

## Patterns of Aggregate Productivity Growth

For the first time since transition, the countries of Eastern Europe and the Former Soviet Union experienced strong and sustained growth across the board during 1999–2005. This growth drove their convergence toward the income and productivity levels of advanced industrial countries. As a result, it has given way to the optimism surrounding transition that the removal of an array of controls on economic activity would bring about dramatic growth in productivity and output as resources were reallocated to more productive functions. Yet, for almost a decade following the start of the transition, the record on growth was mixed: while some countries did experience rapid growth in output and productivity following a temporary decline, others struggled with the reforms necessary to climb out of a trajectory of protracted decline. The scenario has changed decidedly in recent years: the strong growth across the board since 1999 constitutes a distinct new episode in the growth experience of the Region.

At the same time, significant disparities exist in income and productivity levels and policy challenges across the Region. At the end of 2005, per capita GDP in Slovenia, at \$19,797 (in constant 2000 PPP-adjusted prices), was 17 times that in Tajikistan, at \$1,170, whereas per capita GDP in Russia, at \$9,770, was twice that in Albania, at \$4,711. Growth rates in the Kyrgyz Republic and Poland during

1999–2005, at 4 and 3.4 percent, respectively, were sluggish in comparison to the 9.1 and 7.4 percent growth in Kazakhstan and Latvia, respectively. On the policy reform front, while Estonia followed up on its early progress in trade and price liberalization with progress in financial sector reforms and infrastructure reforms, progress in trade and price liberalization has been limited in Uzbekistan. The significant disparities across the Region are likely to be reflected in differences in the trajectory of growth and policy challenges in the years ahead.

This chapter takes a close look at the recent episode of strong growth in output and productivity in the Region. It focuses on the following questions: (a) How has growth in the Region compared with growth in other parts of the world? (b) To what extent has growth been driven by improvements in productivity? (c) How do productivity growth rates and levels vary across countries, and how do they compare with those in other parts of the world? (d) What has been the role of policy reform in driving productivity growth across the Region? and (e) What structural and policy reforms are necessary to sustain and accelerate productivity growth in the years ahead?

The primary findings of the chapter are that the countries of the Region have experienced substantial improvements in productivity that have accelerated their convergence toward the income and productivity levels of the industrial countries. The pattern of productivity growth has been driven by the progress achieved in the policy reforms necessary for the transition to a market economy. At the same time, a sizable gap in income and productivity levels relative to the industrialized world remains. To narrow the gap and continue the process of convergence, sustaining and accelerating productivity growth are important priorities. This will require more progress in the transition policy reform agenda among the lagging reformers, as well as improvements in a range of structural determinants of productivity growth, including infrastructure stock and quality, financial depth, and institutional quality.

## **Patterns of Growth**

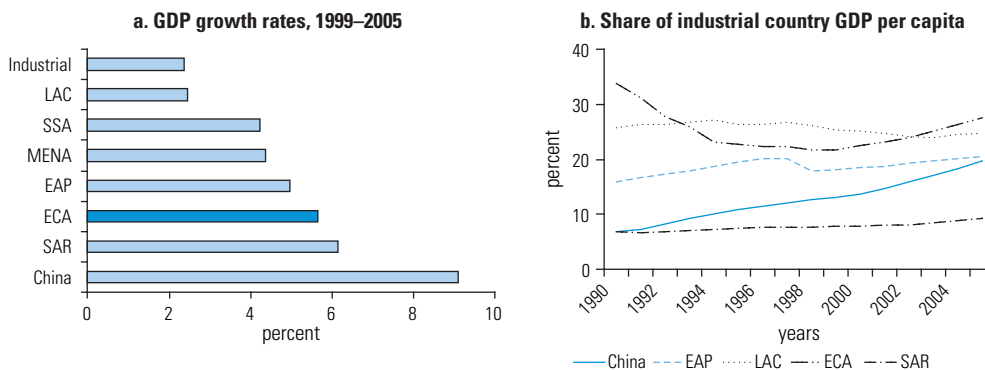
The economies of the Region have generated robust growth since the end of the Russian financial crisis in 1998. During the seven-year period 1999–2005, the Region as a whole grew by 5.7 percent. Growth in the Region during this period was higher than that of the advanced industrial countries, Latin America, and East Asia (excluding China

and Japan). South Asia experienced modestly higher growth during this period, while China experienced dramatically higher growth than any region (figure 1.1).

Rapid growth in the Region since 1998 has led to convergence toward industrial country levels of GDP per capita, although a large gap remains. Figure 1.1 depicts the evolution of GDP per capita in each region as a share of that of advanced industrial countries between 1990 and 2005. Per capita GDP in the Region increased from \$5,903 (constant 2000 PPP-adjusted prices) in 1998 to \$8,411 in 2005, which represents a rise from 21.8 percent of the income levels of industrial countries in 1998 to 27.5 percent in 2005. This convergence toward the levels of the industrial countries since 1998 is in sharp contrast to the earlier period in the 1990s when GDP per capita in the Region fell dramatically, from \$8,036 in 1990 to \$5,903 in 1998 (that is, from 33.8 to 21.5 percent of industrial country per capita GDP). Even though per capita GDP in the Region as a share of the GDP levels in industrial countries has not yet recovered to the corresponding share in 1990, the significantly higher growth rates since 1998 certainly suggest that the Region is moving in that direction. Furthermore, the still large gap in income levels between the countries of the Region and industrial countries suggests that the former have the opportunity to generate high growth by pursuing the policies necessary to close the gap with industrial countries.

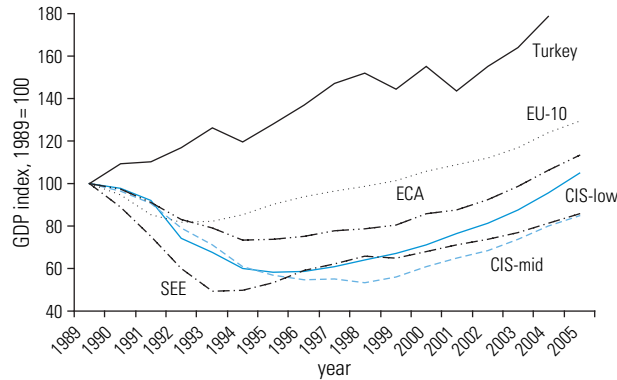
Thanks to high growth, the Region has also moved up in the distribution of GDP per capita among developing countries. By 2005, the Region had the highest level of GDP per capita among all developing

**FIGURE 1.1**  
**Recent Growth Has Been Strong in the Region**



Sources: World Bank staff calculations; World Development Indicators Database 2007.  
Note: SAR = South Asia Region.

FIGURE 1.2

**Growth Has Rebounded across All Country Groups**

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

regions. Between 1998 and 2005, the income level in the Region rose above that of Latin America and pulled further ahead of East Asia (excluding China and Japan).

Even though the Region has experienced strong growth across the board since 1998, countries have followed significantly different trajectories of growth since the start of the transition. During the initial years, 1990–92, the deepest contractions took place in the low income CIS countries, the Baltic states, and the SEE, as shown in figure 1.2. The initial contractions were less severe in Central Europe and the middle income CIS countries. During 1993–98, growth began to take hold in most of the EU-10 and parts of the SEE. Albania and Poland experienced strong growth during this period, while Bulgaria and Romania experienced flat growth. Meanwhile, the CIS countries experienced prolonged and often sharp contractions. During the more recent period, 1999–2005, robust growth took hold across the board. The strongest growth was experienced by the CIS countries that lagged the most during the earlier period.

### Sources of Growth: The Role of Productivity

To assess the capacity of countries in the Region to sustain the rapid growth rates of recent years, it is important to determine the extent to which this growth has been accompanied by improvements in productivity. The neoclassical model of growth and a large body of supporting empirical literature have shown that productivity

differences are an important determinant of differences in income levels across countries and that productivity growth is the ultimate driver of growth in the long run (see, for example, Bosworth and Collins 2003; Hall and Jones 1999; Klenow and Rodríguez-Clare 1997). To the extent that overall growth is accompanied by productivity growth, the latter is likely to be sustained. However, if productivity growth is sluggish and growth is increasingly driven by accumulation, growth itself is likely to taper off as the returns to accumulation diminish over time.

A growth accounting methodology is thus used to measure the rate of TFP growth in the countries of the Region and assess the extent to which growth in output has been driven by improvements in productivity. Specifically, growth of real GDP is decomposed into (a) the contribution of growth in the capital stock, (b) the contribution of growth in the labor force, and (c) TFP growth.<sup>1</sup>

The analysis in this chapter uses a consistent methodology to account for the sources of growth and compute TFP growth rates that are comparable across the Region, as well as across countries in other parts of the world. A number of previous studies have used the growth accounting methodology to compute productivity growth for the countries of the Region. However, most of these studies have been focused on particular countries or groups of countries, with differences in methodologies making it difficult to compare the numbers obtained across countries and over time. The few studies that have attempted to use a consistent methodology across a large group of countries in the Region have been focused on the period preceding the most recent phase of growth. (For example, see De Broeck and Koen [2000] for growth accounting work on the CIS countries and Campos and Coricelli [2002] for growth accounting work on a number of Eastern European countries.) The analysis in this chapter uses a consistent methodology and the best available data to compute TFP growth rates that are comparable across countries and over time (see box 1.1 and appendix 1.A). Furthermore, the analysis uses the same consistent methodology to implement the growth accounting exercise and measure TFP growth for 96 other countries outside the Region. This enables a fair comparison of TFP levels and growth rates in the Region with those in advanced industrial countries, East Asia, China, Latin America, and other parts of the world (figure 1.3).

Strong growth in the ECA region during 1999–2005 has been driven primarily by a productivity surge, in contrast to most other parts of the world where growth has been driven by a more even

## BOX 1.1

**The Growth Accounting Methodology**

The analysis in this chapter uses a growth accounting methodology to decompose the growth of real GDP into the contributions from growth in the capital stock and in the labor force and TFP growth. As is widely appreciated, the measurement of TFP growth is sensitive to the methodology that is used. In transition economies, the measurement of capital stock also presents special challenges. This box reports on the particular growth accounting methodology used and the techniques employed to address the challenges in capital stock measurement.

**Methodology**

Starting with the following standard Cobb-Douglas production function:

$$Y_t = A_t K_t^\alpha L_t^{1-\alpha}$$

where  $Y$  is real GDP,  $K$  is the physical capital stock,  $L$  is the labor force,  $A$  is the level of TFP, and  $\alpha$  is the capital share of income. Taking logarithms and differentiating, we obtain the following growth accounting equation:

$$\frac{dY}{Y} = \alpha \frac{dK}{K} + (1-\alpha) \frac{dL}{L} + \frac{dA}{A}.$$

The above equation shows that the growth of real GDP (the first term) may be decomposed into three sources of growth: (a) the contribution from growth in the physical capital stock (the second term), (b) the contribution from growth in the labor force (the third term), and (c) TFP growth (the final term).

**Data and Challenges in Measuring Capital Stock in Transition Countries**

To implement this decomposition, data on GDP and the labor force have been obtained from the World Development Indicators Database, national statistical offices, and the International Monetary Fund. The basis for constructing the capital stock series is the standard perpetual inventory method:

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

where  $I$  is the level of investment and  $\delta$  is the depreciation rate. Investment data going back to 1980 for most countries have been obtained from *World Development Indicators* and *World Economic Outlook*, supplemented with data from CISStat and the Vienna Institute for International Economic Studies (see World Development Indicators Database; IMF 2007; CISStat Database; WIIW Database). Estimates of the initial capital stock have been obtained from De Broeck and Koen (2000) for the CIS countries and from the Vienna Institute and national statistical offices for Eastern European countries. The commonly assumed capital share in income of 0.35 percent and a standard depreciation rate of 0.05 percent are used in the baseline analysis.

(Continues on the following page.)

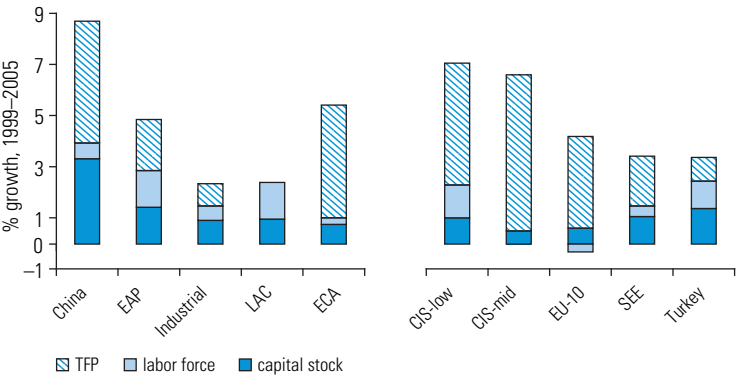
BOX 1.1

The Growth Accounting Methodology (continued)

Implementing the perpetual inventory method for transition economies presents the particular challenge that, during the initial contraction, a significant portion of the communist capital stock may not only be temporarily idled, but may actually be permanently scrapped. If so, this would cause the contribution of capital accumulation to be underestimated during the subsequent recovery. To address this concern, a one-time adjustment has been applied for the permanent scrapping of a portion of the communist capital stock; in particular, the adjustment contracts the capital stock by the same rate as output during the initial contraction, so that the capital output ratio does not rise during the course of the contraction.

Extensive robustness checks were performed with alternative adjustments for the scrapping of communist capital and with alternative values of the capital share and depreciation rates. While the exact TFP growth numbers obtained do indeed change, the patterns across countries and over time are robust to these alternative techniques.

FIGURE 1.3 TFP Growth Is the Primary Driver of Growth in Transition Countries



Source: World Bank staff calculations (see appendix 1.A).

mixture of accumulation of inputs and productivity growth. Figure 1.3 shows the contributions of capital accumulation, labor force growth, and TFP growth to aggregate GDP growth in the ECA region as well as in other parts of the world for the period 1999–2005. In the ECA region, out of an overall GDP growth rate of 5.42 percent, TFP growth accounted for 4.43 percentage points. The contribution of the accumulation of inputs was only about 1 percent (of which the contribution of capital accumulation was 0.72 percentage points

and that of labor force growth was 0.27 percentage points). By contrast, in East Asia (excluding China), out of an overall GDP growth rate of 4.85 percent during this period, the contribution of TFP growth has been 2 percentage points, whereas the contributions of capital accumulation and labor force growth have accounted for the rest. Even in China, where TFP growth of 4.8 percent has exceeded that of ECA, the accumulation of inputs has accounted for another 4 percentage points of growth. In the industrialized world, the contribution of the accumulation of inputs has exceeded that of TFP growth, whereas Latin America as a whole has not experienced productivity growth during this period, so that all of the growth has been the result of capital accumulation and labor force growth.

The predominant role of productivity growth in driving the growth of GDP is found across the different areas within the Region, although a closer look at the figures reveals a number of differences. The most substantial of these differences is between Turkey and the transition economies. In Turkey, a majority of growth during the most recent period has been a result of the accumulation of inputs, as the labor force has grown at a steady rate and TFP growth has been sluggish. Although the sluggish TFP growth rate in Turkey is influenced by the financial crisis of 2001, a look at a longer time horizon confirms the pattern that growth in Turkey (unlike in the transition economies) has been driven by fairly balanced contributions from the accumulation of inputs and productivity growth.

Across the transition economies of the Region, overall GDP growth was highest in the CIS during 1999–2005. Within the CIS, although overall growth has been higher in the low-income countries, productivity growth has been higher in the middle-income countries. The role of productivity growth in driving growth in the middle income CIS countries has been overwhelming: out of an overall growth rate of 6.6 percent during 1999–2005, TFP growth accounted for 6.1 percentage points, with almost no contribution coming from the accumulation of inputs. In the low income CIS, although TFP growth of 4.8 percent was again the driving force behind the overall growth of 7.1 percent, the accumulation of inputs also contributed 2.3 percentage points (thanks to steady labor force growth in these countries). In the EU-10 group of countries, growth was driven primarily by TFP growth, while, in the SEE, the accumulation of inputs contributed about 1.5 percentage points to the overall growth of 3.4 percent during 1999–2005.

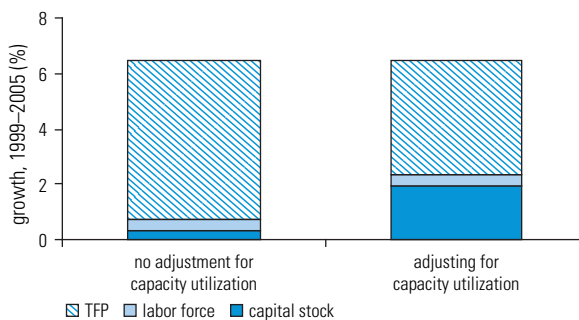
The substantial improvements in productivity accompanying (and, indeed, driving) growth in the Region make it more likely that growth will be sustained in the years ahead. Improved efficiency

in the organization of production should attract investment and allow accumulation to play a greater role in contributing to growth over time.

One concern associated with the measurement of productivity in transition economies especially in the CIS, is that high TFP growth rates may simply be a reflection of higher capacity utilization as growth rebounds from the sharp contractions during the early years of transition. Adjusting growth decompositions for capacity utilization is difficult for a broad range of countries in the Region because comparable data on capacity utilization across countries are not available. In Russia, available survey data on capacity utilization permit growth decompositions to be performed using capital stock series adjusted for capacity utilization.<sup>2</sup> The results, displayed in figure 1.4, suggest that the contribution of capital accumulation does, indeed, rise after one adjusts for capacity utilization. But even after adjusting for the utilization of *available* resources, TFP gains from *employed* resources still accounted for nearly two-thirds of the overall growth in Russia during 1999–2005.

Exploring the evolution of productivity growth since the start of the transition in the EU-10 and SEE countries sheds light on what may happen to productivity growth in the CIS countries going forward. We have seen that strong growth in the Region was driven by a surge in productivity, particularly in the CIS. What is likely to happen to productivity and growth going forward? Moreover, how did the substantial rates of productivity growth in the most recent period, 1999–2005, compare with productivity growth during the earlier periods of transition? In the EU-10 (which have had a longer history of postrecovery growth), the initial productivity surge during 1995–98 was sustained and actually increased into the 1999–2005

**FIGURE 1.4**  
**Higher Capacity Utilization Partly Explains High TFP Growth Rates**



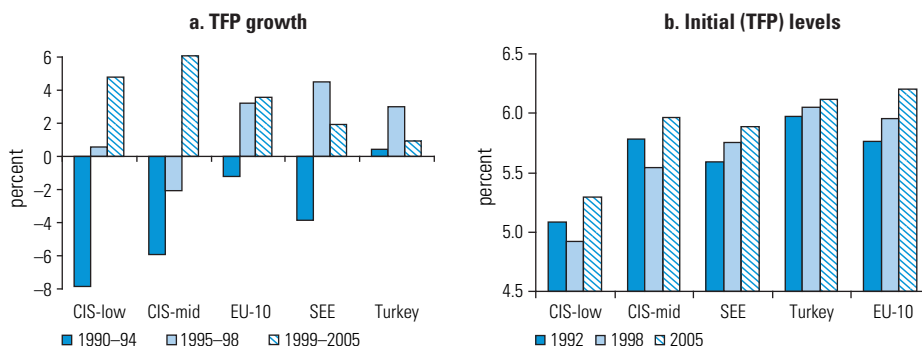
Sources: World Bank staff calculations; Russian Economic Barometer Survey Database, various years.

period (figure 1.5). Conversely, in the SEE countries, the initial spurt of productivity growth during 1995–98 subsided during 1999–2005, although growth was propped up by increasing contributions from the accumulation of inputs. In the CIS, large TFP declines during the earlier years of transition have been followed by high productivity growth since 1999.

While we would expect the contribution from accumulation to increase over time in transition economies, whether or not high productivity growth is sustained over time will ultimately determine how rapidly the countries converge toward the income levels of advanced industrial countries. If the high productivity growth rates in the Region fall off too quickly, then high growth is less likely to be sustained in the long run. Moreover, if improvements in the policy environment lead to sustained high productivity growth over time (as has been the case in China), then rapid growth is likely to continue in the years ahead.

Within the Region, the highest productivity growth during 1999–2005 generally took place in those countries with lower levels of productivity, leading to a convergence in productivity levels during this period. A look at the levels of productivity across the Region points to substantial differences that have been narrowed to some extent in recent years (see figure 1.5). The low income CIS countries, which have levels of productivity far below those in other parts of the Region, have experienced high productivity growth in recent years. Productivity levels in the middle income CIS countries overtook those in the SEE between 1999 and 2005. Similarly, productivity levels in the EU-10 group surged ahead of the level in Turkey during this period. The recent convergence in productivity levels in the Region is in contrast to the divergence in productivity levels during the earlier

**FIGURE 1.5**  
**TFP Levels and Growth Vary across the Region**

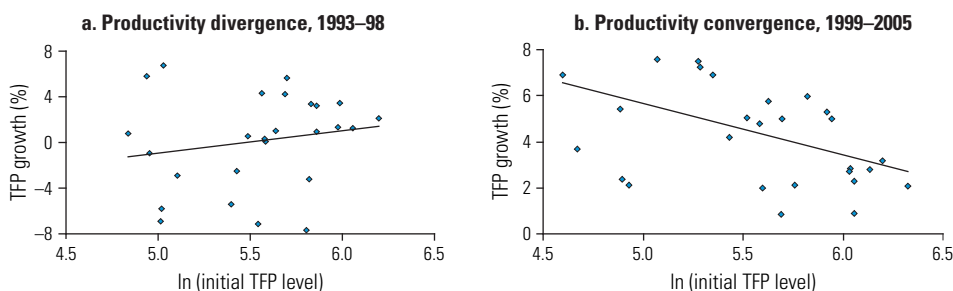


Source: World Bank staff calculations (see appendix 1.A for data sources).

period, when countries with lower productivity levels were generally experiencing sharper contractions (figure 1.6).

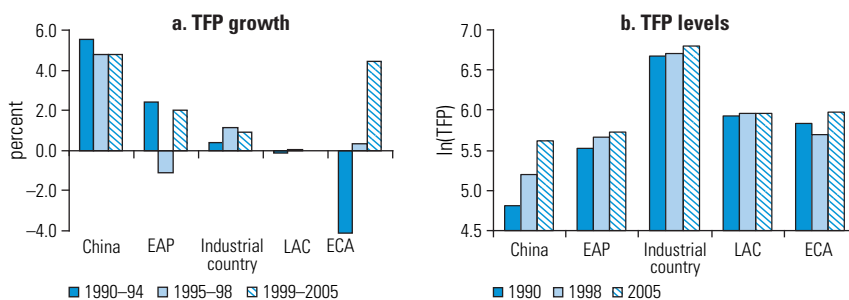
The high rate of productivity growth in the Region since 1998 has led to a convergence toward industrial country productivity levels. However, a substantial gap in productivity remains. How have productivity levels evolved over time and how has this compared with the evolution of productivity in other parts of the world? The growth in TFP by 4.4 percent during 1999–2005 is the first episode of strong productivity growth across the board since the start of the transition (figure 1.7). During 1990–94, the Region experienced significant declines in productivity, while productivity levels were essentially flat during 1995–98. Strong productivity growth since 1999 has led to a convergence toward industrial country productivity levels: between 1999 and 2005, the level of productivity as a share of industrial country productivity levels increased from 35 to 44 percent. This contrasts sharply with the earlier period of transition when productivity levels fell from 43 percent of industrial country productivity levels in 1990 to 35 percent in 1998. It is encouraging to note that the level of TFP

**FIGURE 1.6**  
**Productivity Growth Rates Are Now Converging in the Region**



Source: World Bank staff calculations (see appendix 1.A for data sources).

**FIGURE 1.7**  
**The Region Is Catching Up with Comparators**



Source: World Bank staff calculations (see appendix 1.A for data sources).

relative to that in industrial countries has recovered to the level at the start of the transition.

The phenomenal record of productivity growth in China during its own transition raises the hope that the countries of Eastern Europe and the Former Soviet Union may be able to sustain high productivity growth going forward. The productivity growth in the Region during 1999–2005 was second only to that in China, which generated productivity growth in excess of 4.5 percent throughout the 1990–2005 period. In fact, looking back even further, we find that China’s productivity growth over 1980–2005 was in excess of 4.5 percent per year. The country reaped spectacular gains from the liberalization of repressed sectors, such as agriculture (which had a surplus of labor) and rural industries, and from a massive inflow of foreign investment. This suggests that it is not impossible to sustain high productivity growth during a transition to a market economy.

The large productivity gap between the industrialized world and the countries of Eastern Europe and the Former Soviet Union also offers the opportunity to rapidly gain ground. It is important to bear in mind that China in 1980 (and even in 1990) started from productivity levels that were far below those in the countries of Eastern Europe and the Former Soviet Union today (see figure 1.7, chart b). At the same time, we have seen that productivity levels in the Region today are still substantially behind those in the industrialized world. This suggests that there is significant room to generate high productivity growth in the Region for many years to come by taking advantage of the improved technologies available in the industrialized world. In other words, the high rates of productivity growth in the Region since 1999 should not be viewed merely as a one-time productivity boost during the course of recovery following transition.

Ultimately, of course, sustaining high productivity growth will depend on progress in undertaking the necessary policy reforms. Lagging reformers with a distorted policy environment will require accelerated progress in those reforms necessary during the transition to a market economy. Across the board, improvements will be required in a range of structural determinants of productivity growth. In the rest of this chapter, we explore the role played by policy reforms in sustaining and accelerating productivity growth in the Region.

## **The Overall Record of Policy Reform**

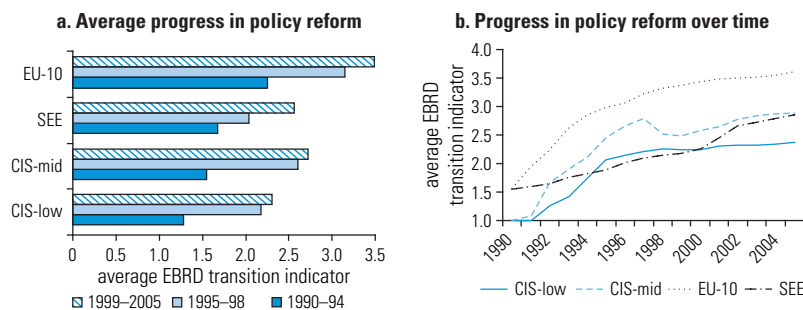
To obtain an overall assessment of progress in the policy reforms necessary for transition to a market economy in the Region, we turn to the European Bank for Reconstruction and Development (EBRD)

transition indicators. These indicators rate countries on a scale of 1 to 4+ on nine dimensions of policy reform that are most relevant to transition countries, including trade and price liberalization, privatization, competition policy, financial liberalization, and the liberalization of infrastructure sectors (transportation, telecommunications, electricity, and water). A rating of 1 refers to conditions resembling a controlled economy, whereas a rating of 4+ resembles standards in advanced industrial market economies. We use the average across the nine indicators (figure 1.8).

The progress in reform has been mixed. Policy reforms in the EU-10 have progressed the most rapidly and to the greatest degree. By 2005, the average EBRD rating for the EU-10 was above 3.5, which is approaching the standards in industrial market economies, although a gap persists. In the low income and middle income CIS countries, some early progress in policy reforms through the 1995–98 period was followed by relative stagnation in reform. Between 1995–98 and 1999–2005, little overall progress in reform was achieved in the CIS. Among our subgroups, the low income CIS countries achieved the least progress during 1999–2005, reaching an average score of 2.3 during this period. The SEE countries, meanwhile, followed a path of steady, but slow, progress in reform.

A country’s record on growth in output and productivity is broadly consistent with progress in policy reforms. Strong and sustained productivity growth in the EU-10 is consistent with the rapid and sustained pace of policy reform we observe in these countries. Furthermore, the initial progress in policy reform in the CIS through 1998 is consistent with the high rates of productivity growth we observe in these countries after 1999, following a prolonged period of contraction. However, sustaining high productivity growth in the CIS will require an acceleration of the sluggish pace of policy reform since 1999 in these countries.

**FIGURE 1.8**  
**The Record on Policy Reform Is Mixed**



Source: EBRD (European Bank for Reconstruction and Development) 2006.

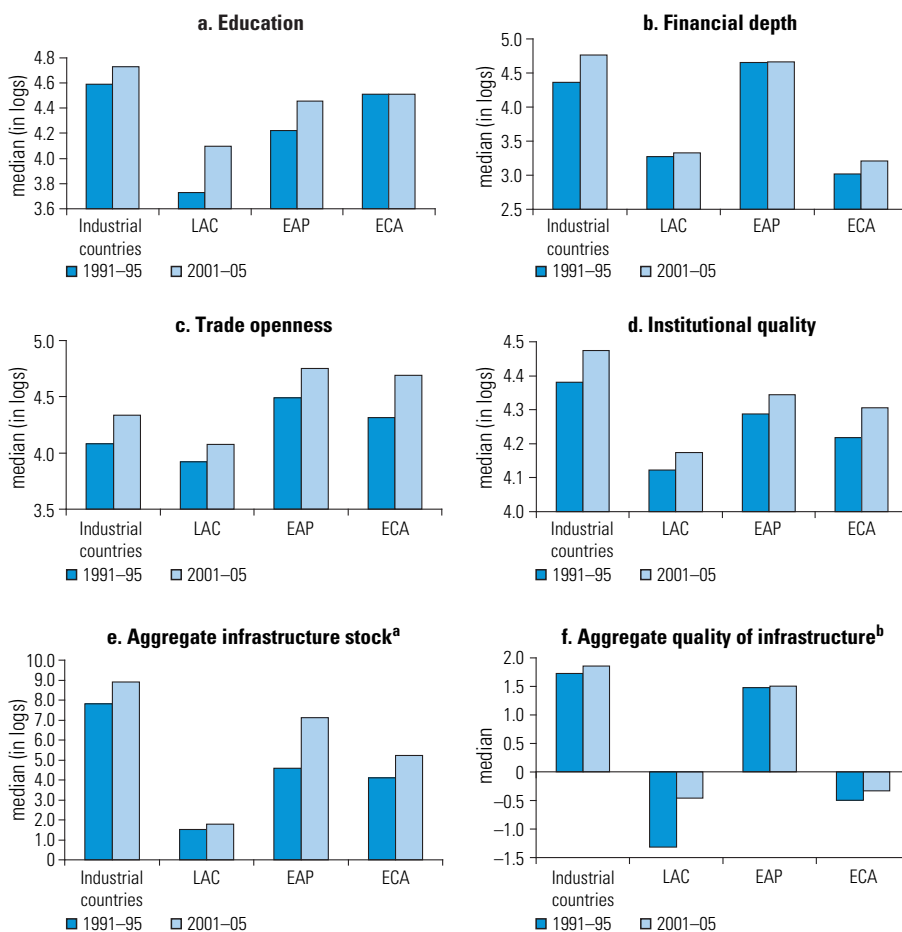
## The Impact of Policy Reform

Sustaining high productivity growth will require further improvements across the Region in a number of structural and policy determinants of productivity. A large body of empirical evidence has shown that cross-country differences in productivity growth are related to differences in macroeconomic stability, human capital, financial depth, trade integration, governance (institutional quality), and infrastructure. Which dimensions of reform are the greatest constraints to sustaining and accelerating productivity growth in the Region? Where should policy makers direct their efforts to generate the greatest impact on productivity in the future? The answer to these questions depends on two factors: first, the extent to which the countries in the Region lag the productivity leader (advanced industrial countries) along each structural or policy dimension and, second, the elasticity of productivity growth with respect to improvements along each dimension of policy. We will look at how the countries in the Region compare with the rest of the world along each structural dimension and then attempt to estimate the impact on productivity growth produced by improvements along each dimension. The measures looked at capture the outcome of an array of reforms along each policy dimension.

The policy reforms in which the Region most lags the industrial countries are financial depth, infrastructure quality and stock, and governance. Figure 1.9 provides a comparison of the levels of education, financial depth, trade openness, institutional quality, and infrastructure stock and quality in the countries in the Region, the industrial countries, and countries in East Asia and Latin America (see box 1.2 for details on the particular measures used to capture these structural determinants of productivity). With regard to financial depth, the Region is on par with Latin America and significantly behind industrial countries and East Asia. The stock of infrastructure in the Region is below levels in industrial countries and East Asia, and the quality of infrastructure in the Region lags that in the industrial countries and East Asia more dramatically. Institutional quality in the Region is better than that in Latin America, somewhat below that in East Asia, and significantly below that in industrial countries. Educational levels in the Region are not dramatically different from those in East Asia and only slightly below those in industrial countries.

We turn next to estimating the impact on productivity growth in the Region of a potential improvement in structural policies to the level of the median advanced industrial country. Attempts to estimate the elasticity of productivity growth with respect to policy in a

**FIGURE 1.9**  
**The Region Lags behind Comparators in Several Key Structural Reforms**



Source: World Bank staff calculations (see appendix 1B for data sources).

a. First principal component of main telephone lines, electricity generating capacity, and total roads.

b. First principal component of telecommunications, electricity, and road quality.

cross-country setting often prove contentious. The most common concerns have to do with omitted variables and the endogeneity of policy. However, the alternative is merely to look at the extent to which a given country lags the cross-country leader along each dimension of policy, without any attempt to obtain a sense of whether the particular policy dimension is related to productivity improvements. In such a scenario, one would need to rely on hunch or assumption to assert that progress along a given dimension of policy should have an effect that equals, is greater than, or is less than the effect of progress along other dimensions. An attempt to instill some rigor in the methodology is clearly a better alternative. Box 1.2

## BOX 1.2

### Estimating the Impact of Structural Reforms

Estimating the productivity impact of potential structural improvements in a country is a two-step process. The first step involves estimating the relationship between productivity growth and the structural determinants of this growth in a cross-country setting. The second step involves using the estimated elasticities from the cross-country relationship to determine the impact on productivity growth of a potential structural improvement in the country of interest. The estimation of the cross-country relationship often proves contentious. The primary concerns have to do with the endogeneity of independent variables and the sensitivity of the estimates to omitted variables. The analysis recorded in this chapter has involved a number of techniques to address these concerns.

#### Methodology

A large macroeconomic panel data set has been used that comprises 86 countries and nine nonoverlapping five-year time periods covering 1960–2005. The dependent variable is the growth rate of labor productivity, and the independent variables include a number of structural variables of interest (education, financial depth, trade openness, institutional quality, infrastructure stocks, and infrastructure quality) and a number of control variables (initial level of labor productivity, lack of price stability, government burden, and terms of trade shocks). The estimation technique is the generalized method of moments estimator developed for dynamic panel data models. This technique offers a number of advantages. First, it controls for unobserved time-specific and country-specific omitted variables. Second, it partially controls for the endogeneity of explanatory variables by using the lagged values as instruments.

#### Measures of Structural Determinants of Productivity

The following measures are used to capture the structural determinants of productivity. Education is proxied by the gross enrollment rate of secondary schooling. Financial depth is measured as domestic credit to the private sector as a percentage of GDP. Trade openness is measured as the sum of exports and imports as a percentage of GDP. Institutional quality is proxied by way of the index of political risk of the *International Country Risk Guide* (PRS Group, various issues). Infrastructure stock is measured using a weighted average of three different measures of physical infrastructure: main or mobile telephone lines per thousand workers, electricity generating capacity per thousand workers, and length of roads per square kilometer of surface area. Similarly, infrastructure quality is a weighted average of three different measures of quality: waiting time for the installation of main telephone lines, percentage of electricity losses in transmission and distribution, and share of paved roads in total roads. The weights used in aggregating the infrastructure indicators are obtained through a principal components analysis that yields weights to maximize the variance of the aggregate index.

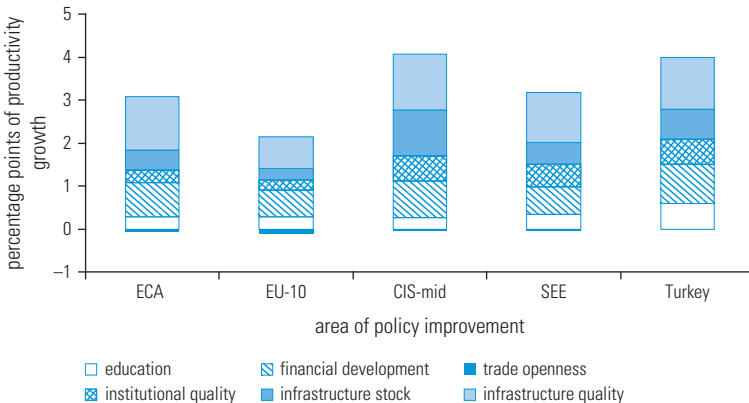
*Source:* Calderón 2007.

provides greater detail on the method used to obtain these estimates and the techniques employed to address the most common concerns.

The greatest boost to productivity growth in the Region would be derived from improvements in infrastructure quality, financial development, infrastructure stock, and institutional quality. Figure 1.10 shows the impact on productivity growth in the Region from raising the level of each dimension of policy to the level of the median industrial country. Thus, if infrastructure quality in the Region were raised to the level of the median industrial country, productivity growth in the Region would be raised by 1.25 percentage points. If infrastructure stock were also raised to the level of the median industrial country, productivity growth would be raised by an additional 0.47 percentage points. Raising financial depth to the level of the median industrial country would provide an additional 0.78 percentage points of productivity growth, while an increase in institutional quality to the industrial country median would provide 0.28 percentage points.

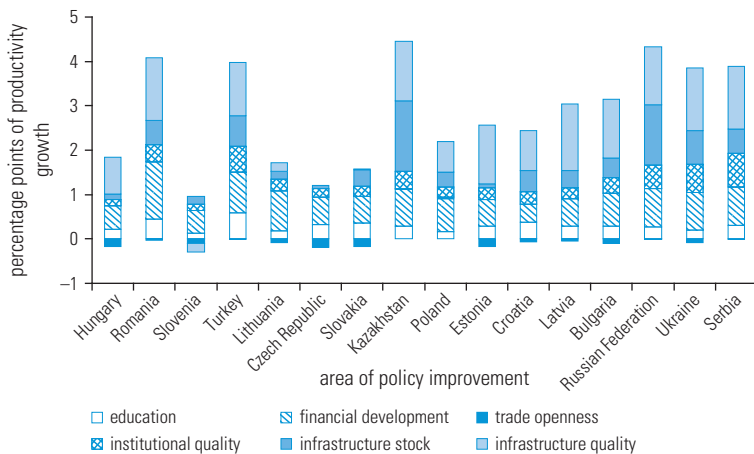
Different countries would respond to the potential improvements in structural indicators depending on their level of progress. The impact of such improvements on productivity growth would be greater in the CIS than in the EU-10. This influence is because, compared with the EU-10, the levels of the various policy indicators in the CIS are further below the median industrial country. Looking at the productivity impact in individual countries in the Region (figure 1.11), one obtains a sense of the policy dimension along which the particular country is relatively further behind the industrial country median. Thus, in Lithuania, the productivity impact of raising financial depth would be greater than the productivity impact of raising infrastructure quality and stock, suggesting that Lithuania lags the median industrial

**FIGURE 1.10**  
**Infrastructure and Financial Depth Improvements Would Do the Most to Boost Productivity**



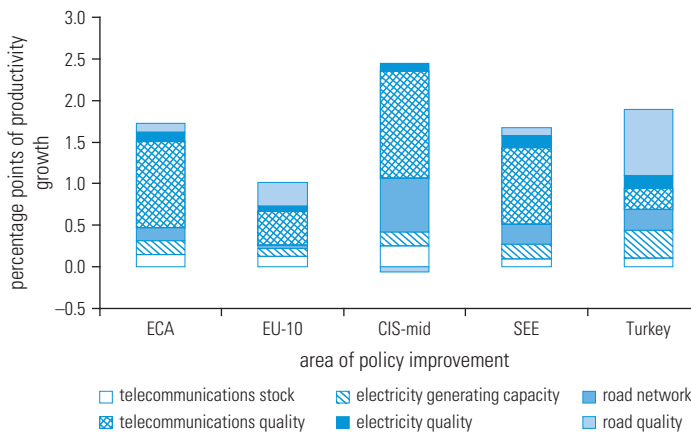
Source: World Bank staff calculations (see appendix 1.B for data sources); Calderón 2007.

**FIGURE 1.11**  
**Productivity Gains from Policy Improvements Vary across Countries**



Sources: World Bank staff calculations (see appendix 1.B for data sources); Calderón 2007.

**FIGURE 1.12**  
**Infrastructure Upgrading Shows High Returns**



Sources: World Bank staff calculations (see appendix 1.B for data sources); Calderón 2007.

country more along the dimension of financial depth than along the dimension of infrastructure. This suggests that improving financial depth in Lithuania is probably a more pressing need than improving infrastructure in the effort to sustain and accelerate productivity growth. Meanwhile, in Croatia, the productivity impact of improving infrastructure exceeds that of improving financial depth.

The productivity impact from an improvement in infrastructure depends on both the type of improvement and the country group within the Region. Because infrastructure stock and quality jointly have the greatest impact, we disaggregate the impact into different components of infrastructure stock and quality (figure 1.12). We find

that telecommunications quality has the greatest impact overall in the Region. Conversely, road density has a large impact in the CIS, while road quality has a large impact in Turkey.

## Conclusions

Substantial improvements in productivity have been the driving force behind strong growth in the Region since 1999. This has put the Region on a trajectory of convergence toward industrial country income and productivity levels. These large productivity improvements are not merely a one-time boost in productivity driven by improvements in capital utilization during the course of recovery following the start of the transition. Rather, they reflect real improvements in efficiency in the organization of production. The following chapters will explore in detail how reallocation and restructuring at the sectoral and firm levels have contributed to these improvements in efficiency.

The pattern of productivity growth across the Region has been driven in large part by progress in the policy reforms necessary for transition to a market economy. The rapid and sustained pace of reforms in the EU-10 has led to strong and sustained productivity growth in these countries over time. Progress in policy reforms in the CIS through 1998 set the stage for strong productivity growth after 1999 in these countries following a period of protracted decline.

The still large productivity gap between the Region and the industrialized world reflects an opportunity for sustained high productivity growth through catchup in the years ahead. The adoption of improved production techniques and other productivity-enhancing technologies available in the industrialized world should allow the countries of the Region to close the productivity gap rapidly. Successful adoption of such techniques will, of course, require a supportive policy environment.

Sustaining high productivity growth in the years ahead will require more progress in structural policy reforms. Lagging reformers will need to accelerate the pace of progress in the transition policy reform agenda. Across the Region, the impact of improvements along a range of structural determinants of productivity will depend on the relative progress made by each country along each structural dimension of policy. If the countries of the Region are able to tackle the different sets of policy challenges necessary to sustain high productivity growth going forward, the optimism that accompanied the start of the transition in 1991 will have been justified for many years to come.

## Notes

1. This decomposition does not include a separate term for the contribution of human capital accumulation because comparable and reliable data on educational attainment are not available for most countries in the Region for the period of interest (1990–2005). The measured TFP growth will thus include any contribution arising from changes in the stock of human capital. However, because the focus is on a relatively short period (1990–2005), with a greater focus on an even shorter period (1999–2005), it is unlikely that much of the difference in the rate of TFP growth across countries will be due to differences in the evolution of the stock of human capital.
2. Capacity utilization–adjusted TFP growth rates are calculated as follows: The capital stock series (which reflects the stock of *available* capital) is multiplied by the capacity utilization rates (obtained from the Russian Economic Barometer Survey Database) to derive a series reflecting *employed* or *utilized* capital stock. This series on *utilized* capital stock is used to repeat the growth decomposition. Because the capacity utilization rate rises rapidly after 1999, the *utilized* capital stock grows more rapidly than the *available* capital stock, so that the contribution of capital accumulation to growth is higher and the TFP growth rate is lower. Oomes and Dynnikova (2006) obtain similar results. Because the capacity utilization numbers are obtained from a survey of enterprises and the capital stock series is constructed using macroeconomic data, our estimates are accurate only to the extent that the numbers reflect capacity utilization trends in the overall economy.