# PART II: SPECIAL TOPIC

# GROWTH IN CENTRAL EUROPE AND THE BALTIC STATES: RECENT TRENDS AND PROSPECTS

## Introduction

The promotion of productivity and growth is on the policy agenda in almost all EU countries, including the New Member States (NMS) striving to catch up with income levels in Western Europe. While the NMS are currently enjoying rapid rates of output growth, little is known about the prospects for sustaining this pace and the role of economic policies in this regard. This may risk leading to complacency in the pursuit of the outstanding reform agenda in the region.

This study analyzes aggregate growth patterns in the EU8 economies, examining the main factors affecting growth as well as some of the policies that may help to sustain or enhance growth prospects. We supplement this analysis with a more detailed, sector-based examination of the largest country in the region—Poland. This will help shed light on whether the same key factors support growth at the sector level as at the country level and potentially strengthen the basis for policy directions.

The study is organized as follows: in section 1, we review sources of output growth and determinants of total factor productivity growth in the EU8 over the past decade; in section 2 we perform a similar analysis at the sector level for Poland; and in section 3 we summarize our findings and discuss their policy implications.

## 1. EU8 Cross-Country Analysis of Output Growth

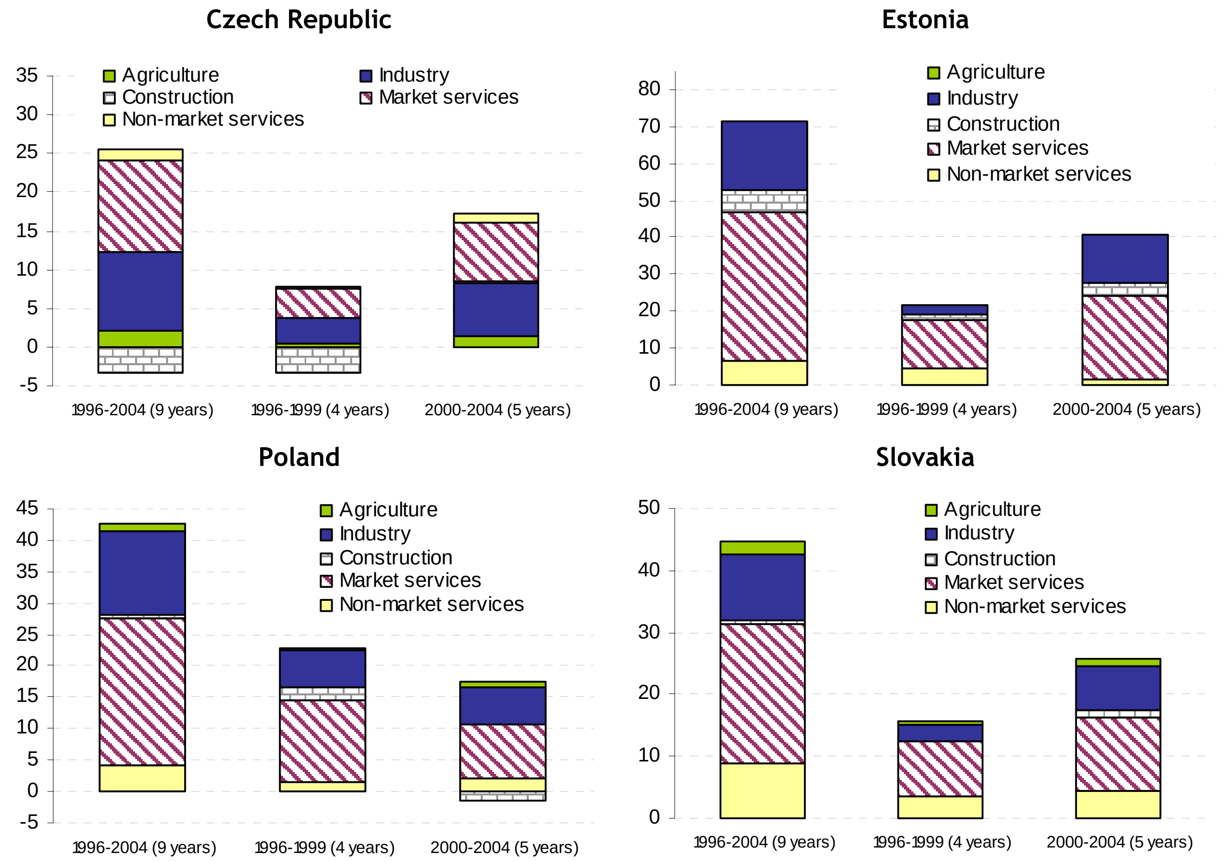
*This section looks at patterns of growth in the EU8 in the period 1996-2004, performs a growth accounting exercise where output growth is decomposed into its main components (labor, capital, and productivity), and analyzes determinants of productivity growth. We find that rapid output growth in the region was driven by services and industry, with domestic demand playing a relatively larger role in the Baltic countries and net exports more important in the Visegrad countries. Total factor productivity rose rapidly in all EU8 countries, but capital accumulation was also important, notably in the Baltics. Openness to trade and competition, R&D spending, and shift of resources toward industry seemed to be key drivers of productivity growth in the region.*

### 1.1. Patterns of growth 1996-2004

**Following the initial output collapse induced by transition to market economies, the EU8 countries recovered gradually in the second half of the 1990s and output growth has gained further strength in most countries in the first half of this decade**. In the first half of the 1990s, GDP and value added declined dramatically due to supply and demand shocks caused by the loss of traditional export markets, the break-up of existing supply chains and decision-making structures, sudden trade liberalization and restrictive macroeconomic policies. Economic recovery got under way from the mid-1990s, but most of the NMS experienced further growth interruptions owing to delayed structural reforms (e.g. corporate restructuring), financial crises (notably spillover from the Russia crisis) and/or macroeconomic imbalances related to unsustainable economic policies. The Baltic States were more affected by the Russia crisis in the summer of 1998 than other countries in the region but recovered rapidly from 2000 and in recent years have been among the fastest growing countries in the world. Growth also picked up in the Visegrad countries except Poland that suffered from a serious slowdown in 2001-02. Slovakia achieved an impressive acceleration of growth thanks to deep market-oriented institutional reforms and improvement of the business climate.

**Services and industry were the main sectors driving growth in the region.** All EU8 countries profited from external openness and closer economic integration with the EU. Thus, industry, as the most export-oriented sector, played an important role in sustaining high growth rates. Nevertheless, services—both market services (including trade and transport) and non-market services—were the major contributor to output (value-added) growth across the region (Chart 1). Agriculture contributed marginally, but positively to overall VA growth, while the contribution from the construction sector was fairly small and even negative in the Czech Republic. On the whole, EU8 countries saw a clear tendency of adjustment towards the broad economic structures prevailing in the EU15.

**Chart 1. Sector composition of value-added growth in selected EU8 countries 1996-2004 (pp).**

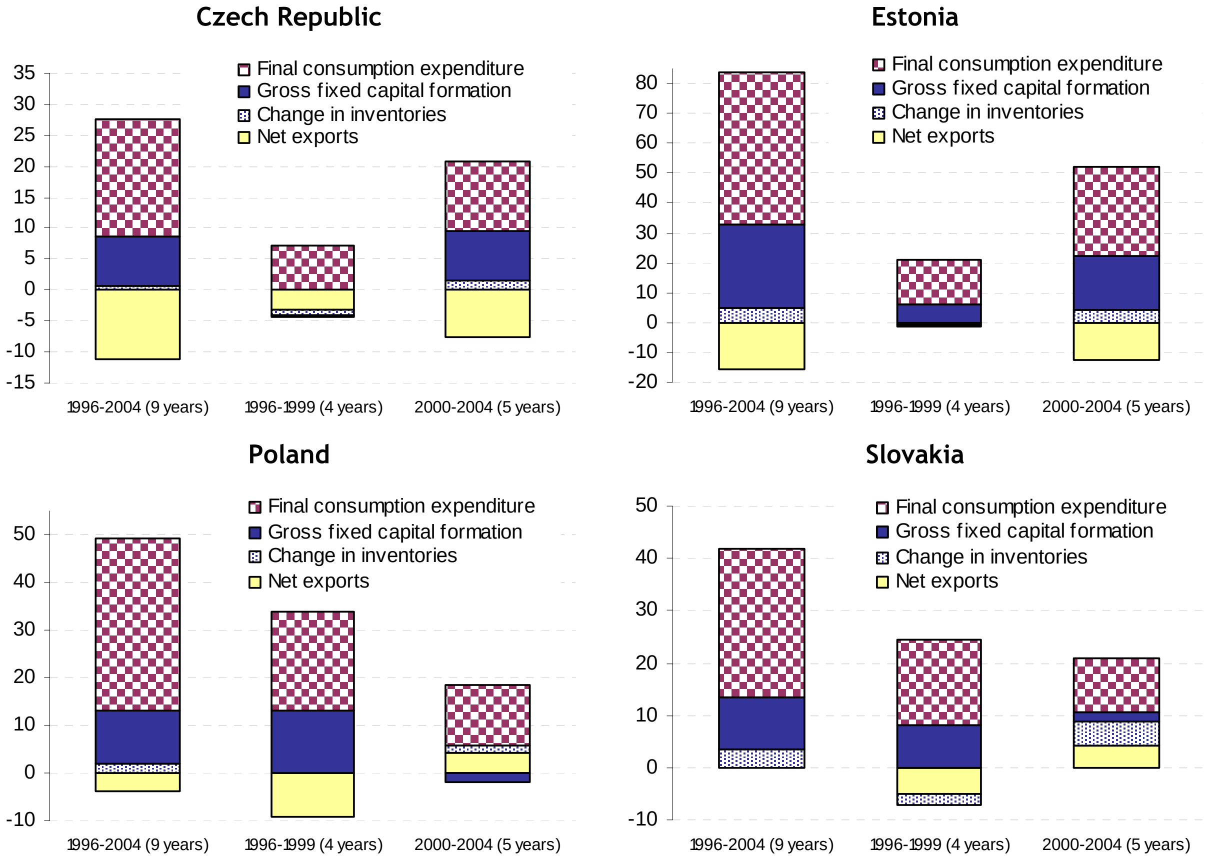



Note: comparability between countries is affected by methodological differences. Comparable data for Hungary, Latvia and Lithuania was not available. Slovenia was not covered by the quantitative analysis in this report owing to data constraints.

Sources: CSOs; and Bank staff calculations.

**Domestic demand led growth on the demand side, while the contribution of net exports was mostly negative.** Both consumption and fixed investment expanded rapidly over the past decade, with the former the main contributor to growth owing to its much larger share in output (Chart 2). This was associated with a rapid expansion of imports, and—despite also buoyant exports—net exports generally contributed negatively to growth over the period as a whole (especially in the Czech Republic and the Baltic States). However, in the second part of the period (2000-04), net exports supported output growth in Poland and Slovakia. EU accession in May 2004 was associated with a further boost to foreign trade in the region, with exports in particular from Poland and the Czech Republic benefiting from better market access and pushing output growth higher. Growth patterns became more balanced in Slovakia and Hungary, while domestic demand continued to lead growth in the Baltic States resulting in large current account deficits and rising inflationary pressures. Large fiscal deficits also contributed to serious external imbalances in Hungary.

**Chart 2. Demand-side decomposition of real GDP growth in selected EU8 countries 1996-2004 (pp).**



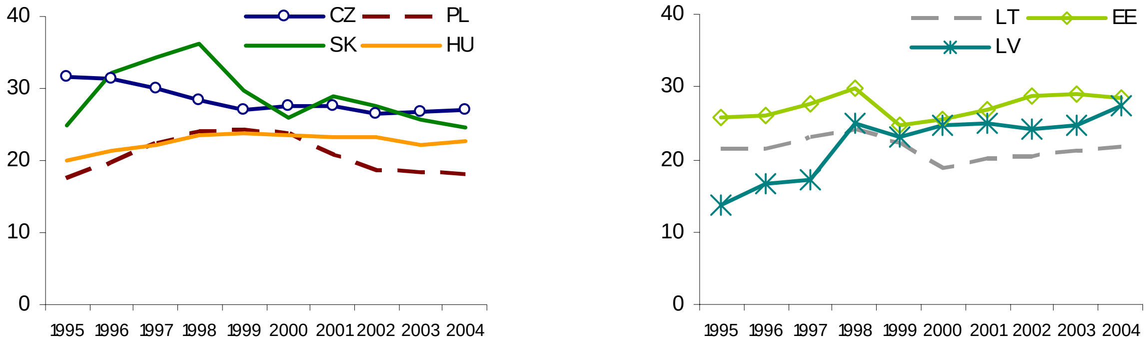

Note: comparability between countries is affected by methodological differences. Comparable data for Hungary, Latvia and Lithuania was not available. Slovenia was not covered by the quantitative analysis in this report owing to data constraints.
Sources: CSOs; and Bank staff calculations.

## 1.2. Growth accounting

**Investment and employment rates in the region have fluctuated significantly during the last decade, but employment rates—and in some countries investment rates—have been disappointingly low.** Gross fixed investment rates in the EU8 countries have fluctuated in the range of 20-30% of GDP, with investments in Latvia accelerating strongly from a low initial level (Chart 3). Investment has been particularly weak in Poland, but also unimpressive in Hungary and Lithuania, while capital formation has been relatively strong in the Czech Republic, Slovakia, Estonia, and—in recent years, in Latvia. In comparison, investment rates in the rapidly growing Asian economies were significantly higher, mostly in the range of 30-40% of GDP. Meanwhile, growth has been largely jobless so far, again in contrast with the Asian experience. Employment rates mostly weakened in the second half of the 1990s in tandem with ongoing restructuring in industry and slow employment generation in the expanding service sectors, although Hungary managed to raise employment but from a very low level (Chart 4). While the growth acceleration in the Baltic States in the first half of this decade was associated with a gradual improvement in employment, the Visegrad countries were only able to stabilize the situation.

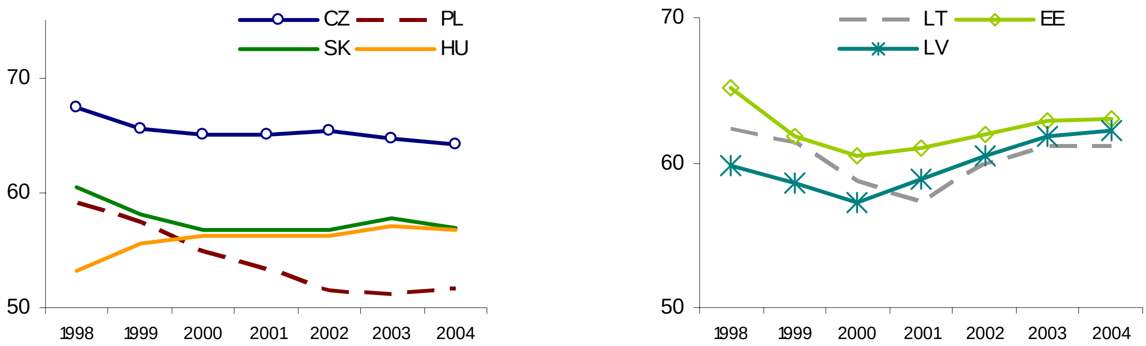
Employment rates in the EU8 are now only around 60% (and in Poland even considerably lower), well below the Lisbon target of 70%.

**Chart 3. Gross fixed capital investment (% of GDP)**




Source: Eurostat.

**Chart 4. Employment rate (population aged 15-64 years)**




Source: Eurostat.

**All EU8 countries have experienced rapid productivity growth over the last ten years, with this being the main driver of growth in the Visegrad countries.** Using growth accounting, where output (value-added) growth is decomposed into the contribution of factor (capital and labor) growth and a "Solow" residual termed Total Factor Productivity (TFP) growth (Box 1), we find that output growth in the Visegrad countries over the period 1996-2004 is explained almost completely by TFP growth while the contribution of capital and in particular labor was small and in several years even negative (Chart 5). Capital is estimated to have contributed 25-35% on average to output growth between 1996 and 2004 in Hungary and Poland, but only about 15% in Slovakia and 5% in the Czech Republic. At the same time, employment made a small or negative contribution to growth in the Visegrad countries, the main exceptions being Hungary in 1999 and 2003 and the Czech Republic in 1998 where labor accounted for more than 30% of value added growth. In contrast, output growth in the Baltic countries was led by factor accumulation, notably capital formation, while TFP growth is estimated to have contributed only 20-40% on average to output growth in the period 1996-2003.

**Productivity growth appears to have been particularly rapid in Slovakia and Poland.** TFP growth averaged around 3½% during 1996-2004 in Slovakia and Poland, while productivity growth in Latvia and the Czech Republic was less than one half of this rate (Table 1). However, the Czech Republic—along with Slovakia and Poland—saw a significant acceleration of TFP growth in recent years. The results for the Visegrad countries are broadly in line with IMF estimates, but somewhat higher than those of the EC (while our result for Latvia is significantly lower than other national and international estimates) (Table 2).[1]

**Box 1. Growth Accounting Methodology**

We used the standard growth accounting framework based on an aggregate production function (expressed in growth rates). This approach assigns little importance to demand, which is generally considered to be more relevant for cyclical behavior, while focusing on the supply-side of the economy (i.e. the accumulation of labor and capital, as well as technical progress, as the drivers of any increase in output over time).

In line with common practice, we assumed Cobb-Douglas production functions with constant returns to scale as well as competitive factor markets. The key parameter, the income share of labor (capital) $\alpha$ $(1 - \alpha)$ was set to the benchmark value of 1/3 (except for Poland—see below) suggested by national income accounts of industrial countries (data on the income of self-employed was generally not available). The period of analysis (1996-2004) was based mainly on the availability of data on capital.

$$Y = f(L, M, K)\, P \qquad (1)$$
$$Y_t = (L_{L(t)}^{\alpha(L)}\, M_{M(t)}^{\alpha(M)}\, K_{K(t)}^{\alpha(K)})\, P \qquad (2)$$

Where Y – output; L – labor; M – intermediate materials; K – capital services; and P – productivity of inputs.

Reflecting data availability, we used value-added instead of output time series. Therefore, intermediate materials were lifted from the right hand side of the equation. Moreover, the assumption of constant returns to scale implies that $\alpha(L) = 1 - \alpha(K)$ and P=TFP (Total Factor Productivity).

$$VA = (L_{L(t)}^{\alpha(L)} * K_{K(t)}^{1-\alpha(L)})\, TFP \qquad (3)$$
$$\ln(VA) = \alpha \ln(L) + (1-\alpha)\ln(K) + \ln(TFP) \text{ in logarithms.} \qquad (4)$$

In terms of growth rates (indicated by lower-case letters):

$$\ln(va) = \alpha \ln(l) + (1-\alpha)\ln(k) + \ln(tfp) \qquad (5)$$

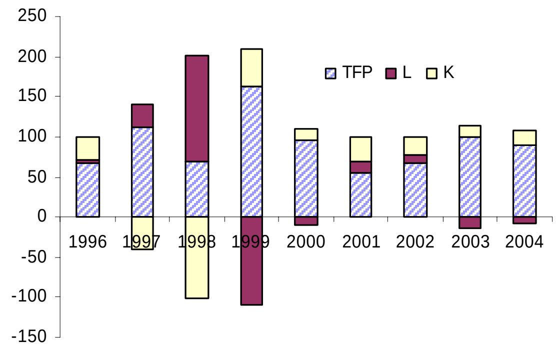
Thus, TFP growth is calculated as a residual (Solow's residual) using the equation:

$$\ln(tfp) = \ln(va) - \alpha \ln(l) - (1-\alpha)\ln(k) \qquad (6)$$

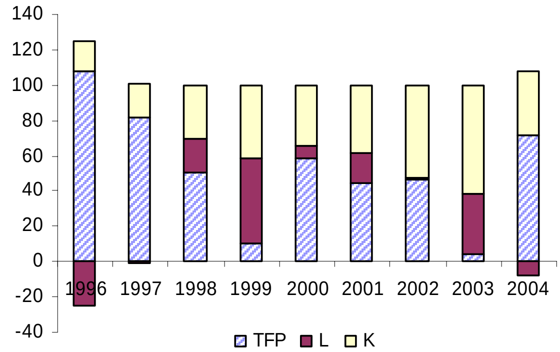
[1] The results are sensitive to assumptions regarding the production function and estimates of labor/capital income shares and factor inputs (notably the capital stock). In the case of Hungary, Benk (2005) finds more support for a Constant Elasticity of Substitution (CES) production function and estimate that TFP growth accounted for about one-half of output growth. The average compensation of employees in the EU8 accounted for roughly 50% of gross value added in the period under review (see e.g. Gradzewicz and Kolasa (2004) for Poland), but this likely underestimates the true labor income share in total VA due to the income generated by self-employed (who are usually classified within the households sector and treated in the national accounts as the part of the gross operating surplus). Our calculations for Poland suggest that the labor income share may be closer to 75% (see section 2). While using a lower income share reduces the contribution of TFP, it does not fundamentally alter the results.

**Chart 5. VA growth decomposition (%; contribution of L, K and TFP sum up to 100%)**

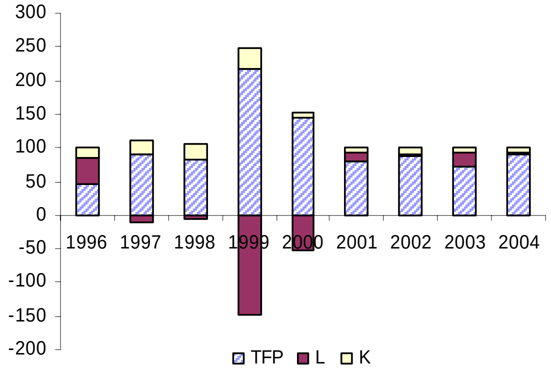
**Czech Republic**



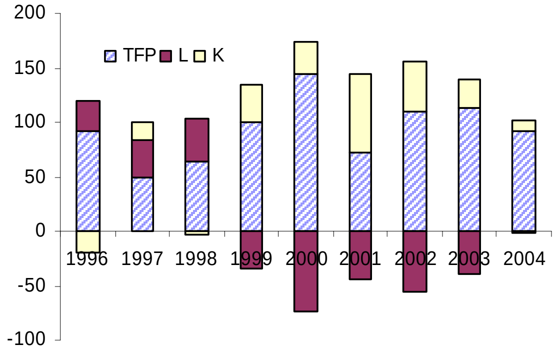

**Hungary**




**Slovak Republic**

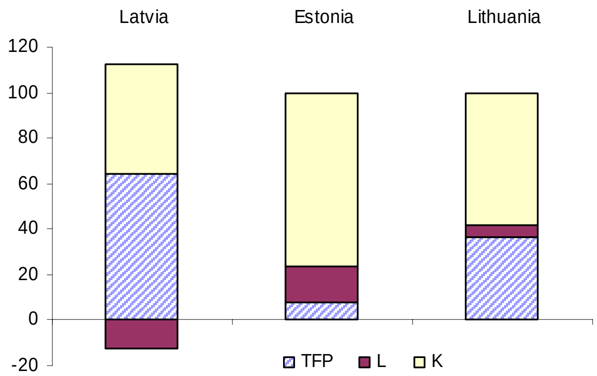



**Poland**




Note: L- employment; K- capital; TFP – Total Factor Productivity.
Source: Bank staff calculations.

**Baltic States (2001-2003)**




Sources: BICEPS (Riga); and Bank staff calculations.

**Table 1. TFP growth 1996-2004 (%)**

| | Czech Republic | Estonia | Hungary | Latvia | Lithuania | Poland | Slovakia |
|---|---|---|---|---|---|---|---|
| 1996 | 2.3 | 1.8 | 2.4 | -1.2 | -0.7 | 4.8 | 2.7 |
| 1997 | -1.9 | 4.3 | 3.8 | 0.6 | -0.9 | 3.1 | 4.7 |
| 1998 | -0.5 | 2.2 | 2.3 | -7.5 | 1.0 | 2.9 | 3.5 |
| 1999 | 2.1 | 8.0 | 0.4 | 4.6 | 1.5 | 3.8 | 2.9 |
| 2000 | 4.2 | 3.8 | 2.8 | 0.5 | 17.3 | 5.3 | 2.6 |
| 2001 | 1.1 | 1.8 | 1.8 | 2.6 | 3.2 | 0.8 | 4.0 |
| 2002 | 1.2 | 0.0 | 1.5 | 6.2 | 2.0 | 1.4 | 3.5 |
| 2003 | 3.0 | -0.3 | 0.1 | 4.2 | 2.4 | 4.1 | 3.6 |
| 2004 | 4.2 | n/a | 3.2 | n/a | n/a | 4.7 | 5.3 |
| **1996-2004** | **1.7** | **2.7** | **2.0** | **1.3** | **3.2** | **3.4** | **3.6** |

| Source: various | CZ | EE | HU | LV | LT | PL | SK |
|---|---|---|---|---|---|---|---|
| 1) capital stock | CSO estimate | BICEPS | MNB estimate | BICEPS | BICEPS | CSO; WB | MOF estimate |
| 2) value added; labor | CSO | BICEPS | CSO | BICEPS | BICEPS | CSO | CSO |
| 3) calculations assume: | constant capital share - 0.35 | constant capital share - 0.33 | constant capital share - 0.35 | constant capital share - 0.33 | constant capital share - 0.33 | WB capital share - 0.22 | constant capital share - 0.35 |

Note: The estimates of TFP reported here should be treated with caution due to methodological and data problems, in particular concerning calculations of the net capital stock and the assumed share of factors inputs in aggregate output.

**Table 2. Other estimates of TFP growth in the Visegrad countries.**

| | Czech Republic | Hungary | Poland | Slovakia |
|---|---|---|---|---|
| **WB (96-04)** | 1.7 | 2.0 | 3.4 | 3.6 |
| **WB (00-04)** | 2.8 | 1.3 | 1.9 | 3.4 |
| **EC (96-05)** | 0.6 | 1.1 | 2.2 | 2.0 |
| **IMF (00-04)** | 1.8 | - | - | 3.8 |

Source: IMF Article IV Consultation Reports 2005; EC 2004.

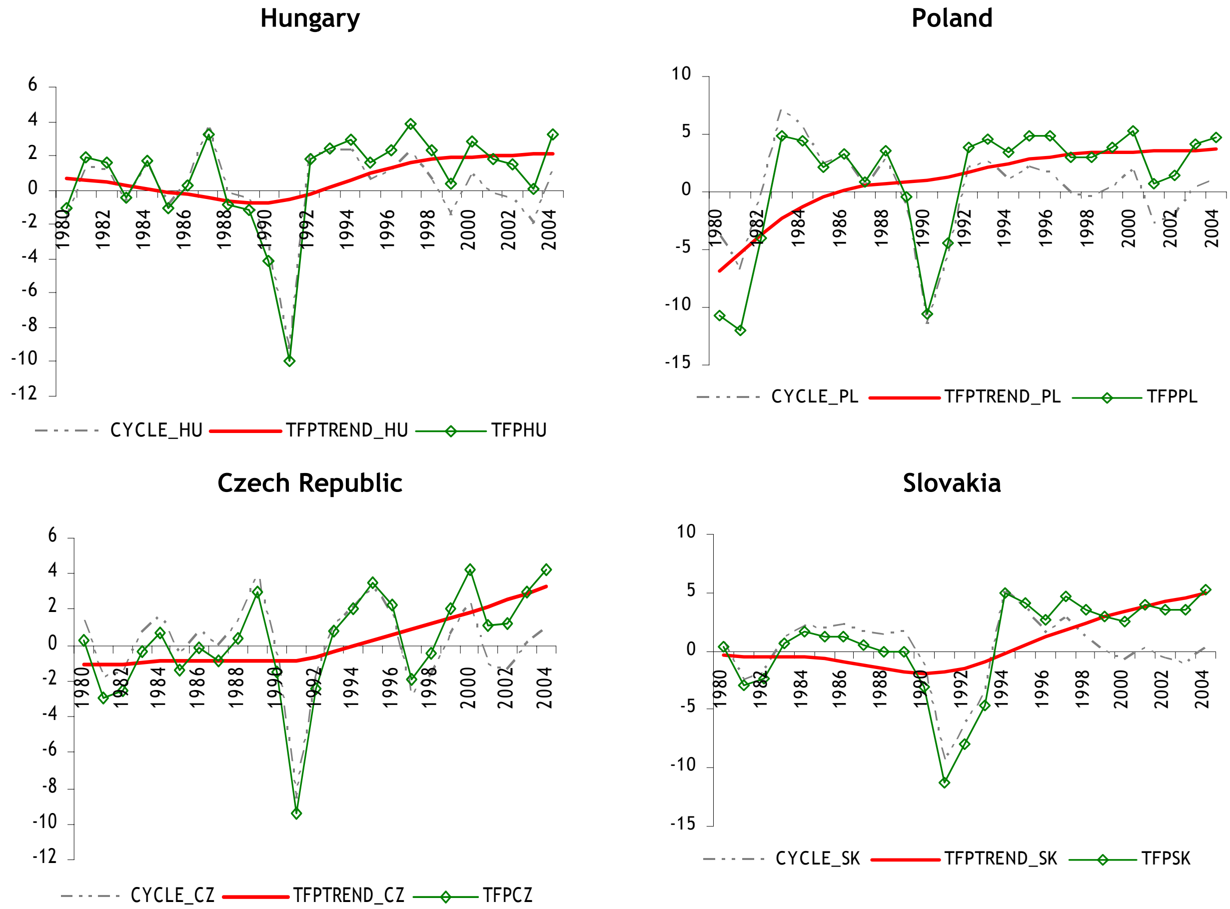
**Medium-term growth prospects remain favorable in the EU8.**[2] Using the growth accounting framework and assuming that the (net) capital stock grows in line with the average of the last four years, that employment grows in line with projected rates in recent Convergence Programs, and that TFP growth (cyclically adjusted) follows the trend from recent years (in all cases slightly higher than the recent 5-year average of unadjusted TFP growth), we project average growth rates of real VA for the period 2005-2008 at 3.8% in the Czech Republic, 4% in Hungary, 5.3% in Slovakia and above 5.5% in Poland (Chart 6 – Chart 8).[3] [4]

[2] Our focus here is on the Visegrad countries (growth prospects in the Baltic States were discussed in the January 2005 Quarterly Economic Report Special Topic).

[3] In the case of Poland, employment growth is based on medium-term government projections prepared for the 2005 budget.

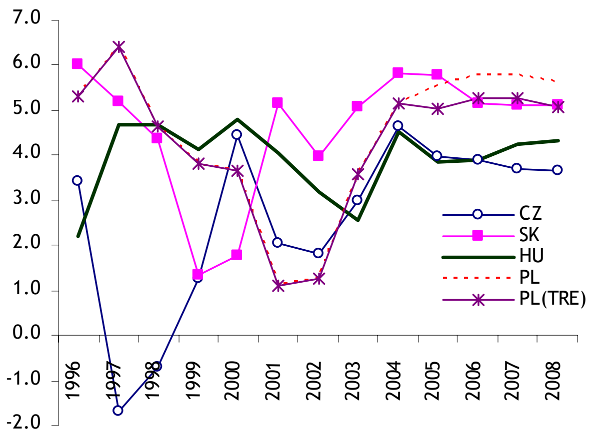
[4] TFP growth tends to be cyclical and we attempted to correct for this (for the purpose of our forward-looking exercise) following the standard practice of filtering the raw TFP series with a HP filter (the HP filter is derived by minimizing the sum of squared deviations of output from its trend subject to a smoothness constraint that penalizes deviations from the trend). Calculations require quite long data series, and we thus extended our TFP growth data back to 1980 with data from other sources.

**Chart 6. Decomposition of TFP into trend & cycle**



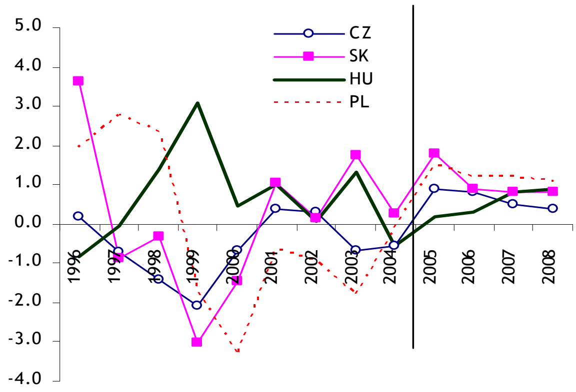

Note: TFP growth in 1980-95 from de Broeck and Koen (2000). In this exercise, the production functions were estimated using a weight of 0.35 for capital and 0.65 for labor.
Source: Bank staff calculations.

**Chart 8. Medium-term VA growth projections, 2005-08 (% y/y)**




Source: Bank staff calculations.

**Chart 7. Medium-term employment projections (% y/y)**




Source: Convergence Programs; MOF (Poland).

**Sensitivity analysis suggests that these projections are fairly robust.** Extrapolating recent (last four years, including 2005) employment trends (rather than assuming improved performance in the coming years as done in recent official projections) lowers average VA growth by only 0.2% in Hungary and the Czech Republic although Poland would suffer more with output growth some 2 pp lower (reflecting the assumed convergence toward other countries in the region in official projections). Thus, in Poland policies to support higher employment are critical to sustain good growth performance in the coming years.[5]

**Looking further ahead, higher employment rates and, in some countries, investment rates will be needed to sustain rapid convergence to average EU income levels.** As the effects of structural transformation and reallocation of resources towards more productive sectors fade, it will become increasingly difficult to sustain the rapid TFP growth experience of the last decade. While most countries still have some potential for reaping productivity gains from resource reallocation, notably from agriculture (and in some countries such as Poland from traditional heavy industries), where productivity remains low, towards modern industry and services, rapid output growth rates are likely to gradually become more dependent on raising employment rates and, where low, investment rates. Higher rates of factor accumulation will be particularly important for Poland and to some degree the other Visegrad countries, while in the Czech Republic the main challenge will be to enhance the productivity of investment. In the Baltic States, raising employment rates will be the main challenge, although in Lithuania stronger investment will also be needed.

**Improving further the investment climate and labor market incentives will be the key economic policy challenges in the EU8**. While the business environment has improved considerably in several EU8 countries in recent years, much remains to be done in countries like Poland to improve the investment climate in order to raise investment and labor demand. Most countries in the region will also need to pursue policies to stimulate labor force participation and incentives to seek employment in the formal sector. Upgrading skills to meet modern market-economy demands will be crucial in all countries in the region. While many, especially older workers, may no longer be employable, others can more easily adapt their skills and would be willing to work provided incentives were right. High labor taxes discourage both the demand and supply of labor, and for low-skill workers minimum wages (at least in

[5] On the other hand, assuming no further TFP growth effect from “reallocation of resources across sectors” (see section 2) has only a marginal impact on output growth projections reflecting the fact that TFP growth has become increasingly driven by intra-sector productivity improvements.

some regions) and social benefits may still be too generous, not least to induce potential workers to move to where the jobs are being generated given high commuting or relocation costs and uncertainty about job prospects.

**Higher investment rates would need to be accompanied by increased savings, not least in countries where current account deficits are already large**. Current account deficits are high in the Baltic States and Hungary, and savings will need to be raised to ensure external sustainability (not least where higher investment rates are likely to be required such as Hungary and Lithuania). In Hungary, the main problem is low government savings and fiscal consolidation will be the key, while in Lithuania and the other Baltic countries raising private savings (including through financial sector development) will be critical.

**At the same time, efforts to support continued rapid TFP growth should not be neglected**. However, little remains understood about the factors that affect productivity growth at the aggregate, national level. TFP growth still has an aura of "manna from heaven", making it difficult for policy-makers to focus their efforts on creating the best possible supportive environment. In the following section, we review the recent international research in this area and probe this in the EU8 region.

### 1.3. Determinants of TFP growth

**The literature generally identifies human capital, research activity, foreign trade, reallocation of production factors, and "catching up" as key factors influencing the pace of TFP growth** (Annex 1). Some studies have also found certain other variables to be important, including demographic factors, macroeconomic volatility, and reforms or institutional factors (e.g., deregulation or privatization).

**We find some evidence in favor of these factors in the EU8**. Our empirical analysis is based on panel data for the EU8 countries (excluding Slovenia) over the period 1996-2004 and a set of variables reflecting the various key factors discussed above (see Annex 2 for further details).[6] Casual observation of the correlations between TFP growth on the one hand and R&D, exports, and shares of industry/ services in value added suggest that these factors all matter as expected (Chart 9 – Chart 12). This is confirmed in our regression analysis. **In particular, trade openness and R&D expenditures have been positively related to TFP growth in the region.** Among the variables representing competition and technological spillovers, trade openness appears to have been the most important. Business research and development spending has had a very small (albeit significant) impact on TFP growth, while foreign direct investment inflows has had a positive but statistically insignificant impact. Also, human capital (measured by tertiary or upper secondary education enrollment) has had a positive effect on TFP growth, although only significant at the 10-percent level.[7] **Further, the reallocation of production factors towards industry has been associated with higher productivity growth**, while the opposite is true for services (although not significantly). Progress on structural reform (measured by the EBRD transition indicator) also seem to matter and its inclusion improves the fit of the regression, although the indicator is significant only at the 10% level. Similarly, catching-up (as measured by the distance to the technology frontier) has the expected positive effect, but is not significant.[8] Finally, we did not detect any relationship between the availability of infrastructure and productivity growth.[9]

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[6] In the selection of explanatory variables, data constraints were taken into account.
[7] Enrollment ratios may not accurately reflect the quality and relevance of human capital formation.
[8] Catching up is typically measured using either the initial TFP level gap to the technology frontier (for the EU8 this would be Germany or EU15) or the difference in TFP growth rates between the two. We used the latter measure (following Kolasa and Zolkiewski, 2004).
[9] Macro volatility variables had the expected signs and were important so we included these into the regression to check its robustness. Using EBA methodology (Levine and Renelt, 1992) we found that only openness and the growth rate of business enterprise R&D expenditure-to-GDP were robustly correlated with TFP growth. The other variables were robust in some combination of conditional variables and had the expected coefficient signs.

**Chart 9. EU8 average TFP growth vs average R&D/GDP growth 1996-2004**

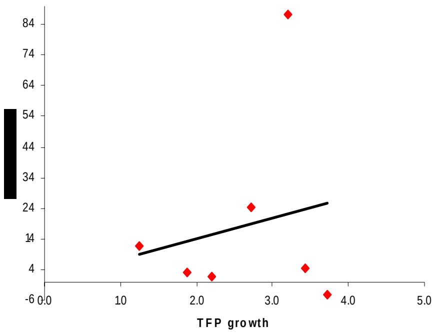



**Chart 10. EU8 average TFP growth vs average EXP /GDP growth 1996-2004**

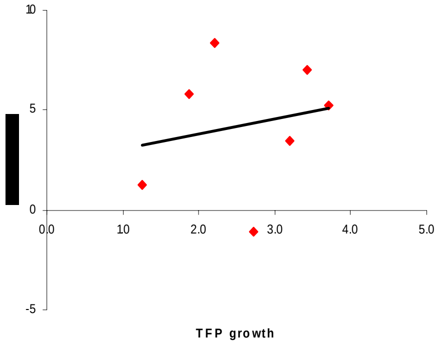



**Chart 11. EU8 average TFP growth vs average industry share in VA growth 1996-2004**

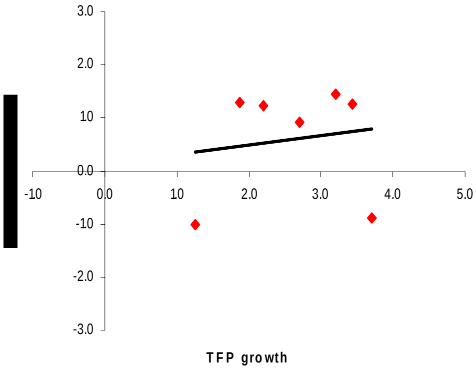
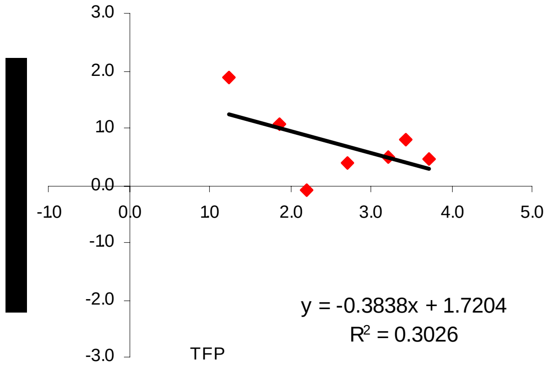



**Chart 12. EU8 average TFP growth vs average share of services in value added growth 1996-2004**




Source: staff calculations.

**Industrialization tends to be more supportive of growth than a specialization towards services (Chart 11 - Chart 12).** Lower productivity of the service sector may result from relatively lower knowledge or skills intensity in this sector or weaker exposure to competitive markets.[10] The service sector is still characterized by labor-intensive production as compared with other sectors, and this may hamper productivity growth. At the same time, resources may be shifting toward less productive service sectors such as social and personal services, health and education, and leisure activities owing to a relatively high income elasticity of these services, demographic changes and the increasing role of service firms as providers of intermediate inputs (Wölfl, 2005; Pilat and Wölfl, 2004). This suggests that there is still some empirical support for the traditional industrialization story in the NMS, although this may be more the case for modern industrial activities than traditional heavy industries (we explore this further in section 2).

[10] Not all services should be considered low-productive. In Poland, for example, productivity grew rapidly in business related services such as financial intermediation and transport and communication (see section 2).

**These findings should be interpreted with caution** given the problems that are commonly encountered in this type of cross-section regression analysis (notably potentially omitted variables and endogeneity). Our empirical analysis probably leaves out some important factors determining TFP as the constant term is high and significant. Also, some of the variables used in the regressions cannot be regarded as strictly exogenous (e.g., openness). Further, there may be concerns about data quality, and measurement or misspecification errors may give rise to heteroscedasticity and thus misleading results (although the latter did not seem to be a major problem in our data). To get a deeper understanding, we now turn therefore to the country level.

## 2. Poland Case Study: Output Growth at the Sector Level

*In this section we look at the growth experience across 34 sectors in Poland during 1995-2003. We first examine trends in sector value added, employment, investment, and productivity growth using the same growth accounting framework as in section 1. We then decompose changes in productivity—both labor productivity and TFP—into effects arising from reallocation of resources across sectors and within sector productivity growth. Finally, we analyze the determinants of TFP growth at the sector level on the basis of the international and regional evidence discussed above. We find that value added and productivity (TFP) growth was particularly rapid in export-oriented and competitive manufacturing industries such as office machinery, pulp and paper, rubber and plastics, fabricated metal products, and machinery and electrical apparatus as well as in motor vehicle manufacturing. TFP growth was the main contributor to value-added growth in most sectors while few relied on factor accumulation. The reallocation of capital across sectors played an important role in fueling overall productivity growth, especially in the first half of the period, while movement of labor mattered less. Our empirical analysis confirmed the importance of competition and openness to trade and FDI for TFP growth.*

### 2.1. Value-added and TFP growth across sectors

**Value added in Poland rose particularly fast during the period 1996-2004 in certain manufacturing sectors**. As discussed above, VA increased at an average rate of 4.7% during this period, with growth more rapid in the second half of the 1990s than in the first half of the current decade (annual average VA growth declined from 5.7% in 1996-99 to 3.2% in 2000-04 reflecting the dramatic economic slowdown in 2001-2002). Output growth was dramatic in competitive and/or export-oriented sectors such as office machinery, motor vehicles, rubber and plastics, fabricated metal products, pulp and paper, and machinery and electrical apparatus (Table A3.3.). **While employment increased in office machinery, most other sectors shed labor. Net investment in these sectors was generally positive, especially in rubber and plastics as well as motor vehicles, although the rate of increase in the capital stock was modest**. Meanwhile, some other sectors declined (notably traditional and/or labor intensive industries such as leather and footwear, energy and mining, and basic metals), generally accompanied by massive reductions in employment. Surprisingly, the capital stock was augmented significantly in the energy sector.

**Productivity surged in several of the rapidly growing manufacturing sectors**. As discussed above, TFP growth accounted for the bulk of the increase (89%) in Polish output during 1995-2003, while capital accumulation accounted for only 15% and labor had negative impact of almost 4%.[11] TFP growth was particularly rapid during the most recent period, reflecting labor shedding and restructuring brought on by the recession. **In general, TFP increased more in manufacturing branches than in services** (Annex 3, Table A3.3), perhaps because manufacturing products were more exposed to foreign competition. The fastest TFP growth during 1996-2003 was recorded in *office machinery* (350%), *motor vehicles* (275%), and *pulp, paper & paper products* (146%) – all relatively modern industrial sectors. Meanwhile, **TFP decreased in several branches which were either producing in a semi-controlled market** (*mineral oil refining; coke & nuclear fuel* – by 95%) **or belonged to services** (r*eal estate* - by 23%; o*ther*

[11] Assuming alternatively a lower depreciation rate of 5% (and the initial book value of capital in 1995), the contribution of investment to total VA growth increased by 5 percentage points. The sensitivity analysis thus confirmed that TFP increases played the dominant role in VA growth during 1996-2003.

*community, social and personal services* – by 17%; and *public administration* – by 10%). In some cases, VA increased despite lower TFP: in *construction,* the driving force of VA growth was capital accumulation, while in *public administration and defense* as well as in *compulsory social security* both labor and capital increased rapidly (especially after 1999 on the back of strong employment growth in the public sector after the implementation of the "4 reforms"). There were also large investments in *other community, social and personal services,* while employment expanded rapidly in *real estate* (by almost 50%). For most of the 34 branches, TFP growth was the strongest component of VA growth.

## 2.2. Decomposition of productivity growth

**Productivity growth can be decomposed into effects arising from reallocation of production factors across sectors and within-sector productivity growth** ("shift-share" analysis; see Annex 3 for further details). The purpose of such an exercise is to distinguish the impact of "structural changes" in the economy from the impact of "intrinsic" productivity growth in the various sectors. In the case of aggregate labor productivity, one can distinguish three separate effects: (i) a *static shift effect* (the effect of relocation of labor towards sectors with above-average initial labor productivity); (ii) a *dynamic shift effect* (the effect of relocation of labor towards sectors with higher labor productivity growth rates); and (iii) and a *within-sector growth effect* (productivity gains achieved by other factors than relocation of labor, including from increases in the capital-labor ratio). Along the same lines, aggregate TFP growth can be decomposed into two effects: (i) an *Intra-Branch Effect* (assuming constant factor-shares); and (ii) a *Total Reallocation Effect* (TRE) resulting from structural shifts of labor and capital between sectors. The TRE is measured as the difference between aggregate TFP growth and output-weighted TFP growth at the sector level.

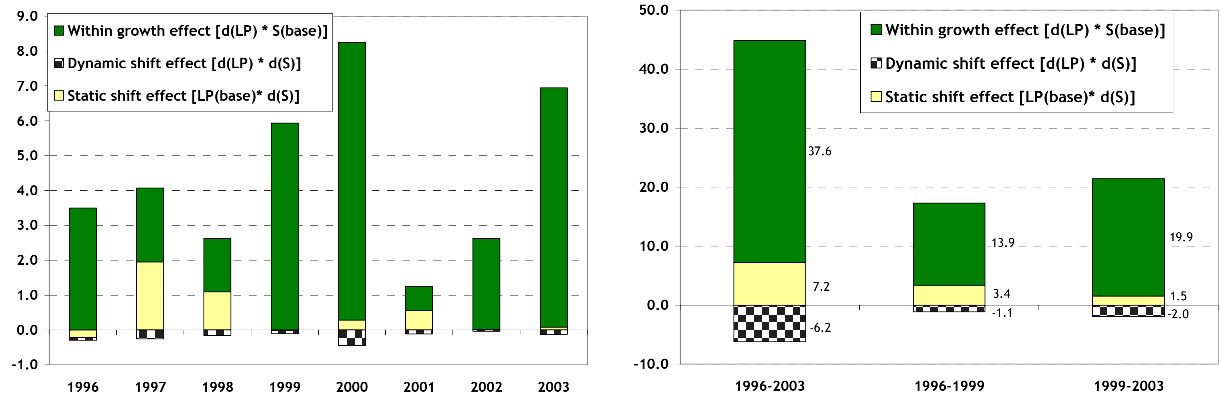
### *2.2.1. Labor productivity and "shift-share" analysis*

**The fastest growing labor productivity (VA in constant prices per working person) was recorded in manufacturing branches**, including motor vehicles and office machinery (close to 400%) (Annex 3, Table A3.4). These branches reached relatively high levels of labor productivity in 2003 (170% of the economy-wide average), although the highest productivity rates were - surprisingly - still found in the energy sector and real estate. The lowest productivity levels were found in agriculture, forestry and fishing (11% of average) and clothing (37% of average). Across sectors, high labor productivity increases in 1995-2003 mostly coincided with high TFP growth.

**The relocation of labor towards more productive sectors played only a small role in shaping overall labor productivity growth** compared to the impact of changes in the capital-labor ratio and "intrinsic" productivity growth (Chart 13). The *static effect* was positive in most years, which means that employment shares grew in sectors with high initial productivity levels. In contrast, the *dynamic effect* was negative throughout the period. This reflects the "structural burden" of the transition economy where sectors with fast growing productivity were shedding labor. The *static and dynamic effect*s were usually acting in opposite directions, with the former dominating. The *within effect* was also positive and dominating the other two. This reflects both the flow of capital towards more productive sectors and "clean" labor productivity gains (for instance organizational or management improvements of labor utilization).[12]

[12] Table A3.4 shows that (1-$\alpha$) coefficient for capital increased by 3 basis points in the period 1995-2003, what suggests the change of capital-to-labor ratio in favor of capital increase.

**Chart 13. Shift-share analysis of labor productivity growth 1996-2003 (%)**



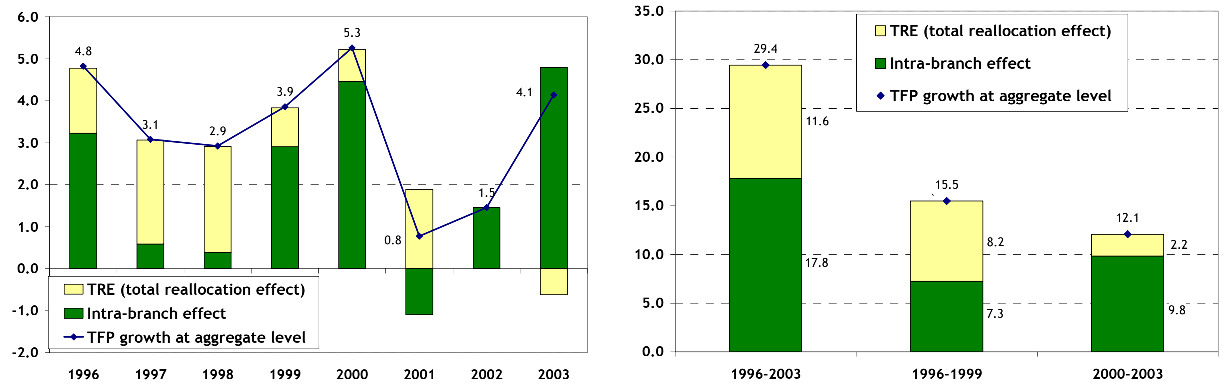

Note: LP - labor productivity; base - base year; S - labor share; and d(…) - change between base and final year.
Source: Bank staff calculations.

### *2.2.2. Total factor productivity and "shift-share" analysis*

**The reallocation of resources has played an important role in driving rapid TFP growth, especially in the second half of the 1990s.** For the period 1996-2003 as a whole, TRE accounted for almost 40% of total TFP growth (Chart 14). The TRE dominated aggregate TFP growth in the early part of the period, while the importance of structural changes has diminished in recent years and TFP growth has become increasingly driven by intra-sector productivity improvements. In several years, the TRE was even stronger than the intra-branch effect (1997-1998) or more than compensated a negative intra-branch effect (2001). These results in line with Timmer and Szirmai (2000).

**Six sectors accounted for most of the "intrinsic" (intra-sector) TFP growth.** During 1996-2003, the strongest impact on total TFP dynamics from this source came from *transport & communication* (3.6 pp), followed by *food, drink & tobacco* and *trade and repair* (both 2.1 pp), *fabricated metal products (*1.7 pp), *motor vehicles* (1.5 pp), and *mechanical engineering* (1.1 pp). These six branches accounted for about 70% of total intra-sector TFP growth.

**Chart 14. Shift-share analysis of TFP growth 1996-2003 ( %)**




Note: *Intra-branch effect* - TFP increases are weighted with value added-shares in constant prices; *Reallocation effect (TRE)* - the difference between total TFP growth and the intra-branch effect (the sum of TRE and intra-branch effects sum up to total TFP growth (all in logarithms).
Source: Bank staff calculations.

**The reallocation effects thus came out much stronger from decomposition of TFP growth than from decomposition of labor productivity**. The dominant role may accordingly be attributed to capital. In other words, the stronger is labor productivity growth arising from higher capital-to-labor ratios, the stronger is the TRE. This finding is in line with economic logic and empirical evidence that mobility of capital is much stronger than mobility of labor. The result is also consistent with O'Mahony (2003) who notes that "between-firm growth contributes more to multifactor productivity growth than to labor productivity growth because entering firms usually invest in new technologies or organizational change, while incumbents increase labor productivity primarily through capital-labor substitution."

**While the TRE effect has slowed in recent years, the question is whether this reflects that the structural transformation is largely over or that the remaining agenda has stalled**. The answer is probably somewhere in between, with the more market-driven structural reallocation of resources across sectors probably well advanced but with some more shielded sectors still facing deep restructuring ahead (e.g. agriculture, mining, energy, railways, post, health, education, and public administration). Thus, there is still some potential for achieving productivity gains from reallocation of resources towards more productive uses, but reaping these benefits will be conditional on both ambitious reforms and allowing market forces to work as well as a general recovery in investment. Meanwhile, it is encouraging that intrinsic productivity growth at the sector level has been increasing.

## 2.3. Determinants of TFP growth at the sector level

**There appears to be a negative (albeit weak) relationship between VA growth and two selected broad areas of the business environment: business regulations; and institutions and property rights** (Box 2). For example, the worst performing sector (*construction)* also included the most firms complaining about the business environment. Although the perception of business regulations was only slightly better among firms from the *manufacturing, transport* and *real estate* sectors, these were the three best-performers as far as value added growth was concerned. The trade sector did well despite sizeable obstacles to doing business.

**On the other hand, the link between TFP growth and business environment indicators has been, if anything, the opposite of what one might expect**. One explanation for this might be that sectors and firms that faced more obstacles in doing business were under greater pressure to innovate and grow through productivity increases. Another explanation could be that firms in sectors subject to burdensome regulations are more likely to unwind assets, and that this translates statistically into a temporary spur in productivity (the capital stock being run down faster than value added). There is little doubt that improving the business environment would generate new investment and higher employment although it is perhaps less clear if it would also support more rapid productivity growth. It is thus promising that firms' perception of the business environment has improved in recent years although reforms are still needed in some important areas.

**The degree of openness to trade and FDI inflows seems to have been important determinants of sector TFP growth**. Reflecting the key determinants of TFP growth discussed above and data availability, we examine the impact of the following variables: exports; FDI, human capital, R&D, and the initial level of TFP (see Annex 3 for further details). FDI and exports were both positively correlated with TFP growth (Chart 15). Consistent with our EU8 cross-country results, the importance of these factors in explaining productivity growth is confirmed in a panel data regression analysis: both exports and FDI have a positive and significant impact on TFP growth. In line with several other studies, we also find that the initial level of productivity matters: the lower the initial level of TFP, the faster the subsequent TFP growth.

**Box 2. Does BEEPS help us understand VA dynamics?**

The EBRD-World Bank Business Environment and Enterprise Performance Survey (BEEPS) provides information on the business environment for 7 sectors in Poland. Firms that operate in sectors subject to government price regulation and prudential supervision, such as banking, electric power, rail transport, and water and waste water, were excluded from the sample. In the case of Poland, this meant that around ¼ of total value added in the economy was excluded from the sample.

We aggregated our 34 sectors into seven sectors broadly corresponding to the BEEPS sectors and compared VA growth in 2000-2003 with perceptions regarding key elements of the business environment according to BEEPS 2002. The results are shown in Chart 16 and Chart 17.

**Chart 16. Business regulations, institutions and property rights, and VA growth 1999-2003 ( %)**

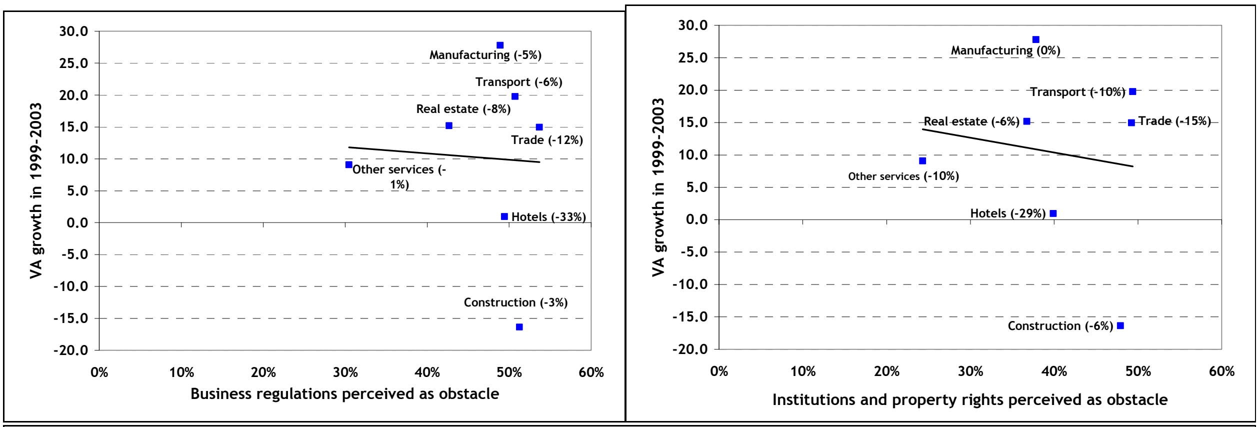
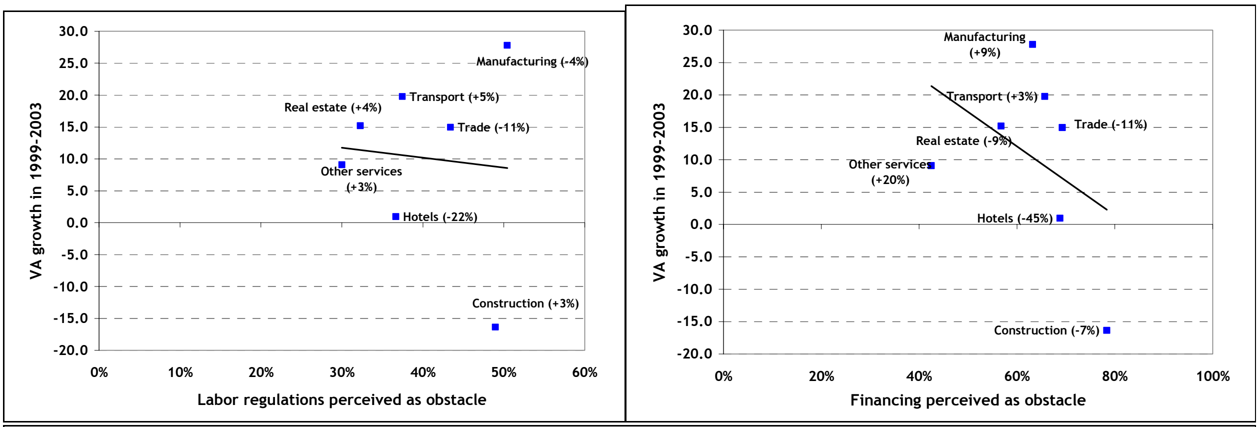



**Chart 17. Labor regulations, financing and VA growth 1999-2003 (%)**



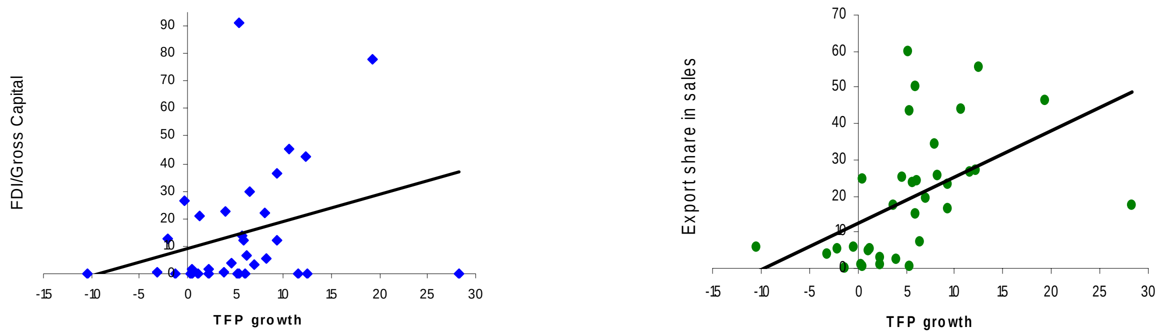

Note: The values in brackets indicate changes between BEEPS 2005 and BEEPS 2002 (negative values denote less obstacles in 2005 than in 2002).
Sources: BEEPS 2002 and BEEPS 2005, and Bank staff calculations.

**On the other hand, in contrast to what we observe at the cross-country level, innovation, as measured by spending on R&D relative to VA, does not appear to matter much in the case of Poland.**[13] One interpretation is that R&D is important on average but that one cannot generalize how important such a relationship is across countries or across sectors. Still, the finding contrasts with

[13] In our panel sample, the Baltic countries were characterized by stronger positive correlation between R&D and TFP than the Visegrad countries.

several other studies of Poland (e.g., Kolasa, 2005; and Jakubiak, 2005). Thus, further research on this issue would be warranted. Finally, as in our findings for the EU8, we did not detect a significant impact of human capital, again most likely because our variable (the number of schooling years) is a poor proxy for the quality of education and human capital.

**Chart 15. Poland: TFP growth, FDI and exports**




## 3. Conclusions and Policy Recommendations

1. The EU8 countries have witnessed relatively rapid output growth over the past decade. Services have been the main driver of output growth in all countries, but industry has not been far behind. On the demand side, domestic demand growth played a relatively larger role in the Baltic States while net exports played a relatively larger role in the Visegrad countries.

2. Total factor productivity (TFP) growth was the main driver of growth in the Visegrad countries, while factor accumulation—especially investment—dominated in the Baltic States. This is consistent with the demand patterns noted above on the presumption that exports and exposure to foreign technology and competition are important drivers of TFP growth. Slovakia, Poland, and Lithuania all saw average TFP growth in excess of 3% during 1996-2004, while in Latvia and the Czech Republic at the other end, average TFP growth was only around 1½%.

3. In Poland, TFP growth led output growth in most sectors, especially the more modern, export-oriented manufacturing sectors. However, overall productivity declined in some regulated sectors as well as in some service sectors. The reallocation of human and especially capital resources across sectors played an important role in supporting overall TFP growth, not least in the second half of the 1990s, but more recently "intrinsic" (intra-sector) technical progress has taken over. Technical progress within sectors was particularly strong in areas such as transport and communication, food, drinks, and tobacco, trade and repair, fabricated metal products, motor vehicles, and mechanical engineering.

4. Also in Poland, the quality of the business environment seems to have been important for output growth but more through factor accumulation than through TFP growth. TFP growth was mainly driven by technology spillovers and competition through trade (exports) and FDI inflows. Business spending on R&D was important for the region as a whole, although we did not find evidence for this in the case of Polish sectors. This suggests that the stage of development and quality of spending is key. Similarly, we did not detect an important role for human capital, but this likely reflects difficulties in measuring its quality. Further, we found some support for the generally acknowledged role of "catching up" and progress with transition. Finally, reallocation of resources towards industry was a key factor in supporting higher TFP growth, while countries that shifted more toward services that are less exposed to foreign competition tended to have slower productivity growth.

5. Thus, policies that would support further competition and outward orientation, including deregulation and attraction of new FDI inflows, will play a key role in sustaining rapid productivity growth. The effectiveness of measures to enhance domestic R&D may vary much more according to country circumstances. Further reforms of various elements of the education system, including higher education and vocational education and training programs, will be critical for providing high quality human capital. Restructuring of remaining "strategic" or "socially important" sectors such as heavy industries, transportation, mining, and agriculture will facilitate the flow of resources towards more productive activities. The growing importance of services makes it important to implement policies that take account of the growing contribution of this sector to aggregate performance. Again, regulatory reform (i.e., product market regulations) and openness to trade and foreign direct investment in services are of great importance in this regard, as the services sector is traditionally less exposed to competitive pressure than the manufacturing sector. Such policies should go hand in hand with efforts to further improve the investment climate in several of the larger countries in the region and enhance incentives for labor market participation and employment in most countries.

6. Extrapolating recent trends in the Visegrad countries suggests that output growth in the coming years could amount to about 4% in the Czech Republic and Hungary and more than 5% in Slovakia and Poland assuming that further efforts to enhance employment bear fruit. Previous analysis done by the Bank suggests that growth could be even higher in Baltic States, although below the recent pace. Higher growth rates in all countries would require significant additional efforts along the lines discussed above as well as to improve further the investment climate and rate of capital formation.

## Bibliography


Allen, F. and D. Gale (2000), "Comparing Financial Systems," Cambridge University Press, Cambridge.

Ascari, G. and V. Di Cosmo (2004), "Determination of Total Factor Productivity in Italian Regions," Pavia University, No 170, December 2004

Barro, R. and J. Lee (1994), "International Comparisons of Educational Attainment," Journal of Monetary Economics, 32(3), 363-394

Broeck, M. and V. Koen (2000), "The "Soaring Eagle: Anatomy of the Polish Take-Off in the 1990s," International Monetary Fund, 2000, WP/00/6.

Chun, H. and M. I. Nadiri (2002), "Decomposing Productivity Growth in the U.S. Computer Industry," NBER Working Paper 9267, October.

Collins, S. and B. Bosworth (1996), "Economic Growth in East Asia: Accumulation versus Assimilation," Brookings Papers on Economic Activity, 135-203.

Escribano, A. and J. L. Guasch (2005), "Assessing the Impact of the Investment Climate on Productivity Using Firm-Level Data: Methodology and the Cases of Guatemala, Honduras, and Nicaragua," World Bank Policy Research Working Paper 3621, June 2005

European Commission (2001), "Current Issues in Economic Growth," European Economy No 1, 2001

European Commission (2003), "Drivers of Productivity Growth," European Economy: 2003 review, No 6, 2003

Gradzewicz, M. and M. Kolasa (2004), „Szacowanie luki popytowej dla gospodarki polskiej przy użyciu metody VECM," Bank i Kredyt No.3.

Hyeok, J. and R. M. Townsend (2004), "Discovering the Sources of TFP Growth: Occupational Choice and Financial Deepening," August 2004.

Jakubiak, M. (2005), "Transfers of Technological Knowledge and the Productivity of Polish Industry in 1995–2003," Polish Economic Outlook No 4/2005, CASE, Warsaw

Kolasa, M. (2005), “What Drives Productivity Growth in the New EU Member States? The case of Poland,” European Central Bank Working Paper No 486, May 2005

Kolasa, M. and Z. Żółkiewski (2004), “Total Factor Productivity and its Determinants in Poland - Evidence from Manufacturing Industries,” The Role of ICT, TIGER Working Paper Series No. 64

Levine, R and D. Renelt (1992), “A Sensitivity Analysis of Cross-Country Growth Regressions,” American Economic Review, Vol. 82, September, pp. 942–963.

Miller, S. M. (2002), “Total Factor Productivity, Human Capital and Outward Orientation: Differences by Stage of Development and Geographic Regions,” Eastern Illinois University Working Paper 2002-33, July 2002

O’Mahony, M. and B. van Ark (eds, 2003), “EU Productivity and Competitiveness: An Industry Perspective. Can Europe Resume the Catching-up Process?” European Commission, Luxembourg, 2003

Pallikara, R. (2004), “Total Factor Productivity Growth: Survey Report,” Asian Productivity Organization

Peneder, M. (2002), “Structural Change and Aggregate Growth,” WIFO Working Papers, No. 192, Vienna.

Phillips, P.C.B. and B. Hansen (1990), “Statistical Inference in Instrumental Variables Regression with I(1) Processes,” Review of Economic Studies, 57, 99-125.

Senhadji A. (1999), “Sources of Economic Growth: An Extensive Growth Accounting Exercise,” IMF Working Paper 99/77

Szilárd, B., Zoltán M. and J. Vadas (2005), “Potential Output Estimations for Hungary: A Survey of Different Approaches,” OP 2005/43 NBH

Timmer, M. and A. Szirmai (2000), “Productivity Growth in Asian Manufacturing: The Structural Bonus Hypothesis Examined,” Groningen Growth and Development Centre and Eindhoven Centre for Innovation studies.

Wachtel, P. (2001), “Growth and Finance: What Do We Know and How Do We Know It?” International Finance, 4:3, pp. 335–362.

Wölfl, A. (2005), “The Service Economy in OECD Countries,” OECD Science, Technology and Industry Working Papers 2005/3

## Annex 1: International Evidence on Determinants of TFP growth

The determinants of total factor productivity growth have been the subject of increased attention in the literature. Prescott (1998) and Prescott and Parente (2004) highlight the role of total factor productivity (TFP) in explaining international income differences (see also Easterly, 2001). There are two obvious candidates to explain different levels of TFP across countries or across sectors within countries. A vast literature investigating national sources of economic growth (e.g. Cameron, 2003 and Griffith et al., 2000, 2001) underlines the linkage between human capital and R&D expenditures, TFP, and growth.

**1) Human capital**

The effects of human capital on productivity could be examined through different models as explained in Wolf (2000): a human capital model,[14] a "catch up" model and an "interaction with technical change" model. The third approach, which was considered by us, is based on a concept of "learning by doing" and argues that the "learning" process occurs more rapidly for workers with higher level of education. The literature has investigated several measures of human capital (e.g. education attainment, the illiteracy rate, student performance indicators, or average years schooling).

**2) Technological spillovers and innovations**

The literature stresses the role of investment in R&D activity, ICT expenditures and international trade in driving technological spillovers. As regards the technological and innovation block, several variables are considered. The two most frequently used are total/business expenditure on research and development as a share of GDP (Fawcett and Cameron, 2005) and the share of researchers in the total workforce (Ascari and Di Cosmo, 2004). For sector analysis (one country dimension), innovations could also be measured as the share of R&D in gross value added, the share of white-collar workers in total employment (as a proxy for employees' innovativeness and absorption of new capabilities) or the share of ICT expenditures in gross value added (Kolasa, 2005). Other possible measures of technological spillover used in the literature is foreign capital and collaboration (proxied by FDI stock, FDI intensity or share of FDI in gross capital). Foreign capital inflows may lead to greater efficiency due to inflow of better technology, inputs, technical and managerial expertise, etc. Finally, greater outward orientation benefits total factor productivity. Removing barriers to competition can reduce the productivity gap versus the leader in lagging industries (OECD, 2003a). Additionally, looking at various industries, it is a well known fact that productivity grows faster in industries producing tradables than in non-tradables (mainly services). The empirical literature captures outward orientation through the export/import-GDP ratio, export/sales in industry ratio, the terms of trade, and alignment of local prices with purchasing power parity (Miller and Upadhyay, 2002).

**3) "Catching up"**

The results from the empirical literature confirm a long-run, annual, catching-up effect which depends positively on the distance to the leader (technology frontier country) and/or initial level of TFP (EC 2003, Kolasa 2005).

**4) Reallocation of production factors**

The reallocation of production factors has frequently been introduced in growth theory. Indeed, the long-term process of economic development implies shifting labor/capital resources towards activities producing higher value-added products and services (Young, 1995; Poison, 1998). Reallocation of capital and employment from the agricultural to the non-agricultural sector is measured by the share of these sectors in value added.

[14] In this model, human capital is treated rather as an input in the production process than a source of higher TFP (see, e.g., Mankiw et al., 1992; and Parente and Prescott, 2004).

**5) Other determinants of TFP:**

- Demographic age structure (e.g. EC, 2003). This is usually measured by the dependency ratio. An aging population leads to a reduction in the inflow of young workers into the labor force and increases their mean age. A declining domestic labor force reduces the return prospects from domestic investment and may lead to overinvestment. A falling dependency ratio allows the working age population to save a larger percent of their income. Little is known so far about the impact that this might have on the creation and adoption of new ideas and technologies, but the results reported by the EC suggest that it contributes to slower productivity growth in the EU15.
-
- Social capital (e.g. Temple, 2001). This may be affected by external shocks, political instability and democratic institutions. As stressed by Temple (2001), it is difficult to find a suitable variable for "social capital".
-
- Macroeconomic volatility. This includes real GDP and inflation volatility. The macroeconomic environment could play a role in determining the level of productivity as it may influence the quality and efficiency of resource allocation and the rate of factor utilization.

- Reforms and institutional factors:
    - Deregulation (e.g. product and labor market regulations - Scarpetta and Tressel, 2002; market concentration or market structure, e.g. ownership/monopolization – Kolasa and Żółkiewski, 2004; and overall economy-wide deregulation index (Fraser Institute; EC, 2003).
    - Privatization (e.g. the share of the private sector in an industry's total production or the ratio of private-sector GDCF to public-sector GDCF – Pallikara, 2004.
    - Structure of financing (e.g. the volume of bank credit-to-GDP or an index of stock market capitalization – EC, 2003). Allen and Gale (2000) see a special advantage of stock markets in promoting innovation. The EC (2003) finds that stock market capitalization has a positive impact on TFP in the EU15 while growth in the volume of bank credit-to-GDP reduces TFP growth.
    - Infrastructure (e.g. number of main telephone lines, length of motorways, etc.)

## Annex 2: Panel Data Analysis of TFP Growth in the EU8

Our panel data covers the period 1996-2004 for a sample of seven EU8 countries (EU8 excluding Slovenia). Our explanatory variables are selected from Table A2.1 below, consistent with the international literature on determinants of TFP growth. After having established important exogenous variables, we specify our regression equation with TFP as a function of the human capital measures, technological spillovers and innovation (proxied by one variable from the "R&D group", openness, and FDI), catching up and reallocation of production factors. To check the robustness of our basic regression, we also tried including macro-volatility variables (GDP, TOT) and aging (OLD).

We follow classical regression analysis and assume that the omitted variables are independent of the included right-hand-side variables and are independently, identically distributed. We started with two basic models, the fixed effect and random effect models and finally decided on model that performed better - random effects model. The random effects model turned out to be more efficient than the fixed effects model and also yielded consistent results. The omitted variables occurred to be uncorrelated with the included right-hand-side variables.[15]

**Table A2.1. Explanatory variables.**

| Description of explanatory variables*) | The explanatory variables considered here are expected to capture the following effects on TFP growth: |
|---|---|
| En - school enrollment, upper secondary (% gross)<br>Et - school enrollment, tertiary (% gross) | **Human capital** |
| TRD - total R&D expenditure-to-GDP;<br>BRD - business enterprise R&D expenditure-to-GDP;<br>ReR - research personnel as % of active population<br>Pepr - total R&D personnel as % of active population<br><br>FDIN - foreign direct investment inflows-to-GDP<br>FDIs- foreign direct investment stock-to-GDP<br>FDI – ratio of FDI inflows-to-GCF<br>EXP - ratio of exports-to-GDP. | **Technological spillovers and innovations**<br><br>} "R&D group" |
| GAP – gap between initial level of TFP in EU15/Germany and respective EU8 country<br>TFPeu15/Germany – change in TFP in the technology frontier country (EU15 or in Germany, we tested both specifications) relative to respective EU8 country<br>INI – initial level of TFP in EU8 countries | **"Catching up".** |
| VAI - ratio of value added in industry-to-total VA<br>VAA/S - ratio of value added in agriculture/services-to-total VA | **Reallocation of production factors** |
| OLD – old age dependency ratio<br>TEL - number of main telephone lines per 100 inhabitants (availability of infrastructure)<br>MOT - total length of motorways in km<br>REG – regulation index (Fraser Institute)<br>TI – transition index<br>TOT - terms of trade in 1995 prices;<br>INF = CPI, standard deviation;<br>GDP = real GDP growth deviation from the mean in 1996-2004 | **Other**<br>Aging<br>Infrastructure<br><br><br><br>Deregulation<br><br>Macro volatility |

[15] We used the "Hausman test" to check a more efficient model against a less efficient.

The results of our regression analysis are shown below and discussed in the main text.

**Table A2.2. Estimation results.**

Random-effects GLS regression — Number of obs = 53
Group variable (i): period — Number of groups = 7

R-sq: within = 0.7347 — Obs per group: min = 5
between = 0.1687 — avg = 7.6
overall = 0.6514 — max = 9

| tfp | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. Interval] |
|---|---|---|---|---|---|
| vai_d | .1151036 | .0610616 | 1.89 | 0.059 | |
| exp_d | .0510827 | .0238184 | 2.14 | 0.032 | |
| brd_d | .0116742 | .0038173 | 3.06 | 0.002 | |
| zR | 7.635471 | .9935971 | 7.68 | 0.000 | |
| _cons | 1.739853 | .4194303 | 4.15 | 0.000 | |

*) Note: _d- denotes growth rate

## Annex 3: Data and Methodology for Poland Case Study

### Data

The growth accounting exercise for Poland in 1996-2003 was based on data available in September 2005. There were two main sources of data – Polish CSO (GUS) as the primary source for value added data, employment and capital. Unfortunately, none of the available sources provide up-to-date VA estimates for the entire period (1995-2003). GUS time series on VA in all 34 sectors are not provided for the whole period 1995-2003. Estimates of annual figures are available only for the period of 2000-2003 together with cumulative dynamics for 1995-2003 and nominal figures for 1995. Thus, annual data for 1995-1999 are outcomes of previous GUS estimates. Employment data by Groningen Institute for 1995-2002 are consistent with GUS data.

Although the available dataset for all variables needed covers only 15 branches, some reasonable estimates allowed extending this number to 34 branches with some reservations: 1) there is a brake in value added and wage bill series in 1999; 2) a proxy for the "wage bill for self-employed" (operating surplus) is estimated for 34 branches based on operating surplus in 16 main branches weighted with the shares of the number of self-employed in 34 branches according to the LFS; and 3) real growth in net capital for 34 branches is calculated based on deflators for gross capital in 15 branches.

*Capital.* GUS provides estimates for gross capital and net capital ($K_{(t)}$) and investments in fixed assets ($I_{(t)}$), all data in current prices for all 34 branches. However, the real growth rates are available only for gross capital in main 15 sectors. To obtain 34-sector time series net capital in current prices was converted into 1995 prices using the imputed deflators for gross capital (for 15 branches). The assumption was made that capital deflators for missing sectors (which were mainly sub-branches of manufacturing) are the same as in a given branch (e.g., as for manufacturing).

*Wage bill and operating surplus of the self-employed.* The share of labor costs in value added determines the key coefficient α in our Cobb-Douglas production function. Having data on employee compensation, we needed to estimate the operating surplus (OS) of the self-employed. We assumed that the work of self-employed is highly labor-intensive and therefore its compensation should be included into labor input. Moreover, the OS accounts for 27-29% of value added at the aggregate level so estimates of this part of labor input are important (the wage bill accounts for 48-51% of total value added).

We estimated the sector operating surpluses based on the aggregate OS of the self-employed and the share in VA produced by the self-employed for each of 15 main branches. The assumption was made here that the share of OS in VA is the same for all 15 branches as for the total economy. More disaggregated estimates of the OS (into 34 sectors, that is after disaggregating manufacturing sector) were based on the share in the total number of the self-employed for each manufacturing sub-branch according to the LFS. This implied that the average OS per self-employed in a given sub-branch of manufacturing was the same as in overall manufacturing. Finally, we assumed that the total cost of labor in branches running losses accounted for 95% of value added as suggested in the literature (*O'Mahony M. and Bart van Ark,* 2003).

*X – Share of exports in sales***.** GUS data for 1997-2003.

*FDI – Cumulative FDI share in gross capital stock*. FDI cross-sector data from PAIIZ database. These are expressed in USD, cumulative (from the beginning of transition) for each year between 1997 and 2004 (for previous years the sector structure is more aggregated). Gross capital in USD was based on the average exchange rate for 1990-1994 (for capital before 1995) and average exchange rate for each year subsequently.

*TFPINI – Initial (1995) level of TFP*. Our panel was estimated with 1995 values of the initial level of TFP (lnTFP in 1995, constant for the whole period, differs between branches). Calculations were based on the production function equation, where VA = $(L_{L(t)}^{(1-\alpha)(L)} * K_{K(t)}^{\alpha(L)})$ TFP and VA and K are in 1995 prices.

*H – Human capital index*. As a proxy for human capital we used average number of schooling years in a given branch (based on the share of people with a given number of schooling years in a given branch multiplied by the number of schooling years).

*RAD – Share of cumulated R&D in VA*. OECD data for 1994-2002 in current PLN prices; assumption of 5% annual depreciation rate.

## Methodology

### *Estimation of depreciation rates*

As a check, we calculated branch-level depreciation rates ($d_{(t)}$) using the following formula:

$$K_{net(t)} = K_{net(t-1)} * (1-d_{(t)}) + I_{(t)} \quad (7)$$

Where $K_{(t)}$ denotes net capital and $I_{(t)}$ investment in fixed assets (all data in current prices for all 34 branches).

**Table A3.1. Capital depreciation rates, %**

| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|---|
| Depreciation rate | 2.6 | 8.4 | 16.4 | 10.5 | 12.0 | 10.3 | 8.5 | 7.3 |

Source: Bank staff calculations.

### *Estimation of income shares ($\alpha$)*

There are two methods of estimating α (labor share in total income) at the aggregate level: (1) econometric regression of the production function; and (2) the Solow method (based on the income-share of labor in value added). The income share of labor is the total wage bill of employees plus the operating surplus as a proxy for compensation of self-employed. We estimated α for each individual branch using the second method (because of short time-series that did not allow for econometric regression).

The value of $\alpha$ at the aggregate level was in the range of 0.78-0.81 during 1995-2002, falling to 0.75 in 2003. This is somewhat higher than normally found in the literature (possibly reflecting overestimation of compensation for the self-employed – the operating surplus may include some capital service costs). The estimated value of $\alpha$ varies significantly across the 34 branches.

### *Shift-share analysis of labor productivity*

The “shift-share” analysis of labor productivity is based on the following equation:

$$\ln(va) - \ln(l) = \alpha \ln(l) + (1-\alpha) \ln(k) + \ln(tfp) - \ln(l) \Leftrightarrow \ln(va/l) = (1-\alpha) \ln(k/l) + \ln(tfp) \quad (8)$$

where VA - output, L – labor, and K – capital (small letters indicate growth rates of the variables).

Growth in labor productivity contains two effects: changes in the capital/labor intensity [k/l] and increases in total factor productivity. We can decompose the aggregate growth of labor productivity into three separate effects (Peneder, 2002):

Equation (9) **Static shift-effect** **Dynamic shift effect** **Within growth effect**

$$growth(LP_T) = \frac{LP_{T,fy} - LP_{T,by}}{LP_{T,by}} = \frac{\sum_{i=1}^{n} LP_{i,by}(S_{i,fy} - S_{i,by}) + \sum_{i=1}^{n} (LP_{i,fy} - LP_{i,by})(S_{i,fy} - S_{i,by}) + \sum_{i=1}^{n} (LP_{i,fy} - LP_{i,by})S_{i,by}}{LP_{T,by}}$$

Where LP=labor productivity; $d(LP_T)$ = growth of LP in time T, by = base year, fy=final year; T=sum over industries i; $S_i$ = share of industry i in total employment.

*Shift-share analysis of TFP*

In order to measure the impact of changes in both labor and capital shares in branches on aggregate total factor productivity growth, we conduct shift-share analysis of TFP. For a given i-branch we have:

$$\ln(va_i) = \alpha_i \ln(l_i) + (1- \alpha_i) \ln(k_i) + \ln(tfp_i) \qquad (10)$$

We can rewrite our production function at the aggregate level as:

$$\ln(va) = \Sigma(VA_i/VA) * \ln(va_i) = \Sigma(VA_i/VA) * \alpha_i \ln(l_i) + \Sigma(VA_i/VA) * (1- \alpha_i)\ln(k_i) + \Sigma(VA_i/VA) * \ln(tfp_i) \qquad (11)$$

At the same time at the aggregate level we have:

$$\ln(va) = \alpha \ln(l) + (1- \alpha) \ln(k) + \ln(tfp) \qquad (12)$$

Using equations (8) and (11) we calculate the difference between aggregate TFP growth, *ln(tfp)*, and value added-weighted TFP growth in branches, $\Sigma(VA_i/VA) * \ln(tfp_i)$, which is referred to as the *Total Reallocation Effect* (TRE).

$$TRE = \ln(tfp) - \sum \frac{VA_i}{VA} \ln(tfp_i) = \sum \frac{VA_i}{VA} \alpha_i \ln(\frac{l_i}{l}) + \sum \frac{VA_i}{VA}(1-\alpha_i)\ln(\frac{k_i}{k}) \qquad (13)$$

Where: tfp = TFP at aggregate level, $tfp_i$=TFP in sector i, $\frac{VA_i}{VA}$ = the share of value added in sector i in aggregate value added, $VA = \sum Y_i$, $l = \sum l_i$ $k = \sum k_i$.

TRE results from shifts of labor and capital from one sector to another: the last term on the right hand side of the equation indicates the effects of changes in capital shares on aggregate TFP and the previous term indicates the effects of changes in labor shares.

*Links between shift-share analysis of labor productivity and TFP growth*

Both *static and dynamic shift effects*, as defined above in Equation (9), describe reallocation of labor to sectors with above-average labor productivity level or growth rates, respectively. They are included in the first term on the right hand side of Equation (13). These two effects turned out to usually act in opposite directions so they did not explain the significant TRE. Nevertheless, the third *within growth effect* in Equation (9) includes labor productivity gains, which can be attributed to both the contribution of capital as a production factor and to gains from capital reallocations from sectors with below-average to sectors with above-average TFP growth. The stronger the labor productivity growth resulting from more efficient capital utilization in the economy as a whole (measured as the sum of output-weighted TFP), the higher the last term on the right-hand side of Equation (13) and the higher the TRE.

*Modeling TFP growth*

Based on our literature survey, analysis of EU8, and data constraints, we formulated the following equation:

tfp = f(X, FDI, TFPINI, H, RAD)

where X is the share of exports in sales, FDI is the cumulative FDI share in the gross capital stock, TFPINI is the initial level of TFP, H is a human capital index, and RAD is the share of cumulative R&D in value-added.

To capture potential endogeneity of exports, we also tried to estimate our model with a one-period lag for export variable.[16]

The model was based on panel data for 34 branches covering 7 years (1997-2003) and estimated using GLS (cross-section weights), with common intercept for all sectors (models with different intercepts had much worse explanatory power). The statistics of our model confirm that the exogenous variables explain well TFP growth (R-squared > 0.995; Durbin-Watson close to 2.0).

**Table A3.2. TFP model regression results**

Dependent Variable: TFP?
Method: Pooled EGLS (Cross-section weights)
Sample (adjusted): 1998 2003
Total pool (balanced) observations: 204
Iterate weights to convergence
Convergence achieved after 6 weight iterations

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 1.007934 | 0.036922 | 27.29879 | 0.0000 |
| X?(-1) | 0.002156 | 0.000395 | 5.458619 | 0.0000 |
| FDI? | 0.001039 | 0.000274 | 3.795125 | 0.0002 |
| TFPINI? | -0.015161 | 0.004440 | -3.414945 | 0.0008 |
| H? | 0.001900 | 0.002520 | 0.753672 | 0.4519 |

Weighted Statistics

| | | | |
|---|---|---|---|
| R-squared | 0.995447 | Mean dependent var | 3.544971 |
| Adjusted R-squared | 0.995356 | S.D. dependent var | 2.938909 |
| S.E. of regression | 0.200281 | Akaike info criterion | -2.124469 |
| Sum squared resid | 7.982349 | Schwarz criterion | -2.043142 |
| Log likelihood | 221.6958 | F-statistic | 10878.00 |
| Durbin-Watson stat | 1.934642 | Prob(F-statistic) | 0.000000 |

[16] The causality between the export share in sales and productivity growth may run both ways.

**Table A3.3. Poland: value-added 1996-2003(%)**

| In percent | Structure of VA | | | Value Added growth and its components | | | | | | | | | | | | VA growth and its decomposition | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1995 | 2003 | 2003-1995 | 1996-2003 | | | | 1996-1999 | | | | 2000-2003 | | | | 1996-2003 | | | | 1996-1999 | | | | 2000-2003 | | | |
| | | | | VA | L | K | TFP | VA | L | K | TFP | VA | L | K | TFP | VA | L | K | TFP | VA | L | K | TFP | VA | L | K | TFP |
| TOTAL | 100.0 | 100.0 | 0.0 | 33.9 | -1.1 | 4.6 | 29.4 | 21.8 | 4.2 | 1.2 | 15.5 | 9.9 | -5.1 | 3.4 | 12.1 | 33.9 | -3.7 | 15.3 | 88.4 | 21.8 | 21.0 | 5.9 | 73.1 | 9.9 | -55.1 | 34.9 | 120.2 |
| 1 Agriculture&Forestry&Fishing | 6.5 | 3.0 | -3.5 | 15.6 | 1.2 | -3.6 | 18.5 | 9.3 | 2.6 | -2.0 | 8.7 | 5.8 | -1.4 | -1.6 | 9.0 | 15.6 | 8.0 | -25.3 | 117.3 | 9.3 | 28.6 | -22.9 | 94.3 | 5.8 | -24.3 | -29.0 | 153.4 |
| 2 Mining and quarrying | 3.9 | 2.2 | -1.6 | -22.5 | -39.9 | -2.1 | 31.8 | -12.1 | -24.2 | -7.3 | 25.1 | -11.8 | -20.7 | 5.5 | 5.3 | -22.5 | 200.0 | 8.5 | -108.6 | -12.1 | 216.0 | 58.6 | -174.6 | -11.8 | 183.8 | -42.5 | -41.3 |
| 3 Food, drink & tobacco | 4.0 | 3.1 | -0.9 | 68.3 | -8.5 | 12.8 | 63.0 | 43.8 | 3.2 | 9.4 | 27.5 | 17.0 | -11.3 | 3.1 | 27.9 | 68.3 | -17.0 | 23.1 | 93.9 | 43.8 | 8.6 | 24.6 | 66.8 | 17.0 | -76.1 | 19.6 | 156.5 |
| 4 Textiles | 0.8 | 0.5 | -0.3 | -12.9 | -45.1 | -1.1 | 60.4 | 0.9 | -22.2 | -0.2 | 30.1 | -13.7 | -29.4 | -0.8 | 23.3 | -12.9 | 433.3 | 7.7 | -341.0 | 0.9 | -2733.7 | -25.0 | 2858.7 | -13.7 | 236.1 | 5.7 | -141.8 |
| 5 Clothing | 1.2 | 0.5 | -0.7 | -16.4 | -38.3 | -1.7 | 37.8 | -0.6 | -5.7 | -0.5 | 5.9 | -15.8 | -34.5 | -1.2 | 30.1 | -16.4 | 270.0 | 9.5 | -179.5 | -0.6 | 927.9 | 78.3 | -906.2 | -15.8 | 245.8 | 7.0 | -152.8 |
| 6 Leather and footwear | 0.4 | 0.2 | -0.2 | -50.5 | -50.6 | -1.7 | 2.0 | -13.7 | -20.0 | -1.4 | 9.4 | -42.6 | -38.2 | -0.4 | -6.8 | -50.5 | 100.3 | 2.5 | -2.8 | -13.7 | 151.6 | 9.3 | -60.9 | -42.6 | 86.7 | 0.7 | 12.6 |
| 7 Wood & products of wood and cork | 0.8 | 0.8 | 0.0 | 75.3 | -4.8 | 5.3 | 75.0 | 40.0 | 11.4 | 5.8 | 18.7 | 25.2 | -14.6 | -0.6 | 47.4 | 75.3 | -8.8 | 9.1 | 99.7 | 40.0 | 32.1 | 16.9 | 51.0 | 25.2 | -70.1 | -2.5 | 172.7 |
| 8 Pulp, paper & paper products | 0.6 | 0.5 | -0.1 | 166.2 | -6.0 | 15.0 | 146.1 | 111.5 | 4.1 | 13.4 | 79.1 | 25.8 | -9.7 | 1.4 | 37.4 | 166.2 | -6.3 | 14.3 | 92.0 | 111.5 | 5.4 | 16.8 | 77.8 | 25.8 | -44.4 | 6.2 | 138.3 |
| 9 Printing & publishing | 1.1 | 0.9 | -0.2 | 47.5 | 11.5 | 27.3 | 4.0 | 69.5 | 15.1 | 12.4 | 31.0 | -13.0 | -3.2 | 13.2 | -20.6 | 47.5 | 27.9 | 62.0 | 10.1 | 69.5 | 26.7 | 22.2 | 51.2 | -13.0 | 23.1 | -89.2 | 166.2 |
| 10 Mineral oil refining, coke&nuclear fuel | 0.6 | 0.2 | -0.4 | -91.8 | -11.1 | 72.2 | -94.6 | -51.1 | -3.1 | 75.0 | -71.2 | -83.1 | -8.3 | -1.5 | -81.3 | -91.8 | 4.7 | -21.8 | 117.1 | -51.1 | 4.4 | -78.1 | 173.7 | -83.1 | 4.9 | 0.9 | 94.3 |
| 11 Chemicals | 1.8 | 1.4 | -0.5 | 49.8 | -17.2 | 17.7 | 53.7 | 28.0 | -7.2 | 18.4 | 16.5 | 17.0 | -10.7 | -0.6 | 31.9 | 49.8 | -46.6 | 40.3 | 106.3 | 28.0 | -30.3 | 68.4 | 61.9 | 17.0 | -72.2 | -3.8 | 176.0 |
| 12 Rubber & plastics | 1.0 | 1.2 | 0.2 | 221.3 | 14.8 | 39.6 | 100.5 | 130.0 | 11.9 | 24.8 | 64.8 | 39.7 | 2.6 | 11.9 | 21.7 | 221.3 | 11.8 | 28.6 | 59.6 | 130.0 | 13.5 | 26.6 | 60.0 | 39.7 | 7.8 | 33.5 | 58.7 |
| 13 Non-metallic mineral products | 1.2 | 1.3 | 0.1 | 112.5 | -17.8 | 32.4 | 95.2 | 60.0 | -0.8 | 22.9 | 31.2 | 32.8 | -17.1 | 7.7 | 48.8 | 112.5 | -25.9 | 37.2 | 88.7 | 60.0 | -1.7 | 43.9 | 57.8 | 32.8 | -66.0 | 26.0 | 140.0 |
| 14 Basic metals | 1.4 | 0.4 | -1.0 | -47.4 | -50.3 | -1.5 | 7.6 | -8.8 | -16.8 | 2.0 | 7.5 | -42.3 | -40.3 | -3.4 | 0.0 | -47.4 | 109.0 | 2.4 | -11.3 | -8.8 | 200.4 | -21.2 | -79.2 | -42.3 | 93.8 | 6.3 | 0.0 |
| 15 Fabricated metal products | 1.4 | 1.7 | 0.3 | 204.9 | 13.5 | 15.1 | 133.5 | 62.4 | 17.5 | 8.3 | 27.6 | 87.8 | -3.5 | 6.3 | 83.0 | 204.9 | 11.3 | 12.6 | 76.1 | 62.4 | 33.3 | 16.4 | 50.2 | 87.8 | -5.6 | 9.7 | 95.9 |
| 16 Mechanical engineering | 1.9 | 1.4 | -0.5 | 18.3 | -33.4 | -4.7 | 86.4 | 15.4 | -12.2 | -3.8 | 36.7 | 2.5 | -24.2 | -0.9 | 36.4 | 18.3 | -242.1 | -28.6 | 370.8 | 15.4 | -91.1 | -27.2 | 218.3 | 2.5 | -1109.7 | -37.0 | 1246.7 |
| 17 Office machinery | 0.1 | 0.1 | 0.0 | 495.2 | 21.3 | 9.2 | 349.4 | 527.7 | 8.1 | 5.4 | 450.9 | -5.2 | 12.2 | 3.6 | -18.4 | 495.2 | 10.8 | 4.9 | 84.2 | 527.7 | 4.2 | 2.9 | 92.9 | -5.2 | -215.7 | -67.3 | 382.9 |
| 18 Machinery and electrical apparatus | 0.7 | 0.9 | 0.1 | 144.3 | -3.2 | 16.4 | 116.8 | 69.1 | 2.7 | 10.5 | 49.0 | 44.4 | -5.8 | 5.4 | 45.5 | 144.3 | -3.7 | 17.0 | 86.6 | 69.1 | 5.1 | 19.0 | 75.8 | 44.4 | -16.2 | 14.2 | 102.1 |
| 19 Radio, TV and telecom. equipment | 0.4 | 0.3 | -0.1 | 79.6 | -31.4 | 10.0 | 138.1 | 61.8 | -11.4 | 11.2 | 64.3 | 11.0 | -22.6 | -1.0 | 44.9 | 79.6 | -64.4 | 16.3 | 148.1 | 61.8 | -25.3 | 22.0 | 103.2 | 11.0 | -245.1 | -10.1 | 355.2 |
| 20 Scientific and other instruments | 0.3 | 0.4 | 0.0 | 65.5 | 1.6 | 9.0 | 49.4 | 106.7 | -1.3 | 4.6 | 100.3 | -19.9 | 3.0 | 4.2 | -25.4 | 65.5 | 3.2 | 17.1 | 79.7 | 106.7 | -1.8 | 6.1 | 95.7 | -19.9 | -13.2 | -18.7 | 131.9 |
| 21 Motor vehicles | 0.7 | 1.0 | 0.3 | 348.8 | -8.0 | 30.0 | 275.3 | 70.6 | 0.9 | 17.7 | 43.7 | 163.1 | -8.8 | 10.5 | 161.2 | 348.8 | -5.5 | 17.5 | 88.1 | 70.6 | 1.7 | 30.5 | 67.8 | 163.1 | -9.5 | 10.3 | 99.2 |
| 22 Other vehicles | 0.6 | 0.4 | -0.2 | -16.7 | -36.8 | -3.0 | 35.9 | 21.9 | -19.1 | -2.1 | 53.8 | -31.7 | -21.9 | -0.9 | -11.7 | -16.7 | 251.5 | 16.6 | -168.2 | 21.9 | -106.7 | -10.5 | 217.2 | -31.7 | 64.9 | 2.5 | 32.6 |
| 23 Furniture, misc. Manuf.; recycling | 1.1 | 1.1 | 0.0 | 80.4 | 2.7 | 17.2 | 50.0 | 36.5 | 11.9 | 7.4 | 13.5 | 32.1 | -8.3 | 9.1 | 32.1 | 80.4 | 4.5 | 26.8 | 68.7 | 36.5 | 36.2 | 23.0 | 40.8 | 32.1 | -31.0 | 31.1 | 99.9 |
| 24 Electricity, gas and water supply | 3.6 | 4.0 | 0.4 | 12.9 | -7.6 | 3.8 | 17.7 | 1.3 | -3.6 | -0.2 | 5.4 | 11.5 | -4.1 | 4.0 | 11.7 | 12.9 | -64.6 | 30.9 | 133.7 | 1.3 | -281.0 | -16.2 | 397.2 | 11.5 | -38.3 | 36.6 | 101.7 |
| 25 Construction | 7.1 | 6.1 | -1.1 | 7.8 | -14.0 | 29.7 | -3.4 | 28.9 | 7.7 | 15.0 | 4.1 | -16.4 | -20.1 | 12.8 | -7.2 | 7.8 | -200.2 | 345.7 | -45.5 | 28.9 | 29.0 | 55.0 | 16.0 | -16.4 | 125.4 | -67.3 | 41.8 |
| 26 Trade | 19.1 | 19.8 | 0.7 | 46.9 | 10.1 | 20.4 | 10.8 | 27.8 | 12.2 | 14.0 | -0.1 | 15.0 | -1.9 | 5.7 | 10.9 | 46.9 | 25.0 | 48.4 | 26.6 | 27.8 | 47.1 | 53.3 | -0.4 | 15.0 | -13.8 | 39.7 | 74.1 |
| 27 Hotels & catering | 0.9 | 1.2 | 0.2 | 56.4 | 9.3 | 7.8 | 32.8 | 54.9 | 8.6 | 3.7 | 37.5 | 1.0 | 0.6 | 4.0 | -3.5 | 56.4 | 19.8 | 16.9 | 63.3 | 54.9 | 18.8 | 8.4 | 72.8 | 1.0 | 63.4 | 408.2 | -371.6 |
| 28 Transport & communication | 6.4 | 7.8 | 1.4 | 57.3 | -7.9 | 0.1 | 70.7 | 31.3 | 1.1 | -4.5 | 36.0 | 19.8 | -9.0 | 4.8 | 25.6 | 57.3 | -18.2 | 0.2 | 118.1 | 31.3 | 4.2 | -16.9 | 112.7 | 19.8 | -52.1 | 25.9 | 126.2 |
| 29 Financial intermediation | 1.0 | 2.1 | 1.1 | 65.4 | 11.0 | 6.3 | 40.2 | 65.0 | 22.8 | 5.0 | 27.9 | 0.3 | -9.7 | 1.2 | 9.6 | 65.4 | 20.7 | 12.2 | 67.2 | 65.0 | 41.1 | 9.8 | 49.1 | 0.3 | -3939.3 | 472.0 | 3567.2 |
| 30 Real estate activities | 10.0 | 14.6 | 4.7 | 21.8 | 53.5 | 3.0 | -23.0 | 5.8 | 25.9 | 0.8 | -16.7 | 15.2 | 21.9 | 2.2 | -7.5 | 21.8 | 217.2 | 15.2 | -132.5 | 5.8 | 412.5 | 14.8 | -327.3 | 15.2 | 140.0 | 15.4 | -55.4 |
| 31 Public administration | 7.1 | 7.2 | 0.1 | 37.5 | 39.7 | 9.3 | -10.0 | 20.2 | 18.2 | 2.2 | -0.6 | 14.4 | 18.2 | 6.9 | -9.5 | 37.5 | 105.0 | 28.0 | -33.0 | 20.2 | 90.9 | 12.1 | -3.0 | 14.4 | 124.3 | 49.8 | -74.1 |
| 32 Education | 4.0 | 5.3 | 1.4 | 21.7 | 14.9 | 3.1 | 2.8 | 11.7 | 6.8 | 1.1 | 3.5 | 8.9 | 7.6 | 2.0 | -0.8 | 21.7 | 70.8 | 15.3 | 13.8 | 11.7 | 59.1 | 9.6 | 31.3 | 8.9 | 86.1 | 22.8 | -8.9 |
| 33 Health and social work | 4.6 | 3.9 | -0.7 | -15.5 | -21.5 | 3.8 | 3.8 | -4.0 | -0.8 | 1.5 | -4.6 | -12.0 | -21.0 | 2.3 | 8.8 | -15.5 | 144.0 | -22.0 | -22.0 | -4.0 | 18.7 | -35.8 | 117.2 | -12.0 | 183.9 | -17.6 | -66.2 |
| 34 Other services | 3.7 | 4.6 | 0.9 | 14.6 | 11.6 | 23.5 | -16.9 | 5.1 | 14.7 | 12.9 | -18.8 | 9.1 | -2.7 | 9.5 | 2.4 | 14.6 | 80.3 | 154.9 | -135.2 | 5.1 | 276.2 | 244.5 | -420.7 | 9.1 | -31.3 | 103.9 | 27.4 |

Sources: GUS; OECD; Groningen Institute; and Bank staff calculations. Sectors marked with blue shading are excluded from the BEEPS sample. In the case of Poland, the sectors excluded from this survey constituted 27.7 percent of value-added in 2003.

## Table A3.4. Poland: working population, labor productivity and $\alpha$ coefficient estimates 1996-2003

| | Working population | | Labor productivity | | | | | $\alpha$–coefficient | |
|---|---|---|---|---|---|---|---|---|---|
| | Structure in percent | | in '000 PLN per worker | | Growth in percent | | | | |
| | 1995 | 2003 | 1995 | 2003 | 1996-2003 | 1996-99 | 2000-03 | 1995 | 2003 |
| **TOTAL** | **100.0** | **100.0** | **19.5** | **48.9** | **35.9** | **15.5** | **17.7** | **0.78** | **0.75** |
| 1 Agriculture&Forestry&Fishing | 26.1 | 16.1 | 4.8 | 5.4 | **14.2** | 6.3 | 7.4 | 0.94 | 0.90 |
| 2 Mining and quarrying | 2.5 | 1.6 | 29.6 | 78.6 | **44.3** | 21.3 | 18.9 | 0.79 | 0.83 |
| 3 Food, drink & tobacco | 3.6 | 3.7 | 21.2 | 46.0 | **91.0** | 37.0 | 39.4 | 0.62 | 0.68 |
| 4 Textiles | 1.1 | 0.7 | 13.6 | 36.5 | **67.4** | 32.0 | 26.8 | 0.89 | 0.85 |
| 5 Clothing | 2.2 | 1.5 | 10.6 | 18.0 | **39.5** | 6.2 | 31.4 | 0.83 | 0.95 |
| 6 Leather and footwear | 0.6 | 0.3 | 11.6 | 24.9 | **4.0** | 9.2 | -4.7 | 0.95 | 0.95 |
| 7 Wood & products of wood and cork | 1.0 | 1.1 | 16.0 | 42.4 | **84.8** | 24.6 | 48.4 | 0.95 | 0.87 |
| 8 Pulp, paper & paper products | 0.3 | 0.3 | 41.4 | 94.3 | **185.9** | 99.0 | 43.7 | 0.53 | 0.54 |
| 9 Printing & publishing | 0.6 | 0.8 | 39.1 | 66.7 | **20.1** | 31.1 | -8.4 | 0.47 | 0.63 |
| 10 Mineral oil refining, coke & nuclear fuel | 0.2 | 0.1 | 72.2 | 99.4 | **-88.7** | -46.3 | -79.0 | 0.39 | 0.68 |
| 11 Chemicals | 1.0 | 0.8 | 36.3 | 95.5 | **112.7** | 47.3 | 44.5 | 0.47 | 0.51 |
| 12 Rubber & plastics | 0.7 | 1.0 | 28.1 | 63.6 | **154.5** | 88.9 | 34.8 | 0.55 | 0.55 |
| 13 Non-metallic mineral products | 1.3 | 1.1 | 19.3 | 69.1 | **187.9** | 61.7 | 78.0 | 0.59 | 0.57 |
| 14 Basic metals | 1.1 | 0.5 | 25.3 | 44.9 | **22.9** | 15.8 | 6.1 | 0.68 | 0.95 |
| 15 Fabricated metal products | 1.3 | 1.8 | 21.6 | 53.8 | **153.6** | 29.6 | 95.7 | 0.63 | 0.57 |
| 16 Mechanical engineering | 2.1 | 1.5 | 17.1 | 53.5 | **99.4** | 37.1 | 45.4 | 0.65 | 0.73 |
| 17 Office machinery | 0.0 | 0.0 | 39.9 | 82.3 | **381.9** | 473.1 | -15.9 | 0.38 | 0.95 |
| 18 Machinery and electrical apparatus | 0.7 | 0.7 | 21.7 | 64.4 | **154.6** | 61.4 | 57.7 | 0.56 | 0.51 |
| 19 Radio, TV and telecom. equipment | 0.3 | 0.2 | 22.7 | 87.5 | **233.9** | 99.9 | 67.0 | 0.64 | 0.56 |
| 20 Scientific and other instruments | 0.3 | 0.4 | 19.7 | 54.7 | **65.8** | 111.6 | -21.6 | 0.74 | 0.71 |
| 21 Motor vehicles | 0.7 | 0.7 | 19.8 | 81.1 | **397.3** | 68.2 | 195.6 | 0.74 | 0.44 |
| 22 Other vehicles | 0.8 | 0.6 | 15.5 | 39.2 | **40.0** | 56.7 | -10.6 | 0.78 | 0.95 |
| 23 Furniture, misc. Manuf.; recycling | 1.3 | 1.6 | 17.2 | 40.7 | **72.1** | 16.3 | 48.0 | 0.76 | 0.58 |
| 24 Electricity, gas and water supply | 1.9 | 1.8 | 37.4 | 121.0 | **34.3** | 9.6 | 22.5 | 0.40 | 0.38 |
| 25 Construction | 5.7 | 5.5 | 24.3 | 61.8 | **30.4** | 17.4 | 11.0 | 0.77 | 0.83 |
| 26 Trade | 12.6 | 16.5 | 29.5 | 67.1 | **30.6** | 10.9 | 17.8 | 0.86 | 0.81 |
| 27 Hotels & catering | 1.3 | 1.7 | 13.8 | 39.2 | **42.5** | 42.1 | 0.3 | 0.95 | 0.90 |
| 28 Transport & communication | 5.7 | 5.9 | 21.7 | 74.0 | **77.2** | 29.3 | 37.0 | 0.74 | 0.60 |
| 29 Financial intermediation | 1.7 | 2.2 | 11.0 | 51.1 | **48.7** | 32.9 | 11.9 | 0.95 | 0.85 |
| 30 Real estate activities | 3.8 | 7.9 | 50.6 | 104.4 | **-31.0** | -23.0 | -10.4 | 0.66 | 0.81 |
| 31 Public administration | 2.6 | 4.5 | 53.0 | 89.7 | **-7.4** | 0.1 | -7.5 | 0.95 | 0.76 |
| 32 Education | 5.8 | 7.8 | 13.4 | 38.3 | **4.8** | 4.3 | 0.5 | 0.95 | 0.92 |
| 33 Health and social work | 6.9 | 6.0 | 12.9 | 36.4 | **12.8** | -3.2 | 16.6 | 0.94 | 0.82 |
| 34 Other services | 2.2 | 2.9 | 33.0 | 87.4 | **0.0** | -11.9 | 13.5 | 0.79 | 0.71 |

Sources: GUS; OECD; Groningen Institute; and Bank staff calculations. Sectors marked with blue shading are excluded from the BEEPS sample. In the case of Poland, the sectors excluded from this survey constituted 27.7 percent of value added in 2003.