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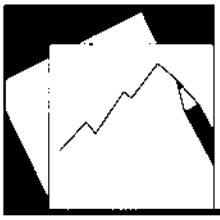

IMF Working Paper

Rapid Growth in Transition Economies: Growth-Accounting Approach

Garbis Iradian

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Middle East and Central Asia Department

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Abstract

This paper uses the growth-accounting approach to determine the sources of growth in transition economies. The central conclusion is that the estimated total factor productivity (TFP) growth for the former Soviet Union republics were significantly higher than other fast growing economies. A key question for prospective growth is whether the TFP gains achieved thus far have already eliminated most of the inefficiencies of central planning—and will therefore soon fade away. Underutilized labor combined with the recent trend of faster capital accumulation may play a more important role in the medium-term growth.

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Contents Page

ACRONYMS

Countries

ALB	Albania	MON	Mongolia
ARM	Armenia	LTU	Lithuania
AZE	Azerbaijan	LVA	Latvia
BEL	Belarus	POL	Poland
BGR	Bulgaria	ROM	Romania
BIH	Bosnia and Herzegovina	RUS	Russia
CZE	Czech Republic	SLK	Slovakia
GEO	Georgia	SLN	Slovenia
EST	Estonia	TAJ	Tajikistan
HRV	Croatia	TUR	Turkey
KAZ	Kazakhstan	HUN	Hungary
KGZ	Kyrgyzstan	UKR	Ukraine
MDA	Moldova	UZB	Uzbekistan
MAC	FYR Macedonia		

Regions

Baltics	Estonia, Latvia, and Lithuania
CE	Central Europe (Czech Republic, Poland, Hungary, Slovakia, and Slovenia)
CIS	Commonwealth of Independent States (Armenia, Azerbaijan, Belarus, Georgia, Moldova, Mongolia, Kyrgyzstan, Kazakhstan, Russia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan)
FSU	Former Soviet Union Republics
SEE	Southeast Europe (Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Macedonia, and Romania)

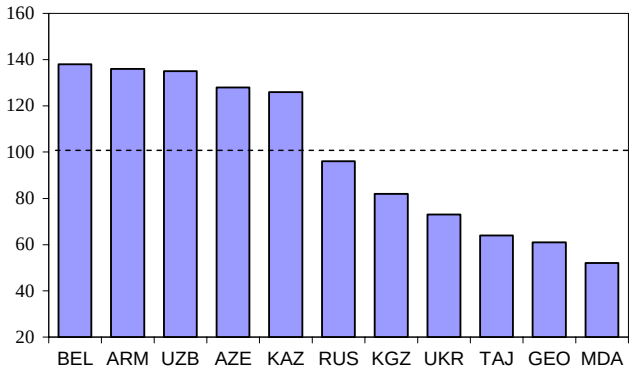
Other

CEA	Center for Economic Analysis
GDP	Gross Domestic Product
EBRD	European Bank for Reconstruction and Development
FDI	Foreign direct investment
GKS	Goskomstat or Rosstat
ILO	International Labor Organization
OECD	Organization for Economic Cooperation and Development
REB	Russian economic barometer
TFP	Total factor productivity
UNCTAD	United Nations Conference for Trade and Development
UNECE	United Nations Economic Commission for Europe
WEO	World Economic Outlook (IMF)

I. INTRODUCTION, PURPOSE, AND SCOPE OF STUDY

This study analyzes the sources of the recent rapid growth in the Commonwealth of Independent States (CIS) and the prospects for its continuation.[2] In the past six years, unweighted average growth of the CIS and the three Baltics countries have been above that of most other regions. The contraction in output during the first half of the 1990s, however, was so deep that, as of end-2006 real GDPs of Moldova, Georgia, Tajikistan, Ukraine, and Kyrgyzstan were still well below their 1990 levels.

Figure 1. Real GDP Index in 2006 (1990=100)



Source: Derived from the IMF's World Economic Outlook (WEO).

The extent to which output collapsed in some CIS countries far exceeded expectations, partly due to special factors including regional political conflicts and the absence of support institutions to manage the transition to a market economy. By the time output had bottomed, it had fallen by more than 50 percent in Armenia, Azerbaijan, Georgia, Moldova, and Tajikistan.[3] The pick up in growth rates since the output troughs has been impressive. But it would take until 2010 for Ukraine, 2012 for Georgia and Tajikistan, and 2015 for Moldova to regain the previous the 1990 real GDP level assuming that these countries manage to grow steadily at about eight percent a year (close to their annual average for the past five years). This would imply that the transition to regain the

Table 1. Output Decline and Recovery

	Cumulative Decline to Lowest Level (1990=100)	Output was Lowest in	Average Growth from Lowest Level to 2006
Georgia (GEO) 1/	68	1994	6.5
Moldova (MDA) 1/	66	1999	6.0
Ukraine (UKR)	59	1999	7.1
Azerbaijan (AZE)	58	1995	10.7
Armenia (ARM)	53	1993	8.6
Tajikistan (TAJ)	51	1996	7.4
Kyrgyzstan (KGZ)	49	1995	4.5
Russia (RUS)	42	1998	6.6
Belarus (BEL)	37	1995	7.2
Kazakhstan (KAZ)	39	1995	6.8
Uzbekistan (UZB)	18	1995	4.6

Source: Authors' own calculation from the WEO.
1/ The sharp fall in output is partly due to civil conflicts over the autonomous region of Ossetia and Abkhazia in Georgia, and Transnistria in Moldova.

[2] The CIS region, in this paper, is defined to include Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Mongolia, Russia, Tajikistan, Ukraine, and Uzbekistan. Turkmenistan is excluded due to the poor quality of national accounts statistics. Mongolia, which is not a member of the CIS, is included in this group for reasons of geography and similarities in economic structure.

[3] The rate of real GDP declines in the early 1990s were likely overstated in the official data, due to the emergence of the private sector, which in the early days of the transition was typically not fully included in the statistical base, and to the development of the underground economy.

previous peak in output (1990) has lasted more than two decades for some of the former Soviet Union republics (FSU). In this connection, a few historical points provide useful perspective to the fall in output and the length of the transition: (i) in the United States during the Great Depression, output per capita fell by 31 percent and recovered to its pre crisis level in 10 years; and (ii) the output fall from pre-World War II (1938) to postwar trough was 51 percent in West Germany and 45 percent in Japan; both of these countries regained their 1938 level of output by 1953—eight years after the end of the war.[4]

The experience of fast-growing economies shows that to sustain economic growth of at least six percent a year for a long period, high investment (more than 25 percent of GDP) is needed (examples include China, South Korea, Malaysia, Thailand, and Vietnam). But investment outlays for the CIS, excluding Azerbaijan and Mongolia,[5] averaged about 20 percent of GDP in 1996–2006, and total employment for the region as a whole at end-2006 was about 10 percent below its 1990 level.

In the economic literature there are mainly two approaches with regard to sources of growth, namely the cross-section growth-accounting approach and the panel regression approach. This paper uses the growth accounting approach to analyze the sources of the recent rapid growth in transition economies and compare these with other fast growing economies.[6] The research questions include the following: What explains the strong economic recovery in the CIS? Is either investment or TFP growth responsible for the major shifts in economic growth?[7] What can be learned from the experiences of other countries that sustained rapid growth for a long time?

The main contributions of this paper are as follows. First, it examines the sources of recent growth for all transition economies and compares them with other fast growing economies in East Asia over the past three decades, and Western Europe and Japan during the "Golden Age" (post-war period). The data used for transition economies are the latest covering 1991−2006. Second, instead of the arbitrary assumptions regarding the share of capital in income that were often made in the growth literature, the paper adopts the most up-to-date econometric techniques to properly estimate it, including fixed effects, 2SLS, and cointegration techniques. However, the estimation is regional rather than country-specific, given the short time span of reliable and comparable national accounts statistics. Third, for the sake of sensitivity analysis, the sources of

[4] See World Bank, 2005, p.31.

[5] Investment in Azerbaijan averaged about 40 percent of GDP in 2000–06, with foreign investment in the energy sector accounting for more than half of this investment.

[6] Iradian, 2007, uses the panel regression approach.

[7] TFP is a measure of elements such as managerial capabilities and organizational competence, research and development, intersectoral transfers of resources, increasing returns to scale, embodied technical progress, and diffusion of technology.

growth were also estimated under different assumptions of capital shares and initial capital output ratios.

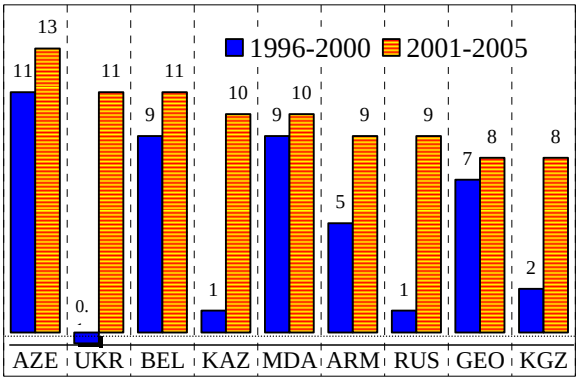
The growth-accounting exercise suggests that the CIS's recent strong growth has been driven largely by growth in TFP. On average, capital accumulation made a modest contribution and employment rates continued to drop till recently in some countries in the region. Looking ahead, the critical question is whether the rapid TFP growth can be sustained. Assuming that TFP growth slows down, other sources of growth will be essential to sustain a rapid catch-up. In this connection, the recent trend of faster capital accumulation and the improvement in employment in some of the CIS countries are expected to play a more important role in future growth.

The rest of the paper is organized as follows. Section II records the region's growth performance both on the expenditure and production sides with brief overviews of individual countries. Section III reviews the various growth-accounting methodologies and data issues. Section IV uses the growth-accounting approach to identify the sources of growth. The contribution of the estimated TFP growth to output in the CIS is compared with other fast-growing economies in Europe, Latin America, and East Asia. Section V summarizes the findings and draws conclusions.

II. Overview of Output Development

During 2001–06, real GDP growth for the CIS region picked up strongly to an unweighted average of eight percent a year, outperforming the average growth in other regions (including the fast growing economies of East Asia, with the exception of China). The rapid growth has been driven by domestic demand. Real private consumption grew by about nine percent per year for the region as a whole, underpinned by large hikes in real wages (Figure 2). In some CIS countries, the substantial increase in remittances also supported the rise in private consumption. While the benign global environment and higher commodity prices have encouraged a rapid increase in exports, the sharp increase in consumption has led to an even higher growth in imports. The contribution of net exports to GDP growth, therefore, was negative in some CIS countries and marginally positive in others.

Figure 2. Real Private Consumption, 1996–2005
(Average percentage change)

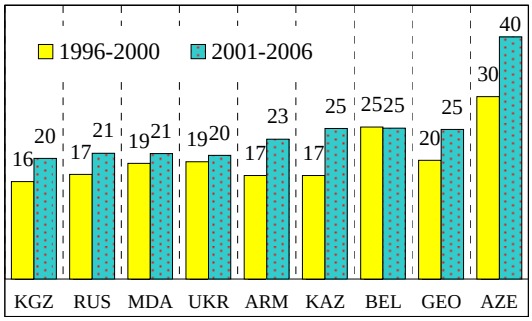


Source: Authors' calculations from the UNECE's database.

While real investment grew by double-digits levels in several CIS countries, the ratio of investment to GDP remained relatively low (Figure 3). Despite the very favorable growth performance, the average investment to GDP ratio for the CIS was about five percentage points below the simple average for the three Baltics, three percentage points below the five Central European (CE) economies, and some 10 percentage points below

the fast-growing countries in East Asia. In particular, the level of investment remained low in sectors other than oil, gas, and metallurgy. FDI inflows outside the commodity sectors remained low.

Figure 3. Investment, 1996–2006
(In percent of GDP)



Source: Derived from the IMF WEO database.

What were the country special factors explaining the rapid growth in the CIS?

Turning to individual countries, Russia experienced eight years (1999–2006) of strong economic growth. Beyond 2000, the impetus to growth was mainly private consumption fuelled by rising incomes following the sharp rise in international oil and gas prices. The rising domestic demand led to significant increase in imports. As in other energy exporting countries, the income and wealth effects associated with high oil and gas prices lifted non-energy output. The latter reflected the rebound in real wages from the depressed levels in the wake of the 1998 financial crisis. While real fixed investment grew by an annual average rate of nine percent, the investment-to-GDP ratio remained relatively low, particularly in the non-energy sectors.

The strong growth in Ukraine in 2000–06 was due to the cumulative effect of structural reforms introduced in 2000–01 and positive terms-of-trade shocks. An export-led upturn in key manufacturing sectors (particularly in steel and chemicals), which benefited from increased external demand and higher international prices of metal products, contributed to an overall surge in real industrial output. Foreign direct investment has soared since 2004 to an estimated US$10 billion in 2005–06—more than the cumulative total for all preceding years. The bulk of the recent inflow is accounted for by the privatization of Kryvorizhstal, the steel mill sold in 2005 to Mittel Steel, and a handful of bank deals. Other sectors have been barely touched by foreign capital due to high bureaucratic interference and influence of domestic oligarchs.

FDI-led reconstruction of the energy sector has also contributed to the strong economic performance in Azerbaijan and Kazakhstan. The completion of the Baku-Tbilisi-Ceyhan oil pipeline (with a capacity of one million barrels a day) and the extraction from the large Azeri-Chriag-Guneshi oilfield raised the annual growth rate in 2005–06 to 27 percent in Azerbaijan. In Kazakhstan, high oil prices helped boost economic growth to an average of about 10 percent a year in 2001–06.

Growth in Armenia, Georgia, Moldova, and Tajikistan was also strong. On the expenditure side, economic growth has been driven by private consumption and small scale private investment. On the production side, construction and services accounted for most of the growth. High levels of remittances from workers living abroad combined with substantial growth in real wages have fueled private consumption growth. In Georgia, the economy benefited greatly from its role as a transit corridor for oil and natural gas. The construction sector was boosted by the work on the Baku-Tbilisi-

Ceyhan oil pipeline and the Shah-Deniz gas pipeline, which have provided employment and generated demand for business services. Growth in Kyrgyzstan was much lower than in the other CIS countries due to the accident in 2002 at the Kumar gold mine, which accounts for a large share of the country's industrial output and exports, and to political upheaval of 2005 (Tulip Revolution).

Belarus, with limited market reforms, has experienced 10 years of uninterrupted strong growth averaging about seven percent a year. Unlike other CIS countries, this rapid growth has occurred from a relatively high initial base—Belarus suffered a smaller drop in output in the early 1990s than most other CIS countries. The rapid growth reflected the country's ability to import energy from Russia at below-market prices while the prices for its energy-intensive exports grew markedly. Belarus used the trading gains to pay large wage increases, subsidize state enterprises, and finance large-scale investment projects that underpinned a policy of strong government interference in the economy.

Strong growth has also been recorded in Turkmenistan and Uzbekistan, also nonreformed economies, underpinned by higher commodity prices. According to official figures, real GDP growth in Turkmenistan averaged more than 15 percent in 2000–06, but it is likely that these estimates have a significant upward bias.[8] Uzbekistan's average growth of five percent in 2001–06 has been driven by favorable world market prices for gold and cotton—Uzbekistan's main exports—and increasing exports of natural gas and cotton. The binding constraint on higher economic growth in Turkmenistan and Uzbekistan (in the nonresource sectors) continues to be the extensive state intervention and the relatively closed nature of these two economies, which hold back private sector development.

III. Methodology and Data Issues

Growth accounting helps explain economic growth by decomposing output growth into the contributions of capital, labor, and a residual measure of gains in the efficiency with which capital and labor are used. This residual is an estimate of the changes in total factor productivity (TFP) that reflect, in addition to biases due to methodological assumptions and measurement errors, a wide range of factors affecting input efficiency. The residual is defined as the growth in output that occurs with unchanged levels of the factor inputs. The interpretation of this residual depends on the definition of factor inputs employed in the analysis. Labor's productivity is affected, among other things, by educational attainment and work experience. The productivity of capital is affected, among other things, by the age of the equipment, the level of technology embodied within it, and whether the capital good is publicly or privately owned.

[8] This growth rate diverges considerably from the officially reported changes in physical volume of output of the country's key commodities. The Turkmen authorities apportion the increase in their hydrocarbon export prices over the past few years to quality improvements.

Any measurement errors present in the variables used to measure labor (i.e., employment in the informal sector was not captured) and capital (for example the extent of capacity utilization) are mechanically imputed to TFP. Also a failure to account for improvements in the quality of the capital stock (including age of capital stock) or labor (including hours worked, education, and training) will lead to an overestimation of the TFP component. The organizing principle of growth accounting is the Cobb-Douglas aggregate production function:

$$Y = e^{\theta} K^{\alpha} L^{\beta} \quad (1)$$

where Y is GDP in real terms, θ is the rate of productivity growth (TFP), α represents the share of capital in GDP, β represents share of labor, K is capital stock, and L is employment. Output growth is then divided into components attributable to changes in the factors of production. Differentiating the logarithm of equation (2) with respect to *t*, we obtain

$$g = \theta + \alpha \text{ (growth rate of capital)} + \beta \text{ (growth rate of labor)} \quad (2)$$

where g is the growth rate in output, θ is the growth rate of TFP, α is the elasticity of output with respect to capital, and β is the elasticity of output with respect to labor. The question then is how to estimate α and β.

Measuring capital stock

Measuring capital stock is fraught with difficulties as most developing and transition countries have no official capital stock estimates. The World Bank data set on capital stock is based on Nehru and Dhareshwar (1993), which uses the perpetual inventory method (PIM) to estimate physical capital for a group of 92 developing and industrial countries. Nehru and Dhareshwar estimated the initial capital stock from investment data going back to 1950, where available.[9] They assume an identical share of capital in output of 0.40 for all countries. According to the PIM the value of the capital stock in a given year is equal to the value of the capital stock of the previous year, plus the real gross investment during the year, minus the depreciation of the initial capital during the year.

$$K_{(t+1)} = K_t + I_t - \delta * K_t \quad (3)$$

where K is the capital stock, I is the investment, and δ is the depreciation rate of capital. Equation (3) implies that the initial capital would be needed to calculate the capital stock series from accumulation of investments. In the literature, one popular approach to generate an estimate of the initial capital stock is based on Harberger (1978). This approach begins with the observation that if the capital-output ratio is constant in a

[9] The effect of the initial capital stock on the capital stock series decreases rapidly with the sample size of investment figures.

given period, the capital and output growth rates are equal during that period. From equation (3) the rate of growth of capital could be derived as:

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

which is here assumed to be equal to the rate of growth of output. Thus, equation (4) can be written as:

$$K_{t-1} = I_t / (g + \delta) \quad (5)$$

In the growth literature, *g* (growth in output) in equation (5) is estimated by using the three-year or five-year average annual growth rate of real GDP with the view to avoid short-run fluctuations. The base-year capital stock would then be centered in the middle of the three or five-year period, and the recursion formula (3) for capital accumulation would have to be applied in reverse to arrive at the initial capital stock. The effect of the estimate of initial capital stock on growth accounting estimates is significant in the early years, but then it gradually fades away with time.[10] Nevertheless, this paper also estimates the TFP growth using different levels of initial capital stock to GDP ratios.

Measuring capital and labor shares in output

There are several approaches in the growth literature to estimating the shares of capital and labor in output. The first approach assumes that factor markets are perfectly competitive so that earnings of the factors (capital and labor) are proportional to their productivities. However, this approach cannot be used for most CIS and developing countries due to unavailability of detailed national accounts statistics. The second approach uses a priori measure of capital in the range of 0.3–0.4 (most commonly used in the growth literature).[11] But many studies have found that the share of capital for developing countries is significantly larger than 0.4. The third approach would be to estimate the coefficients of the production function by regressing the growth rate of output on the growth rate of inputs and on the growth rates in capital and labor. The intercept (θ) then measures the growth in TFP, and the coefficients on the factor growth rates measure the shares of capital and labor, respectively. The main advantage of this process is that it dispenses with the assumption that factor social marginal products coincide with the observable factor process. The disadvantage of the regression approach, however, is that the growth of capital and labor cannot usually be regarded as exogenous with respect to variations in TFP—in particular, the factor growth rates would receive credit for correlated variations in unobservable technological change.

[10] The long-term trend of the capital-output ratio is an important indicator of growth. A declining or constant capital-output ratio imply that rapid growth may be sustainable. An increasing capital-output ratio would imply that eventually the net investments required to maintain sufficient capital growth would exhaust all income.

[11] Aiyer and Dalgaard (2005) establish that the standard Cobb-Douglas methodology of assuming a constant capital share of one-third for all countries is a very good approximation to a more general formulation under which countries have different aggregate production functions that do not require a constant elasticity of substitution among factors.

Also, the regression framework has to be extended from its usual form to allow for time and cross-section variations in factor shares and in the TFP growth rate (Barro, 1998).

Shigeru, Khan, and Murao (2003) proposed a fourth approach that does not need the assumption of perfectly competitive factor markets nor assumes any particular functional form of the aggregate production function. Their approach is based on nonparametric kernel derivative estimation techniques developed in the statistics and econometrics literature (see Pagan and Ullah, 1999). This approach estimates much lower elasticity of output with respect to capital (around 0.20) for several East Asian countries, thus emphasizing even more the role of the residual (growth in TFP) in explaining growth.

Finally, in recent years few studies used the cointegration technique to estimate the share of capital in output in nontransition economies. If the factor inputs in equation (2) are nonstationary, then the parameter estimates using standard techniques do not have standard asymptotically normal distributions and are prone to spurious correlations. Econometrically, the cointegration approach is useful because of the following: (i) it is robust to endogeneity; (ii) robust to many forms of simultaneity; (iii) robust to many forms of measurement error; and (iv) can isolate long run steady state relationships from short run dynamics.

Shares of capital and labor in output used by the growth-accounting literature

Boseworth and Collins (1996) adopted the Nehru and Dhareshwar data and extended it to 1994 using PIM. The share of physical capital and labor was assumed to be identical across countries at 0.35 and 0.65, respectively. Boseworth and Collins (2003), using again identical physical capital share of 0.35 in output across countries, estimated the sources of growth for 84 countries during the four decades from 1960–2000. For 1960–70, they find that TFP accounted for 42 percent in the OECD; 29 percent in Latin America; and 23 percent in East Asia. For 1990−2000, their estimate show that productivity growth slowed down in all regions of the world, including OECD to 20 percent and Latin America to 12 percent.

Senhadji (2000), while using the same sample, estimated the share of capital for individual countries and for different regions by applying the Fully Modified estimator in levels and first differences. The estimated shares for physical capital by regions were as follows: East Asia 0.48, South Asia 0.56, Latin America 0.52, Middle East and North Africa 0.63, and sub-Saharan Africa 0.43.

In a study on the sources of growth in ten Middle Eastern and North African (MENA) countries over the period 1960−98, Abu-Qarn and Abu Bader (2006) estimate the long-run share of capital in output using cointegration (country specific) and panel data (region-specific) methods. They find that the share of capital in the MENA countries is much higher than the conventional share of 0.3−0.4. Their analysis of the sources of growth showed that the role of TFP in determining economic growth is insignificant and negative in some of the MENA countries and that most of the growth was due to the accumulation of factor inputs.

As to transition countries, and in the absence of information on factor prices that would allow to approximate the elasticities of output with respect to capital and labor, De Broeck and Koen (2000) assumed shares of 0.3 for capital and 0.7 for labor. Loukoianova and Uigovskaya (2004) extended the period used by Broeck and Koen but using the same elasticities of output with respect to capital and labor for all transition countries. To the extent that capital share in output is underestimated, it is no surprise that the results in their papers showed that most of the decline in output in 1991−97 and recovery in output in 1998–2002 are explained by the movement in TFP growth. A more recent study on the sources of recent rapid growth in Central and Eastern European countries (Schadler and others, 2006) also assumed shares of 0.35 and 0.65 for capital and labor, respectively.

Data issues

The appropriate use of growth accounting techniques depends on the availability of reliable statistics on output and factor inputs. With reference to the CIS, this may pose some constraints on the application of more elaborate approaches, including those comprising multiple production factors (i.e. in addition to labor and capital). In view of these constraints, this paper's approach is limited to the traditional measure of TFP, that is the Solow residual. With this caveat in mind, the calculation of TFP in this paper covers 27 transition countries (comprising thirteen CIS, three Baltics, five Central European (CE), and six Southeast European (SEE) countries covering the 1991–2006 period. For comparison purposes the growth accounting for several fast-growing economies, including Chile, China, Ireland, and South Korea is also performed.

A new database has been compiled from a number of sources including the IMF's, World Economic Outlook (WEO), the International Labor Organization (ILO), and the United Nations Economic Commission for Europe (UNECE). The data set on the CIS, in particular, suffers from various serious weaknesses due to underreporting by private enterprises to avoid taxes and regulations, particularly in the early years of transition. The decline in output in the CIS during the first half of the 1990s could be overstated because the statistical system was designed to collect information only on publicly-owned enterprises. Beyond the mid-1990s, the information on the emerging private sector gradually became available and was incorporated into the statistical system. Also, the data for Tajikistan, Turkmenistan, and Uzbekistan are still incomplete and not always of good quality, hence data from these countries should be interpreted cautiously. The initial capital stock, K(0), is estimated using equation (3).[12] But, one major concern about the measurement of the capital stock is that a significant portion of the communist capital stock may have been permanently scrapped. If so, this would cause the contribution of capital accumulation to be underestimated during the subsequent recovery. In order to address this concern, a one-time adjustment for the

[12] Estimates of the steady state capital-output ratios for emerging Asian countries are in the range of 2.0 to 3.0, and the average for industrial countries during 1970–2004 is slightly below 3.0. The effect of the initial capital stock on the capital stock series decreases rapidly with the sample size of investment figures.

permanent scrapping of a significant portion of the capital stock during the communist era is applied; that is, the capital stock for the CIS countries is reduced by the same rate as output between 1990 and 1995 so that the capital-output ratio is not allowed to rise during the course of the sharp contraction in output. Also, this paper treats the quality of capital the same over time and across countries. An example for improvement in the quality of capital would include a shift from long-life capital (buildings) to short-life capital (machinery and equipment).

This paper treats all workers as if they were identical over time and across countries. In reality, there are major differences in the quality of labor. Obviously, workers in different countries have different levels of skills. Typically, education and number of hours worked are emphasized as key components of effective labor. Such data, however, are not available for most CIS countries.

Alternatively, the inputs are also adjusted for utilization of capital stock and labor. Failure to make adjustments for capacity utilization of capital and labor, such as the failure to account for improvements in capital and labor quality, tend to overestimate growth in TFP.[13] But among the CIS countries, capacity utilization estimates are only available for Russia, based on industry surveys industry.[14] These surveys suggest a "U-shaped" pattern of capital utilization that falls until 1996 and rising from 1999 onward. High capacity utilization in recent years may have been spurred by structural reform as well. These surveys also show that labor utilization increased from around 70 percent during 1994–98 to around 85 percent during 2000–04. In this paper, the results of the capacity utilization for Russia are used as proxy for capital stock and labor utilization in other CIS countries.

Few growth-accounting studies on nontransition economies made adjustments to labor quality by including education, age, or gender (Young ,1994, and Boseworth and Collins, 2003). Such information is available only for selected years and is limited for industrial countries as well as for some emerging countries. More importantly, the education level in transition economies, as measured by secondary school attainment or average years of study, is relatively high as compared with other developing and emerging economies, and there is little variation among them. Thus, the correlation between the education level and growth is expected to be weak in this case. In the absence of adequate indicators that reflect changes in the quality of labor over time and across countries, the growth in total factor productivity will therefore be overestimated.

[13] An example of improvement in the quality of capital would include a shift from long-life capital (buildings) to short-life capital (machinery and equipment). An example of labor quality would include improvement in the skills and education of the labor force.

[14] See Oomes and Dynnikova (2006). The surveys include Rossat (GKS), the Institute for the Economy in Transition (IET), the Russian Economic Barometer (REB), and the Center for Economic Analysis (CEA).

Estimated results of the shares of capital and labor

The estimated TFP growth during 1996−2006 was the highest for the Baltics (3.0 percent), followed by the CIS (2.3 percent), and CE (1.6 percent). For the CIS sample, using the fixed effects econometric technique with cross-section weights, the estimated elasticity of capital is 0.63 and of labor 0.51.[15] Ideally, separate production function for each country should be used. But given the short historical period (1991−2006), this paper assumes that the production functions are similar for each region. The countries included in each region (CIS, CE, and Baltics) share some common characteristics and are likely to have similar production functions. The sum of the capital and labor elasticities reported in Table 2 is not far away from unity for the three Baltics and the five Central European countries, but slightly higher than one for the CIS. The endogeneity problem is partially addressed by using 2SLS or instrumental variables, although finding good instruments remains a challenge. The estimates of the shares of capital and labor using the 2SLS are almost identical with the fixed effect technique.

Table 2. Regional Estimates of the Shares of Inputs
(1996-2006)

Sample	TFP Growth (in percent) θ	Elasticity		R^2	Number of Observations
		Capital (α)	Labor (β)		
	Method: Fixed effects using cross-section weights				
CIS-12	2.3	0.63	0.51	0.62	132
Baltics-3	3.0	0.49	0.52	0.66	33
CE-5	1.6	0.40	0.62	0.66	51
SEE-6	0.8	0.78	0.29	0.63	60
		Method: 2SLS			
CIS-12	2.6	0.66	0.53	0.59	131
Baltics-3	3.0	0.49	0.52	0.66	33
CE-5	1.6	0.40	0.62	0.66	55
SEE-6	0.7	0.71	0.34	0.62	60

Source: Authors' own calculations.
Note: All coefficients are significant at least at 1 percent confidence level.
The instruments for 2SLS are the lagged capital and labor growth rates.
Baltics-3: includes Estonia, Latvia, and Lithuania.
CE-5: includes Czech Republic, Hungary, Poland, Slovaka, and Slovenia.
SEE-6: includes Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Macedonia, and Romania.

[15] The majority of existing literature show capital elasticity of 0.3 to 0.5 in industrial countries. The share of physical capital for industrial countries is likely to be lower than for developing countries where the marginal product of capital is higher (Boseworth and Collins, 1996, p. 155).

Box 1. Labor Market

The transition from central planning to market economy has involved large losses in employment as unproductive firms have been closed, state enterprises were privatized, and production processes became more efficient. For the region as a whole, employment declined by about 20 percent from 1990 to 1997. The economic expansion that started in most countries of the region after the Russian crisis in 1998 has led only to modest employment increases in Russia, Ukraine, and Central Asia. As of 2006 and relative to the pre-transition level of 1990, the region still lost slightly more than 10 percent of its employment (Figure 8).

Most transition economies have experienced large shifts in labor between the public and private sectors. But, the reduction in employment in the public sector was not offset by the increase in private sector, except for Azerbaijan, Kyrgyzstan, Mongolia, Tajikistan, and Uzbekistan. By 2006, the private sector generally accounted for between 60−80 percent of total employment. It is noteworthy that the share of employment in the public sector remains higher in the slower-reforming economies (such as Turkmenistan and Uzbekistan).

In 1995–2006**,** population and labor force growth rates increased in the range of 1-2 percent a year in Uzbekistan, Tajikistan, Kyrgyzstan, and Azerbaijan. In contrast, population and labor force rates declined by 1 to 1½ percent a year in Armenia, Georgia, Moldova, Russia, and Ukraine due to reduced fertility, increasing mortality and emigration. With respect to the quality of the labor force, the secondary school enrollment rate in the CIS countries is still much higher than in most low- and middle-income developing countries. The human capital stock inherited from the Soviet era was very high.

The jobless recovery in some CIS countries may reflect the poor quality of labor market statistics. Official statistics fail to fully capture fully the improvement in employment in small and medium-size enterprises and in service sectors that are less well-monitored in the industry. A difficult business environment in some of the CIS countries appears to have limited the ability for small and medium-sized enterprises to play a key role as employment generators. Self employment has increased substantially and is mainly concentrated in farming, wholesale and retail trade, and construction.

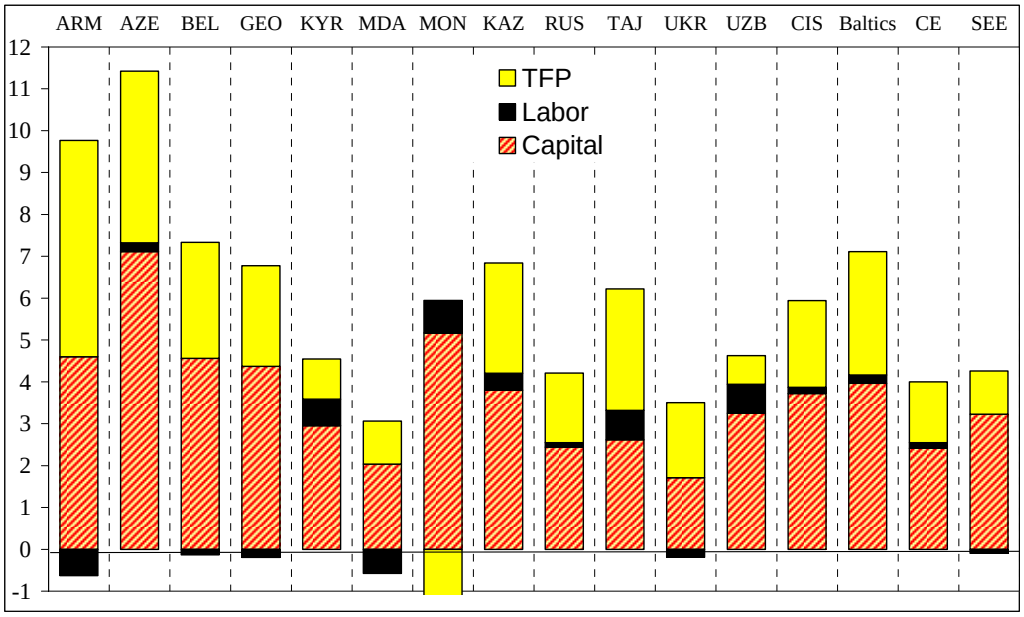
The registered unemployment rates, according to an ILO definition, are relatively low. But, the labor force survey data indicate high rates of unemployment rate (varying from 9 percent in Kazakhstan, Russia, and Ukraine to 20 percent in Armenia, Georgia, and Moldova). Engagement in the informal sector by those officially listed as unemployed or economically inactive is widespread in the CIS countries. According to the ILO, the size of the informal sector employment accounts for about one-half of all employment in the CIS as compared to about a quarter in Central European (CE) economies. Informal sector jobs are defined as value-adding activities outside the tax net and regulation. These activities may be unregistered and untaxed by their nature (household subsistence economy) or emerge because of purposeful evasion and noncompliance.

IV. Growth Accounting Results

A. Transition Economies

The contribution of factor inputs (capital and labor) to growth in output, measured by factor growth rates weighted by their income shares, is presented in Figure 4 and Table 3 as is the rate of growth of TFP. Unlike previous studies on transition economies, results indicate that for 1996-2006 the most important source of growth by far has been capital accumulation, with the exception of Armenia, Tajikistan, and Ukraine, where the contribution of TFP growth was higher. At the same time, the contribution of labor has been remarkably low, given the sharp decline in employment in the 1990s (improvements in quality of labor are reflected in TFP growth).

Figure 4. Sources of Growth in Transition Economies, 1996–2006
(In percentage points of GDP)



Sources: Authors' own calculations based on the IMF World Economic Outlook database.
Baltics (Estonia, Latvia, and Lithuania).
CE: Central Europe (Czech Republic, Hungary, Poland, Slovak Republic, and Slovenia).
SEE: Southeast Europe (Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Macedonia, and Romania).

The results also indicate that growth differences across countries and over time were driven by labor productivity as well. Growth in labor productivity can be decomposed into capital deepening (i.e., increases in physical capital) and growing TFP, which in this study includes improvement in labor quality. During 1996-2006, average annual TFP growth in the CIS was higher than in CE and SEE, but lower than in the Baltics. There is significant variation in the estimate of TFP growth among CIS countries, with Armenia and Azerbaijan above 4 percentage points, Georgia and Belarus between 2−3 percentage points, Moldova, Russia, and Ukraine from 1 to 2 percentage points. TFP growth was less than one percentage point in Uzbekistan and negative in Mongolia.

Table 3. Growth Accounting Results for Transition Economies
(In percent, annual averages, 1996−2006)

	Real GDP Growth (In percent)	Investment as Percent of GDP	Contribution to Growth (Percentage points)			Share of TFP in Output (In percent	Growth in Productivity of Labor (In percent)
			Capital	Labor	TFP		
CIS-12	6.0	22.8	3.7	0.2	2.1	35	5.6
CIS Excluding MON and UZB	6.2	21.4	3.6	0.0	2.5	41	6.0
Armenia (ARM)	9.1	20.6	4.6	-0.6	5.2	57	10.9
Azerbaijan (AZE)	11.4	35.5	7.1	0.2	4.1	36	10.8
Belarus (BLR)	7.2	24.8	4.6	-0.1	2.8	38	7.6
Georgia (GEO)	6.8	22.3	4.4	-0.2	2.4	35	6.9
Kyrgyzstan (KGZ)	4.5	18.2	3.0	0.6	1.0	21	2.9
Kazakhstan (KAZ)	6.8	21.2	3.8	0.4	2.6	39	5.8
Moldova (MDA)	2.5	20.0	2.0	-0.6	1.0	41	2.5
Mongolia (MON)	4.7	35.6	5.2	0.8	-1.3	-27	4.7
Russia (RUS)	4.2	19.1	2.4	0.1	1.7	40	3.9
Tajikistan (TAJ)	6.2	12.9	2.6	0.7	2.9	47	5.0
Ukraine (UKR)	3.3	19.8	1.7	-0.2	1.8	54	3.8
Uzbekistan (UZB)	4.6	23.6	3.3	0.7	0.7	15	2.8
Baltics	7.1	26.1	4.0	0.2	2.9	41	6.7
Estonia	7.6	29.6	4.5	0.1	3.0	39	7.4
Latvia	7.4	26.2	4.2	0.4	2.8	38	6.6
Lithuania	6.4	22.5	3.1	0.1	3.1	49	6.1
Central Europe	4.0	25.1	2.4	0.1	1.4	36	3.8
Czech Republic	2.9	28.9	2.3	-0.2	0.8	29	3.2
Hungary	4.2	22.9	2.3	0.4	1.5	36	3.6
Poland	4.4	21.0	2.2	0.0	2.1	48	4.3
Slovak Republic	4.5	28.5	2.9	0.4	1.3	28	3.8
Slovenia	4.0	24.2	2.4	0.1	1.5	38	3.9
Southeast Europe	4.2	21.0	3.2	-0.1	1.0	25	4.5

Sources: Authors' own calculations.
Note. Annual depreciation rate of capital stock is assumed at 5 percent; elasticity of output with respect to capital 0.6 for the CIS and Southeast Europe, 0.5 for Baltics, and 0.40 for Central Europe; and initial capital stock to GDP ratio of 2.

Overall the estimated TFP growth for CIS countries is high compared with the results found in the literature on growth accounting for other countries. A natural question is then, what were the factors that led to these high TFP growth?

- The inefficiencies inherited from central planning left much scope for managerial improvements, labor shedding, and gains from inter-industry resource reallocation.

- Higher TFP growth could also be explained by the scale of some of the CIS economies, which are relatively poor economies with very low endowment of technology. Hence, for a given technological innovation, the smaller the initial endowment the higher the growth of TFP. When capital is scarce, its marginal productivity is considerable. Therefore, for similar investment rates, the contribution of capital deepening should be larger in economies with less capital.

- Increases in capacity utilization could also raise TFP growth. Most CIS countries experienced significant increases in capacity utilization from their low levels reached in the mid-1990s.

- There is a strong correlation between the successful macroeconomic stabilization and the progress made in market reforms in the late 1990s and total factor productivity growth (see Iradian, 2007).

- More importantly, a significant portion of the high productivity growth is attributable to the rebound effect after the sharp fall in output in the first half of the 1990s (see Iradian, 2007).

Table 4. Sensitivity of TFP Growth Estimates, 1996−2006

	TFP in percentage points					TFP as share of output (percent)				
Share of capital (α) →	0.6	0.6	0.6	0.4	0.4	0.6	0.6	0.6	0.4	0.4
Share of labor (β) →	0.4	0.4	0.4	0.6	0.6	0.4	0.4	0.4	0.6	0.6
Initial capital/GDP (k) →	1.5	2.0	2.5	2.0	2.5	1.5	2.0	2.5	2.0	2.5
CIS-12	0.9	2.1	3.2	3.5	4.0	11	35	53	57	67
Armenia (ARM)	4.1	5.2	6.0	7.0	7.6	45	57	65	77	83
Azerbaijan (AZE)	2.6	4.1	6.7	7.5	8.1	23	36	59	66	71
Belarus (BLR)	1.4	2.8	5.0	5.4	5.8	20	38	69	75	81
Georgia (GEO)	1.2	2.4	3.3	3.9	4.5	17	35	49	57	66
Kyrgyzstan (KGZ)	-0.2	1.0	2.1	1.9	2.4	-4	21	45	42	52
Kazakhstan (KAZ)	1.4	2.6	4.0	4.1	4.6	20	39	58	59	67
Moldova (MDA)	0.0	1.0	1.6	2.0	2.4	-1	41	66	79	97
Mongolia (MON)	-2.3	-1.3	-0.5	0.0	0.6	-49	-27	-11	0	12
Russia (RUS)	0.6	1.7	2.5	2.5	3.0	14	40	60	60	71
Tajikistan (TAJ)	2.0	2.9	4.5	4.1	4.5	32	47	72	66	72
Ukraine (UKR)	0.8	1.8	2.5	2.5	2.9	23	54	74	75	88
Uzbekistan (UZB)	-0.4	0.7	1.4	1.4	1.9	-8	15	31	31	41
Baltics-3	2.0	2.9	3.1	3.7	4.3	28	31	43	52	60
Central Europe-5	0.8	1.4	1.3	1.7	2.1	20	16	33	42	53
Southeast Europe-6	0.4	1.0	1.7	2.2	2.6	11	26	40	54	63

Source: Authors' own calculations.
Note. Annual depreciation rate of capital stock is assumed at five percent.

To test for the robustness of the TFP growth estimates, other scenarios are also prepared based on different assumptions of initial capital to output ratio *(k)* and elasticities of output with respect to capital *(α)*. An increase in *k* from 1.5 to 2.5 (with share of capital of 0.6) raises the estimated TFP growth for the CIS region from 0.9 to 3.2 percentage points. A decrease in the capital share (*α)* from 0.6 to 0.4 (close to the share of capital used in the literature) increases average annual TFP growth from 2.1 to 3.5 percentage points (equivalent to 57 percent of output growth in 1996–2006). In general, countries with higher capital shares *(α)* will tend to have lower TFP growth (for the same growth rates of capital and labor); a higher α would result in a rise of the contribution of physical capital and a decline in the contribution of TFP growth.

Appendix Table 6 reports the results for the three sub-periods (1991–95, 1996–2000, and 2001–06) with and without adjustment for capacity utilization. TFP growth was sharply negative in the early years of the transition but turned to significantly positive after the mid-1990s, indicating that part of the initial sharp productivity decline was temporary, with production factors being less than fully utilized. During the sharp contraction of 1991–95, TFP fell dramatically, and accounted for about half of the contraction in output. Factor contribution was also negative in the CIS and the Baltics during the first half of the 1990s, reflecting the reduction in employment and investment. With the exception of Mongolia and Uzbekistan, total labor employment fell in all CIS and Baltic countries.

The increase in capital contribution in 2001−06 as compared with 1996–2000 is attributable to a rebound in savings that has taken place in most CIS countries since 2001. The average ratio of investment to GDP for the CIS increased by about four percentage points from 1996–2000 to 2001–06. Finally, with adjustment for capacity utilization (Scenario B in Table 6), the average TFP growth in 2001–06 went from 3.8 to 2.9 percentage points.

B. Fast Growing and Major Industrial Countries, Historical Perspective

Examining differences between the sources of the recent fast growth in the CIS, East Asia over the past three decades, and of the rapid growth in Europe during the Golden Age is instructive. Growth-accounting estimations suggest that periods of sustained, rapid growth typically result from high investment combined with strong TFP. During the "Golden Age" (post-war period) in Western Europe and Japan, there were strong contributions to growth from TFP gains. The average contribution of TFP to output growth was 2.7 percentage points for the seven major industrial countries—close to the estimated TFP growth for the CIS, and accounting for about half of the growth in output. Catching up, scale effects, and improvements in resource allocation made strong contributions to TFP during 1950–60 (Maddison, 1996).[16] These improvements stemmed from adjusting to trade liberalization, exploiting opportunities for mass production as larger and better integrated markets emerged, and from moving resources out of relatively low-productivity agriculture. As catch-up growth weakened, the magnitude of TFP growth fell markedly after 1973.

East Asian growth has relied much more heavily on factor inputs, both labor and capital, and less on TFP growth than that of "Golden Age" Europe and the current CIS rapid growth. Gains in the TFP of the "four tigers" (Korea, Taiwan, Hong Kong, and Singapore) accounted for only one fourth of the growth in output over the past three decades. According to Young's (1995) estimates, physical capital accumulation boosted growth in the "four tigers" by 4 percentage points during 1966–90, much more than observed in other regions. TFP contributed only 1.7 percentage points to growth and

[16] The United States of America saw per capita income growth averaging 2.4 percent a year between 1950 and 1973; over the same period, per capita income grew on average by 5 percent a year in Germany; and by slightly more than 8 percent in Japan.

labor 3.3 percentage points. But Shigeru, Khan, and Murao (2003) using a nonparametric derivative estimation techniques, found that during 1960–95, the estimated TFP growth explains 44 to 47 percent of the output growth. On the other hand, capital growth contributes only 25 to 28 percent of output growth in East Asian countries. These results provide little support for the strong version of the accumulation hypothesis of Young (1995).

The estimates in this paper show that factor inputs (capital and labor) in Korea over the past three decades (1975–2006) accounted for two-thirds of the growth. TFP growth in China averaged about 4 percentage points over the past two decades (contributing to 41 percent of output). This is evidence that China's gains are coming from both the contribution of very high capital accumulation and from TFP.

There are very few countries around the world that were able to sustain rapid growth for more than 15 years with relatively low shares of investment in GDP:

- In Chile, factor accumulation accounted for two-thirds of the growth in 1986-1995, and about 90 percent in 1996−2006. The main policies underpinning the sustained rapid growth included the following: (a) strong fiscal discipline; (b) a strengthened financial system; and (3) improved institutional arrangements that created a more stable macroeconomic environment.[17]

- Ireland's impressive economic performance over the past two decades was also driven largely by factor inputs. Although productivity growth was strong, what set Ireland apart was the large increase in labor utilization in the past two decades. Although not the only factor, social partners contributed significantly to the increase in the employment rate since the early 1990s, which averaged about 4 percent per annum.[18] Consequently, unemployment declined from double digit levels in the 1980s to 4 percent in 2005.

- India achieved its growth with relatively little emphasis on capital accumulation and more substantial gains in TFP. In that mix of gains, it differs from the East Asian economies. Growth has been driven largely by increased labor utilization and efficiency gains. Since 2000, the volume of exports has grown three times faster than in the latter half of the 1990s. This acceleration has been led by services exports—particularly software and information technology (IT).

A key question for prospective growth is whether the TFP gains achieved thus far have already eliminated most of the inefficiencies of central planning—and will therefore soon fade away. Sustaining productivity growth rates such as those experienced recently in the CIS countries is difficult. As shown in Table 4, some of the fastest-growing

[17] International Monetary Fund, 2004, Chile: Selected Issues.

[18] In contrast to other European countries, fertility rates in Ireland were very high in the 1960s and 1970s. Population growth also supported the increase in output, helped by the reversal of migration flows. The net inflow of migrants to Ireland between 1996 and 2003 was close to 0.2 million (about 5 percent of the population). See International Monetary Fund, 2004, Ireland: Selected Issues.

economies in the world over the past three decades (e.g., Chile, Ireland, Korea, and post-war II, 1950-73, France, Germany, and Japan) have not been able to sustain average annual productivity growth rates in excess of 2.5 percent for a long time. Underutilized labor combined with the recent trend of faster capital accumulation is expected to play a more important role in the medium-term growth.

Table 5. Sources of Growth, Historical Perspective, 1950−2006
(In percent, annual averages)

		Real GDP Growth (In percent)	Investment as Percent of GDP	Contribution to Growth (Percentage points)			Share of TFP in Output (In percent	Growth in Productivity of Labor (In percent
				Capital	Labor	TFP		
Chile	1976-1985	3.4	15.9	1.4	2.0	-0.1	-2	0.2
	1986-1995	7.7	21.8	2.8	1.8	3.1	41	4.5
	1996-2006	4.3	22.9	2.4	1.2	0.6	14	2.2
China	1976-1985	8.7	29.0	3.4	1.4	3.9	45	6.3
	1986-1995	10.0	31.4	4.2	1.1	4.6	46	8.0
	1996-2006	8.8	36.8	4.4	0.8	3.7	40	7.4
Ireland	1976-1985	3.6	25.2	2.4	0.2	0.9	26	3.2
	1986-1995	4.6	20.2	1.3	1.1	2.3	50	2.8
	1996-2006	7.3	24.6	2.8	2.6	1.9	26	2.9
Korea Rep. of	1976-1985	7.4	29.7	3.7	1.4	2.3	31	4.9
	1986-1995	8.7	34.3	4.0	1.9	2.8	32	5.4
	1996-2006	5.4	34.4	2.7	0.9	1.9	34	3.8
France 1/	1950-1960	4.9	…	1.8	0.2	2.9	59	…
	1961-1973	4.5	24.2	2.4	0.4	1.7	37	3.8
	1974-1985	1.7	22.6	1.3	0.1	0.4	21	1.5
	1986-1995	1.7	22.6	1.0	0.2	0.5	29	1.3
	1996-2006	1.9	23.3	0.9	0.6	0.4	20	0.9
Germany 1/	1950-1960	8.2	…	2.5	1.0	4.7	57	…
	1960-1973	4.4	25.9	2.6	0.2	1.6	36	4.0
	1974-1985	1.8	21.0	1.1	-0.1	0.8	46	2.0
	1986-1995	2.8	20.6	1.0	0.4	1.4	51	2.2
	1996-2006	1.4	20.0	0.8	0.2	0.4	30	1.1
Japan 1/	1952-1960	10.9	…	3.5	2.9	4.5	41	…
	1961-1973	9.7	25.4	4.3	0.8	4.6	47	8.2
	1974-1985	3.3	27.3	2.4	0.5	0.4	12	2.5
	1986-1995	3.2	28.5	1.9	0.6	0.6	19	2.1
	1996-2006	1.2	24.7	0.8	-0.1	0.5	41	1.3
USA 1/	1947-1960	3.7	…	1.7	0.6	1.4	38	…
	1960-1973	4.3	15.7	1.5	1.2	1.6	37	2.3
	1974-1985	2.8	15.7	1.4	1.2	0.3	11	0.9
	1986-1995	2.9	16.2	1.3	0.9	0.6	21	1.3
	1996-2006	3.3	19.2	1.7	0.8	0.7	23	1.9
East Asia 2/	1966-1990	8.9	32.0	4.0	3.3	1.7	19	…

Sources: Authors' own calculations for Chile, China, Ireland, and Korea Republic of.
1/ Christenson et al (1980) for the period 1951-60.
2/ Young (1995); simple average for Hong Kong, Singapore, Korea, and Taiwan.

C. Technical Efficiency

It would be interesting to distinguish between technological change and changes in the efficiency. Benhabib and Spiegel (1994) suggest that human capital affects TFP growth through the adoption and implementation of new technologies. Their present a model where they decompose TFP growth into two separate components: a catch-up term and a technological change component. Färe et al. (1994) use a data envelopment analysis (DEA) to decompose total output growth into technical change and efficiency change in OECD countries from 1978–88.[19] The authors construct a deterministic frontier for the sample, and compare each country's distance from the frontier in a framework of constant returns to scale. They use distance functions to calculate the Malmquist index as an alternative measure of TFP. The Malmquist index isolates the changes in efficiency (or catching-up) from technological change, which is measured by shifts in the frontier.

This paper follows Nishimizu and Page (1982) in attempting to decompose TFP change into technological progress and changes in technical efficiency. Technological progress could be defined as the change in the best-practice production frontier, and all other productivity change—learning by doing, diffusion of new technological knowledge, and improved managerial practice, for example—into technical efficiency. An internationally accessible best-practice production function is defined as

$$G^f(t) = F(Z(t); t) \tag{4}$$

where $G^f(t)$ is potential output at best practice, and Z(t) is a vector of inputs in natural units at time t. It is assumed that the function F satisfies the usual neoclassical properties and that an appropriate aggregate index of output exists. The best-practice function defines the "state of the art" in the sense that further increases in output at given levels of inputs cannot be achieved without the introduction of new techniques. Firms can move along the best-practice function, increasing output as the result of accumulation of inputs. The introduction and dissemination of new techniques move the best-practice frontier and its technological progress as defined by Solow (1956).

Observed performance in a sample of economies or firms reveals that few are at best practice.[20] The economies of most developing economies (including the CIS) lie below the production frontier due to the use of inefficient use of best-practice techniques. Observed output $G(t)$ for a vector of inputs $Z(t)$ can be expressed as

$$G(t) = G^f(t)\, e^{u(t)} = F(Z(t); t)e^{u(t)} \tag{5}$$

[19] The DEA methodology produces deterministic non-parametric frontiers that provide a single aggregate measure of relative efficiency for each production unit in terms of its utilization of input factors (independent variables) to produce outputs (dependent variables). The estimation of the production frontier is based only on the hypothesis of monotonicity, convexity, and free disposability of inputs and outputs.

[20] There is a large literature on technical inefficiency (see Färe 1994, Limam and Miller 2004, Arestis and others 2006).

where $u(t)$ is the level of technical efficiency $[0< e^{u(t)} = G(t)/G^f(t) <1]$ corresponding to observed output G(t). The derivative in logarithms of equation (5) with respect to time yields:

$$\dot{G}(t)/G(t) = F_z \dot{Z}(t)/Z(t) + F_t + \mathring{u}(t) \quad (6)$$

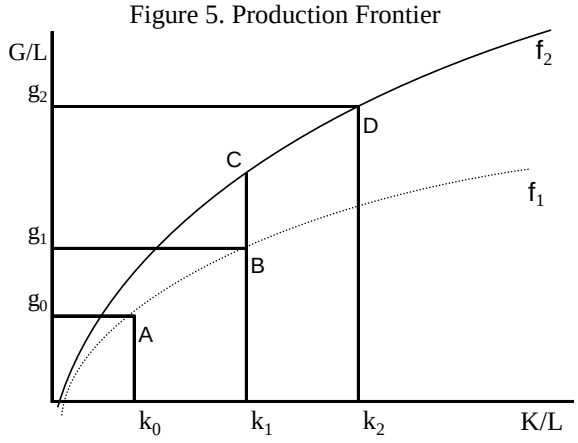
Where F_z and F_t are the output elasticities of $F(Z(t);t)$ with respect to inputs $Z(t)$ and time t, and dotted variables indicate time derivatives. Output changes in equation (6) are decomposed into three main elements. The first one gives output changes due to input changes, weighted by the elasticity of output with respect to each input. The second element is the rate of technological progress of the best-practice frontier, and the last element, $\mathring{u}(t)$can be either positive or negative.

The rate of TFP change can be defined as the variation in output not explained by input changes. Thus for any observation, i:

$$TFP_i(t) = F_t + \mathring{u}_i(t), \quad (7)$$

is the sum of technological progress, measured at the frontier, and the change in efficiency observed at the individual level. These concepts are represented in Figure 7.[21] The international best-practice production function, f_2, relates output per labor to capital (including human capita) input per labor. Economies that are technically inefficient operate along functional relationships such as f_1 in Figure 5. Catch-up can be achieved by moving from a point such as A to D, combining accumulation with a movement toward best practice.

Figure 5. Production Frontier



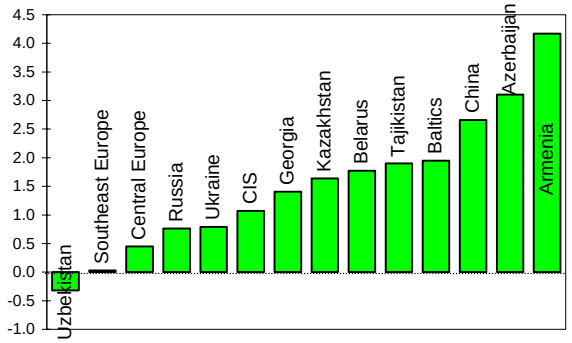
This interpretation of TFP change is useful in understanding the sources of rapid catch-up in technologically backward economies. Developed economies, which employ international best practice, are listed to rates of TFP change determined by the rate of technological progress. Economies that do not employ best practice can have TFP growth rates exceeding the rate of technological progress if technical efficiency change $u_i(t)$ is positive. It is also possible for TFP change to be negative, if technical efficiency change is negative and greater in absolute value than technological progress. A rapid shift from average practice to best practice—positive technical efficiency change—can provide a powerful engine of growth that is recorded as high rates of TFP change, as in the case of the CIS in recent years.

[21] Proponents of the endogenous growth theory would not accept the depiction of the production function with diminishing returns to capital.

Improvements in factor efficiency appear to have contributed to strong output recovery in the CIS. The estimated TFP change in this paper, using the growth-accounting framework, consists of both technological progress and technical efficiency change. It is assumed that technological change (the movement of best practice) is constant and does not vary across countries.[22] Under this assumption, all of the variance in rates of TFP change derives from variance in the rate of technical efficiency change.

Figure 6 shows the residual estimate of technical efficiency change by subtracting from the estimated TFP growth the average TFP growth for developed economies. The estimated annual average technical efficiency is positive for all CIS except Uzbekistan where the reallocation of resources has been limited, reflecting the slow pace of structural reforms.

Figure 6. Technical Efficiency, 1996−2006
(In percentage points of GDP, annual averages)



Source: Authors' own calculations.

The estimates of TFP that are derived in this section should be interpreted with caution, since the methodology used here does not adjust factor inputs for quality changes. The implication is that the incremental effect on growth of embodied technological advancement is not attributed to capital but is rather measured as a higher level of TFP. The same measurement problem can also arise in the case of labor. As for education and on-the-job training act to improve the quality of labor, measured TFP will be enhanced. This "mis-measurement" of TFP may well be significant in the case of the CIS, following the move from central planning to market economies in the past 15 years.

It is unclear whether the recent rapid growth driven mostly by improvements in TFP will be sustained over the medium- to long-term. A large part of productivity growth in the CIS reflects improvements in the allocation of resources, the better use of investment, increases in capacity utilization, elimination of inefficiency and higher intensity of work. These aspects of productivity gains are essentially transitory in the sense that they cannot produce growth indefinitely, but they can have a substantial impact over one or two decades.

[22] Industrial sector estimates of TFP change in developed economies generally yield a compact distribution of rates with a mean value close to one percent a year, both within and across economies. This may therefore be a good first approximation of the rate of technological change (see also IMF, World Economic Outlook, May 2007, Figure 1.14).

V. CONCLUSIONS

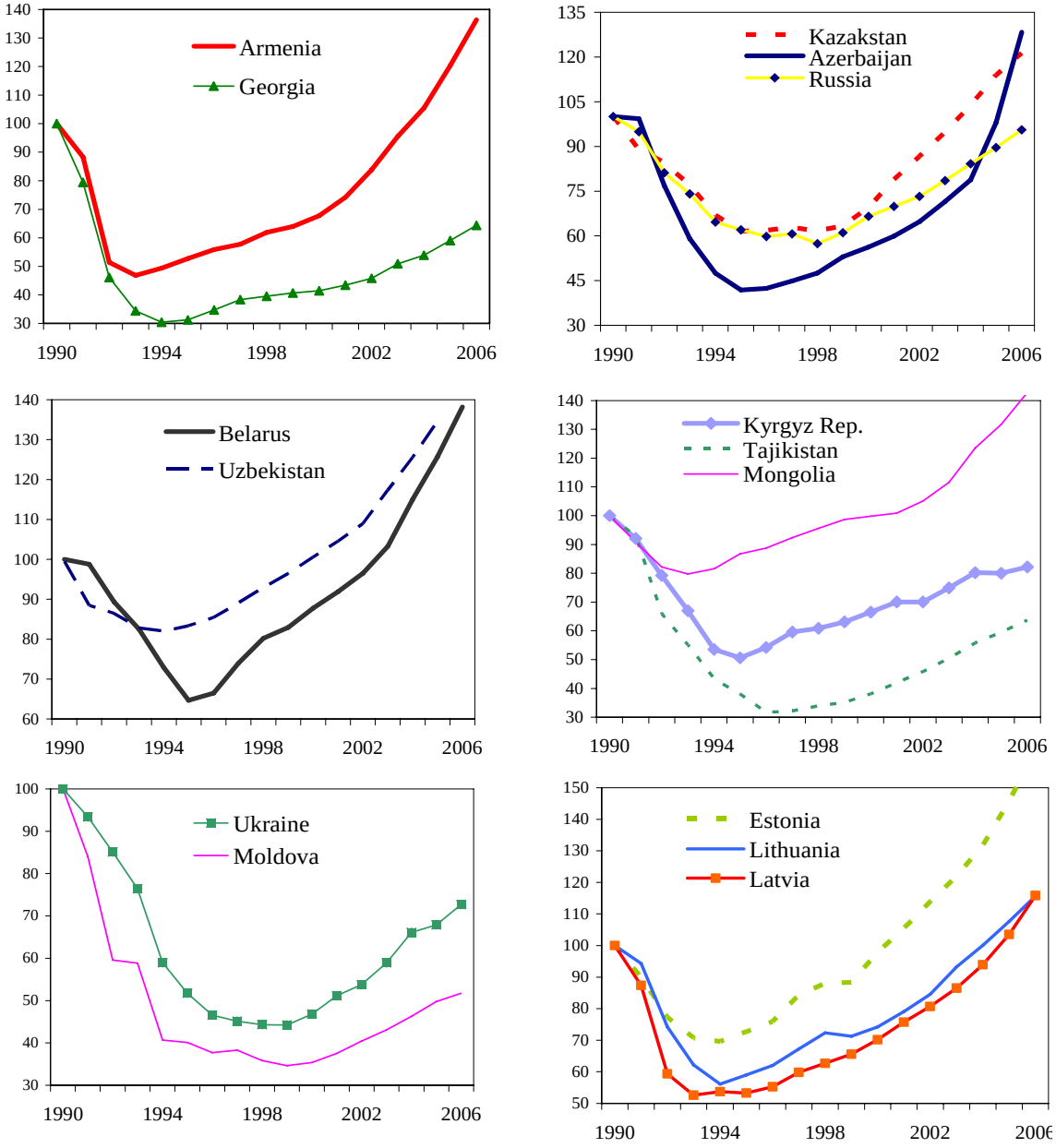
This paper uses the growth-accounting approach to determine the sources of growth in the CIS and compare them with other fast-growing economies and with Western Europe and Japan during the "Golden Age" (postwar period). Instead of the arbitrary assumptions regarding the share of capital in income that were often made in the growth literature, the paper estimate the shares of capital in output. For the sake of sensitivity analysis, the sources of growth were also examined under different initial capital output ratios and capital shares.

The central conclusion is that the estimated total factor productivity (TFP) growth for the former Soviet Union Republics were higher than other fast-growing economies. Capital accumulation in most of the CIS countries made modest contributions to growth—on average much smaller than in the three Baltics and the five Central European economies. Investment outlays, despite some improvement in recent years, remained relatively low with the exception of Azerbaijan and Mongolia.

The inefficiencies inherited from central planning left much scope for managerial improvements, labor shedding, and gains from inter-industry resource reallocation. During the initial years of transition, the disorganization or chaos resulting from the removal of central controls and coordination produced negative TFP growth rates as output fell, and a large part of the capital stock lay idle. Subsequently, as the economies achieved macroeconomic stability and introduced structural reforms, the reallocation of resources to more productive activities allowed the economies to generate rapid growth with low rates of investment so that total factor productivity growth rates increased.

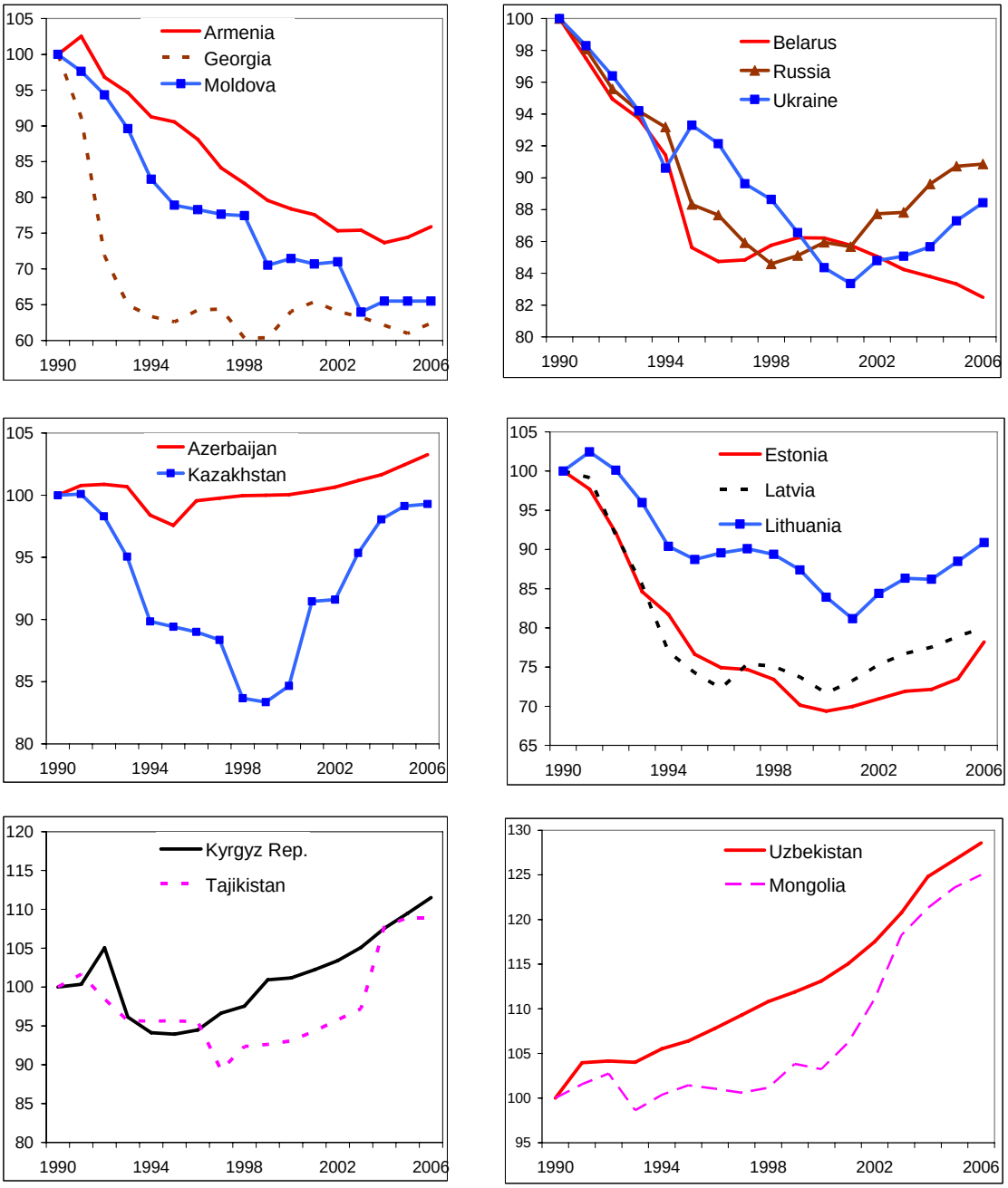
A key question for prospective growth is whether the TFP gains achieved thus far have already eliminated most of the inefficiencies of central planning—and will therefore soon fade away. In Moldova, Georgia, Tajikistan, and Ukraine real GDP base is still substantially lower than real GDP level of 1990 suggesting further catch-up potential. However, as the CIS countries approach the world technology frontier, thereby exhausting the opportunity for further TFP growth from this source, alternative channels to improve TFP growth will need to be sought. Further improvement in market reforms and institutions would need to play a role in this endeavor (see Iradian 2007). Also, greater labor use and the recent trend of faster capital accumulation are expected to play a more important role in the medium-term growth.

Figure 7. Output Profile, 1991−2006
(Real GDP index 1990 = 100)



Sources: IMF, World Economic Outlook database.

Figure 8. Employment, 1991– 2006
(1990=100)



Sources: Derived from the IMF World Economic Outlook and ILO databases.

Table 6. Growth-Accounting Results for Transition Economies, 1991−2006

Country	Period	Real GDP Growth Rate	Investment to GDP Ratio	Capital Growth (percent)	Labor Growth (percent)	Labor Product-ivity Growth	Contribution in Percentage Points of GDP			
							Scenario A			Scenario B 1/
							Capital	Labor	TFP	TFP
Armenia	1991–1995	-11.1	17.8	-11.9	-1.9	-9.5	-7.1	-0.8	-3.2	-1.5
	1996–2000	5.2	17.0	4.5	-2.8	8.2	2.7	-1.1	3.6	2.7
	2001–2006	12.5	23.3	10.1	-0.5	13.1	6.1	-0.2	6.6	5.0
Azerbaijan	1991–1995	-15.8	15.6	-9.6	-1.1	-14.9	-5.7	-0.5	-9.6	-8.3
	1996–2000	7.0	30.3	6.3	0.5	6.5	3.8	0.2	3.0	2.0
	2001–2006	15.1	39.8	11.4	0.5	14.5	6.8	0.2	8.1	6.3
Belarus	1991–1995	-8.3	31.3	-1.0	-2.5	-6.0	-0.6	-1.0	-6.7	-6.8
	1996–2000	6.4	24.8	4.5	0.1	6.2	2.7	0.1	3.6	2.9
	2001–2006	7.9	24.8	5.5	-0.7	8.7	3.3	-0.3	4.9	4.0
Georgia	1991–1995	-19.7	8.6	-20.5	-8.7	-13.0	-12.3	-3.5	-4.0	-1.6
	1996–2000	5.8	19.5	6.2	0.5	5.3	3.7	0.2	1.9	0.9
	2001–2006	7.6	24.6	8.2	-0.4	8.1	4.9	-0.2	2.9	1.6
Kyrgyzstan	1991–1995	-12.1	15.6	-10.0	-1.2	-10.9	-6.0	-0.5	-5.6	-4.2
	1996–2000	5.6	16.3	3.2	1.5	4.1	1.9	0.6	3.1	2.5
	2001–2006	3.6	19.8	5.2	1.6	2.0	3.1	0.7	-0.1	-1.0
Moldova	1991–1995	-15.7	15.0	-14.9	-4.3	-15.7	-8.9	-1.7	-5.1	-3.2
	1996–2000	-2.4	19.1	2.8	-2.2	-2.4	1.7	-0.9	-3.2	-3.8
	2001–2006	6.6	20.6	4.1	-0.7	6.6	2.4	-0.3	4.4	3.7
Mongolia	1991–1995	-2.6	25.8	-2.0	0.3	-2.6	-1.2	0.1	-1.5	-1.3
	1996–2000	2.9	32.3	9.4	0.4	2.9	5.6	0.1	-2.9	-4.4
	2001–2006	6.2	38.4	8.3	3.3	6.2	5.0	1.3	-0.1	-1.6
Kazakhstan	1991–1995	-9.2	27.8	-6.5	-2.2	-7.2	-3.9	-0.9	-4.4	-3.6
	1996–2000	2.6	16.9	2.3	-1.1	3.6	1.4	-0.4	1.6	1.2
	2001–2006	10.4	24.7	8.0	2.7	7.5	4.8	1.1	4.5	3.0
Russia	1991–1995	-9.0	22.4	-7.2	-2.4	-6.7	-4.3	-1.0	-3.7	-2.9
	1996–2000	1.8	17.2	2.3	-0.5	2.3	1.4	-0.2	0.6	0.2
	2001–2006	6.2	20.7	5.0	0.9	5.3	3.0	0.4	2.9	2.0
Tajikistan	1991–1995	-16.2	27.9	-12.5	-1.2	-15.1	-7.5	-0.5	-8.2	-6.5
	1996–2000	2.9	8.5	-1.1	-0.5	3.5	-0.7	-0.2	3.8	3.9
	2001–2006	9.0	16.6	5.4	1.7	7.1	3.2	0.7	5.0	4.1
Ukraine	1991–1995	-12.2	25.3	-8.7	-1.4	-11.0	-5.2	-0.5	-6.4	-5.2
	1996–2000	-1.9	19.3	1.8	-2.0	0.2	1.1	-0.8	-2.1	-2.6
	2001–2006	7.6	20.3	3.6	0.8	6.8	2.2	0.3	5.2	4.7
Uzbekistan	1991–1995	-4.0	21.7	-2.4	1.3	-5.2	-1.5	0.5	-3.1	-2.6
	1996–2000	3.3	23.8	5.8	1.2	2.1	3.5	0.5	-0.6	-1.4
	2001–2006	5.7	23.5	5.1	1.9	3.7	3.1	0.8	1.9	1.3
CIS-12	1991–1995	-11.3	21.2	-8.9	-2.1	-9.8	-5.4	-0.8	-5.1	-4.0
	1996–2000	3.3	20.4	4.0	-0.4	3.5	2.4	-0.2	1.0	0.4
	2001–2006	8.2	24.8	6.7	0.9	7.5	4.0	0.4	3.8	2.9
Baltics 2/	1991–1995	-9.1	17.3	-5.6	-4.4	-4.8	-3.4	-1.8	-4.0	…
	1996–2000	5.5	23.6	5.4	-1.2	6.9	3.3	-0.5	2.8	…
	2001–2006	8.4	28.2	7.9	1.8	6.6	4.7	0.7	3.0	…
Central Europe 3/	1991–1995	-0.6	21.4	3.1	-2.9	2.3	1.9	-1.1	-1.4	…
	1996–2000	3.8	25.4	4.7	-0.2	4.1	2.8	-0.1	1.1	…
	2001–2006	4.2	24.9	4.1	0.6	3.6	2.4	0.2	1.5	…
Southeast Europe 4/	1991–1995	-6.6	15.2	-6.9	-3.0	-3.6	-4.1	-1.2	-1.3	…
	1996–2000	5.5	19.8	6.1	0.0	5.4	3.7	0.0	1.8	…
	2001–2006	4.7	22.7	6.1	0.2	4.6	3.7	0.1	0.9	…

Sources: Authors' own calculations, as explained in text, based on the IMF World Economic Outlook and the ILO databases.
1/ Adjusted for capacity utilization based on the results of surveys of the Russian industry.
2/ Includes Estonia, Latvia, and Lithuania
3/ Includes Czech Republic, Hungary, Poland, Slovak Republic, and Slovenia.
4/ Includes Albania, Bulgaria, Croatia, Macedonia, and Romania.

Table 7. Real GDP Growth, 1991−2006

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Albania	-27.5	-7.2	9.6	9.4	8.9	9.1	-10.2	12.7	10.1	7.3	7.0	2.9	5.7	5.9	5.5	5.0
Armenia	-11.7	-41.8	-8.8	5.3	6.9	5.9	3.3	7.3	3.3	5.9	9.6	12.9	13.9	10.5	14.0	13.4
Azerbaijan	-0.7	-22.6	-23.1	-19.7	-11.8	1.3	5.8	6.0	11.4	6.2	6.5	8.1	10.4	10.2	24.3	31.0
Belarus	-1.2	-9.6	-7.6	-11.7	-11.3	2.8	11.4	8.4	3.4	5.8	4.7	5.0	7.0	11.4	9.3	9.9
Bosnia and Herzegovina	-12.0	-30.0	-40.0	-35.0	15.0	34.0	45.0	15.6	9.5	5.2	3.6	5.0	4.1	5.8	5.0	6.0
Bulgaria	-8.4	-7.3	-1.5	1.8	2.9	-9.4	-5.6	3.9	2.3	5.4	4.1	4.9	4.5	5.7	5.5	6.2
Croatia	-17.0	-11.7	-8.0	5.9	6.8	5.9	6.8	2.5	-0.9	2.9	4.4	5.6	5.3	3.8	4.3	4.6
Czech Republic	-11.6	-0.5	0.1	2.2	5.9	4.2	-0.7	-1.2	1.3	3.6	2.5	1.9	3.6	4.2	6.1	6.1
Estonia	-10	-14.1	-8.5	-1.6	4.5	4.4	11.1	4.4	0.3	10.8	7.7	8	7.1	8.1	10.5	11.4
Georgia	-20.6	-44.9	-25.4	-11.4	2.6	11.2	10.5	2.9	3.0	1.9	4.7	5.5	11.1	5.9	9.6	9.0
Hungary	-11.9	-3.1	-0.6	2.9	1.5	1.3	4.6	4.9	4.2	5.2	4.1	4.3	4.1	4.9	4.2	3.9
Kazakhstan	-11.0	-5.0	-9.0	-13.0	-8.0	0.5	1.6	-1.9	2.7	9.8	13.5	9.8	9.3	9.6	9.7	10.6
Kyrgyz Republic	-7.9	-13.9	-15.5	-20.1	-5.4	7.1	9.9	2.1	3.7	5.4	5.3	0.0	7.0	7.0	-0.2	2.7
Latvia	-12.6	-32.1	-11.4	2.2	-0.9	3.8	8.3	4.7	4.7	6.9	8.0	6.5	7.2	8.6	10.2	11.9
Lithuania	-5.7	-21.3	-16.2	-9.8	5.2	5.1	8.5	7.5	-1.5	4.1	6.6	6.9	10.3	7.3	7.6	7.5
Macedonia	-6.8	-7.0	-9.1	-1.8	-1.2	1.2	1.4	3.4	4.3	4.5	-4.5	0.9	2.8	4.1	3.8	4.0
Moldova	-16.0	-29.1	-1.2	-30.9	-1.4	-5.9	1.6	-6.5	-3.4	2.1	6.1	7.8	6.6	7.4	7.5	4.0
Mongolia	-9.2	-9.5	-3.0	2.3	6.3	2.4	4.0	3.5	3.2	1.2	1.1	4.2	6.1	10.8	6.6	8.4
Poland	-7.0	2.6	3.8	5.2	7.0	6.0	6.8	4.8	4.1	4.0	1.0	1.4	3.8	5.3	3.5	5.8
Romania	-12.9	-8.8	1.5	4.0	7.2	4.0	-6.1	-4.8	-1.2	2.1	5.7	5.1	5.2	8.3	4.1	7.5
Russia	-5.1	-14.5	-8.7	-12.7	-4.1	-3.6	1.4	-5.3	6.3	9.0	5.1	4.7	7.3	7.2	6.4	6.7
Slovak Republic	-14.6	-6.7	-3.7	6.2	5.9	6.2	4.6	4.2	1.5	2.0	3.8	4.6	4.5	5.5	6.0	7.5
Slovenia	-8.9	-5.5	2.8	5.3	4.1	3.5	4.6	3.8	5.2	3.9	2.7	3.3	2.5	4.2	4.0	5.0
Tajikistan	-7.1	-29.0	-16.4	-21.3	-12.4	-16.7	1.7	5.3	3.7	8.3	10.2	9.1	10.2	10.6	6.7	7.0
Ukraine	-6.6	-8.9	-10.2	-22.9	-12.2	-10.0	-3.0	-1.9	-0.2	5.9	9.2	5.2	9.6	12.1	2.7	7.1
Uzbekistan	-0.5	-11.1	-2.3	-4.2	-0.9	1.6	2.5	4.3	4.3	3.8	4.2	4.0	4.2	7.7	7.0	7.2

Sources: IMF World Economic Outlook database with some revisions for the early 1990s based on national authorities.

Table 8. Gross Fixed Capital Formation, 1991−2006
(Calculated at constant prices)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Albania	6.9	5.2	15.5	23.5	24.0	20.3	16.6	16.7	20.9	25.4	29.1	25.9	25.7	26.1	26.0	27.4
Argentina	14.4	17.5	19.1	20.5	18.3	18.9	20.6	21.1	19.1	17.9	15.8	11.3	14.3	17.7	19.8	21.7
Armenia	25.0	17.0	13.0	18.0	16.2	17.9	17.7	21.1	20.6	22.5	21.7	25.5	29.9	30.4	33.7	32.7
Azerbaijan	20.0	20.0	15.0	8.0	14.9	25.8	37.0	36.9	28.5	23.1	22.9	34.1	52.9	57.7	42.7	28.6
Belarus	31.0	33.5	33.9	33.3	24.7	21.1	25.4	25.8	24.0	23.2	23.5	23.9	27.2	29.2	28.6	28.1
Bosnia & Herzegovina	….	….	….	….	….	….	….	25.0	20.3	20.2	19.2	22.1	21.8	21.7	21.5	20.7
Bulgaria	11.7	11.8	11.0	11.6	11.1	11.2	9.3	12.1	14.3	15.7	18.2	18.3	19.4	20.8	23.8	26.3
Croatia	8.9	13.4	14.4	13.3	16.1	20.9	24.2	24.2	23.4	21.9	22.5	24.2	28.7	28.8	29.0	31.1
Czech Republic	19.4	23.4	23.3	24.7	29.5	30.5	28.9	28.9	27.6	28.0	29.1	30.0	29.1	29.3	27.9	28.3
Estonia	15.0	25.6	22.7	24.3	23.5	24.3	26.3	28.7	24.1	26.0	26.5	30.4	30.4	31.9	32.6	35.0
Georgia	14.0	10.0	7.2	6.3	18.3	24.0	25.7	28.2	29.9	26.1	23.8	24.3	24.0	27.2	25.2	26.0
Hungary	17.8	17.9	18.3	20.0	18.5	19.5	20.4	22.0	22.4	22.9	23.1	24.4	23.9	24.6	24.9	24.3
Kazakhstan	31.7	31.3	29.2	24.4	22.3	18.0	16.9	16.5	15.5	17.3	24.4	23.5	23.0	25.1	26.3	26.1
Kyrgyz Republic	17.5	14.6	13.3	12.1	20.4	22.1	13.1	12.5	15.5	18.1	19.2	19.5	20.2	21.1	22.4	24.0
Latvia	15.0	10.4	9.5	11.3	13.0	15.4	17.1	26.4	23.5	24.2	25.0	26.5	27.8	31.7	34.1	36.5
Lithuania	21.0	13.6	16.5	15.9	14.3	16.4	20.6	22.7	21.6	18.8	20.0	19.2	17.7	17.1	17.1	28.0
Macedonia, FYR	23.3	24.9	13.0	14.3	17.5	18.4	17.3	16.3	15.4	14.6	13.9	16.3	16.0	17.0	17.3	17.9
Moldova	17.0	28.2	21.9	17.8	16.0	21.3	19.8	23.2	18.5	16.5	18.3	17.9	19.9	20.1	22.2	23.1
Mongolia	33.6	27.3	21.9	19.2	27.1	28.0	25.8	33.6	35.0	39.2	39.0	36.2	41.8	39.1	39.1	35.3
Poland	15.1	15.2	15.0	15.5	16.9	19.1	21.7	23.6	24.1	23.7	21.2	19.6	18.8	19.0	19.6	21.6
Romania	12.2	14.8	15.8	18.3	18.3	18.6	20.1	19.9	19.2	19.8	20.7	21.3	21.9	22.1	24.0	26.2
Russia	25.0	33.6	27.3	23.1	20.9	17.1	15.5	14.3	14.3	15.4	16.1	15.8	16.7	17.5	17.8	19.0
Slovak Republic	26.4	29.8	28.7	26.2	24.9	30.0	32.3	34.1	28.7	25.7	28.2	27.1	25.4	25.3	28.1	28.2
Slovenia	17.3	16.0	17.2	18.6	20.9	22.3	24.1	25.3	28.4	27.8	27.2	26.5	27.6	28.6	27.9	29.6
Tajikistan	19.0	23.1	28.1	27.1	24.2	23.2	24.7	24.9	25.4	26.3	26.2	25.4	23.4	22.6	22.2	22.2
Ukraine	27.5	27.4	31.2	30.5	25.5	23.8	20.0	18.1	18.2	19.3	18.8	18.5	20.6	20.2	21.1	22.6
Uzbekistan	25.1	19.5	17.1	18.3	19.2	19.5	21.7	20.6	17.7	19.1	18.5	19.7	22.4	22.2	22.8	24.0

Sources: IMF World Economic Outlook database, and for missing earlier years from the respective IMF staff reports.

Table 9. Employment, 1991−2006
(In thousands)

Year	Armenia	Azerbaijan	Belarus	Georgia	Kazakhstan	Kyrgyzstan	Moldova	Mongolia	Russia	Tajikistan	Ukraine	Uzbekistan	CIS 1/	Estonia	Latvia	Lithuania	Baltics
1990	1,630	3,703	5,151	2,870	7,796	1,748	2,120	784	75,235	1,939	25,214	7,941	136,132	826	1,313	1,666	3,805
1991	1,671	3,732	5,022	2,616	7,796	1,754	2,070	796	73,800	1,971	24,786	8,255	134,269	807	1,302	1,707	3,816
1992	1,578	3,735	4,891	2,062	7,796	1,836	2,000	805	71,908	1,909	24,307	8,271	131,099	779	1,206	1,855	3,635
1993	1,543	3,728	4,828	1,864	7,400	1,681	1,900	773	70,858	1,855	23,752	8,259	128,441	710	1,123	1,778	3,421
1994	1,488	3,644	4,710	1,818	6,899	1,645	1,750	787	70,108	1,854	22,844	8,379	125,926	693	1,010	1,675	3,191
1995	1,476	3,613	4,410	1,797	6,552	1,642	1,696	795	66,450	1,855	23,525	8,449	122,259	656	975	1,644	3,086
1996	1,436	3,687	4,365	1,844	6,519	1,652	1,660	792	65,950	1,852	23,232	8,561	121,549	646	949	1,659	3,060
1997	1,372	3,694	4,370	1,848	6,472	1,689	1,646	788	64,642	1,731	22,598	8,680	119,530	617	990	1,669	3,108
1998	1,336	3,702	4,417	1,731	6,128	1,705	1,642	793	63,642	1,791	22,349	8,800	118,034	606	986	1,489	3,082
1999	1,297	3,703	4,442	1,733	6,105	1,764	1,495	814	64,033	1,796	21,824	8,885	117,892	579	968	1,457	3,003
2000	1,278	3,705	4,441	1,839	6,201	1,768	1,515	809	64,658	1,805	21,269	8,983	118,271	572	941	1,398	2,912
2001	1,265	3,715	4,417	1,878	6,699	1,787	1,499	832	64,458	1,829	21,016	9,136	118,531	578	962	1,352	2,892
2002	1,228	3,727	4,381	1,839	6,710	1,807	1,505	871	66,008	1,857	21,379	9,333	120,645	586	989	1,406	2,981
2003	1,230	3,747	4,339	1,815	6,985	1,837	1,468	927	66,075	1,885	21,449	9,589	121,345	594	1,007	1,438	3,040
2004	1,201	3,764	4,316	1,783	7,143	1,880	1,463	951	67,417	2,090	21,599	9,911	123,518	596	1,018	1,436	3,050
2005	1,213	3,794	4,292	1,750	6,934	1,914	1,452	968	68,258	2,112	22,010	10,060	124,757	607	1,036	1,474	3,117
2006	1,238	3,824	4,249	1,792	6,963	1,949	1,440	980	68,361	2,112	22,296	10,211	125,414	646	1,051	1,514	3,211

Year	Czech Rep.	Hungary	Poland	Slovakia	Slovenia	Central Europe	Albania	Bulgaria	Croatia	Macedonia	Romania	Southeast Europe	Bosnia
1990	5,300	5,052	16,450	2,345	1,115	30,262	1,434	3,880	1,599	706	11,501	19,120	…
1991	5,100	4,534	15,829	2,008	1,028	28,499	1,400	3,510	1,901	667	11,058	18,536	…
1992	4,900	4,083	15,657	2,013	960	27,612	1,020	3,270	1,748	645	10,633	17,316	…
1993	4,850	3,827	14,632	2,148	925	26,383	987	3,190	1,697	620	10,328	16,822	…
1994	4,903	3,752	14,398	2,110	914	26,077	1,083	3,280	1,680	595	9,956	16,594	…
1995	4,995	3,679	14,529	2,147	912	26,262	1,114	3,390	1,658	555	10,069	16,787	…
1996	4,980	3,648	14,703	2,225	894	26,450	1,117	3,226	1,540	538	9,641	16,061	…
1997	4,927	3,646	14,908	2,206	877	26,563	1,107	3,061	1,598	512	9,279	15,557	575
1998	4,853	3,698	15,083	2,199	875	26,707	1,085	3,039	1,544	540	8,984	15,192	639
1999	4,765	3,812	14,518	2,132	888	26,115	1,065	2,876	1,492	545	8,694	14,671	670
2000	4,732	3,849	14,268	2,102	895	25,846	1,068	2,792	1,553	550	8,490	14,453	650
2001	4,728	3,860	13,945	2,124	899	25,554	920	2,694	1,469	599	8,772	14,454	628
2002	4,765	3,871	13,538	2,127	912	25,212	920	2,736	1,528	561	8,417	14,161	616
2003	4,733	3,922	13,617	2,165	909	25,345	926	2,836	1,537	545	8,394	14,238	609
2004	4,733	3,900	13,795	2,170	913	25,512	926	2,928	1,563	523	8,354	14,294	610
2005	4,764	3,902	14,116	2,216	916	25,914	934	2,979	1,573	545	8,388	14,419	623
2006	4,818	3,923	14,594	2,300	924	26,559	943	3,160	1,588	573	8,449	14,713	636

Sources: International Labor Organization and IMF World Econmic Outlook databases.
1/ Includes Mongolia but excludes Turkmenistan.

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