This chapter aims to describe the patterns of productivity growth across and within sectors (agriculture, manufacturing, and services) and identify the main policy factors driving these patterns. One must look beneath the aggregate numbers presented in chapter 1 to see how sectoral differences explain productivity growth. This chapter shows that the productivity surge in the Region is a reflection of a better allocation of resources across sectors, but, more importantly, of within-sector productivity growth.

The chapter begins with an overview of the sectoral shifts that have taken place since the start of transition. It next analyzes the respective contributions of cross-sectoral reallocation and within-sector productivity growth. It then discusses in detail the patterns of productivity in agriculture, manufacturing, and services and outlines the main policy implications.

**Cross-Sectoral Shifts**

**A Dramatic Shift of Resources to Services**

There has been a large resource reallocation into the service sector. The economies of Eastern Europe and the Former Soviet Union faced significant challenges in reallocating resources at the start of the
transition as a result of structural distortions inherited from central planning: an oversized manufacturing sector and an underdeveloped service sector. Services have grown relative to agriculture and industry across the Region. For instance, in the EU-10, the share of services in total value added rose dramatically, from 40 percent in 1999 to 60 percent in 2005. Labor also moved to services across all country groups except for the SEE countries (figure 2.1).

These sectoral shifts followed the standard development paradigm, although patterns of labor reallocation differed across countries. The structural gap inherited from central planning narrowed, but this adjustment differed across countries. Following the methodology developed by Raiser, Schaffer, and Schuchhardt (2006) and drawing on updated sectoral shares of employment, this section illustrates country transition paths (with the starting point set in 1990 and the ending point set in 2004). The changes in sectoral employment shares are then benchmarked against the average among 50 industrialized market economies. The main results of this analysis are summarized below (see appendix 2.A for additional details).

- In all countries, workers moved away from manufacturing. The move toward market economies was reflected in significant declines in the share of employment in manufacturing. However, the wealthier countries (EU-10) found themselves, in 2004, with shares of manufacturing employment that were still higher than the market economy benchmark (figure 2.2). In contrast, the low income CIS countries had shares of manufacturing employment below the market economy benchmark.

**FIGURE 2.1**
A Substantial Shift of Output and Employment to Services

Sources: World Bank staff calculations; World Development Indicators Database 2007.

Note: The definition of services in the World Development Indicators Database includes government services and market services. The definition of industry covers manufacturing, construction, electricity, gas, and water.
• **Labor shifted to agriculture in most low income CIS countries.** In poorer countries of the Former Soviet Union, labor shifted out of manufacturing toward agriculture, which increased the share of agriculture by around 20 percentage points. Agriculture was the employer of last resort because of the lack of opportunities in services and the absence of adequate social safety nets. As a result, the share of employment in agriculture in 2004 was still well above the corresponding share in the market economies (figure 2.2).

• **Labor shifted to market services in all countries.** All the transition economies started the transition with small market-oriented service sectors. During transition, the EU-10 countries and the middle income CIS countries adjusted by increasing the share of employment in services, moving closer to the patterns in market economies (figure 2.3). In these countries, the share of services in total employment increased by about 5 percentage points during the transition, while the share of manufacturing fell by about 3 percentage points. In contrast, in the low income CIS countries, market services gained little as a share in total employment, and the employment share was still below that in market economies.

The shift to services drove up overall productivity levels in most countries (except the CIS). Value added per worker is the lowest in agriculture and the highest in services. As a result, the shift in employment away from agriculture and manufacturing into services, as occurred in the EU-10, was productivity-enhancing (figure 2.4).
Unleashing Prosperity

Within-Sector Productivity Improvements Are Drivers of Productivity Growth

Is overall productivity growth mainly driven by sectoral shifts or by within-sector productivity gains? Answering this question requires performing a shift-share analysis that decomposes aggregate productivity growth into three main components: (a) the within effect, which captures the impact of productivity growth within individual sectors on aggregate productivity in the economy; (b) the between effect, which reflects the impact of the reallocation of employment from less
productive to more productive sectors; and (c) the cross effect,¹ which captures the impact of reallocation of employment into sectors with growing productivity (see box 2.1 and appendix 2.B).

The analysis conducted in this section decomposes labor productivity growth by sectors.² The analysis is first conducted for the entire economy and focuses on the relative contributions of three main sectors—agriculture, industry, and services—to overall labor

---

**BOX 2.1**

**Shift-Share Analysis: Decomposing Aggregate Labor Productivity Growth**

Shift-share analysis permits the decomposition of aggregate labor productivity growth to assess the relative roles of (a) within-sector productivity gains, (b) shifts of employment from sectors with low productivity growth to sectors with high productivity growth, and (iii) shifts of employment from sectors with low productivity levels to those with high productivity levels. Productivity for the entire economy is expressed as the sum of the productivity level of each sector weighted by the sectoral employment shares, as follows:

\[ P_m = \frac{Y_m}{L_m} = \sum_{j=1}^{n} \frac{Y_j}{L_j} * \frac{L_j}{L_m} = \sum_{j=1}^{n} P_j * S_j \]

where \( Y \) is output, \( L \) is employment by sector \((j = 1 \ldots n)\) and the total economy \((m)\), \( P \) is labor productivity \((Y/L)\), and \( S \) is the sectoral employment share. In a discrete time perspective, the expression may be rewritten as follows:

\[
\frac{P'_m - P'_0}{P'_m} = \sum_{j=1}^{n} \frac{(P'_j - P'_0) * S'_0}{P'_0} + \sum_{j=1}^{n} \frac{P'_0 * (S'_j - S'_0)}{P'_0} + \sum_{j=1}^{n} \frac{(P'_j - P'_0) * (S'_j S'_0)}{P'_0}
\]

for a current year \( t \) and a base year \( 0 \).

The first term on the right-hand side is the within-industry contribution to overall productivity growth (the within term). The second term may be defined as the static shift effect, which captures the contribution arising from changes in the sectoral composition of employment (the between term). The third term represents the joint effect of changes in employment shares and sectoral productivity (the cross term). It is positive if sectors with above-average productivity growth increase their share in total employment; it is negative if expanding sectors have below-average productivity growth or if the shares in total employment of sectors with high productivity growth are also declining.

productivity growth. It covers all countries in the Region and draws on data from the World Development Indicators Database.

The main finding in this section is that the bulk of the Region’s productivity surge over 1999–2004 is explained by within-sector productivity growth. Reallocation effects were also important, but the contribution of these was small. The largest contributor to total productivity growth was the within component (see figure 2.5). The within component is not as large in Turkey as it is in other countries because the period average is affected by the decline in productivity following the currency collapse in Turkey in February 2001. Labor is generally moving to sectors with high productivity (manufacturing and services) and out of sectors with low productivity (agriculture). This change is reflected in a positive between term. Labor is also moving out of sectors with increasing productivity (agriculture and manufacturing) and into sectors with lower productivity (services). This shift is reflected in a negative cross term (figure 2.5). In the CIS and SEE, the cross and between terms tend to cancel each other out. These findings are consistent with the firm-level analysis carried out on a sample of Eastern European and Former Soviet Union countries covering NACE 74 sectors (see chapter 3).

A more disaggregated analysis is then performed for the EU-8 (the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, the Slovak Republic, and Slovenia) across nine broad sectors of the International Standard Industrial Classification of all Economic Activities (ISIC). The data are taken from the EU KLEMS Database (see appendix 2.B

FIGURE 2.5
Within-Sector Productivity Is the Main Driver of the Productivity Surge, 1999–2004

Sources: World Bank staff calculations; World Development Indicators Database 2007.
for more details). The disaggregated shift-share analysis yields three main sets of findings (see appendix 2.B for details):

- First, the within component contributions to aggregate productivity growth were large and increased over time; in contrast, the reallocation effects were small and were mostly driven by labor shifts away from agriculture and manufacturing toward services.

- Second, the largest within component contributions to total manufacturing productivity growth arose from fabricated metals, machinery, and food and beverages. The reallocation effects were small except in a few industries. Medium- and high-technology industries (motor vehicles, electrical machinery, and radio and television) accounted for a large proportion of the reallocation effects. This finding is not surprising. In these industries, the entry of new productive firms contributes the most to total productivity growth (see chapter 3).

- Third, the within component contributions to service productivity growth, aside from construction and real estate, were largely driven by backbone services: electricity and water, transport, telecommunications, and financial services. These industries are called backbone because they have both direct and indirect effects on aggregate productivity growth, providing critical inputs to downstream manufacturing firms. The reallocation effects were small, suggesting small labor shifts across service industries. Business support services and real estate accounted for the largest reallocation effects toward service productivity growth. In these industries, the between component was large and positive.

In sum, the productivity surge seems to have been mostly driven by within-sector productivity improvements, although the reallocation effects were also important. In slow reformers (CIS and SEE), the reallocation effects reflected the response to recent policy reforms aiming at strengthening competition. However, these countries still face deep restructuring. They need to accelerate the reallocation of resources away from low-productive to higher-productivity activities if they are to catch up with more advanced reformers in the Region. The reallocation effects have slowed in the more advanced reformers (EU-8), reflecting the gains already made. However, even in the more advanced reformers, there are some sectors (agriculture, mining, energy, transport services) in which there is still potential for achieving productivity gains from the reallocation of resources toward more productive uses.
Productivity Growth within Sectors: A Bird’s-Eye View

The previous section concluded that within-sector productivity growth explained most of the productivity surge in the Region. The focus now turns to the productivity patterns of the main sectors of the economy (agriculture, manufacturing, and services) and the main policy drivers of sectoral performance.3

The shares of agriculture and industry in total value added and employment have fallen, while the share of services has grown. The share of industry in total value added averaged 36 percent during 1990–98 and fell to 32 percent during 1999–2004. The share of services in total value added grew from 44 to 54 percent during the same period. The share of industry in total employment averaged 30 percent over 1990–98 and fell to 26 percent over 1999–2004, while the average share of services in total employment increased from 63 to 68 percent (figure 2.6). In the EU-15, these structural changes followed the same pattern.

Productivity growth in both industry and agriculture exceeded that in services, and productivity gains in most countries in the Region were higher than those in the EU-15 during 1999–2005. In Turkey and the SEE, the growth in agricultural productivity exceeded that in manufacturing and services. In the EU-10, productivity grew more quickly in manufacturing and agriculture than in services. In the CIS, productivity growth, particularly in the most recent period, was the highest in the Region, and the growth followed similar patterns across all three sectors, reflecting a broad economic recovery after a deep recession (figure 2.7). However, across sectors, a substantial gap in productivity levels remained between the Region and the EU-15. Labor productivity in the EU-15 is more than three times greater than the average in the Region. To accelerate a convergence toward EU-15

FIGURE 2.6
The Share of Services in Valued Added and Employment Has Risen

Sources: World Bank staff calculations; World Development Indicators Database 2007.
levels, sustained productivity growth is needed across agriculture, manufacturing, and services.

The next three sections assess in detail the productivity patterns within agriculture, manufacturing, and services. The main findings are as follows:

- **Agricultural productivity growth was driven by labor shedding, though higher farm efficiency was also important.** In labor-intensive countries (Albania, Armenia, Georgia, and the Kyrgyz Republic), a shift from large-scale collective farming to small-scale individual farming led to dramatic gains in technical efficiency, with relatively small losses in scale efficiency. In capital- and land-intensive countries (the Czech Republic, Hungary, and the Slovak Republic), any gains in labor productivity arose primarily because large farms shed labor after privatization. In countries where neither type of reform (privatization and land reforms) was undertaken vigorously, the productivity gains were generally delayed and modest. During the first stage of transition, trade liberalization, privatization, and land reforms were required so as to accelerate farm restructuring and facilitate the sectoral reallocation of labor. As countries progressed along the transition path, a better investment climate and greater efficiency in service sectors are needed to boost within-farm productivity growth and provide off-farm job opportunities.

- **Manufacturing productivity growth was driven by efficiency gains in industries with higher capacity for innovation.** In manufacturing, a group of medium- and high-technology industries seemed to drive productivity growth, exhibiting the highest average annual productivity growth rates. This group employed a large proportion of high-skilled workers, produced ICT goods, or used a relatively
A large amount of ICT capital. The manufacturing industries in the high-technology group included office machinery, electrical and electronic equipment, and optical instruments. Other industries, such as traditional consumer goods manufacturing, were within the low-technology groups, with lower average productivity growth. Not surprisingly, high-technology industries displayed higher TFP growth in countries that showed more progress in liberalizing key service industries and in financial sector development and that had more skilled workforces, more flexible labor markets, and higher R&D investments financed by the private sector.

- Service productivity growth was driven by strong performance in backbone industries: transport, telecommunications, and financial intermediation services. Service productivity growth was driven by backbone industries with higher productivity and a greater propensity to use or produce ICT: the retail trades, transport, telecommunications, and financial intermediation services. Productivity growth in these industries during 1997–2004 outstripped average productivity growth in the EU-15, suggesting that there is a potential for services to drive growth in the Region. Policy makers in the Region can play a major role in sustaining growth momentum in services by pursuing more service liberalization across the board, removing regulatory barriers to competition, and attracting more foreign investment and trade flows.

**Agricultural Productivity**

Farm systems under central planning targeted production rather than profitability and operated in an environment of highly distorted incentives. Output prices were not set in response to forces of supply and demand. Farms were overdimensioned or uneconomic in size and run under soft budget constraints, with strong subsidies for energy and fertilizer inputs. It was expected that the transition to a market economy would significantly improve productivity in the short to medium term by providing incentives for a more efficient utilization of resources. While many of the expected changes have occurred in many EU-10 countries, the experience of the Region has been uneven, and, in the CIS and SEE, progress has been much slower.

The main finding of this section is that labor reallocation was a key driver of agricultural productivity growth, although within-farm productivity growth was also important. In most countries relying on labor-intensive technologies, agricultural productivity growth arose from within-farm productivity growth ignited by the shift from large-scale collective farming to small-scale individual farming. In
land-abundant countries relying on capital-intensive technologies, agricultural productivity gains arose primarily because large farms shed labor following land privatization and farm restructuring. However, the boost provided to labor productivity by land redistribution was a one-time event. Sustained gains in agricultural productivity will require (a) greater trade and foreign investment flows into the sector to support on-farm technology transfer, (b) improved financial and transport sectors to facilitate the development of the sector, and (c) less labor market rigidities and greater education investments to improve the mobility of agricultural workers.

The analysis focuses mainly on labor productivity, though other productivity indicators are also used depending on data availability: (a) yields (output per unit of land) and (b) TFP growth. The latter is estimated for a subset of countries in the Region for which input factor data (land, labor, capital, fertilizer, and animal stock) are available. Drawing on farm-level data, the analysis is also performed on TFP growth.

### Agriculture Performance

As we saw in the previous section, agricultural shares in total output declined in most countries in the Region, but employment shares differed across countries. In general, the decline in the terms of trade and the reduction in agricultural output prices were accompanied by dramatic reductions in input use in agriculture. Agricultural shares of output fell across the Region. In contrast, land use remained relatively stable, with the exception of some CIS countries (such as Kazakhstan and the Kyrgyz Republic) where land abandonment has increased in recent years. The trends in agricultural labor use have diverged significantly across countries. Notably, labor use in agriculture declined dramatically in most EU-10 countries, while it remained constant or even increased in low-income CIS and SEE countries.

The Region saw a remarkable recovery in agricultural productivity growth over 1999–2004, but a substantial gap in productivity levels remains. Most CIS countries that experienced the deepest declines in productivity before 1998 have seen a remarkable recovery. Since 1999, labor productivity has been growing throughout the Region, albeit at quite different rates. In the EU-10, strong labor productivity growth in agriculture has been largely due to labor flowing away from agriculture. Nevertheless, a substantial divide in productivity levels remains, with EU-10 at one side of the spectrum, and the low income CIS at the opposite end (figure 2.8).

Agricultural TFP growth follows the same patterns as agricultural labor productivity growth across countries. Data on input factors
(land, labor, capital, fertilizer, and animal stock) from the Food and Agriculture Organization of the United Nations and the OECD permit the estimation of aggregate agricultural TFP growth for eight countries in the Region: Albania, Bulgaria, the Czech Republic, Hungary, Poland, Romania, the Slovak Republic, and Slovenia. TFP growth is higher in early reformers (figure 2.9).

Farm-level data confirm aggregate patterns: the more advanced EU-10 countries enjoy higher average farm efficiency than do the CIS and SEE countries (figure 2.9). 4

Differences in agricultural productivity across countries reflect the deep divergences in the chosen paths of policy reforms. Three main groups of countries may be distinguished.

- In land- and capital-intensive EU-10 countries, labor productivity growth in agriculture is explained to a greater extent by reallocation...
(labor shedding) and subsequent capital deepening. In these countries, only about 5 percent of employment was in agriculture. The rapid outflow of labor from agriculture resulted in major gains in labor productivity despite modest yield increases (an average of about 3 percent annually). In some countries, such as the Czech Republic, Estonia, Hungary, Lithuania, and the Slovak Republic, productivity growth was still very strong (an average between 7 and 20 percent per year). A significant share of agriculture in all these countries was organized in large-scale farming companies that had made significant investments in capital. In countries dominated by small-scale individual farms, such as Latvia, Poland, and Slovenia, labor productivity growth was more limited.

- In labor-abundant countries, most low income CIS countries and the SEE, agricultural productivity growth did not arise from labor shedding, but from a shift to small farms following land privatization reforms. In Albania and Azerbaijan, almost half the population is still employed in agriculture, and virtually all agricultural land is cultivated on small individual farms. In these countries, there was no significant outflow of labor away from agriculture, unlike in the EU-10. Productivity growth arose from gains spurred by land reforms that strengthened the incentives of farmers to boost efficiency. However, in most of these countries, land privatization in the absence of a social security mechanism led to the absorption of a typically older labor force into farming. As a result, productivity levels in these countries remained low.

- In countries with strong regional differences in initial technology and farm structures, regional variations in farm restructuring and labor adjustment patterns mimicked cross-country evidence. In Poland, the southern and eastern regions were characterized by small-scale and relatively small intensive production, while the western and northwestern regions were dominated by large-scale farms. In the western and northwestern regions, there was a rapid outflow of labor away from agriculture in the early transition years, with strong increases in labor productivity. In contrast, in the eastern and southern regions, there were fewer such adjustments, and surplus labor stayed on farms.

**Policy Drivers of Agricultural Productivity**

Uneven progress in reform and the interplay with initial resource intensities contribute in explaining differences in agricultural productivity
patterns. Several policy reforms affected agricultural productivity patterns, including trade liberalization, the reduction of agriculture subsidies, and land privatization.

Trade liberalization, removal of or cuts in subsidies, and price liberalization had different effects on productivity and labor use across the Region. The reforms caused a substantial decline in the agricultural terms of trade in all but the poorest countries in the Region. This decline implied a strong reduction in the demand for agricultural labor. But trade and price liberalization also changed the relative factor costs. In many cases, price liberalization caused prices for other inputs, especially capital inputs, to increase relative to wages.

The effect of land privatization on agricultural productivity varied across countries. In labor-abundant countries, the breakup of large-scale farms into smaller individual farms increased the incentives of farmers to improve efficiency. In capital-abundant EU-10 countries, privatized farms, facing hard budget constraints and competition pressures, shed a large number of workers and made substantial technological improvements. In middle income CIS countries with relatively land- and capital-intensive production systems, but with ongoing soft-budget constraints, labor shedding was limited. However, after 1998, labor shedding by large corporate farms in Russia also contributed to labor-productivity increases.

After the initial impact of land privatization and trade liberalization, broader structural reforms are needed to sustain agricultural productivity growth. Policies aimed at strengthening market competition, improving the investment climate, and promoting service liberalization may boost agricultural productivity growth by improving the incentives for farmers to innovate.

Evidence offered by farm-level data shows a positive correlation between farm-productivity growth and reforms in the investment climate and competition. The correlation is closer with the EBRD index (a nonagricultural index capturing progress in the overall investment climate and market competition) than with the agricultural reform index compiled by the World Bank (capturing progress in land reforms, privatization, and other reforms in the sector). This suggests that the main policy drivers of farm-productivity growth are not specific to agriculture. General reforms improving the investment climate stimulate investments in some upstream agricultural sectors (such as agroprocessing) and also create off-farm employment. Trade and the inflow of foreign investments may also bring new technology into agrifood chains, fostering within-farm productivity growth.
The efficiency of service industries is also particularly important for agricultural productivity. Better performance in services as a result of liberalization may be crucial for productivity gains in agriculture. The use of service inputs in agriculture varies across the Region, but some common patterns emerge. Electricity, transport, and financial services have the highest shares of total service inputs in agriculture. Electricity usage in agriculture ranges from 4 percent of total inputs in Estonia and the Slovak Republic to 2 percent in Lithuania. The share of transport, the second most important service input, ranges from 3 percent in Bulgaria and Romania to nearly 5 percent in Lithuania (figure 2.10).

Empirical analysis shows that service liberalization exerts a strong positive effect on farm-productivity growth. The effect of liberalizing backbone services (transport, telecommunications, electricity, water, and financial intermediation) on labor productivity among corporate farms is positive and significant (see appendix 2.C). Farms that rely more on inputs from more liberalized services exhibit higher productivity than do other farms.

Although most countries of the Region have implemented (to a greater or lesser extent) these first-generation reforms, sustaining agricultural productivity growth requires parallel progress on two fronts:

- **Accelerating the pace of reallocation, particularly in the CIS.** State intervention in both price formation and trade policy remains a challenge in many CIS countries. Although there has been significant

**FIGURE 2.10**
The Efficiency of Service Industries Is Important in Agricultural Productivity

Sources: World Bank staff calculations; input-output tables (see appendix 2.C).

Note: The figure shows the share of the total intermediate consumption of agriculture that is accounted for by service industries, NACE 40–70.
progress toward a more liberal agricultural trade policy in recent years, land privatization and trade liberalization remain a priority in Tajikistan and Uzbekistan. In Russia and Ukraine, although land ownership has been transferred to private hands, the larger farms are still intact. Improvements in the education of rural workers and in social protection systems, by enhancing worker mobility, favor the reallocation of labor away from agriculture. The EU-10 countries also face the challenge of progressively reducing protection to the sector that has increased since EU accession.

- *Boosting within-farm productivity growth through stronger market competition in backbone services.* In the EU-10, backbone services (finance and transport) have improved considerably, but remain weak and mostly dominated by foreign banks that do not extend much credit to the agriculture sector. In most CIS and SEE countries, financial systems have not yet fully adjusted to the needs of a market-based agriculture sector, although, in some countries (Armenia, Georgia, and Moldova), agricultural credit cooperatives have recently emerged.

**Manufacturing Productivity**

This section focuses on a subset of countries (EU-8) for which disaggregated manufacturing data and comparable industrial PPP deflators are available.

**Manufacturing Performance**

Average annual labor productivity growth in manufacturing was much higher in the EU-8 than in the EU-15 (figure 2.11). Among the EU-8, the average annual labor productivity growth rate was highest in Lithuania and Poland and lowest in the Czech Republic and Latvia. Average annual labor productivity growth decreased in Estonia, Poland, and Slovenia. But, even in the EU-8, productivity levels lagged behind the EU-15. Although average labor productivity increased in all EU-8 countries from 1995–98 to 1999–2004, average labor productivity in the EU-8 was still less than 30 percent of that in the EU-15. Productivity also varied across the EU-8; it was highest in Poland and Slovenia and lowest in Latvia and Lithuania.

The productivity surge in manufacturing was driven by ICT industries that are often export oriented (figure 2.12). The highest average annual labor productivity growth in the EU-8 was in ICT-producing
industries (radios and office machinery), as well as ICT-using industries (rubber and plastics, machinery and electrical apparatuses). In the EU-15, office machinery and electronics showed the highest productivity growth. In these industries, the large productivity gain is not only a reflection of capital deepening, but, more important, a result of rapid technological developments, which increased by several times the utility value of ICT products for the same value of inputs. (In the next section we examine in greater detail the roles of ICT and foreign trade in manufacturing productivity.) The highest labor productivity during 1999–2004 was in office machinery and chemicals. Across most industries, labor productivity is higher in the EU-15 than in the EU-8.

Only a few industries managed to sustain rapid productivity growth. Radio, television, and communication equipment; motor vehicles; and office machinery had the strongest productivity growth after 1995 (figure 2.13). These industries tend to be closely integrated into global production chains. (Later in the chapter we discuss in more detail the role of global production chains and network effects.)

**Policy Drivers of Manufacturing Productivity**

Wide disparities existed in labor productivity growth across manufacturing industries. Some of these differences were due to different
FIGURE 2.12
Labor Productivity Growth in Manufacturing Is Higher in the EU-8 Than in the EU-15, 1999–2004

a. Average labor productivity growth

b. Average labor productivity

Sources: World Bank staff calculations; EU KLEMS Database 2007.
levels of investment (capital deepening) in capital-intensive industries (such as metals). Capital-intensive industries invested in ICT because the scope to automate plant operations and upgrade equipment to save labor and capital costs is greater. In these high-technology industries, TFP growth tends to be lower than labor productivity growth. But capital deepening is only part of the story. The highest productivity growth was in medium- and high-technology industries that employed highly skilled labor, drew on external financing, were more active in R&D, generated greater export sophistication and more innovation, and were more deeply integrated into global production chains (see figure 2.14).

**Investing in ICT**

ICT-producing industries showed the highest productivity in manufacturing and more rapid productivity growth over 1999–2004. In the EU-8, ICT-producing industries had the highest labor productivity during 1999–2004 (about 28,000 euros per worker in 1997 PPP terms; see figure 2.15). ICT-producing industries also experienced the most rapid productivity growth over 1999–2004, at more than 12 percent, relative to an average 7 percent labor productivity growth in non-ICT industries over the same period. However, the ICT-manufacturing sector in the EU-8 is still small and is potentially the main driver of convergence with EU-15 productivity levels (see later section on ICT).
FIGURE 2.14
Policy Drivers of Manufacturing TFP Growth, 1999–2004

a. TFP growth and ICT skills

b. TFP growth and labor market rigidity

c. TFP growth and R&D

d. TFP growth and financial development

e. TFP growth and FDI inflows

f. TFP growth and export sophistication

g. TFP growth and producer networks

h. TFP growth and buyer networks

Sources: Authors’ calculations; b. Economic Freedom of the World Database.

Note: The dependent variable is the change in log TFP from 1999 to 2004, subtracting the effects of all other repressors. See appendix 3.B for details.
**Investing in Skills**

Manufacturing industries that drew on high-skilled workers displayed higher productivity and more rapid productivity growth (9 percent annual labor productivity growth over 1999–2004) than industries that relied on low-skilled workers (figure 2.16).

Investing in skills may also help accelerate the pace of reallocation, leading to more productivity improvements. In the Region, high-technology industries were absorbing younger and more highly skilled workers than the low-technology sectors (figure 2.17). In Slovenia, younger and more skilled workers showed a higher probability of transiting into nonagricultural employment, specifically in the service sector (figure 2.18). An increase in the supply of tertiary education and, in particular, ICT-skilled labor, favored the shift of workers from lower- to higher-productivity activities in the EU-8.

**FIGURE 2.15**

**ICT Industries Showed More Rapid Productivity Growth, 1999–2004**

![Graph](image1)

Sources: World Bank staff calculations; EU KLEMS Database 2007.

Note: See appendix 2.D on ICT taxonomy. EU-8 = Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Republic, and Slovenia.

**FIGURE 2.16**

**Industries with High-Skilled Workers Displayed Higher Productivity, 1999–2004**

![Graph](image2)

Sources: World Bank staff calculations; EU KLEMS Database 2007.

Note: See appendix 2.D on skill taxonomy.
Secondary educational attainment was high and tertiary enrollments also started to grow thanks to education reforms beginning in the 1990s that aimed to meet the educational needs of a changing labor market. In upper secondary education, the reforms were geared to providing more work-oriented skills and reinforcing the general educational component of the system, which increased the proportion of students attending general secondary courses. The level of secondary educational attainment tended to be high by international standards. Tertiary enrollments also grew, driven principally by high and rising incomes and employment opportunities. In the Czech Republic, for example, the tertiary education enrollment rate more than doubled, from 7 to 15 percent, between 1995 and 2004.
But tertiary educational attainments are still low by international standards, and diversifying tertiary education toward more vocationally oriented courses is needed to reduce skill shortages and raise productivity. Reflecting demographic decline, the demand for secondary education will soon fall quite rapidly. At the same time, the tertiary education population will increase, and the pressures will stem not only from 19- to 25-year-olds, but also from a backlog in demand from older cohorts.

In addition, population aging in the EU-10 implies that considerable attention will have to be paid to improving the opportunities for lifelong learning. Currently, participation in continuing education is low, at only 5 percent of the working-age population. This is partly because providers have been slow to adapt to economic changes and business needs and partly because the possibilities of transferring individual qualifications across levels and types of institutions have been limited.

**Improving Labor Market Flexibility**

Onerous labor market regulations may depress productivity in low-technology industries if employers are restricted from shedding labor after the introduction of labor-saving technologies. Strict employment protection legislation is also likely to reduce productivity growth in high-technology industries with relatively low levels of market concentration where technologies tend to evolve or be replaced quickly. But the negative impact of labor market rigidities on industry-level productivity is likely to be less in high-technology industries with higher market concentration, such as in electronic components and aircraft (OECD 2001, 2004).

Greater labor market flexibility may improve worker mobility and facilitate the shift of labor from less- to more-productive activities. The direction of labor market reforms has been toward improving flexibility in hiring and firing regulations (for example, lower direct dismissal costs or the removal of trade union vetoes on dismissals), promoting temporary and part-time employment, and allowing for opting out on collective agreements. The EU-10 countries, as they were approaching entry into the EU, were more aggressive in liberalizing labor markets than others (Ukraine, for example). This development suggests that EU accession may have played a disciplining role in promoting labor market reforms (World Bank 2005a).

However, there is still room for more flexible labor markets. In the EU-10, the protection of permanent workers is better than in the OECD (figure 2.19). While employment protection legislation may help in ensuring secure and decent work, it is also important to balance these
considerations against the need for sufficient flexibility to promote the efficient allocation of labor and boost productivity growth. Allocative efficiency is still much lower in the EU-10 than in the EU-15 and the United States (see chapter 3).

**Supporting Private R&D**

R&D investments, particularly those financed by the private sector, tend to raise productivity both directly through a firm’s own investments and indirectly through spillover effects within industries. Empirical evidence shows that firms operating in industries with higher R&D investments financed by the private sector tend to display higher productivity growth (see appendix 3.B). These findings are consistent with the literature (see Griliches 1988; O’Mahony and Vecchi 2002).

There is more business-financed R&D in industries that obtain higher returns from it. Business-financed R&D intensity differs across countries, but it is higher in medium- and higher-technology industries with high productivity growth and a strong outward orientation. Private R&D investments are still much lower in the EU-10 than in industrialized countries. Almost two-thirds of R&D spending in the EU-10 is financed by government. Less than one-third is financed by industry. In contrast, in countries that are world leaders in R&D (Finland, Japan, Sweden, and the United States), the proportions are reversed: the industry share of R&D spending ranges from 65 to 70 percent, while government spending amounts to only 20–30 percent. Governments in the EU-10 recognize this
challenge and have supported business R&D through tax concessions and grants and by encouraging public research agencies and universities to conduct collaborative research with business enterprises (OECD 2004).5

**Financing Innovation**

A large literature emphasizes the positive influence of the development of a country’s financial sector on industrial and macroeconomic performance.6 Empirical analysis conducted for this study confirms the link between financial deepening and productivity growth. Firms operating in industries with higher dependence on external financing exhibit higher productivity growth in countries where financial markets are more developed (see chapter 3 and appendix 3.B for details).

In the Region, the underdevelopment of financial products for the support of innovation hinders productivity growth. Even in the EU-10, it is difficult to find funds to finance intermediate phases of project or product development (such as the preparations to bring a product to market and to market it). Finance may be obtained for earlier phases, such as laboratory work, in the form of research grants. Later development phases, in which a new product is launched on the market, are financed by private equity. But the middle phase is particularly difficult to finance.

Even in advanced reformers, equity markets remain small, and venture capital investments are low. At the end of 2005, with the exception of the Czech Republic, Hungary, Lithuania, and Poland, stock market capitalization was less than 30 percent of GDP in the Region. The ratio of venture capital to GDP was also low. In the Czech Republic and Poland, the venture capital–GDP ratio is about 0.1 percent, whereas in the United Kingdom or the United States, venture capital accounts for 1 percent of GDP. Moreover, private equity investments in mature ventures dwarf venture capital. In Poland, buyout and replacement capital investments represent about 70 percent of total private equity investments, most going to mature companies (Ben-Ari and Vonortas 2005).

**Promoting Innovation through Trade and Foreign Investment**

Openness to trade and foreign investment improves productivity directly by providing access to new investment capital, technologies, expertise, and export markets and indirectly by speeding up the reallocation process. A key reform at the beginning of the transition from central planning to the market economy was trade liberalization and openness to foreign capital inflows. Total merchandise exports expanded, particularly in the EU-10, reaching about 45 percent over
1999–2004. Trade in services, which had been considered a low priority under central planning, also rose rapidly in the EU-10, though it still represented a small share of GDP (about 7 percent). Foreign direct investment (FDI) inflows likewise increased dramatically. In the EU-10, these inflows accounted for 2.5 percent of GDP (figure 2.20).

Trade and foreign investment improve productivity growth by providing access to new investment capital, new technologies, expertise, and export markets. Research in the Czech Republic, Latvia, and Lithuania finds that foreign entry in downstream manufacturing industries boosts the productivity of local suppliers upstream (Arnold, Javorcik, and Mattoo 2007; Javorcik 2004). Recent empirical evidence shows that exports and FDI are driving productivity growth in the Czech Republic and Poland (figure 2.21).

**Integrating into Global Production Chains**

Productivity growth rates were particularly strong in medium- and high-technology industries showing rapid export growth and were well integrated into global production chains. The EU-10 saw rapid growth rates in medium- and high-technology industries and an increase in export products with a world comparative advantage. In contrast, low income CIS countries saw declines in their shares in medium- and high-technology exports. These countries also saw a reduction in the number of export products with a comparative advantage (figure 2.22).

In medium- and high-technology industries, productivity growth is driven by small niche producers who specialize in certain parts, components, or subassemblies (typically in the ICT and automobile sectors). The countries of the Region began by participating in the network trade in clothing and furniture, which are intensive in unskilled labor and embedded in buyer-driven production chains,

---

**FIGURE 2.20**

**Trade and FDI Have Grown**

![Graph showing trade and FDI growth](image)

Sources: World Bank staff calculations; UN Comtrade 2007.
whereby global buyers create a supply base for production and distribution systems that are built up without their direct ownership. However, the advanced reformers (the EU-10 and Turkey) were able to shift quickly to producer-driven networks in manufacturing industries such as the automotive industry and information technology (figure 2.23). Producer-driven networks divide the value chain into smaller components and move them to countries where production costs are lower. This transition to producer-driven networks has not taken place in the CIS and SEE countries, however; these countries are still involved in the buyer-driven production chains for clothing and furniture.

Empirical analysis conducted for this report confirms the link between manufacturing productivity growth and participation in...
producer-driven network trade. Regression analysis conducted on a group of countries in the Region shows that firms operating in industries with increased participation in producer-driven networks (and buyer-driven networks to a lesser extent) show higher productivity growth than firms in other industries (see appendix 3.B).

Foreign investment has also been instrumental in incorporating local manufacturing capacities into global production networks. Indeed, entry into producer-driven networks appears to be virtually impossible without foreign investment. Two of the largest recipients of FDI—the Czech Republic and Hungary—have also been the best performers in producer-driven network exports. There is a strong positive association between the stock of FDI in manufacturing per capita and producer-driven network exports per capita in the Region (World Bank 2005b). Countries with larger stocks of FDI per capita also show a higher share of skilled labor and capital-intensive products in total exports.

Export Innovation and Sophistication
Productivity patterns are associated with different export strategies: countries with stronger manufacturing performance display higher numbers of export discoveries and export sophistication. The share in new export products in total exports is higher in the EU-10 and Turkey than in the rest of the Region. Most of these new exports are produced with capital-intensive methodologies in medium- and high-technology industries (figure 2.24).
Figure 2.24
Early Reformers Also Display More Export Discoveries

Sources: World Bank staff calculations; UN Comtrade 2007; Klinger and Lederman 2006; Leamer 1984.
Behind the productivity differences are also varying export strategies. Poland and Russia offer an example. Although both countries started the 1990s with export packages of roughly equivalent sophistication (as measured by the export sophistication index developed by Hausmann, Hwang, and Rodrik 2006), Poland’s manufacturing sector has been engaged in a continuous upgrading of its export basket toward more sophisticated products, such as automobile components. In Russia, this process has stagnated since 1998, and the country specializes in low-sophistication export products such as metals and petroleum. The degree of export sophistication in Russia is now only 75 percent of that in Poland (figure 2.25). What has been holding back the process of structural transformation in the Russian manufacturing sector? One answer is the structure of production. Russia is specialized in highly peripheral products: goods requiring inputs that have few alternative uses in the development of new products. This is reflected in the low value of its open forest (indicating the small number of new products for which current productive capabilities may be used). Poland, moreover, is specialized in a dense part of the product space. This specialization is reflected in the high value of its open forest, which makes the process of structural transformation and export upgrading much easier because there are many new export products requiring productive capabilities similar to those already existing in the country (figure 2.25; see also box 2.2 and appendix 2.D for more details).

Rendering manufacturing productivity growth sustainable will also require support for the process of structural transformation through the provision of public goods that spur export innovation.

**FIGURE 2.25**

A Gap in Export Sophistication and Capabilities Remains between Early and Late Reformers, 1990–2005

- a. Export sophistication index
- b. Export option value, open forest

Sources: Klinger 2007a, 2007b.

*Note: RCA = revealed comparative advantage.*
either through product innovations (new exports) or through process innovations (improving the sophistication of manufacturing exports). The links between export sophistication, the capability to develop new exports (open forest), and productivity levels are strong and positive in the Region (figure 2.26).

In sum, policies that support innovation through financial deepening, investments in human capital, and outward orientation should be a priority so as to sustain productivity growth in manufacturing.

**BOX 2.2**

The Product Space in Russia and Poland

The differences in export bundles are reflected in the relative comparative advantage of the product space in each country. The product space is a measure developed by Hausmann and Klinger (2006). Each product not currently exported with a comparative advantage has a particular distance from the country’s current export basket (x-axis). In addition, each of these products has a level of sophistication (y-axis). A smaller value of the x and y axes represents a product that is closer to the current productive structure. Products below the line are less sophisticated than the country’s export basket as a whole. The colors correspond to Leamer commodity clusters of export products (Leamer 1984).

The product space is relatively dense in Poland and Russia, but the productive capability to export new products differs greatly in these countries. In both countries, there are many new export products above the line (meaning that there are many products that the country is not currently exporting that would generate higher added value than the products currently exported). However, in Russia these products are far away (density of 2) from the country’s current export structure. In Poland, in contrast, there are many products that the country is not currently exporting that are close to its current productive capabilities (starting density at 1). The current productive structure of the manufacturing sector in Poland may therefore be adapted for the development of new export products more easily than the productive structure in Russia.

![Diagram of the Product Space in Russia and Poland](image)

Sources: Klinger 2007a, 2007b.

Note: For explanations of PRODY and EXPY, see appendix 2.D.
FIGURE 2.26
The Gap in Productivity Was Associated with a Gap in Export Sophistication, 1999–2005

Sources: World Bank staff calculations; Klinger 2007a, 2007b.

Note: RCA = revealed comparative advantage. Φ = bloc of countries; ● = individual countries.
These policies may also include efforts to attract new FDI inflows and support export diversification, measures to enhance private R&D and support investments in ICT, additional reforms in higher education and training programs, and more efforts to improve the performance of service sectors. The next section explores the link between service performance and manufacturing productivity.

**Service Productivity**

Improvements in service productivity may affect productivity growth directly and indirectly. We saw earlier that the recent sectoral shift toward services has contributed to an increase in aggregate productivity in the Region. An efficient service sector also has indirect consequences for economic growth through the efficiency of other sectors in the economy (Eschenbach and Hoekman 2006; Arnold, Javorcik, and Mattoo 2007). High-quality market services such as transport or telecommunications affect production costs and, consequently, the competitiveness and the degree of integration into global markets of firms in all sectors. Moreover, high-quality services may also influence the attractiveness of a location for FDI. Service liberalization may help increase average productivity for incumbent firms and may also facilitate the new entry of firms likely to be more innovative and successful in meeting consumer demands and similarly encourage the exit of less-productive firms (see chapter 3).

**Service Performance**

Labor productivity growth in services was higher in the EU-8 than in the EU-15. Labor productivity growth in services increased substantially in the EU-8 between 1997–2000 and 2001–04 (figure 2.27). There was wide variation of country performance across the EU-8. During 1997–2004, the best EU-8 performer, Hungary, had an unweighted average service labor productivity of 69.7 percent of the EU-15 average (58.2 percent weighted), while Lithuania had an unweighted average service labor productivity of only 25.6 percent of the EU-15 average (26.2 percent weighted).9

The EU-15 exhibited substantially higher average labor productivity in the service sector than the EU-8, with a few exceptions. For instance, Estonia and Hungary displayed higher average service labor productivity than the EU-15 in computer and related activities and in legal, technical, and advertising activities.10
There was wide variation in EU-8 service productivity performance across industries. Real estate and financial intermediation exhibited the highest average labor productivity; in contrast, tourism services (hotels and restaurants) and wholesale trade exhibited the lowest average labor productivity. Transport, telecommunications, financial intermediation, and retail trade showed the strongest productivity growth in 1997–2000 and 2000–04. But the wholesale trade and hotels and restaurants saw declines in productivity (figure 2.28).

If recent service productivity growth rates continue, they will lead to improvements in efficiency among backbone services such as transport, telecommunications, and finance. Any efficiency improvements would be crucial for the competitiveness of other sectors (via reductions in production costs) and would facilitate the participation of the Region in the global service production chains.

Policy Drivers of Service Productivity

A number of factors explain differences in performance across service industries, including capital intensity, market size, the scale at which services may be sold, technological innovations (particularly the use of ICT), skilled labor, and progress in service policy reform.

ICT

ICT service industries showed substantially higher average labor productivity than non-ICT service industries in most EU-8 countries during 2000–04. These findings suggest that there was a progressive penetration and efficient use of ICT in the service industries in the
EU-8 during this period (figure 2.29). ICT users experienced the most rapid productivity growth in all EU-8 countries except Latvia and Lithuania. In Hungary and Poland, ICT producers (in services) also showed more rapid productivity growth than did non-ICT service industries. The high productivity growth in financial intermediation and in transport, storage, and telecommunications documented elsewhere above for these countries may be explained by the introduction of cost-reducing ICT. Productivity growth has been higher among ICT users in most EU-8 countries recently. The next section will explain in detail the potential of ICT to reduce the large productivity gap between the EU-8 and the EU-15.

**Skilled Labor**

Service industries that draw on a more highly skilled workforce have not only shown higher productivity levels in recent years, but have also achieved more rapid growth. In contrast service industries that have relied mostly on low-skilled workers have experienced declines in productivity growth; their productivity levels are...
only about 25 percent of the productivity levels in industries that employ more highly skilled workers (figure 2.30).

**Service Liberalization**

The performance of service industries is also tied to the progress of the policy reforms leading to liberalization in these industries. Eschenbach and Hoekmann (2006) discuss in detail the content of service policy reforms in the Region and the progress in liberalization. These policy reforms combine deregulation (the dismantling of entry barriers and the promotion of competition) and improved regulation (the establishment of an appropriate legal and institutional environment). On average, more progress in liberalization reform has been achieved in the telecommunications and the electricity industries and in the EU-10.
Despite significant progress, the Region still exhibits high levels of product market regulation that stifles competition, growth, and innovation in the service sector (OECD 2005). Moreover, there is still significant cross-country heterogeneity in the degree of liberalization and the quality of the regulatory framework facing the service sector, which may help explain the differences in performance documented elsewhere above. To capture the extent of service liberalization across the Region, we have used the EBRD index of progress in policy reform (which is industry specific and varies over 1997–2004). The service industries covered by the EBRD index are electricity, water distribution, road transport, telecommunications, banking reform, interest rate liberalization, and nonbanking financial institutions.\textsuperscript{13}

Empirical analysis conducted for this report shows that there is a strong association between service liberalization and productivity performance in service sectors. The regressions are estimated using ordinary least squares, including country dummies, industry dummies, year dummies, and an interaction between industry dummies and year dummies, or by using industry fixed effects, including year dummies. Year dummies account for the business cycle or other macroeconomic factors affecting all industries equally, while service industry dummies account for fixed differences in productivity growth across industries. The interaction dummies control for problems in the measurement of output in service industries and problems related to the use of imperfect deflators for real value added (see appendix 2.E for the results).\textsuperscript{14}

The liberalization of services may influence the average performance of service industries through its impact on firm productivity and on reallocation. Service liberalization may help increase the average productivity among incumbent firms and facilitate the entry of new firms, which are likely to be more innovative and successful in meeting consumer demand, and the exit of less-productive firms (see chapter 3).

**The Effect of Services on Manufacturing Productivity**

The efficiency of service industries is important partly because these sectors are increasingly contributing to the economies in the Region and partly because service industries account for critical inputs in downstream manufacturing sectors. Hence, liberalization-related improvements in the performance of the service sector may be crucial in promoting productivity growth. Interestingly, the use of service inputs in manufacturing varies greatly across the Region.
Electricity, road transport, and financial services represent the highest shares of total service inputs in manufacturing. Average electricity use in manufacturing ranges from 2 percent of total inputs in the Czech Republic to 11 percent in Romania (figure 2.31). Across the Region (except in Lithuania and Romania), inputs from electricity, gas, and steam represent a higher share of the total inputs used in textiles and textile products than of the inputs used in electrical and optical equipment. The second most important service industry in terms of input provision to manufacturing is road transport, the average share of which in total inputs ranges from 1.3 percent in Poland to 6 percent in Lithuania.

Empirical analysis conducted for this study shows that the effect of service liberalization on labor productivity in downstream manufacturing is strong and positive (see appendix 3.B). More specifically, manufacturing industries that rely more heavily on inputs from more liberalized services exhibit higher productivity than do other manufacturing industries. This is consistent with the findings of Arnold, Javorcik, and Mattoo (2007) on the Czech Republic (see chapter 3 for more analysis on the role of service liberalization in firm productivity).

In sum, the prospects for sustained productivity growth are likely to depend to a large extent on more efficient and more dynamic services. There is clear potential for service-driven productivity growth in the Region if policy makers sustain the momentum of reform by pursuing service liberalization, removing the product market barriers that are still limiting competition in various industries, allowing more FDI, and providing incentives to promote the trade in services. Productivity growth in services would also benefit
from the penetration of more ICT, which requires improvements in competition and the continued liberalization of telecommunications.

The Role of ICT in Productivity Growth

This section provides a detailed analysis of the impact of ICT on labor productivity growth in the EU-8—whenever the data allow, the analysis includes Bulgaria, Romania, and Russia—and examines the productivity effects of various types of policy reforms in ICT-related manufacturing and service industries.

Because ICT products and services represent both the outputs of ICT-producing industries and inputs into ICT-using industries, ICT may affect labor productivity through three channels.

- ICT capital is an input in the production of other goods and services.
- Productivity increases in ICT-related industries contribute to aggregate TFP growth in the economy.
- Productivity increases in non-ICT-producing sectors occur through the use of ICT (spillover effects).

The Contribution of ICT Capital to Productivity Growth

Much of the attention on the role of ICT in growth has focused on the contribution of ICT production in growth. However, a number of studies have shown that, as a source of growth in the United States, the G-7 countries, and the EU-15 during the 1990s and early 2000s, ICT capital was more important than ICT-related TFP growth.\textsuperscript{15}

The contribution of ICT capital to labor productivity growth in the EU-8 was equal to or greater than that in the EU-15. Piatkowski and van Ark (2007) perform growth accounting and compare the contributions of ICT capital to labor productivity growth in the Region, the EU-15, and the United States during 1995–2003 (figure 2.32). In absolute terms, the contribution of ICT capital to labor productivity growth in the EU-8 was greater or comparable with that in the EU-15.

However, there are substantial differences across the Region. Only the ICT capital contributions in the Czech Republic, Hungary, and Poland were above those in the EU-15 in absolute terms. The ICT capital contributions to labor productivity growth were much lower in slower reformers (Romania and Russia) than in the EU-15 (figure 2.33).

ICT investment in the Region may have been dependent on network effects. Within the EU-8, countries with higher labor productivity
levels show larger contributions from ICT capital, implying that these countries have successfully used ICT to increase growth in labor productivity to the same degree as the most ICT-intensive countries in the EU-15. This usage suggests that ICT investment in the EU-8 may have been dependent on network effects; in other words, higher levels of development, particularly in ICT infrastructure, have stimulated more rapid growth in the use of ICT through feedback effects. In most EU-8 countries, TFP growth is also driven by productivity effects from the production or use of ICT goods and services.
The Contribution of ICT Production

Although ICT capital has been an important source of productivity growth in the EU-8, there is reason to assume that at least some countries may also have benefited greatly from attracting the production of ICT goods, particularly through FDI.

The growth in ICT-producing industries accelerated the convergence of the EU-8 toward the EU-15 average. ICT production made the largest absolute contribution to labor productivity growth in Estonia, Hungary, and Latvia. The (unweighted) average of the ICT contribution to productivity was higher in the EU-8 than in the United States and the EU-15 (figure 2.34). Hence, the growth in the ICT-producing sector accelerated the convergence between the EU-10 (with the exception of the Slovak Republic and Slovenia) and the EU-15.

What explains the difference between the rapid growth of the ICT sector in some countries and the much slower growth in others? van Ark and Piatkowski (2004) argue that the rise of the ICT sector in the EU-8 may be explained largely by inflows of FDI because domestic industries were not sufficiently competitive to develop. This was so because of technological retardation, lack of access to high-risk financing, and the low level of innovation. In turn, FDI was dependent on the progress made on first-stage reforms (trade openness, development of infrastructure, rule of law, macroeconomic stability) and privatization policies.

Despite its positive contribution to productivity growth, the ICT-producing sector in the Region is still too small. Even in the most

---

**FIGURE 2.34**
The Contribution of ICT-Producing Industries to Labor Productivity Growth, 1995–2004

![Image showing the contribution of ICT-producing industries to labor productivity growth in various countries from 1995 to 2004.](source: Piatkowski and van Ark 2007.)
advanced reformers (the EU-8), the share of ICT-producing industries in GDP is only 5–6 percent. The ICT-related spillover effects are too scant to drive the sustained convergence toward the income levels in the EU-15. So, convergence will have to rely on productivity growth outside the ICT-producing industries.

The Contribution of ICT Use

Given the overwhelming share of ICT-using industries in total GDP, the productive use of ICT in manufacturing and services will be key to more rapid growth and convergence toward the incomes in the EU-15.

Productivity growth in ICT-using manufacturing industries in the EU-8 was substantially higher than that in the EU-15 and the United States. Thanks to high productivity growth, the manufacturing industries in the EU-8 contributed 0.4–1.9 percentage points to aggregate labor productivity growth between 1995 and 2004, substantially more than in the EU-15 or the United States.

However, productivity growth in ICT-using service industries was much lower than that of ICT-using manufacturing industries over 1995–2004 and much lower than the corresponding growth in the United States. So, although market services contributed two-thirds of GDP, their contribution to productivity growth was less than that of manufacturing in most EU-8 countries (figure 2.35).

What explains such large differences in the productivity growth rates between ICT-using industries in manufacturing and services? To answer this question, the empirical analysis in this section studies the

FIGURE 2.35
ICT-Using Services Contribute Less to Productivity Growth
Than Do ICT-Using Manufacturing

![Figure 2.35](image)

Source: Piatkowski and van Ark 2007.
types of structural reforms that have been most effective in driving productivity growth in manufacturing during the first stage of transition and the reforms that will be key in supporting productivity growth in the future. The higher productivity growth in ICT-using service industries in the United States suggests that only that country has succeeded in moving to the second phase in the productive use of ICT in the service sector. As argued by Piatkowski and van Ark (2007), this is because of the much more conducive business environment in the United States, stemming primarily from the more competitive product markets, the flexible labor markets, organizational innovations, the large investments in R&D, and the availability of high-risk financing.

Labor productivity growth in ICT-using manufacturing industries is more closely correlated with basic fundamental reforms, whereas productivity growth in ICT-using market services is more correlated with a more sophisticated set of reforms. Drawing on a panel data analysis of four EU-8 countries (the Czech Republic, Hungary, Poland, and the Slovak Republic), the EU-15, and the United States, this section explores the policy determinants of labor productivity growth in ICT-using industries in manufacturing and services over 1995–2005 (see appendix 2.F). Despite the low statistical fit because of the small data set and the high volatility of productivity growth rates, the regression results show that labor productivity growth in manufacturing is more closely correlated with basic fundamental reforms (governance quality, trade openness, macroeconomic stability, and financial system development) than with productivity growth in market services. At the same time, we find that more sophisticated reforms (ICT investments, quality of human capital, and labor market and product market flexibility) seem to be more important for productivity growth in market services than in manufacturing.

These findings suggest that the ICT-led convergence in the Region may be divided into two phases. In the first phase, convergence is driven by growth in ICT production and in the ICT-aided reallocation process. In the second phase, convergence must rely on the intensive use of ICT in non-ICT sectors, particularly services.

The completion of the first phase of convergence seems to be mostly dependent on some basic fundamental reforms: market competition, greater openness to trade and FDI, stronger governance, improved access to finance, and sustained macroeconomic stability. It appears on the basis of the available evidence that most EU-10 countries have more or less realized the first convergence phase (though this is less accurate in the case of Bulgaria and Romania) partly through ICT investments and productivity growth in ICT-using manufacturing and
partly through productivity growth in ICT production. In contrast, Russia, like many other CIS and SEE countries, has not yet completed the first convergence phase. For these lagging reformers, convergence will depend on continued progress in first-generation reforms.

Success in the second phase of convergence, however, seems to require more sophisticated reform measures: the deregulation of product and service markets, increased labor flexibility, better ICT infrastructure, organizational innovations, improved management practices, access to financing, and investment in a broader palette of human capital and ICT skills. These reforms are especially important for the EU-10 because the productivity effects of the first phase of convergence have been mostly exhausted (Piatkowski and van Ark 2007; Schadler et al. 2006). These reforms are, however, more difficult to achieve than those required during the first stage of convergence.

Conclusions

A large resource reallocation to services raised productivity in the Region. While sectoral reallocation effects were important, the main driver of the productivity surge was within-sector productivity growth. Reallocation effects were important, although, in some countries, such as the CIS countries, they tended to offset each other. Labor was generally moving toward sectors with high productivity levels (services) and out of sectors with low productivity levels (agriculture). At the same time, labor was moving out of sectors showing increasing productivity growth (agriculture and manufacturing) and into sectors showing decreasing productivity growth (services). Most of the productivity growth was arising from gains within each of the sectors (agriculture, manufacturing, and services).

Agricultural productivity growth was driven by labor shedding, though improvements in farm efficiency were also important. In labor-abundant countries, a shift from large-scale collective farming to small-scale individual farming led to dramatic gains in technical efficiency with relatively small losses in scale efficiency. In capital- and land-abundant countries, gains in labor productivity, if any, arose primarily because large farms were shedding labor as farms were privatized. In countries in which land privatization and trade reforms were not implemented vigorously, productivity gains were generally delayed and modest. During the first stage of transition, trade liberalization, price liberalization, subsidy cuts, and land
reforms were required to accelerate farm restructuring and facilitate the sectoral reallocation of labor. As countries progressed along the transition path, an improved investment climate and stronger competition in services were needed to raise within-farm productivity growth and provide off-farm job opportunities.

Manufacturing productivity growth was driven by efficiency gains in industries with a higher capacity for innovation. In manufacturing, a group of medium- and high-technology industries seemed to be driving productivity growth. This group of industries employed a large proportion of highly skilled workers, produced ICT goods, or used a relatively large amount of ICT capital. The manufacturing industries in the high-technology group included producers of office machinery, electrical and electronic equipment, and optical instruments. Other sectors, such as traditional consumer goods manufacturing, fell within the low-technology groups and showed lower productivity growth. Not surprisingly, high-technology industries exhibited higher TFP growth in countries with stronger progress in liberalizing key service industries, deeper financial markets, more highly skilled workforces, more flexible labor markets, and greater R&D investments by the private sector.

Service productivity growth was driven by a strong performance in backbone services: transport, telecommunications, and financial intermediation. In addition to trade and real estate, service productivity growth was mainly driven by backbone industries with higher productivity levels and a higher propensity to use or produce ICT: transport, telecommunications, and financial intermediation services. The productivity growth in these industries over 1997–2004 outstripped the average productivity growth achieved in the EU-15. The strong performance of these service industries hints at the potential for service-driven growth in the Region.

The efficiency of backbone services is crucial to the productivity of other sectors. Backbone services enable firms to participate in the global production chains that are associated with productivity gains. But these potential gains will not be achieved automatically. A substantial gap remains in productivity across services. Moreover, the penetration and efficient use of ICT in services remain limited. More investment in ICT in service industries may spur productivity growth. Policy makers in the Region might play a major role in sustaining the growth momentum in services by pursuing service liberalization across the board, removing regulatory barriers to competition in various service industries, and allowing and attracting more FDI and trade flows.
Notes

1 There is a large literature on the impact of changes in sectoral labor composition on aggregate productivity growth in advanced economies and also in the Region (see Timmer and Szirmai 2000; Caselli and Tenreyro 2004; Lenain and Rawdanowicz 2004).

2 A number of studies have also performed the shift-share analysis for EU-8 countries (see the text for the countries), while focusing on TFP growth. The reallocation effects (combining capital and labor shifts) tend to be more dominant in TFP growth decompositions than in labor productivity decompositions. This is mainly attributed to capital shifts across sectors. The stronger the labor productivity growth arising from higher capital-to-labor ratios (capital deepening), the stronger the reallocation effect. This finding is not surprising because capital mobility tends to be greater than labor mobility.

3 The analysis will be conducted at two levels of disaggregation. First, a distinction is made between agriculture, industry, and services that draws on the World Development Indicators Database for all countries of the Region. The analysis on agriculture also covers most countries of the Region. However, detailed analysis of productivity in the manufacturing and service industries is performed on a subset of countries in the Region for which data are available. Aggregate manufacturing and service data draw on the 2006 WIIW Database data set and cover 14 countries in the Region. Second, disaggregated analysis on the manufacturing and service industries is performed only on EU-8 countries with comparable industrial-level purchasing power parity (PPP) deflators available. The analysis draws on the EU KLEMS Database. For both manufacturing and services, an effort is made to distinguish between ICT-related industries and industries not related to ICT and between industries that use skilled labor and industries that rely mostly on low-skilled labor. Throughout, the focus is mostly on labor productivity.

4 Evidence also shows that there is less productivity dispersion across farms. In Kazakhstan, most farmers (80 percent) have an efficiency score lower than 30, and only a very small share of farmers (2 percent) achieve an efficiency score close to 100. In contrast, in Hungary, most farmers have an efficiency score between 40 and 70, and 9 percent have an efficiency score between 90 and 100. A country more advanced in the transition has more farms on the boundary of the production frontier, with farms reaching higher average efficiency.

5 Business R&D intensity at the industrial level tends to be correlated with a high rate of technological progress. Those industries that are currently located on rapidly rising technological paths (such as electronics, pharmaceuticals, aircraft) enjoy high returns to R&D. These returns are likely to be larger than those in industries with lower market concentration (OECD 2004).

6 At the macro-level, the relationship between financial development and economic growth was postulated early by Schumpeter (1911). Empirical evidence has been provided by King and Levine (1993) and Levine and Zervos (1998) using cross-country data and by Rajan and Zingales (1998) using industry-level data across countries. In particular, Beck, Levine,
and Loayza (2000) find that the positive effect of financial intermediation on GDP growth occurs through the impact of financial intermediation on TFP growth rather than through its impact on physical capital accumulation and private savings rates.

7. To capture the readiness of a country to move into new exports, Hausmann and Klinger (2006) develop a measure called open forest. This indicator shows the degree to which a country’s export basket is close to other products for the production of which the currently installed productive structure may be easily adapted. High values of the open forest measure indicate lower barriers to the development of new export products that may boost manufacturing productivity growth.

8. The definition of the service sector covers both market services and public utilities, while excluding government services and construction. The section also investigates the effect of service policy reforms on downstream manufacturing productivity. Depending on data availability, the analysis considers Bulgaria, Croatia, FYR Macedonia, Romania, Russia, Serbia, Montenegro, Ukraine, and the EU-8.

9. The exceptions are the Czech Republic and Slovenia, where the average share of wholesale and retail trade and the repair of motor vehicles in total employment was almost unchanged between 1997–2000 and 2001–04.

10. We should note that our data cover only formal economic activities. Subsectors such as retail trade are characterized by high levels of informality, and their contributions to total value added and employment in the Region may, therefore, actually be higher.

11. Given the large number of 2-digit NACE industries, only the share of value added of those industries that (a) represent more than 1 percent of total value added on average in the EU-8 or (b) have a high-technologically or high-skill content are covered.

12. Labor productivity in services for the EU-15 has been obtained as an average of the labor productivity in all subsectors across all EU-15 countries; KLEMS labor productivity for each subsector and country is calculated in a similar way to KLEMS labor productivity for each subsector and country. The consideration of a simple average of labor productivity across the more-advanced and less-advanced EU-15 countries may actually underestimate the true value. The EU-8 may be significantly more distant in terms of labor productivity levels relative to the best performers in the EU-15.

13. To combine the EBRD index with the WIIW Database, we average the index to match the industries covered by the database. Specifically, we average (a) the EBRD index for electric power and the EBRD index for water distribution to match the electricity, gas, and water subsector; (b) the EBRD index for road transport and the EBRD index for telecommunications to match the transport, storage, and telecommunications subsector; and (c) the EBRD index for banking reform and interest rate liberalization and the EBRD index for nonbanking financial institutions to match the financial intermediation subsector.

14. The results based on two-year lagged values of the EBRD index are qualitatively similar.

16. Röller and Waverman (2001) argue that improvements in telecommunications infrastructure provide for nonlinear network effects.

17. Perminov and Egorova (2005) provide productivity growth estimates for the ICT sector in Russia; yet, their results are not directly comparable with those in this study.

18. The analysis excludes nonmanufacturing industries, including agriculture, forestry, mining and quarrying, and fishing, and nonmarket services, which mostly involve the public sector.

19. For a discussion of the importance of organizational changes in enterprises and of improved management, refer to Brynjolfsson and Hitt (2000) and Dorgan and Dowdy (2002).