national accounts data.

Overall, for the reasons discussed above, this method of arriving at a one-time estimate of the initial capital stock provides us with a lower bound for the capital stock estimate. Adding up the fixed asset data and estimates for the stock of residential housing we conclude that the lower bound of the capital-output ratio for the end of 1995 in the Baltic states is around 1.3. This number is obtained using 0.9 as the ratio for fixed assets of companies to output, and 0.4 as the ratio of residential housing stock to output. Available data indicates that this number is roughly the same in Estonia, Latvia and Lithuania. 1995 was chosen as the year for which the one-time capital stock estimate is obtained, since estimates for the residential housing stock in the Baltic states, as well as other Eastern and Central European countries, are available only for the early 90s (e.g. Bems and Jonsson (2003), Pula (2003)).

Estimates from the literature

We have some recent estimates of capital output ratios for the Baltic states: Room (2001) and Vetlov (2003). We also have estimates for other comparable countries.

Vetlov (2003) estimates a Cobb-Douglas production function to infer the 1995 capital stock in the three Baltic countries. This yields a 1995 capital output ratio of 1.3 for

[9] From national accounts net investments for each year were obtained as the difference between gross investments and consumption of fixed capital.

[10] Note that, unless net investments in the sectors not covered are negative, the actual difference in Estonia is even bigger, since fixed asset data excluded several sectors that are accounted for in the national accounts data.

Lithuania, and about 1 for Estonia and Latvia. Vetlov argues that this ranking is plausible because in Soviet times Lithuania was the most industrialised of the three republics[11]. Room (2001) is not directly concerned with growth accounting but incidentally reports capital output ratios. Room also estimates initial capital on the basis of a Cobb-Douglas production function with assumed parameter values. The implied capital output ratios for 1995 are: for Estonia about 1.1, about 1.25 for Lithuania and about 0.75 for Latvia. Thus the production function approach to inferring an initial capital output yields somewhat lower figures than the direct approach.

Turning to other comparable countries, PWT 5.6 provides a capital stock estimate for Poland in 1990, which expressed as a capital-output ratio is 1.6. Pula (2003) presents estimates of capital stock (excluding residential housing) for Hungary and arrives at a capital-output ratio of 1.37 in 1991, which then gradually increases to 1.5 by 1999. After adding a residential housing estimate, which Pula reports as 30-50 percent of GDP, we arrive at an estimate of capital-output ratio for Hungary of around 1.8 in 1995.

Steady state

A further alternative is to follow the method used by a number of authors e.g. Klenow and Rodriguez-Clare (1997), who use the formula:

$$\left(\frac{K}{Y}\right)_{1995} = \frac{I/Y}{g+\delta+n} \tag{5}$$

The left hand side of (5) represents the capital output ratio in 1995, the numerator is the average investment share over the period 1995 to 2003, and in the denominator we have *g*, the average per capita growth rate of output, the depreciation rate, δ, and *n* which is the rate of growth of employment. This is basically the formula for the steady state capital output ratio.

Applying (5) to the Baltics we may note that the rate of growth of employment over the period has been negligible, so *n* can be taken as zero and per capita output growth is the same as output growth. Inserting data on the investment share, the growth rate and the depreciation rate from Table A3 into (5) yields the following 1995 capital output ratio estimates: Estonia 2; Latvia 1.76; and Lithuania 1.69. The average of these is about 1.8. A higher depreciation rate would imply a lower capital output ratio.

Equation (5) is the formula for the capital output ratio in steady state growth. It seems plausible that the Baltics were not in steady state growth over the period. Rather the capital output ratio in 1995 was very likely below the steady state which means that the formula overstates 'true' capital out put ratios. Moreover, it overstates most for Estonia which had the highest investment rates over the period

[11] The existence of the Vetlov (2003) paper came to light after we had completed our basic work. The paper is written in Lithuanian and the results reported here together with comments on method come from a personal communication with the author.

Indirect evidence

We can also look at other evidence to seek an upper bound for the capital-output ratio. Here it is instructive to look at evidence from Germany, Sweden and Denmark. These countries were the main source of the substantial capital inflows in the Baltic states over the 1990s. It is therefore reasonable to assume that the marginal product of capital in Denmark, Germany and Sweden during that period was lower than in the Baltic states.

We can use the standard neoclassical growth model together with our presumption about relative marginal products of capital to predict the relationship of capital-output ratios as between the Baltic states and these Western European countries. According to the model, the return on capital in country j is

$$r_{jt} = \theta_{jt}(Y_{jt}/K_{jt}). \quad (6)$$

If capital income shares, θ_{jt}, are the same across countries and the marginal product of capital is higher in the Baltic states, then we have $K_{it}/Y_{it}<K_{zt}/Y_{zt}$, where *i* stands for any of the Baltic states and *z* represents Denmark, West Germany or Sweden. In other words capital output ratios in the Baltics should be lower than in the countries from which they receive capital. According to PWT 5.6 in 1990 the capital-output ratio in Denmark was 2.00, in West Germany – 1.97 and in Sweden – 2.27. Thus the model predicts that capital-output ratios in the Baltic states during 1990s should not exceed a value of about 2.0.

Conclusions on the capital output ratio

The direct approach to estimating the capital output ratio suggests a lower bound of 1.3; the production function approach puts this lower at about 1 (or less than 1 in the case of Latvia). A variety of evidence suggests an upper bound in the range1.7 to 2. Thus we have a broad range of 1 to 2 and a narrower range of 1.3 to 1.7. The evidence on the ranking of the countries in terms of capital output ratios is mixed. For this reason and also because of the structural similarities between the three countries for the baseline scenario we have chosen a common value of 1.5 for the capital output ratio. This is exactly the mid point of the plausible range of values.

Parameters

Finally, an important role in the growth accounting exercise is assigned to the capital and labour income shares and the depreciation rate. The income shares attributed to capital and labour depend very much on accounting conventions. Gollin (2002) has argued that national accounts data for countries other than developed ones need to be adjusted in order to correctly capture income shares. When the appropriate adjustments are made, Gollin finds that factor income shares around the world do not correlate with income levels and typically the capital share lies within the 0.20-0.35 range.

What is the evidence for the Baltic states? Bems and Jonsson (2003) use data from the 1997 input-output tables to calculate the labour income share in Latvia. Defining labour income as the sum of ‘remuneration of employees’ and ‘mixed income’, they arrive at a

capital income share of 0.36 for Latvia in 1997. The adjustments made by Bems and Jonsson (2003) are identical to the ones recommended by Gollin (2002) as a way of correcting income shares in developing countries. Mixed income is added to labour income, since unincorporated enterprises in developing countries tend to be labour intensive.

Other evidence includes estimated production functions and also Eurostat national accounts data. Thus, Room (2001) has estimated a production function for Estonia and comes up with a capital share of 0.35 and Stikuts (2003) has done the same for Latvia and his estimation yields a capital share of 0.225. The Eurostat adjusted wage share of GDP in the Baltic states data (see Table A5) suggests that over the period the capital share has varied between 0.41 and 0.3 in Latvia and 0.4 and 0.29 in Estonia.

In Lithuania by contrast the Eurostat data imply an average capital share of 0.53 over 1995 to 2002. This is seriously out of line with the 0.20-0.35 range obtained by Gollin (2002). We believe that the Lithuanian figure is the result of attributing reported mixed income to capital rather than to labour as suggested by Gollin. Thus if we use the 1998 input-output table for Lithuania and treat mixed income as part of capital income (rather than as wages as recommended by Gollin) we obtain a capital income share of 0.53, which corresponds exactly to the Eurostat data.

The balance of the evidence suggests a capital share in the Baltics at the higher end of the Gollin range and accordingly for the baseline scenario we have chosen $\theta = 0.33$.

On the depreciation rate we assume $\delta = 0.8$ for all three countries. This may be compared with estimates of depreciation rates in the Baltic states obtained using national accounts data on consumption of fixed capital, combined with investment data and our estimated capital stock. In Table A8 we calculate the depreciation rates for each year between 1995 and 2002 and each of the Baltic states. The resulting depreciation rates vary between 0.07 and 0.11, with Lithuania exhibiting slightly higher depreciation rates than Latvia and Estonia. This range includes our assumed depreciation rate of 0.08.

4.2. Results of the growth decomposition

Once the capital output ratio, the income shares and the depreciation rate have been chosen the growth accounting 'experiment' is a simple application of equation (3). Using the input data from Table A3 output growth may be decomposed into growth of labour and capital inputs and growth of TFP. Detailed results of the exercise can be found in Table A4. and Table 1 below offers a summary of the results[12].

[12] We note the effect of the assumed constant returns to scale in production on the results of the growth accounting. If the true production function exhibits increasing returns to scale, TFP growth is overstated, as it captures some of the increase in production that is due to increasing returns. The opposite is the case, if the true production function exhibits decreasing returns to scale. Although we do not attempt to estimate the returns to scale for the aggregate production functions in the Baltic states, using the data accompanying this paper the reader can make any desired corrections. Note also that with constant returns to scale, a

Table 1 reports results for three periods 1996-2002, 1994-2002 (for Estonia and Latvia) and 1996-2003. The data for 2003 have been incorporated into the data set and the accounting exercise including 2003 data is reported. However, since the 2003 data are 'provisional' and may be subject to considerable revisions we take the 1996-2002 as our core 'experiment' for the aggregate economy. As it happens adding 2003 does not alter the overall picture very much, as can be seen from Table 1. The 1994-2002 results are included for interest.

The evidence conveys a very similar message for all three countries.

- Employment (labour input) has played either a modest positive role (Latvia) or a negative one (Estonia and Lithuania) in the Baltic growth acceleration. Given the discussion of employment growth trends in Section 2, this result is hardly surprising. However, it should be noted that if 2003 is added (when employment grew by between 1.5% and 2.2%) the labour contribution increases for all three countries.

- Across the three countries, growth in the capital stock accounts for 50-60 percent of accumulated output growth over 1996-2002. This result indicates that around half of the output growth in the Baltic states can be explained with a standard neoclassical growth model.

- The remaining 'unexplained' growth of output (45-60%) is attributed to the growth of TFP. Thus contribution of TFP to Baltic growth has been comparable to that of the physical capital stock. TFP can be interpreted as containing any growth-enhancing factor not accounted for by the growth of labour input or the capital stock.

It is of considerable interest as to what has 'caused' TFP growth. It could be that, if we have underestimated the contribution of either of the standard inputs, then such 'misspecification' would show up as TFP. Examples here would include growth of human capital or an overestimation of the initial capital stock However, as discussed in section 4.1 we are rather confident about our assumptions regarding labour inputs and as the sensitivity analysis in section 4.3 argues, if the initial capital out put ratio lies within a plausible range the contribution of TFP always remains quite large. This is entirely to be expected. So we believe that Baltic TFP is picking up genuine productivity improvements not originating in factor accumulation, but Box 1 shows that all too little is known in general about what exactly determines TFP growth and the same is true of the Baltic states

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switch from the assumed perfect competition to monopoly profits will overstate the elasticity of output with respect to capital. In this case an adjustment of income shares would be required.

Table 1: Aggregate growth accounting results for the Baltic states

Country	1996-2002				1996-2003*				1994-2002			
	Annual growth of GDP	Contribution of capital	Contribution of labor	Contribution of TFP	Annual growth of GDP	Contribution of capital	Contribution of labor	Contribution of TFP	Annual growth of GDP	Contribution of capital	Contribution of labor	Contribution of TFP
Estonia	0.052	0.031	-0.008	0.028	0.051	0.031	-0.005	0.025	0.043	0.033	-0.014	0.024
% contribution		61	-15	54		62	-10	49		77	-33	56
Latvia	0.056	0.029	0.001	0.026	0.058	0.029	0.003	0.026	0.042	0.024	-0.009	0.028
% contribution		51	2	46		50	5	45		56	-22	66
Lithuania	0.047	0.027	-0.009	0.029	0.052	0.027	-0.006	0.031				
% contribution		58	-19	62		52	-12	60				

Sources: see Table A1 in appendix

* non-final data for 2003

Box1: Total Factor Productivity

According to Easterly and Levine (2000) "Different theories provide very different conceptions of TFP. Some model TFP as changes in technology (the "instructions" for producing goods and services), others highlight the role of externalities, some focus on changes in the sector composition of production, while others see TFP as reflecting the adoption of lower cost production methods…… we do not have empirical evidence, however, that confidently assesses the relative importance of each of these conceptions of TFP in explaining economic growth. Economists need to provide much more shape and substance to the amorphous term 'TFP'."

Possible sources of TFP growth in the Baltic states include all of the above. Important potential channels of TFP growth include: (i) technology transfer; (ii) improvements in productivity of workers (human capital) not captured by standard measures of schooling and (iii) improvements in efficiency of organizations. All of these channels could be influenced by FDI. However, casual examination of the evidence is not promising. Thus, Estonia has an accumulated stock of FDI per capita that is more than twice as large as in Latvia or Lithuania, but the contribution of TFP to growth is not materially different from its contribution in the other two countries. In fact as Table 1 shows the Estonian TFP contribution lies exactly between the Lithuanian and Latvian figures. Moreover, the leading country for FDI per capita in Central and eastern Europe – the Czech Republic has experienced rather low TFP growth.

Generally it is rather difficult to identify the sources of TFP growth at the aggregate level. However, Benhabib and Spiegel (1994, 2002) estimate an equation for TFP growth that depends on the gap with the lead country and the level of human capital. They find that the level of human capital as measured by average years of schooling is highly significant in explaining the growth of total factor productivity. The idea here is that higher levels of human capital imply a faster catch-up of TFP. Thus on the basis of this work the particularly fast Baltic TFP growth can be explained by a combination of an initially large gap and high levels of human capital.

A promising route for identifying the channels by which TFP is determined is to look at firm-level evidence. An example of such a study is Smarzynska Javorcik (2002) who finds that in Lithuania FDI has contributed to productivity growth through productivity spillovers on upstream local suppliers of multi-national enterprises.

4.3. Sensitivity analysis of the baseline results

In this section we discuss the sensitivity of baseline growth accounting results with respect to four key assumption of the exercise concerning: (i) estimates of the capital stock, (ii) labour and capital income shares, (iii) the depreciation rate for the capital stock and (iv) the intensity and quality of labour input.

Capital stock
Table A6 reports the results of a numerical simulation of how the baseline case varies in response to changes in these four underlying assumptions. The first column presents the baseline case. The second column shows the results when the initial capital output ratio is assumed to be 1.3 (as compared with the baseline assumption of 1.5) and the third column reports the results for a capital output ratio of 1.7. In all other respects the growth accounting exercise remains the same as in the baseline case.

A lower initial capital stock combined with the same net investment data implies a higher capital stock growth rate and therefore must increase the contribution of capital to output growth. Following the same reasoning, a higher initial capital-output ratio (or capital stock) decreases the contribution of capital. From equations (3) and (4) it is clear that the contribution of labour is not affected by changes in the capital stock. Hence a change in the contribution of capital following a variation in the initial capital stock must be accompanied by an offsetting effect for the contribution of TFP.

In the range of reasonable values, the results of the growth accounting are not especially sensitive to changes in the initial capital-output ratio. Changing the ratio all the way from the lower bound of 1.3 to the upper bound of 1.7 decreases the contribution of capital to the output growth by only 17% in Estonia, 16% in Latvia and 19% in Lithuania. This decrease is, of course, offset by a corresponding increase in the contribution of TFP.

The income shares
The fourth column of Table A6 reports the case where for each country time varying capital income shares are taken from the Eurostat data (see Table A5) instead of the assumed baseline value of 0.33. The Eurostat data imply on average higher capital income shares than the assumed 0.33 in the baseline experiment and equation (3) implies that an increase in the capital income share leads to an increase in the contribution of capital to output growth and a decrease in the contribution of labour.

However, the magnitude of the effect of a change in income shares on capital and labour contributions is also affected by the growth rate of each of these production factors and therefore the increase in the capital contribution induced by an increase in the capital share may not be exactly offset by a reduction in the labour contribution. In fact, for Estonia and Latvia the growth rate of labour is negligible and too small for the effect not to be reported in Table A6. For Lithuania the Eurostat data imply a much larger capital share than we have assumed and the consequent change is much more dramatic. Any change in capital and labour contributions must be offset by an opposite change in the TFP contribution

The depreciation rate
Sensitivity of aggregate growth accounting results with respect to the assumed capital depreciation rate is reported in the fifth column of Table A6, where instead of the baseline depreciation rate of 0.08 we use the depreciation rates implied by the consumption of fixed capital data from national accounts (see Table A8). From equation (4) the depreciation rate affects the growth accounting through its effect on net

investments. Keeping all the other inputs in the growth accounting constant, an increase in the depreciation rate decreases net investments for each year and consequently decreases the growth of the capital stock. As in case of capital-output ratio, changes in the depreciation rate do not affect the contribution of labour.

The numerical results reported in Table A6 suggest that results of the growth accounting are not particularly sensitive to changes in the depreciation rate. For example, in the case of Lithuania, where the average depreciation rate implied by the national accounts data is by 0.02 higher than in the baseline case (0.10 vs. 0.08), the contribution of capital decreases from 58% to 48% with an offsetting increase in the contribution of TFP. In the case of Latvia and Estonia, the resulting changes in contributions are considerably smaller.

Note that the results in columns four and five (changes in the income shares and in the depreciation rate) move in opposite directions as compared with the baseline case and thus at least partly cancel each other out. If we consider a growth accounting exercise with income shares from the Eurostat data and depreciation rates as estimated from national accounts, the results for Estonia and Latvia would be very close to the baseline case. This finding is reported in the sixth column of Table A6.

Employment

Finally, the last column of Table A6 reports the case where employment data is adjusted for hours worked. A decrease in hours worked decreases the supply of labour, which in turn decreases the contribution of labour to output growth. The contribution of capital is not affected. As in the previous columns, we conclude the empirically relevant changes in hours worked have only a minor effect on the growth accounting results. In Latvia, where the hours worked showed the largest variation (decreased by 5.4% over 1996-2002), the contribution of labour decreases by 9% with an offsetting increase in the contribution of TFP.

Summary

Table 3 summarises the results of the sensitivity analysis in the form of a range of estimated contributions for plausible variations in the underlying assumptions.

Table 3: Range of values for contributions based on sensitivity analysis (1996-2002)

	Average growth of GDP	**Capital contribution**		**Labour contribution**		**TFP contribution**	
		Max	**Min**	**Max**	**Min**	**Max**	**Min**
Estonia	5.2%	3.6%	2.7%	-0.8%	-1.0%	3.2%	2.3%
Latvia	5.6%	3.3%	2.5%	0.1%	-0.4%	3.1%	2.1%
Lithuania	4.7%	4.3%	2.3%	-0.6%	-1.3%	3.4%	1.1%

Although these results are not amenable to statistical testing, we believe the sensitivity analysis confirms our main propositions about the proximate causes of the recent growth acceleration in the Baltics, namely:

- the labour contribution to growth has been negligible but mainly negative

- capital and TFP have contributed almost equally, with perhaps a slight edge for the contribution of capital.

4.4. Comparison with growth accounting results for other countries

Many growth accounting studies are available for a wide variety of countries that may be used for comparison with our results for Estonia, Latvia and Lithuania. Bosworth and Collins (2003) report results for 84 countries over the period 1960 to 2000. For all 84 countries taken together the contribution of capital (45%) and TFP (41%) to the growth of output per worker was close to 50/50. The remainder of growth was was attributed to education (human capital). Our results for the Baltics are not out of line with this broad international experience.

One interesting comparator set is the experience of France, Germany, Italy, Netherlands and UK after the Second World War, i.e., for the 1947-1973 period (see Barro and Sala-i-Martin (1995)). Over this period annual output growth in these countries ranged from 3.7% in the UK to 6.6% in Germany. As in the Baltic states, output growth could be attributed more or less equally to the growth of the capital stock and TFP. At the same time, labour growth contributed only around 5 percent of the output growth.

Although the Baltic growth acceleration is often compared with the Asian tigers, the growth accounting evidence from Hong Kong, Singapore, South Korea and Taiwan suggests that their rapid economic expansion period differed substantially from the experience of the Baltic states. Annual growth rates in the four East Asian economies during 1966-1990 period ranged from 7.3% for Hong Kong to 10.3% for South Korea, thus exceeding the recent growth rates in Estonia, Latvia and Lithuania. Young (1994) finds that output growth in the East Asian economies during the period can mostly be accounted for by capital (40 percent) and labour growth (40 percent), with TFP growth accounting for only 20 percent.

Closer to home, Doyle et al. (2001) report growth accounting results for Czech Republic, Hungary, Poland, Slovak Republic and Slovenia. They share with the Baltics the feature that the labour input contribution to output growth during the 1990s was largely negative and positive but small only in the case of the Slovak Republic. With respect to the role of capital and TFP, these countries show considerable differences. In the Czech Republic and Slovakia during 1991-1999 the growth of capital stock contributes more then twice as much to output growth as does growth in TFP. In Hungary and Slovenia, the opposite has been the case, while for Poland the results are similar to those we find for the Baltic states.

Interestingly, in nearly all of the comparisons discussed here the contribution of capital lies in the 40-60 percent range. The case of Czech Republic is the only exception to this

rule. Thus the evidence suggests that the main differences in sources of growth across countries arise from different contributions of labour input and TFP.

Box 2 : Vetlov's Growth Accounting Results for the Baltics

In an independent study Vetlov (2003) also reports a growth accounting exercise for all three Baltic states. A summary of the results is shown in the following table:

Contributions of capital, labour and TFP to GDP growth 1996 -2002

	Capital contribution	Labour contribution	TFP contribution
Estonia	74%	0%	26%
Latvia	62%	-14%	53%
Lithuania	37%	-16%	79%

Source: Vetlov (2003)

These results confirm the relatively small and negative impact of labour. They also confirm that the contribution of TFP has been highest in Lithuania. However with respect to the relative role of capital and TFP in Estonia and Latvia they are somewhat different from the results reported in Table 1. It turns out that differences in assumptions about parameters can explain much of the difference. Firstly, Vetlov assumed capital output ratios of 1 for Latvia and Estonia and 1.3 for Lithuania. These are much lower than we have assumed and would have the effect of increasing the calculated contribution of capital as compared with Table 1, with the effect disproportionately greater for Estonia and Latvia than for Lithuania. Also Vetlov used the following capital shares (personal communication from the author):

Estonia: 0.48
Latvia: 0.54
Lithuania: 0.58

These are much larger than we have assumed and would also have the effect of boosting the capital contribution.

5. Sectoral growth accounting

In this section we disaggregate the economies of the three Baltic countries into traded and non-traded sectors and undertake a growth accounting by sector. This exercise is motivated by the belief that developments in the traded and non-traded sectors have been shaped by different forces and indeed it turns out that factor accumulation and TFP have contributed rather differently as between the sectors.

The technical nature of the exercise is identical to the one presented in the previous section for the aggregate economies - using sectoral data for output, employment and capital stock, equation (3) allows us to account for the contribution of the different factors to output growth and hence to obtain the sectoral TFP as a residual value. We first discuss the additional assumptions needed to implement sectoral growth accounting and then present and discuss the results.

5.1. Additional assumptions

In defining the traded and non-traded sectors we follow the standard procedure in the literature and define industry and agriculture as the traded sector of the economy, which then leaves all other sectors of economic activity aggregated into a non-traded sector. Such a division of the economy inevitably involves some degree of arbitrariness, since any form of economic activity has a non-traded component and some services and other activities that appear in the 'non-traded' sector do in fact enter into international trade. At the same time it is empirically the case that output of agriculture and especially industry is traded much more than the output of other sectors.

For sectoral output data we use value added at constant prices for traded and non-traded sectors. Ideally, on top of the value added we should add taxes and subsidies incurred by each sector; however such data is not available at a yearly frequency. By ignoring taxes we approximate the sectoral output growth rate (at market prices) with the growth rate of sectoral value added. Data on sectoral employment is taken from the official employment estimates and labour market surveys. All the raw sectoral data inputs can be found in Table A10.

We assume that income shares, capital output ratios and depreciation rates are the same across traded and non-traded sectors, and are identical to the values assumed for the aggregate economy. We now discuss these assumptions.

Income shares

Eurostat reports the labour income share for the manufacturing sector separately as well as for the aggregate economy (see Table A13). Since manufacturing constitutes approximately 65 percent of the traded sector, labour income in manufacturing can serve as a proxy for the labour share in the traded sector as a whole. Comparing the labour share in the aggregate Baltic economies (Table A5) with the manufacturing labour share (Table A13) we conclude that, although labour income shares in manufacturing are higher than for the whole economy in all three countries, the differences are rather small: just 0.03 in Estonia, 0.02 in Latvia and 0.04 in Lithuania. Thus at the traded/non-traded level of disaggregation the assumption of factor income share equality across sectors is closely approximated in the data for the Baltic states. This finding is in line with Parente and Prescott (2000, p 43), who argue that capital and labour shares in value added vary little across highly aggregated industrial sectors.

Capital output ratios

We assume that the initial capital stock in 1995 is distributed across sectors in proportion to the sectoral output, so that in each sector the capital-output ratio is the same as for the aggregate economy.[13] This assumption is motivated by a property of the model that underlies the sectoral growth accounting, i.e., equalization of the marginal return of capital across sectors coupled with identical capital income shares implies identical capital-output ratios in the two sectors.[14]

Lack of data does not allow us to check on direct empirical support for this assumption. However, examining investments as a fraction of value added (see Table A11) suggests that in Latvia and Lithuania the capital output ratio has been increasing faster in the non-traded as compared with the non-traded sector. The same is also true for Estonia once taxes are added to the value added in each sector.[15] This suggests that the return on capital has been higher in the non-traded sector. Using equation (6), a higher rate of return coupled with identical factor income shares would imply that the capital-output ratio in the non-traded sector in 1995 was lower than in the traded sector. It turns out that if this were indeed the case then our results about the relative role of TFP in traded and non-traded sectors would be reinforced.

The capital stock for years after 1995 is obtained using sectoral investment data and equation (4).

Depreciation rates

There is agreement in the literature that depreciation rates for equipment are higher than depreciation rates for construction items (see e.g. Hulten and Wykoff (1981)). In view of this, the assumption that depreciation rates are the same in traded and non-traded sectors are valid only if the equipment (to construction item) intensity of investment in traded and non-traded sectors of economy is the same. Unfortunately we have no evidence on this.

However, if the depreciation rate was lower in the non-traded sector (as would be the case if the equipment intensity was lower), the contribution of capital to output growth in that sector would increase, which in turn would further reinforce our results on the relative role of TFP growth in the two sectors.

Labour inputs

Only fragmented data on hours worked and others characteristics of the labour force are available in the Baltic states at the level of traded/non-traded sectors. For Latvia and Lithuania the relevant time series are available only starting with 1998-99. We have checked for differences across the two sectors by comparing data for manufacturing

[13] In order to obtain sectoral output at market prices for this calculation, we distribute net taxes on value added of traded and non-traded sectors. Distribution is based on data from the 1997 input-output table for Latvia, in which 91 percent of taxes are added to the value added of the traded sector.

[14] Formally, marginal product in sector j can be expressed as $r_{jt} = \theta j(Y_{jt}/K_{jt})$. If for sectors j and i we have $r_{jt}=r_{it}$ and $\theta_j = \theta_i$, then $Y_{jt}/K_{jt}=Y_{it}/K_{it}$.

[15] As already mentioned in an earlier footnote, around 90 percent of taxes should be allocated on top of the value added of traded sector.

sector with the aggregate economy. Neither hours worked, the age structure of the employed, the gender of the employed, nor educational attainment exhibit differences that imply a need to deviate from the assumption that employment is an acceptable measure of sectoral labour input.

5.2. Results of the growth accounting for traded and non-traded sectors

Descriptive data

Table 4 below reports the basic growth data for the two sectors which shows that in all three countries over the 1996-2002 period output has grown more in the non-traded sector than in the traded sector, and by considerably more in Estonia and Latvia.

Table 4: Basic growth data for traded and non-traded sectors (1996-2003)

	Cumulative growth		Annual average growth	
	Traded	Non-traded	Traded	Non-traded
Estonia	33.8%	41.7%	4.8%	6%
Latvia	27%	45.2%	3.9%	6.5%
Lithuania	31.1%	34.1%	4.4%	4.9%

Source: Authors calculations

Table A11 shows the basic sectoral developments in inputs. Thus we see that employment in the traded sector has fallen substantially in all three countries, with an accumulated contraction ranging from –12% in Latvia to –29% in Estonia. At the same time employment in the non-traded sector has increased in all three countries. However, except for Latvia, this does not represent a simple transfer of workers from traded sector to non-traded sectors. In both Estonia and Lithuania employment in the non-traded sector increased by much less than it declined in the traded.

Also from Table A11 we see that in all three countries the capital stock has increased faster in the non-traded sector. The difference in growth rates is most pronounced in Latvia, where during 1996-2002 the capital stock in the non-traded sector grew by 87% as compared with just under 27% in the traded sector.

These observations about output growth and input patterns point towards one common development in the Baltic states during the 1990s – namely a shift of economic activity from the traded to the non-traded sector. It may be noted that this pattern of sectoral growth rates for output, labour and capital is not unique to the Baltic states. Bems (2004) finds similar sectoral growth patterns also in Poland, the Czech Republic, Slovakia, Hungary and to a lesser extent in Slovenia.

In both the Baltic states and in other Central and Eastern European countries the observed trends can be explained by the rapid transition towards a market economy starting in the late 1980s and the early 1990s. Due to over-industrialization, the Baltic states inherited from the Soviet Union a large and inefficient traded sector, including the inherited stock of physical and human capital employed in the sector (see e.g. Bems (2004), Kornai

(1992)). At the same time, the inherited services sector was inadequate for the needs of a market economy. So transition to a market economy required two major structural changes: firstly the elimination of the inefficient industrial sector and secondly the creation of a modern service sector. This is exactly what happened.

Growth accounting results

The results for the period 1996-2002 are presented in Table 5. The same results in accumulated terms are also available in Table A12. The main features are as follows:

- In the traded sector, the contribution of labour is uniformly very negative. This leaves capital and TFP with the task of not only accounting for the output growth but also compensating for the decrease in traded sector employment.

- The contribution of capital to output growth in the non-traded sector is in the range 59% to 65%. This is a little more than in the aggregate exercise In the traded sector capital contributes somewhat less, with a range of 34% to 51%.

- The relatively small contribution of capital in the traded sector leaves TFP with the task of compensating for the large decrease in traded sector employment. Thus, not surprisingly, TFP growth plays a considerably more important role in the traded sector of each of the Baltic states. TFP contributes more in the traded sector as compared with the non-traded by 71 percentage points in Estonia, by 73 percentage points in Latvia , and by 77 in Lithuania.

Table 5: Growth accounting in traded and non-traded sectors, 1996-2002

	Nontraded sector				Traded sector			
Country	annual growth rate	contribution of capital	contribution of labour	contribution of TFP	annual growth rate	contribution of capital	contribution of labour	contribution of TFP
Estonia	0.060	0.035	0.003	0.021	0.048	0.025	-0.028	0.051
% contribution		59	6	35		51	-57	106
Latvia	0.065	0.041	0.009	0.014	0.039	0.013	-0.011	0.037
% contribution		64	14	22		34	-29	95
Lithuania	0.049	0.032	0.002	0.015	0.044	0.021	-0.024	0.048
% contribution		65	4	31		47	-55	108

Sources: See Table A12 in appendix

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The results of the sectoral growth accounting can be interpreted as consisting of two effects that together account for the sectoral output growth differences. First, there is a high degree of substitutability between the contribution of employment and the contribution of TFP. Second, accumulation of capital plays a more important role for the output growth in the non-traded sector. These two effects then lead to the observation that in the traded sector TFP contributes 2-3 times more to output growth than the capital stock, while the opposite is the case in the non-traded sector. Recall from Table A4 that at the aggregate level contribution of the two factors was approximately equal.

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5.3 A further disaggregation

An alternative approach to exploring the relationship between 'tradability' and TFP is to disaggregate further. Thus we have extended the growth accounting exercise to four of the five largest sectors of economic activity in each of the Baltic states: (i) manufacturing, (ii) retail and wholesale trade, (iii) construction and (iv) transport, storage and communications.[16] These four sectors together account for more than a half of total economic activity in each of the Baltic states and exhibit wide differences in terms of the tradability of sectoral output. The goal of this exercise is to check if the findings from the traded/non-traded exercise are present at a more disaggregated level.

As can be expected, the main problem is again related to finding reliable capital stock estimates for each sector. Since each of the four sectors is covered in the enterprise balance sheet data discussed earlier, we can obtain estimates for the stock of fixed tangible and intangible assets in each of the sectors.[17] However, as we have argued in section 4.1, there are good reasons to believe that the balance sheet data in the Baltic states substantially underestimate the capital stock.[18]

We think that despite these limitations the results of the growth accounting experiments for the four sectors of economic activity can still be useful for identifying the *relative* role that TFP plays in different sectors of economic activity. The only assumption that is important in this case is that the underreporting of assets is proportionally the same in the four sectors.

For each sector value added, employment and investment data is available from national statistical offices. Factor income shares and depreciation rates in each of the four sectors are assumed to be the same as for the aggregate economy. Finally, the four sectors are ranked according to their tradability, measured as (exports+imports)/(gross output) in each sector.

The results of this exercise are reported in detail in Table A14 and visually in Figure 2. The results generally support the findings of the growth accounting for traded and non-traded sectors. Following our definition, tradability in Figure 2 increases as we move to

[16] Real estate, renting and business activity was left out, since this sector includes residential housing and thus enterprise balance sheet data is not an appropriate source for capital stock data for this sector.

[17] The same could not be done for traded and nontraded sectors since not all sub-sectors of these two sectors are covered in the enterprise balance sheet data.

[18] The capital-output ratios implied by the balance sheet data in the four sectors of each of the Baltic states are reported in Table A15. In the case of Lithuania, enterprise fixed asset data is available only starting with 2000. For the growth accounting exercise Lithuanian capital stock for 2000 in each sector is multiplied with 1.43 to adjust it for underreporting of assets between 1995 and 2000. The value 1.43 is obtained by assuming that the underreporting of assets in Lithuania is the same as cumulative 1996-2002 underreporting of assets in Latvia (see Table A2). This adjustment for underreported assets is needed, since otherwise pre-2000 capital stock values in construction and trade sectors are negative. Note also that in Table A15 capital is expressed relative to the value added and thus ratios in this table are not directly comparable to capita-output ratios in Table A2.

the right on x-axis. Thus the first observation in each of the country panels is construction (with a tradability index of less than 10% for all three countries), second is trade (14% to 19%), third is transport (46% to 55%) and fourth is manufacturing (74% to 82%). Figure 2 clearly shows that in general the contribution of TFP is increasing with the tradability of the sector, the while contribution of labour decreases with tradability. Capital accounts for roughly the same share of output growth in all four sectors, with a slightly decreasing significance for more tradable sectors. There are two exceptions to these general properties: capital appears to have an unusually large contribution in the Lithuanian construction sector and in the Estonian trade sector. By the logic of growth accounting this must be reflected in unusually low TFP contributions. We believe that in these two instances the results come from an abnormally low initial capital stock valuation [19]

Overall, we conclude that growth accounting for the traded and non-traded sectors as well as the more disaggregated exercise point to a similar picture – namely capital has been the most important driving force of growth in the non-traded sector(s), while TFP growth has been relatively more important in the traded sector(s).

[19] Importantly, our approach does not reliably define the absolute level of contribution of capital and TFP to output growth in any of the sectors. The reason is that the enterprise fixed asset data underestimates the level of the capital stock and thus overstates the contribution the capital stock growth to output growth. This is evident when we compare the contribution of capital stock growth in Table A14 with growth accounting results for aggregate economy as well as traded and non-traded sectors (Tables 1 and 3). The overly large contribution of capital to output growth leads in turn to an underestimate of the contribution of TFP. This is the reason for the negative TFP contributions in some sectors.

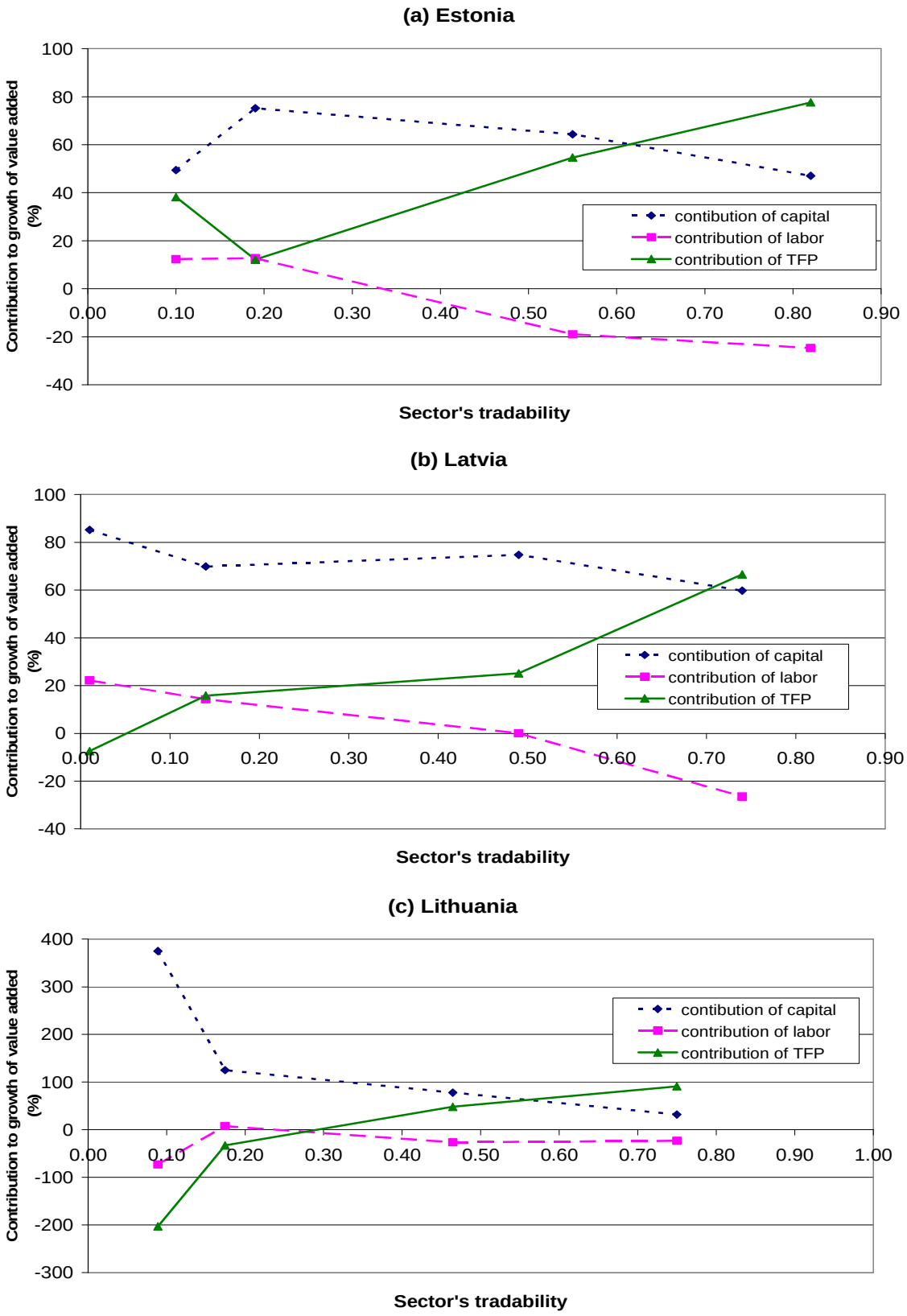

Figure 2: Growth accounting for selected sectors of economy

5.4 Discussion

What stands behind these differences in contribution at the sectoral level? Do the results reflect the working of real and identifiable economic processes? Or are they driven by the specific assumptions of the growth accounting exercise?

Could the observed results be driven by the assumptions of our accounting exercise? For example, what is the significance of the assumed equality of capital income shares in the traded and non-traded sectors or the assumption that capital stock is equally distributed across the two sectors? What would be plausible alternative assumptions? In the case of the 1995 capital stock it might be argued that at that time the capital stock in the non-traded sector was below its long run level and that this was reflected in a higher rate of return to capital than in the traded sector (and the subsequent observed higher investment share). The logic of equation (6) would then imply that the non-traded sector had a lower initial capital output ratio than the traded sector, with the consequence that the relative importance of capital and TFP across sectors would be reinforced as compared with our results ie capital would have made an even bigger relative contribution and TFP a lower one as compared with our results. As to alternative assumptions about the capital share – economic theory has little to offer here, but the capital share in the traded sector would have to be substantially higher in the traded sector to remove our core result about the relative importance of capital and TFP across sectors. The evidence does not support this.

The differences in TFP and capital contribution can be picking up two distinct economic forces at work. Firstly, the observed TFP growth in the traded sector could be a correction to the very low initial TFP (in absolute terms as well as relative to the non-traded sector) in the traded sector while at the same time the high rate of capital accumulation in the non-traded sector has reflected the need to create in the Baltics a modern services sector – financial intermediation, modern retail outlets, modernised cinemas etc.

Alternatively, the growth accounting could be picking up parts of a Balassa-Samuelson effect. Because of foreign exposure, the traded sector has faced more competition than the non-traded and thus companies operating in this sector have been forced to be more productive than companies in the non-traded sector. The contraction of employment in the traded sector, which has been observed in the Baltic states, could be a result of such productivity increasing measures. The higher productivity in the traded sector has resulted in increased wages in the whole economy. The non-traded sector in turn has responded to higher wages in part by increasing the price of its final products rather than productivity.

A further alternative interpretation of the data is that the shift from traded to non-traded sector is a result of a rapid (and so far successful) economic development in the Baltic states. In the context of a two-sector growth model if a country is subject to a negative output shock (transition) the optimal recovery path for a small open economy is to shift domestic economic activity towards the non-traded sector, while relying on the rest of the

world for its supply of traded goods. Thus, as the economy expands and consumers demand more of both traded and non-traded goods, non-traded goods can be supplied only domestically and hence require investment in domestic production capacity, but traded goods may be imported. Thus the structural switch to non-traded sector production represents a form of inter-temporal consumption smoothing. For further discussion of this model see Bems and Jonsson (2003) and Bems (2004).

6. Prospects for future growth

The results presented above point to accumulation of physical capital and TFP growth as the drivers in about equal measure of recent GDP growth in the Baltic states, with TFP growth more important in more tradable sectors and capital accumulation relatively more important in less tradable sectors.

What do these results imply for future growth? The logic of growth accounting is that expectations about future growth depend on what we believe about the future growth of inputs and the future growth of TFP. In this section we consider what we might reasonably expect with respect to these variables. An alternative approach is to use growth regressions for prediction of future growth. We report on one recent paper that attempts to do this for the transition economies, including the Baltics.

Future capital accumulation

For growth at current rates to be sustainable then either capital accumulation and TFP growth must continue at the same rates or if one declines, there must be compensation in the form of a higher input elsewhere. Thus if capital accumulation falters it must be compensated either by more TFP growth or by accumulation of human capital.

What are the prospects for future capital accumulation? At first sight it might seem that as the services sector of the economy in the Baltics is built up to the same level as in a Western market economy and as the capital of the traded sector is modernised there might well be a slow down in physical capital accumulation, thereby compromising the sustainability of current growth rates. However, recent investment rates as a % of GDP are by no means exceptionally high by the standards of developing countries. In fact current investment to GDP ratios are below the 30% levels assumed as 'optimistic' by Fischer, Sahay and Vegh (1998) in their famous growth projections for the transition economies. The optimistic scenario was one in which the institutional quality approached that of Western countries. We would regard that there remains some mileage to be gained in this sphere.

Moreover, as Klenow and Rodriguez-Clare (1997) point out TFP growth raises the marginal product of capital and creates a further incentive to invest. So, if TFP growth is maintained capital accumulation may also be maintained. So one key to sustainability centres on whether current rates of Baltic TFP growth are sustainable.

TFP growth

Table 6 below offers some historical comparisons. It can be seen that the TFP growth in the Baltics is by no means exceptional – Germany. Italy, and Japan all exceeded recent Baltic rates for the a 25 year period from 1947, while France and the Netherlands maintained rates very similar to that of the Baltics over the same period

Table 6: Historical evidence on TFP growth (average annual %)

1995-2002		1960-1980	
Estonia	2.5	Argentina	1.1
Latvia	2.6	Brazil	1.85
Lithuania	3.1	Chile	1.5
		Colombia	1.2
		Mexico	2.3
		Peru	0
1947-1973		Venezuela	0.5
Canada	1.75	1996-1990	
France	2.96		
Germany	3.74	Hong Kong	2.2
Italy	3.37	Singapore	-0.4
Japan	4.2	South Korea	1.2
Netherlands	2.48	Taiwan	1.8
UK	1.93		
US	1.35		

Source: Barro and Sala-I-Martin (1995); own calculations

On the other hand Table 6 also shows that it is not easy. None of the Latin American countries achieved anything like Baltic TFP growth rates over the twenty years from 1960 and of the Asian tigers only Hong Kong posted a TFP growth rate in excess of 2% during 1966-1990.

Another comparator data set may be found in Benhabib and Spiegel (2002) who compute TFP growth for a sample of 85 countries between 1960 and 1995. Of the 85 only 7 achieved TFP growth over the period in excess of Lithuania's 3.1% and only 11 achieved a higher rate than Estonia's 2.5^%.

Labour input

As discussed in Section 4.1 labour input is made up of physical input + an adjustment for human capita. Because of the shortness of our data series we have not been able to consider changes in human capital. Investment in human capital is a long process with a long pay-off period. Thus in the Baltics it is unlikely that we can yet pick up the effects

of increased tertiary enrolments, especially in business related subjects. Moreover, although there has been some curriculum reform Baltic universities are still dominated by faculty inherited from the Soviet Union. This will surely change and better human capital is also likely to have positive spin-offs on both the accumulation of physical capital and on TFP growth.

However, we have considerably more information on possible developments in physical labour input. The Baltic states have experienced considerable and continuing falls in population since the beginning of the 1990s. This has been especially acute in Estonia and Latvia. In the first instance population fell because of emigration – mainly to Russia, but since then low birth rates have sustained a persistent natural decline in population. In their growth regressions, Crafts and Kaiser (2004) (see Box 3) make assumptions about population growth rates for transition countries over the 20 years from 2000. From 23 transition countries Estonia, at an assumed population growth rate of -1.5% is assumed to have much the largest population decline and Latvia, at -1.2% comes next in a group with Georgia (-1.3) and Kazakhstan (-1.2). The next placed country is Ukraine at -0.8% and for Lithuania the projected population growth is -0.1%.

However, with respect to the workforce (usually regarded as population in the age group between 15 and 64 years) we can make quite precise predictions. We already know the number of persons entering the work force for each of the next 15 years since they have already been born and in the absence of war or major disaster almost all of them will survive to age 15. We can also use data on life expectancy to estimate exits from the work force. This exercise has been done for Latvia for the period to 2023 by Hansen (2005) and the summary results are reported in Table 7 below.

Table 7: Cumulative changes in Latvian population in different age groups

	Under 15 years	15-64 years	Over 64 years
1991-2003	- 34.6%	- 10.4%	17.5%
1991-2023*	- 48.2%	- 21.2%	26.3%
2003-2023*	- 20.9%	- 12.6%	7.6%

Source: Hansen (2005)
* projections

The key figures are in the second column, which show that in the period from 2003 to 2023 the Latvian working age population will decline by nearly 13%. This is bigger than the decline in the 12 years from 1991 (most of which took place in the early 1990s) and moreover does not take into account any possible migration (eg to the rest of the EU). By 2013 the working age population will be down by 3.5% and by 2018 by about 8%. During 1995-2002 working age population in Latvia declined by about 3.3% so the

projections for the next ten years imply something very similar to what has happened during the period of the current growth acceleration .However over the ten years from 2013 the decline will be three times as large at nearly 10%. This represents a major shock to the Latvian labour market and hence to the prospects for medium term growth. The data for Estonia are rather similar. Both countries have recently implemented measures that substantially increase the financial incentives for families to have children but even if they work the effects will not be seen in the workforce before 2020.

Growth regressions

Growth regressions provide an alternative means of understanding the 'determinants' of growth. The growth regression approach has the advantage of addressing the impact of factors such as initial levels of income (thus addressing the catch-up model of growth) and of institutional quality which does not appear directly in a growth accounting exercise but which may show up indirectly as TFP. Growth regressions have been widely used to make growth projections but as with growth accounting the quality of projections depend on the quality of the projections of the determining components as well as on the quality of the regressions themselves. Box 3 reports on some recent projections for transition economies.

Box 3: Projections for transition countries using growth regressions

In the context of transition Fischer, Sahay and Vegh (1998) estimated an equation of the form:

$$GYP = a + bY_0 + c\,POP + d\,SEC + e\,INV$$

where GYP is growth per capita, Y_0 is initial income, POP is population growth, SEC is secondary school enrollment, and INV is the investment share in GDP. They then used the equation to make growth projections for the transition economies. Subsequently more sophisticated versions of this equation have been estimated to include things like institutional quality, financial development etc. Crafts and Kaiser (2004) have done an update of the Fischer, Sahay and Vegh (1998) projection making a variety of adjustments, such as using updated data, allowing for institutional quality, adjusting the initial income variable etc. They then project average annual growth for 20years from 2000. The results for the Baltics of the seven different equations used by Crafts and Kaiser are reported in the table below:

	1	2	3	4	5	6	7
Estonia	6.86	4.17	2.77	4.48	2.96	4.04	2.79
Latvia	5.72	3.21	2.12	3.58	2.26	3.28	2.58
Lithuania	5.44	3.45	2.45	3.93	2.58	3.61	2.74
Average EU accession	5.58	3.46	2.50	3.91	2.62	3.64	2.33

Equation 1 is the based on the original Fischer, Sahay and Vegh (1998) equation with revised data and adjustment of initial income, the other equations make a variety other adjustments to the original equation. Two things are worth noting in the Baltics context: (i) the original equation adjusted for up to date data is the best predictor of recent Baltic growth, although the performance of Estonia is over-estimated, and (ii) in all the equations the projections for the Baltics are not as far in front of the accession average as has actually been the case.

7. Concluding remarks

Why have the Baltic states grown so fast? Why have they grown faster than both other former Soviet Union states and other Central and Eastern European new EU member states? Our growth accounting exercises point to the following as proximate 'causes':

- capital accumulation – needed to create a market economy services sector,
- and total factor productivity growth – needed for the traded sector to compete in world markets.

But this does not explain why the same forces have not worked equally elsewhere. What is special or unique about the Baltic states? We suggest the following; the Baltic states are the only transition economies that are ***both*** former Soviet Union ***and*** have become EU member states, This links up with growth theory which identifies 'catch-up' and 'institutional quality' as positive factors for growth. As former Soviet republics the Baltic started transition with lower income levels than the CEE countries and as EU accession candidates from 1995 when all three applied for membership the Estonia, Latvia and Lithuania have been subject to a rigorous process of institution building to prepare them for EU membership.

Can this continue? Catch-up, if it works, must eventually work itself out. Institutional quality is much improved as compared with the early 1990s when many institutions hardly existed, but there is still a long way to go, especially in terms of the gap between the legal forms and practice or implementation.

What places the Baltic growth acceleration most at risk is not the exhaustion of improvements in institutional quality nor the imminence of catch-up, but especially for Estonia and Latvia the demographic time-bomb.

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